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Regulation Fixtures in Hydronic Heating Installations

Types, Structures, Characteristics and Applications

Springer

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Contents

Symbols

A	Surface area of the inner cross section of a pipe or valve carrying the medium, (mm^2, m^2)
A_i	Surface area of the inner cross section of a pipe carrying the medium in the *i*-th section of the circuit, (m^2)
A_M	Active surface area of the valve membrane, (mm^2, m^2)
A_x	Surface area of the medium flow cross section at the position of the valve closing/throttling element corresponding to partial opening, (mm^2, m^2)
A_{100}	Surface area of the medium flow cross section at the position of the valve closing/throttling element corresponding to full opening, (mm^2, m^2)
a	Valve regulated section authority, (–), or the slope factor of the pump throttling characteristic, (–)
a'	Valve superior role, (–)
a_c	Valve total authority, (–)
$a_{\mathrm{c},100}$	Total authority of the valve closing element for full opening of both regulation stages, (throttling and closing sections), (–)
$a_{\mathrm{c,x}}$	Total authority of the valve closing element for a given pre-setting, (–)
$a_{\text{dł}}$	Valve throttling criterion, (–)
a_m	Share of local hydraulic resistances in total hydraulic resistance of a section of the pipework, (–)
a_w	Valve inner authority, (–)
$a_{\mathrm{w},100}$	Inner authority of the valve closing element at full opening, (–)
$a_{\mathrm{w,min}}$	Minimum value of the valve closing element inner authority, (–)
$a_{\mathrm{w,I,min}}$	Minimum value of the throttling element authority (full opening) of a valve with two adjustable sections of the medium flow, (–)

$a_{\mathrm{w,max}}$	Maximum value of the valve closing element inner authority, (–)
$a_{\mathrm{w,x}}$	Inner authority of the valve closing element for a given pre-setting, (–)
a_{z}	Valve outer authority, (–)
$a_{\mathrm{z,100}}$	Valve outer authority at full opening, (–)
$a_{\mathrm{z,min}}$	Minimum value of the valve outer authority, (–)
$a_{\mathrm{z,x}}$	Valve outer authority at partial, x-th-degree opening for a given pre-setting, (–)
$a(n_{\mathrm{i}})_{c,\mathrm{min}}$	Function describing the total authority variability depending on the pre-setting of a valve with one adjustable section of the medium flow, for no constraints on the range of the closing/throttling element travel, (–)
$a(n_{\mathrm{i}})_{w,\mathrm{min}}$	Function describing the inner authority variability depending on the pre-setting of a valve with one adjustable section of the medium flow, for no constraints on the range of the closing/throttling element travel, (–)
$[a(n_{\mathrm{i}})_{\mathrm{w,I,min}}]_{X\mathrm{p}}$	Function describing variability in the throttling element inner authority depending on the thermostatic valve pre-setting, for the closing element position corresponding to a given proportional range X_p, for no constraints on the range of the throttling element travel, (–)
$[a_{\mathrm{w,I,min}}]_{X\mathrm{p}}$	Minimum value of the thermostatic valve throttling element authority (no constraints on the range of travel) for the closing plug lift corresponding to a given proportional range X_p, (–)
$[a_{\mathrm{z,min}}]_{X\mathrm{p}}$	Thermostatic valve outer authority for the closing element position corresponding to a given proportional range Xp, for no constraints on the range of the throttling element travel, (–)
c	Equal-percentage factor of the valve primary closing characteristic, (–)
c_{w}	Specific heat of water, (J/(kg deg))
C_1, C_2, C_3	Coefficients for the *Colebrook-White* formula, (–)
d	Inner diameter of the pipe or element carrying the medium, (m, mm)
d_{i}	Inner diameter of a pipe in the i-th section of the pipework, (m, mm)
$\mathrm{d}h_{\mathrm{x}}$	Elementary increment in the valve opening degree, (m, mm)
$\mathrm{d}\dot{V}_X$	Elementary increment in the medium volume flow, (m^3/h, m^3/s), (–)
e	Relative roughness of the pipe inner surface, (–)
e_{gr}	Boundary value of the pipe inner surface relative roughness, (–)
F_{F}	Spring tension force, (N)
F_{M}	Force on the valve membrane and plug, (N)
g	Gravitational field acceleration, (m/s^2)

