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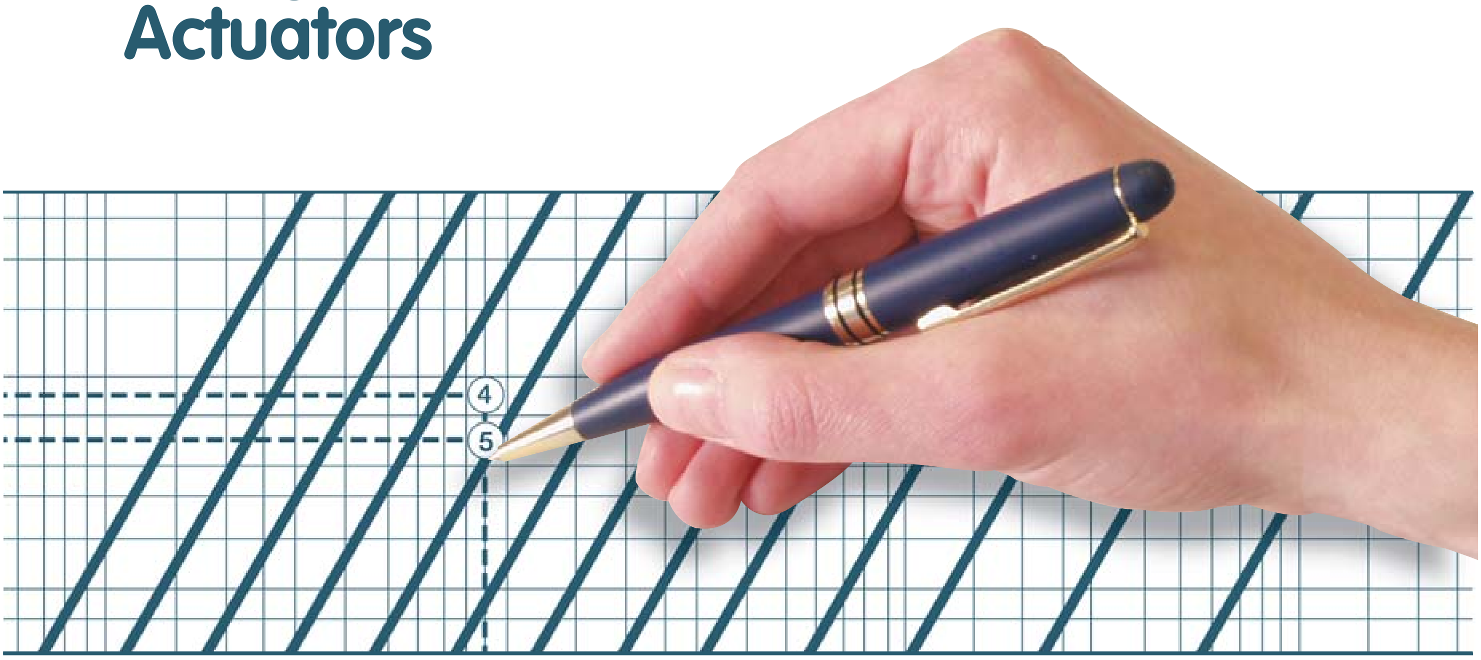
Quick Choice of

Temperature Controls

Sizing of Valves and Actuators



Clorius
Controls A/S

- ensures reliable
control of heating, cooling
and ventilation systems.

Quick Choice of Temperature Controls

Ever since 1902 we have produced reliable temperature controls for nearly all forms of water, oil and steam systems.
The experience thereby gained has formed the basis of the present control and valve programme, which makes it possible to determine the optimal combination of valve and actuator.

Control types

Self-acting Temperature Controllers

- Work on the liquid expansion principle without any auxiliary energy
- P-controls
- Reliable under all conditions
- Secured against over-temperature

Electronic Temperature Controllers

- Low energy consumption
- PI and PID performance
- Adjustable PID-values
- Many adjustment possibilities

Control Valves

All of our control valves fulfil the demands for seat leakage as per VDI/VDE 2174, i.e. the flow through the closed valve is less than the percentage of full flow (by same Δp_V) indicated in this table:

Type of valve	Max. seat leakage
Single seated	0,05%
Single seated, balanced	0,05%
Double seated	0,5%
3-way	0,5%

Regarding the control characteristics and general characteristics of the valves, please refer to the corresponding data sheets. We can deliver the valves with certificates from the maritime classification companies.