h_{100}	Position of the valve closing/throttling element corresponding to full relative opening, (mm, m)
h_{max}	Position of the valve closing/throttling element corresponding to full absolute opening, (mm, m)
h_{N}	Closing plug lift over the valve seat corresponding to the nominal proportional range, e.g. for $X_p = 2\mathrm{K}$, (mm, m)
h_{x}	Position of the valve closing/throttling element corresponding to partial opening, (mm, m)
h	Position of the thermostatic head follower, (mm, m)
h_{h}	Height of the liquid column, (m)
H	Heat loss coefficient, (W/K)
k_{z}	Valve amplification factor, (–)
k_{m}	Thermostatic head amplification factor, (mm/K, m/K)
$k_{\mathrm{m},\%}$	Thermostatic head percentage amplification factor, (%)
k_{s}	Room amplification factor, (K/W, °C/W)
$k_{\mathrm{s},\%}$	Room percentage amplification factor, (%)
k	Mean absolute roughness of the pipe inner surface, (m, mm)
k_{v}	Flow factor, m^3/(h bar$^{0.5}$), m^3/h (according to the simplification of units adopted in practice)
$k_{\mathrm{v,z}}$	Valve flow factor, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,rz}}$	Flow factor real value obtained by means of experimental measurements, (m^3/h)
$k_{\mathrm{v,ob}}$	Circuit flow factor, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v}}(n_{\mathrm{i}})$	Function describing the flow factor variability depending on the pre-setting of a valve with one adjustable section of the medium flow (no possibility of a current increase in the flow above the value resulting from the pre-setting), (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,k}}$	Valve body flow factor, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,k+I,i}}$	Resultant flow factor of the valve body and throttling element for the *i*-th pre-setting of the valve, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,reg}}$	Flow factor of the valve current-regulation element, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,reg,100}}$	Flow factor of the current-regulation element of a fully open valve, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,reg,x}}$	Flow factor of the valve current-regulation element for partial opening corresponding to the pre-setting, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,x}}$	Valve flow factor for partial opening corresponding to the pre-setting or to an intermediate position of the closing element, (m^3/(h bar$^{0.5}$), m^3/h)
k_{v0}	Valve flow factor for full (mechanical) closing, (m^3/(h bar$^{0.5}$), m^3/h)
$k_{\mathrm{v,100}}$	Flow factor of a fully open valve, (m^3/(h bar$^{0.5}$), m^3/h)

k_{vN}	Flow factor of a thermostatic valve for the closing element opening corresponding to proportional range $X_p = 2\mathrm{K}$, (m^3/(h bar$^{0.5}$), m^3/h)
k_{vs}	Mean flow factor of the tested series of fully open valves, (m^3/(h bar$^{0.5}$), m^3/h)
$[k_{\mathrm{v}}(n_{\mathrm{i}})]_{X\mathrm{p}}$	Function describing the flow factor variability depending on the pre-setting of the thermostatic valve throttling element, for the closing element position corresponding to a given proportional range X_{p}, (m^3/h, m^3/(h bar$^{0.5}$))
$[k_{\mathrm{v,x}}]_{X\mathrm{p}}$	Thermostatic valve flow factor for a given pre-setting, at the closing plug lift corresponding to a given proportional range X_{p}, (m^3/h, m^3/(h bar$^{0.5}$))
$[k_{\mathrm{v100}}]_{n_i}$	Flow factor of a thermostatic valve, or a double-regulation manual valve, for the throttling element pre-setting, at the closing plug maximum lift, (m^3/h, m^3/(h bar$^{0.5}$))
$[k_{\mathrm{vs}}]_{X\mathrm{p}}$	Mean flow factor of the thermostatic valve series for the maximum pre-setting, at the closing plug lift corresponding to a given proportional range X_p, (m^3/h, m^3/(h bar$^{0.5}$))
l_{i}	Length of a straight pipe section in the *i*-th section of the pipework, (m)
$l_{\mathrm{z,i}}$	Equivalent length of the *i*-th local obstacle, (m)
m	Correction exponent of a straight pipe hydraulic characteristic, (–)
$\dot{m}$	Working medium mass flow, (kg/s, kg/h)
$\dot{m}_i$	Working medium mass flow through the *i*-th element of the pipework, (kg/h, kg/s)
$\dot{m}_X$	Working medium mass flow for the valve partial opening, (kg/s, kg/h)
n	Correction exponent of the pipework characteristic, (–)
n_{i}	*i*-th value of the valve pre-setting, (–)
n_{max}	Maximum value of the valve pre-setting, (–)
p_{A}	Pressure on the secondary side of the valve membrane, (bar, Pa)
p_{atm}	Atmospheric pressure, (bar, Pa)
p_{E}	Pressure on the primary side of the valve membrane, (bar, Pa)
p_{h}	Hydrostatic pressure, (bar, Pa)
P_{el}	Electric power needed to drive the pump, (W)
$\dot{Q}_i$	Thermal power in the room, (W)
$\dot{Q}_{\mathrm{N}}$	Nominal thermal power in the room, (W)
$\dot{Q}_X$	Thermal power corresponding to the valve partial opening, (W)
$\dot{Q}_{\mathrm{ob}}$	Thermal power supplied in the circuit, (W)