Sizing of Controls

General points

The diagrams have been worked out to obtain the optimal combination of valve and thermostat etc.
In order to secure stability in the control circuit the following points should be observed:
The valve is to be sized according to load and pressure – over sizing (too big valve) corresponding to a large proportional band (PB) may cause unstable control.
In case of thermostat control with large load variations a small proportional band should be avoided. The proportional band (PB) is calculated as the rated travel (mm) of the valve divided by the amplification of the thermostat (mm/°C) = the two last figures of the type description of the V-thermostat. It is strongly recommended to calculate the PB.

Example: 20 M1F valve (rated travel 6.5 mm) with V4.05 thermostat:
PB= 6,5/0,5 = 13°C

Experience shows that a PB-value in the green field, 8-13°C, is often to be preferred:

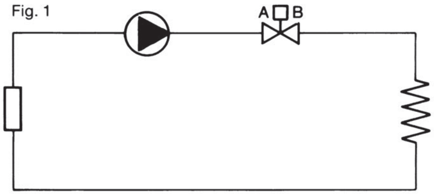
Load variation	Proportional band (PB)	Colour
Small	4-8 °C	Red
Medium	8-13 °C	Green
Large	Above 13 °C	Yellow

To avoid noise as well as wear and tear the sizing pressure drop Δp_V across control valves for water should not exceed 1 bar in domestic premises. Otherwise the control should be distributed on more valves.

Δp_V must be at least 10% of the total pressure drop of the control circuit.

Control circuits with 2-way valves should be sized so that the pressure drop across the valve $\Delta p_{A\rightarrow B}$ is 30-50% of the total pressure drop of the control circuit ($\Delta p_{A\rightarrow B} + \Delta p_{B\rightarrow A}$), fig. 1.

Fig. 1



Control circuits with 3-way valves should be sized so that the following rules are observed:

1. The pressure drop across the valve port A and AB ($\Delta p_{A\rightarrow AB}$) is more than 50% of the pressure drop across the section C-A ($\Delta p_{C\rightarrow A}$), fig. 2 and 3.
2. The pressure drop across the section C-A ($\Delta p_{C\rightarrow A}$) should be less than 25% of the pump pressure H, fig. 2 and 3.
3. The pressure drop across the section C-A ($\Delta p_{C\rightarrow A}$) should be equal to the pressure drop across the section C-B ($\Delta p_{C\rightarrow B}$), fig. 2 and 3.

Fig. 2

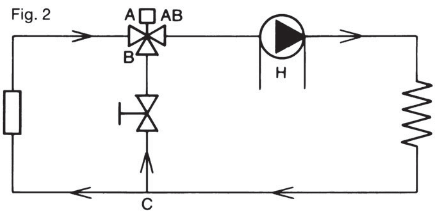
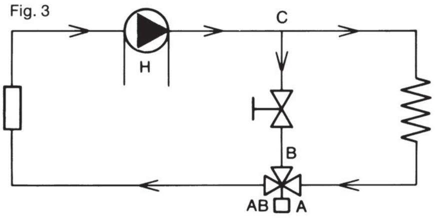


Fig. 3



Control Systems for Water

Necessary sizing values:

1. Max. water flow: G m^3/h (e.g. G = 3,0 m^3/h)
2. Pressure drop Δp_V in bar across valve at G m^3/h (e.g. Δp_V = 0,1 bar).
3. Pressure drop Δp_L in bar across closed valve (e.g. Δp_L = 5,0 bar)
4. The working pressure of the system p bar (e.g. p = 5 bar)
5. The working temperature of the system T °C (e.g. T = 90°C)
6. Load variation of the system (e.g. medium = green field)

In diagram 1 the correct valve size is determined by the intersection between the lines for the water flow G and the pressure drop Δp_V (e.g. 32 mm valve).

The required proportional band (green field) and the max pressure Δp_L, against which the controller is to close, is decisive for the choice of thermostat etc. which can be found from the table – e.g. 32 mm single seated valve + V8.09 thermostat (Δp_L = 6,8 bar) or 32 mm M3F valve + V4.10 thermostat (Δp_L = 12 bar).

When controlling cooling systems with V-thermostat and 2-way valve, reverse acting valves type L2SR, M2FR, G2FR or H2FR should always be used. See data sheet.