q_{mmax}	Maximum mass flow—the highest possible mass flow of water (fully open valve) at differential pressure of 10kPa, (kg/h)
$\dot{m}_{\mathrm{N}}$, q_{mN}	Nominal mass flow—characteristic mass flow for the intermediate position of the thermostatic head selector (20–24 °C). In the case of a valve with the possibility of pre-setting, this is the mass flow through a valve with no pre-setting, (kg/h, kg/s)
q_{ms}	Characteristic flow established for $X_p = 2\mathrm{K}$ and differential pressure of 10kPa at any value of the thermostatic head setting, (kg/h)
R_{i}	Unit linear pressure losses in the *i*-th straight section, (Pa/m)
Re	Reynolds number, (–)
Re_{gr}	Reynolds number boundary value, (–)
$r_{\mathrm{c,i}} = r_{\mathrm{l,i}} + r_{\mathrm{m,i}}$	Total resultant hydraulic resistance of the pipework *i*-th section, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{c,100}}$	Total hydraulic resistance of a given section of the pipework and of a fully open valve, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{c,x}}$	Total hydraulic resistance of a given section of the pipework and of a valve for partial opening, ((h^2 bar)/m^6, (Pa s^2)/m^6)
r_{I}	Hydraulic resistance of the valve throttling element, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{I,0}}$	Hydraulic resistance of the valve throttling element at the valve minimum opening, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{I,100}}$	Hydraulic resistance of the valve throttling element at the valve full opening, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{I,i}}$	Hydraulic resistance of the valve throttling element at the opening position determined by the *i*-th opening degree corresponding to a given pre-setting, ((h^2 bar)/m^6, (Pa s^2)/m^6)
r_{II}	Hydraulic resistance of the valve closing element, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{II,100}}$	Hydraulic resistance of the valve closing element for the full available range of travel, ((h^2 bar)/m^6, (Pa s^2)/m^6)
r_{k}	Hydraulic resistance of the valve body, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{k+I,100}}$	Total hydraulic resistance of the valve body and the valve throttling element at the valve full opening, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{k+I,i}}$	Total hydraulic resistance of the valve body and the valve throttling element at a given opening degree corresponding to the pre-setting, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{l,i}}$	Hydraulic resistance of straight sections of pipes in a given part of the pipework related to the volume flow of the medium, ((h^2 bar)/m^6, (Pa s^2)/m^6)

$r_{\mathrm{m,i}}$	Hydraulic resistance of the *i*-th local obstacle, ((h^2 bar)/m^6, (Pa s^2)/m^6)
r_{i}	Hydraulic resistance of the *i*-th element of the pipework related to the mass or the volume flow, (–)
r_{ob}	Hydraulic resistance of the circuit, ((h^2 bar)/m^6, (Pa s^2)/m^6, kPa/(dm^3/s)^2)
r_{reg}	Hydraulic resistance of the valve current-regulation section of the medium flow, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{reg,100}}$	Hydraulic resistance of the valve current-regulation section of the medium flow for full opening, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{reg,x}}$	Hydraulic resistance of the valve current-regulation section of the medium flow for a given opening degree, ((h^2 bar)/m^6, (Pa s^2)/m^6)
r_{str}	Hydraulic resistance of all elements of a given part of the pipework excluding the valve, ((h^2 bar)/m^6, (Pa s^2)/m^6)
r_{z}	Hydraulic resistance of the valve, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{z,100}}$	Hydraulic resistance of the valve at full opening of both elements of regulation, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$r_{\mathrm{z,x}}$	Hydraulic resistance of the valve for a given degree of opening of both elements of regulation, ((h^2 bar)/m^6, (Pa s^2)/m^6)
$[r_{\mathrm{z,100}}]_{X\mathrm{p}}$	Hydraulic resistance of the valve at full opening of the thermostatic valve throttling element for the closing plug lift corresponding to a given proportional range X_{p}, ((h^2 bar)/m^6, (Pa s^2)/m^6)
t_{i}	Conventional air temperature in the room, ($^{\mathrm{o}}$C)
t_{e}	Conventional outdoor temperature, ($^{\mathrm{o}}$C)
$t_{\mathrm{i,k}}$	Conventional final air temperature in the room, ($^{\mathrm{o}}$C)
t_{p}	Working medium temperature at the radiator outlet, return temperature, ($^{\mathrm{o}}$C)
t_{z}	Working medium temperature at the radiator inlet, supply temperature, ($^{\mathrm{o}}$C)
t_{zad}	Temperature set at the temperature regulator selector, ($^{\mathrm{o}}$C)
t_{c}	Temperature measured by the temperature sensor, ($^{\mathrm{o}}$C)
$\dot{V}$	Working medium volume flow, (m^3/h, m^3/s)
$\dot{V}_{100}$	Working medium volume flow through the valve at the valve full (100%) opening, (m^3/h, m^3/s)
$\dot{V}_{\mathrm{k}}$	Working medium volume flow through the valve body, (m^3/h, m^3/s)
$\dot{V}_{\mathrm{z}}$	Working medium volume flow through the valve, (m^3/h, m^3/s)
$\dot{V}_{\mathrm{i}}$	Working medium volume flow through the *i*-th section of the circuit, (m^3/h, m^3/s)

$\dot{V}_{\mathrm{x}}$	Working medium volume flow through the valve at the valve partial opening, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$), or volume flow for a given intermediate working point on the pump throttling characteristic, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$, $\mathrm{dm^3/s}$)
$\dot{V}_{\mathrm{max}}$	Working medium maximum volume flow through the pump, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$, $\mathrm{dm^3/s}$)
$\dot{V}_{\mathrm{i}}$	Working medium volume flow through the *i*-th element of the pipework, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$, $\mathrm{dm^3/s}$)
$\dot{V}_{\mathrm{N}}$	Working medium volume flow through the valve at the closing element opening corresponding to proportional range $X_p = 2\mathrm{K}$, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$)
$\dot{V}_{\mathrm{k+I,i}}$	Working medium resultant volume flow through the valve body and the throttling element for the *i*-th pre-setting, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$)
$[\dot{V}_{100}]_{X\mathrm{p}=2}$	Working medium volume flow at the thermostatic valve throttling element full opening and proportional range $X_p = 2\mathrm{K}$, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$)
$\dot{V}_{\mathrm{ob}}$	Working medium volume flow in the circuit, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$)
w	Working medium mean velocity in the cross section of a pipe or an element carrying the medium, (m/s)
w_{i}	Working medium mean velocity in the cross section of a pipe in the pipework *i*-th section, (m/s)
$\dot{V}_1$, $\dot{V}_2$, $\dot{V}_3$, $\dot{V}_3$, $\dot{V}_4$	Working medium volume flow, for example, working points, ($\mathrm{m^3/h}$, $\mathrm{m^3/s}$)
X_{p}	Proportional range of the thermoregulator, (K, °C), or of the automatic balancing valve, (kPa, bar)
$X_{\mathrm{p,max}}$	Maximum proportional range of the thermoregulator, (K, °C)
$X_{\mathrm{p,s}}$	Proportional range of the room (room thermal characteristic), (W)
Z_{i}	Pressure losses on local obstacles in the *i*-th section of the circuit, (bar, Pa)