Control Systems for Steam

Only 2-way valves should be used for steam.
Necessary sizing values:

1. Max. steam flow: G ton/h (e.g. G = 1,5 ton/h)
2. Inlet pressure (saturated steam) p_1 bar absolute (e.g. p_1 = 10 bar)
3. Steam temperature T at p_1 bar (e.g. T = 179°C)
4. Variation of load in the system (e.g. medium = green field)

In diagram 2 the vertical line for the actual inlet pressure p_1 should be followed to the intersection with the line for δ = 0,42 (or below if a smaller δ is specified).
The intersection between the horizontal line from this point and the line for steam flow G lies in the field for the optimal valve size (e.g. 40 mm valve).
The required proportional band (green field) and the max pressure Δp_L, against which the controller is to close, is decisive for the choice of thermostat etc. which can be found from the table – e.g. 40 mm single seated balanced M1FB valve + V8.09 thermostat (Δp_L = 11 bar).

Valve Material

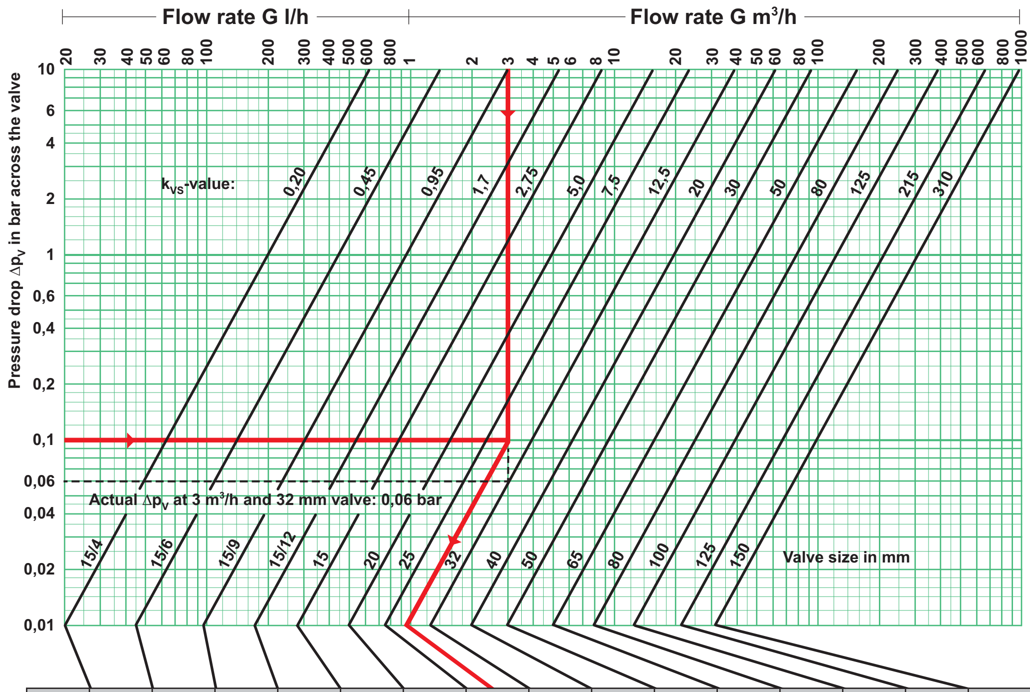
The necessary valve material is determined by diagram 3 at the intersection for the actual temperature and pressure lines.

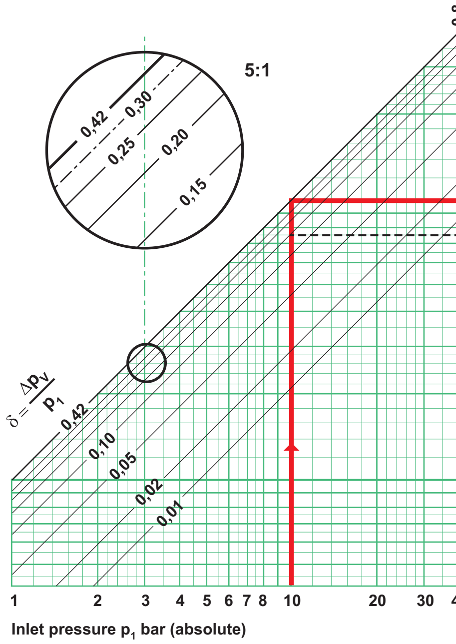
Control Systems for Other Media

Oil systems with viscosity v_k in:
If actual cSt $< 35 \cdot \sqrt{G} \cdot \sqrt{\Delta p}$ should be sized as water systems. The flow G measured in m^3/h. If measured in kg/h, G will have to be divided by the density of the oil (in kg/m^3) before entering diagrams.
When sizing other oil systems – or systems for other media – please contact our company.

Sizing for Water

Diagram 1



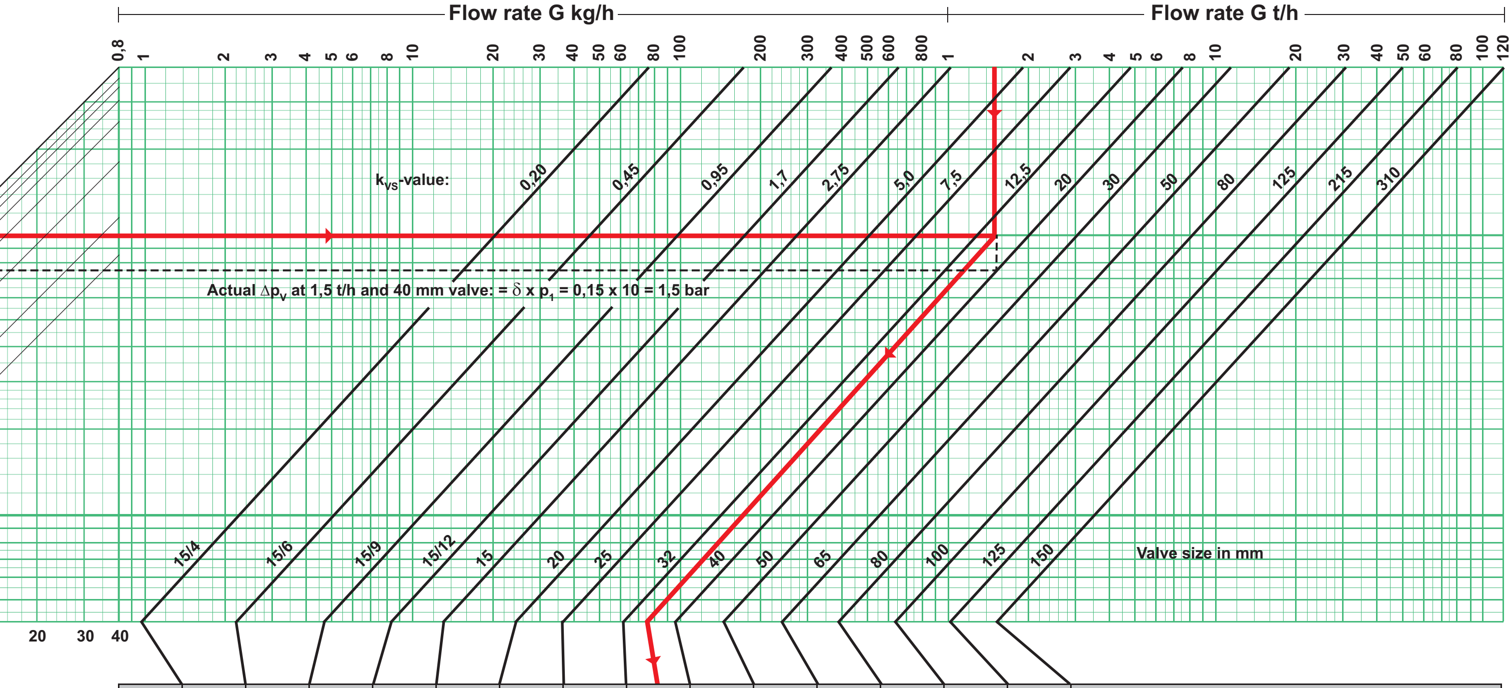


15/4	15/6	15/9	15/12	15	20	25	32	40	50	65	80	100	125	150	Valve size in mm		
Max. pressure in bar (Δp_L), against which the control can close 1)															Type of valve 3)		Actuator
	16	16	11	6,7	3,8	6									L1S / L1SB	single seated	Type V2.05
21	21	13	10	6,1	2,8	1,8	0,9								M1F, G1F, H1F		
					16	13	7,8	3,5	2,5						L2S	double seated	
					16	14	7,9	4,3	3,3						M2F, G2F, H2F		
				5,4	5,4										4) L3S	3-way	
				2,2	1,9										5) L3S		(200 N)
	16	16	16	16	9,8	16									L1S / L1SB	single seated	Type V4.05, TD-58, TD-66-4 2)
40	40	38	25	16	7,6	5	2,8	1,8	1,4						M1F, G1F, H1F		
						15	12	8,8	6,5						M/G/H1FB	single seated,bal.	
					40	40	25	21	14	9,2	7,3	5,7	3,8	2,7	L2S, M/G/H2F	double seated	
				10	10	9,2	9,2	6,6	6,6	4,2	3,7	2,9			4) L3S, L3F	3-way	
				2,2	1,9	10	10	6,2	6,2	3,3	2,9	2,1			5) L3S, L3F		
						14	12	8	6,8	5,4	3,7	2,9			4) M3F		
						19	16	9,1	7,7						4) G3F, H3F		
						14	10	8	6,3	4	2,9	2,1			5) M3F, G3F, H3F		(400 N)
	16	16	16	16	9,8	16									L1S / L1SB	single seated	Type V4.10, TD-58, TD-66-4 2)
40	40	38	25	16	7,6	5	2,8	1,8	1,4						M1F, G1F, H1F		
						15	12	8,8	6,5						M/G/H1FB	single seated,bal.	
					40	40	25	21	14	9,2	7,3	5,7	3,8	2,7	L2S, M/G/H2F	double seated	
				10	10	9,2	9,2	6,6	6,6	4,2	3,7	2,9			4) L3S, L3F	3-way	
				2,2	1,9	10	10	6,2	6,2	3,3	2,9	2,1			5) L3S, L3F		
						14	12	8	6,8	5,4	3,7	2,9			4) M3F		
						19	16	9,1	7,7						4) G3F, H3F		
						14	10	8	6,3	4	3,9	2,1			5) M3F, G3F, H3F		(400 N)
40	40	40	40	36	17	11	6,8	4,3	3,3						L1S, M/G/H1F	single seated	Type V8.09 and type TD-66-8 2)
						22	20	14	12	10	5,2				M/G/H1FB	single seated,bal.	