Greek Symbols

α	Valve discharge coefficient, (–)
$\Delta k_{\mathrm{v,max}}$	Maximum error in the flow factor determination, ($\mathrm{m^3/h}$)
Δn	Change in the number of the pump impeller rotations, (rpm)
Δp_1	Pressure value from the thermoregulator measurement performed according to relevant standards, $\Delta p_1 = 10\mathrm{kPa}$, or pressure for an example working point, (bar, Pa)

Δp_2	Pressure loss for the nominal flow or for the flow characteristic of valves with a possibility of pre-setting with no pressure losses in the regulated section, read from the $\Delta p = f(q_\mathrm{m})$ characteristic of a fully open valve and corresponding to the maximum flow, (kPa) or pressure for an example working point, (bar, Pa)
Δp_3, Δp_3, Δp_4	Pressure, for example, working points, (bar, Pa)
Δp_0	Working medium pressure loss on the valve, according to the flow factor definition, $\Delta p_0 = 1\mathrm{bar} = 10^5\mathrm{Pa}$
$\Delta p_{\mathrm{c,i}}$	Working medium total pressure loss in the pipework *i*-th section, (bar, Pa)
Δp_{I}	Working medium pressure loss on the valve throttling element, (bar, Pa)
$\Delta p_{\mathrm{I,i}}$	Working medium pressure loss on the valve throttling element at the opening position determined by the *i*-th opening degree corresponding to a given pre-setting, (bar, Pa)
$\Delta p_{\mathrm{I,0}}$	Working medium pressure loss on the valve throttling element at its minimum opening, (bar, Pa)
$\Delta p_{\mathrm{I,100}}$	Working medium pressure loss on the valve throttling element at its full opening, (bar, Pa)
Δp_{II}	Working medium pressure loss on the valve closing element, (bar, Pa)
$\Delta p_{\mathrm{II,100}}$	Working medium pressure loss on the valve closing element for its full available range of travel, (bar, Pa)
Δp_{k}	Working medium pressure loss on the valve body, (bar, Pa)
Δp_{i}	Working medium pressure loss caused by the pipework *i*-th element, (bar, Pa)
$\Delta p_{\mathrm{k+I,i}}$	Working medium total pressure loss on the valve body and the valve throttling element at a set opening degree corresponding to the *i*-th pre-setting, (bar, Pa)
$\Delta p_{\mathrm{l,i}}$	Working medium pressure loss on a straight section in the pipework *i*-th section, (bar, Pa)
$\Delta p_{\mathrm{m,i}}$	Working medium pressure loss on local obstacles in the pipework *i*-th section, (bar, Pa)
Δp_{ob}	Pressure loss in the circuit, (bar, Pa)
Δp_{cz}	Active (differential) pressure in the circuit, (bar, Pa)
Δp_{reg}	Working medium pressure loss on the valve current-regulation section of the medium flow, (bar, Pa)
$\Delta p_{\mathrm{reg,100}}$	Working medium pressure loss on the valve current-regulation section of the medium flow for full opening, (bar, Pa)
$\Delta p_{\mathrm{reg,x}}$	Working medium pressure loss on the valve current-regulation section of the medium flow for a given opening degree, (bar, Pa)
Δp_{str}	Working medium pressure loss on all elements of a given part of the pipework excluding the valve, (bar, Pa)