					40	40	40	40	40	25	20	17	11	9,3	L2S, M/G/H2F	double seated	
				10	10	10	10	10	10	10	10	10	5,9	5,9	4) L3S, L3F	3-way	
				2,2	1,9	10	10	6,2	6,2	3,3	2,9	2,1	3,2	3,2	5) L3S, L3F		
						40	40	25	22	16	10	10	6	4,3	4) M3F, G3F, H3F		
						14	10	8	6,3	4	2,9	2,1	3,3	2,1	5) M3F, G3F, H3F		(800 N)
40	40	40	40	36	17	11	6,8	4,3	3,3						L1S, M/G/H1F	single seated	Type V8.18 and type TD-66-8 2)
						22	20	14	12	10	5,2				M/G/H1FB	single seated,bal.	
					40	40	40	40	40	25	20	17	11	9,3	L2S, M/G/H2F	double seated	
				10	10	10	10	10	10	10	10	10	5,9	5,9	4) L3S, L3F	3-way	
				2,2	1,9	10	10	6,2	6,2	3,3	2,9	2,1	3,2	3,2	5) L3S, L3F		
						40	40	25	22	16	10	10	6	4,3	4) M3F, G3F, H3F		
						14	10	8	6,3	4	2,9	2,1	3,3	2,1	5) M3F, G3F, H3F		(800 N)
				16	11,3										L1UP, L1IP	single seated	Valve motor type MT40/A (450 N)
	16	16	16	16	16	16									L1S / L1SB	single seated	Valve motor type VB, VBA up to DN 50
40	40	40	40	40	27	18	10	6,8	5,3						M1F, G1F, H1F		
						22	20	14	12						M/G/H1FB	single seated,bal.	
					40	40	40	40	40						L2S, M/G/H2F	double seated	
				10	10	10	10	10	10						4) L3S, L3F	3-way	
				2,2	1,9	10	10	6,2	6,2						5) L3S, L3F		
						40	40	40	40						4) M3F, G3F, H3F		
						14	10	8	6,3						5) M3F, G3F, H3F		(1200 N)
	16	16	16	16	16	16									L1S / L1SB	single seated	Valve motor type V, AV 3)
40	40	40	40	40	27	18	10	6,8	5,3						M1F, G1F, H1F		
						22	20	14	12	10	7/3,8				M/G/H1FB	single seated,bal.	
					40	40	40	40	40	25	25/17	25/14	19/7	16/5,3	L2S, M/G/H2F	double seated	
				10	10	10	10	10	10	10	10	10	10	10	4) L3S, L3F	3-way	
				2,2	1,9	10	10	6,2	6,2	3,3	2,9	2,1	3,2	3,2	5) L3S, L3F		
						40	40	40	40	16	10	10	10	9,4	4) M3F, G3F, H3F		
						14	10	8	6,3	4	2,9	2,1	3,3	2,1	5) M3F, G3F, H3F		(1200 N)

1 bar = 100 kPa = 10,2 mVS = 0,99 Atm. = 1,02 kp/cm² 1 cSt = 0,01 St = 10-6 m²/sec. °E into cSt: $v_k \cong 7{,}6 \times °E \cdot (1-1/°E^3)$

Sizing for Steam

Diagram 2



15/4	15/6	15/9	15/12	15	20	25	32	40	50	65	80	100	125	150	**Valve size in mm**		
Max. pressure in bar (Δp_L), against which the control can close 1)															**Type of valve 2)**		**Actuator**
	16	16	10	6	2,9	5									L1S / L1SB	single seated	Type V2.05
20	20	13	9,3	5,3	1,9	0,9									M1F, G1F, H1F		
					15	13	7,3	3,8	2,7						M2F, G2F, H2F	double seated	(200 N)
	16	16	16	16	9	16									L1S / L1SB	single seated	Type V4.05
40	40	38	24	15	6,7	4,1	1,9	0,8	0,4						M1F, G1F, H1F		
						15	12	8,1	5,7						M/G/H1FB	single seated, bal.	(400 N)
					40	40	24	20	17	8,4	6,5	4,9	2,9	1,8	M2F, G2F, H2F	double seated	
	16	16	16	16	9	16									L1S / L1SB	single seated	Type V4.10
40	40	38	24	15	6,7	4,1	1,9	0,8	0,4						M1F, G1F, H1F		
						15	12	8,1	5,7						M/G/H1FB	single seated, bal.	(400 N)
					40	40	24	20	17	8,4	6,5	4,9	2,9	1,8	M2F, G2F, H2F	double seated	
	16	16	16	16	16	13									L1S / L1SB	single seated	Type V8.09
40	40	40	40	35	16	10	5,8	3,3	2,3						M1F, G1F, H1F		
						18	14	11	8,7	6,4	4,3				M/G/H1FB	single seated, bal.	(800 N)
					40	40	40	40	40	24	19	16	10	8,4	M2F,G2F, H2F	double seated	
	16	16	16	16	16	13									L1S / L1SB	single seated	Type V8.18
40	40	40	40	35	16	10	5,8	3,3	2,3						M1F, G1F, H1F		
						18	14	11	8,7	6,4	4,3				M/G/H1FB	single seated, bal.	(800 N)
					40	40	40	40	40	24	19	16	10	8,4	M2F,G2F, H2F	double seated	
				16	10,4										L1UP, L1IP	single seated	Valve motor type MT40/A (450 N)
	16	16	16	16	16	16									L1S / L1SB	single seated	Valve motor 3)
40	40	40	40	40	26	17	9,8	5,8	4,3						M1F, G1F, H1F		type V, AV;
						18	14	11	8,7	6,4	5,1/2,8				M/G/H1FB	single seated, bal.	Type VB, VBA up
					40	40	40	40	40	25	25/16	25/13	19/6	15/4,4	M2F, G2F, H2F	double seated	to DN 50.(1200 N)

1) As Δp_L is normally decreasing by increasing inlet pressure p_1, all Δp_L values for water are calculated for $p_1 = \Delta p_L$ - and for steam as max allowable inlet pressure (pos. pressure) on the basis of vacuum behind the valve.
For 15/4 and 15/6 mm valves where Δp_V is increasing by increasing inlet pressure (p_1 is minimum by $\Delta p_V = 0$), Δp_L is, however, in both cases calculated as the max. allowable inlet pressure p_1 by $\Delta p_V = 0$.