$\Delta p_{\mathrm{str},100}$	Working medium pressure loss on all elements of the circuit (pipework) excluding the valve for the valve full opening, (bar, Pa)
$\Delta p_{\mathrm{str,x}}$	Working medium pressure loss on all elements of the circuit (pipework) excluding the valve for a given degree of opening of both regulation elements of the valve, (bar, Pa)
Δp_{z}	Working medium pressure loss on the valve, (bar, Pa)
$\Delta p_{\mathrm{z},0}$	Working medium pressure loss on the valve for full closing of both regulation stages (throttling and closing section), (bar, Pa)
$\Delta p_{\mathrm{z},100}$	Working medium pressure loss on the regulation valve for full opening, (bar, Pa)
$\Delta p_{\mathrm{z,x}}$	Working medium pressure loss on the regulation valve for a given degree of opening of both regulation stages (throttling and closing section), (bar, Pa)
$\Delta p_{\mathrm{z,max}}$	Maximum error in the measurement of the pressure drop on the valve, (bar)
$\Delta\Delta p$	Change in the working medium pressure, (bar, Pa)
$[\Delta p_{\mathrm{z},100}]_{X\mathrm{p}}$	Working medium pressure loss on the thermostatic valve at full opening of the throttling element for the closing plug lift corresponding to a given proportional range X_{p}, (bar, Pa)
Δp_{x}	Pressure for a given intermediate working point on the pump throttling characteristic, (bar, Pa)
Δp_{max}	Maximum pressure produced by the pump, (bar, Pa)
Δt_{i}	Change in conventional temperature of air in the room, (°C)
Δt_{w}	Water cooling in the radiator, (°C)
$\Delta \dot{V}_{\mathrm{max}}$	Maximum error in the working medium volume flow measurement, (m^3/h)
$\Delta \dot{Q}_i$	Change in the room thermal power, (W)
$\Delta \dot{Q}_{i,\%}$	Percentage change in the room thermal power, (W)
ΔP_{el}	Change in the electric power needed to drive the pump, (W)
$\Delta \dot{V}$	Change in the working medium volume flow, (m^3/h, m^3/s)
λ_{i}	Coefficient of linear pressure losses in the pipework *i*-th section, (–)
λ	Coefficient of linear pressure losses, (–)
μ	Dynamic viscosity of the medium, (Pa s)
v	Kinematic viscosity of the medium, (m^2/s)
$\eta_{\mathrm{c,i}}$	Total efficiency of the pump, (–)
ρ_{i}	Working medium density at set values of temperature and pressure in the pipework *i*-th section, (kg/m^3)
ρ_{o}	Working medium density according to the flow factor definition, (kg/m^3)
ρ	Working medium density, (kg/m^3)

δ	Percentage error in the circuit balance, (%)
τ	Time, (s)
ζ	Coefficient of local pressure losses, (–)
ζ_i	Coefficient of local pressure losses in the pipework i-th section, (–)

Introduction

The book *Regulation Fixtures in Hydronic Heating Installations: Types, Structures, Characteristics and Applications* is devoted to issues of the selection, the principle of operation and the types and structures of regulation valves in hydronic heating systems. It also deals with hydraulic problems of the valves operation.

The publication presents a broad discussion of the types and kinds of regulation fixtures used in heating installations at present and describes practical aspects of their selection. Reasons are indicated for the application of specific types of valves in certain installation points, and their impact on the other elements of the system is described. The analysis is supplemented with connection diagrams, figures and photographs of cross sections of real valves. Such an approach facilitates the understanding of the principle of operation of individual elements.

A considerable part of the book is devoted to the problem of the working medium pressure losses in the installation pipe system, the hydraulic resistance and the valve co-operation with the pipework and the regulation elements, which is the fundamental aspect of the valve operation. The most common hydraulic characteristics encountered in the theory of regulation are presented together with an extensive mathematical basis. This provides a solid foundation for the presentation of a mathematical model that enables an analysis of the effects of the installation control by means of regulation valves and of their impact on the operating parameters of the other elements of the system. A lot of attention is given to the notion of the valve *authority*, as one of the main parameters determining the process of regulation by means of a valve. An extensive theoretical basis is presented together with a detailed mathematical analysis. The algorithms are compared to those used in the engineering theory and practice so far, indicating the differences, the reasons behind them and their consequences for the heating installation regulation process. Moreover, the book offers a novel and original analytical method of the regulation valve sizing. It also presents a novel and original technical solution in the form of a double-regulation valve free from the limitations having a negative impact on the quality of the hydraulic circuit regulation process, which are typical of the known and popular structures currently in use.

The book is closed with a chapter presenting computational examples. The examples are specially constructed to offer great theoretical value but also to relate to practical problems of the regulation valve operation in a heating installation and of the valve co-operation with the regulated objects, i.e. the room radiators.

The publication is intended for teaching specialists, designers, heating installation makers and operators, as well as scientists and authors of computer programs used for the heating system thermal and hydraulic balancing. It will also prove useful for students of specialities such as environmental engineering, power engineering.