2) Colour code (PB) is only valid for thermostats. The other type designations apply to pressure differential controls – with the same tabular values.

3) Tabular values preceded by a slanted stroke (e.g. 4,9/0,5) apply for motors with spring return – in cases where Δp_L is reduced.

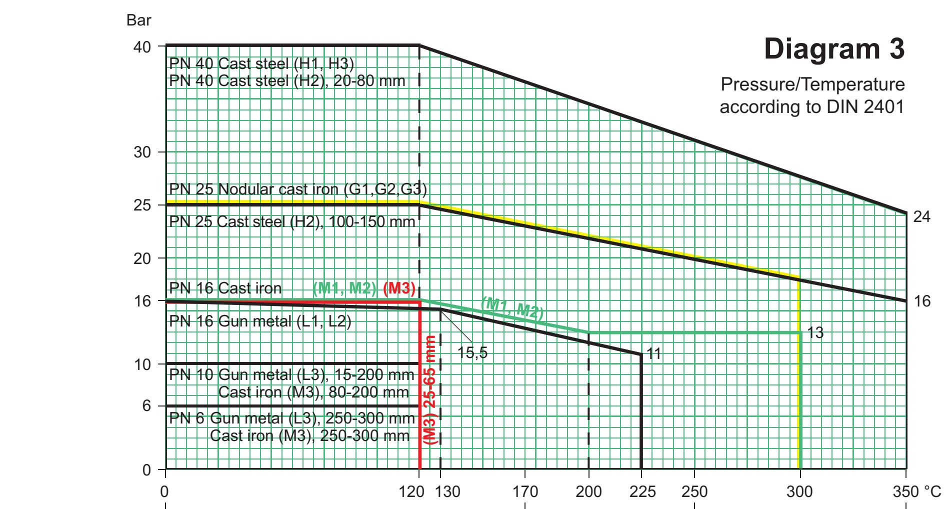
4) Tabular values valid for mixing valves by closing port A(2) – and for diverting valves by opening port B(3). See also: 5).

5) For mixing valves by closing port B(3) and for diverting valves by opening port A(2) - Δp_L is independent of actuator.

The sizing chart for steam is based on saturated steam. For superheated steam increase the required flow rate by the percentage shown in this table before entering the chart:

Superheat	Increase flow by
10°C	1%
50°C	5%
100°C	9%

We reserve the right of changes without notice.



Thermostat down:	Without Cooling Unit	Cooling Unit KS-4	Cooling Unit KS-5/KS-6
Thermostat up:	Without Cooling Unit	Must be avoided	Must be avoided

Complete control systems

Clorius Controls offers a complete range of tested and reliable equipment for control of heating, cooling and ventilation systems, all with the purpose of achieving the highest reliability and saving energy.

Controllers

Clorius Controls offers a wide range of electronic controllers for heating, cooling and ventilation systems. The controllers are available for systems in the maritime industry, general industry, institutions and residences. Clorius Controls offer controllers for simple stand-alone solutions or for larger BMS-plants.

Control valves

Clorius valves are simple and reliable for regulation of temperature and pressure differences in heating, cooling and ventilation systems for maritime industry, general industry, institutions and residences.

Motors

Clorius Controls offers a large program of conventional regulation motors and analogue motors. This includes special motors for maritime use, which are designed to withstand vibrations.

Balancing valves

With Ballorex balancing valves the amount of water in the individual heating circuits can be balanced and regulated.

Thermostats

Self-acting thermostats from Clorius Controls function directly and are available with sensors for air or liquids. They are also available as safety thermostats for the protection of secondary pipe installations.

Pressure differential controllers

The controllers from Clorius Controls lower large and variable pump pressure to stabilize the flow in the plant.

Service

Clorius Controls has an international network of service engineers who perform commissioning and trouble shooting in heating and ventilation plants. We are available 24 hours a day, 365 days a year.
We offer service contracts including preventive maintenance for all brands of regulating equipment.
We are also ready to help in case of urgent problems.

Clorius Controls A/S

Vendor:

Clorius Controls A/S
Tempovej 27
DK-2750 Ballerup
Denmark
Tel.: +45 77 32 31 30
Fax: +45 77 32 31 31
www.cloriuscontrols.com