

Ballorex® Thermo

7.1 Introduction



Ballorex Thermo description

The Ballorex Thermo is a thermostatic valve installed in domestic water systems on circulation lines. It is used to balance the system by controlling flow in reference to the water temperature.

The water temperature at which the Ballorex Thermo is to restrict the flow is set on the scale of the valve. As sufficiently hot water reaches the Ballorex Thermo the valve closes forcing water to the remaining sections of the system. The Ballorex Thermo in other risers and branches acts the same way providing balance within the whole system and ensuring immediate access to hot water for the end user.

The integrated automatic disinfection function enables bacteria fighting in the system by allowing water of up to 75°C in the supply and circulation pipes.

A minimum constant flow function ensures that flow breaking is prevented. No still water in the system helps to prevent bacteria germs from growing.

Flow limitation performed by the integrated static balancing valve helps to quickly balance a system when it starts operating and during normal working conditions. The static balancing valve is also used for isolation.

The Ballorex Thermo is as a standard provided with an integrated drain for service purpose. A thermometer and insulation shells are provided as accessories.

Ballorex Thermo benefits

- » Perfect domestic water system balance
- » Automatic thermal disinfection function
- » Shut-off function
- » Integrated drain valve with hose connection
- » Static valve incorporated for flow setting
- » Precise temperature setting
- » Two temperature setting ranges for precise system control
- » Optional thermometer for water temperature measurement
- » Minimum constant flow for preventing Legionella and other bacteria germs from growing
- » Energy saving compared to traditionally balanced domestic water systems

Ballorex Thermo design

The Ballorex Thermo consists of a thermostatic valve unit which can be set to the temperature at which the water flow should be restricted. The Ballorex Thermo is available with two setting ranges: from 30°C to 50°C and from 50°C to 60°C.

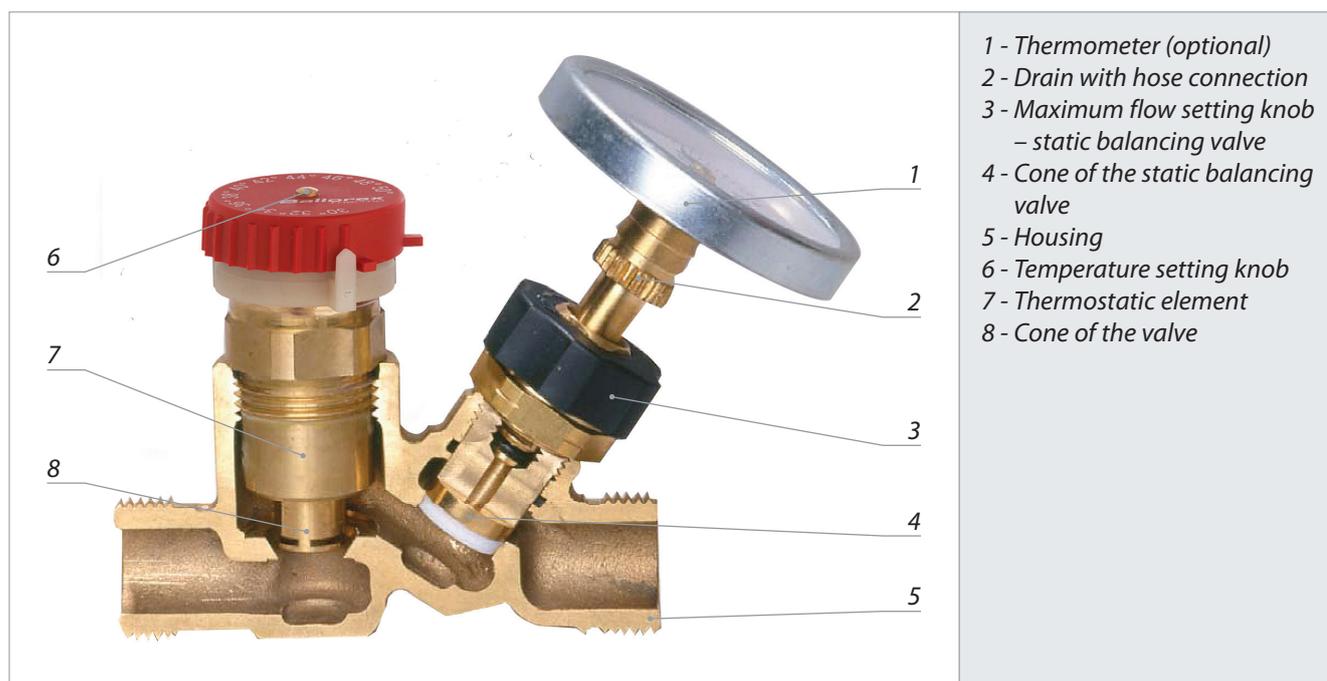
A static balancing valve is built into the Ballorex Thermo to limit the flow. By rotating the setting knob the required Kv of the valve is set.

This function is particularly useful when the system starts to operate and the thermostatic element of the Ballorex Thermo is fully open. By ensuring hydronic balance hot water will be provided almost simultaneously to all water points. The static balancing valve is also used for shutting off the flow.

The Ballorex Thermo has an integrated drain. When the flow is isolated and the drain opened the circulation pipe can be emptied. A hose should be mounted on the drain to prevent water spillage.

A thermometer can be inserted into the drain valve pocket to monitor water temperature. The thermometer is provided as an accessory and can be mounted at any time, also during system operation.

The Ballorex Thermo includes thermal disinfection function. When the water temperature is above the setting point, the flow through the valve is restricted. As the thermal disinfection starts and water temperature increases above 65°C, the thermostatic element continues to expand and again opens the flow. At 75°C the flow is shut off by the Ballorex Thermo again.



Ballorex® Thermo

7.1 Introduction

Ballorex Thermo system balancing and servicing

The Ballorex Thermo temperature setting is provided by turning the red knob. The scale is accurate and enables temperature setting with the accuracy of $\pm 1^{\circ}\text{C}$.



The Ballorex Thermo static valve setting is done by first closing it and then opening with a counterclockwise rotation of the setting knob. The number of turns needs to be counted to ensure the required Kv value of the valve. The graphs provided in the technical specification chapter specify the available Kv values in reference to the number of turns of the setting knob.



The drain can be used after closing the static valve. The drain opens when the hose connector is rotated counterclockwise. The hose connector also moves outwards during opening. A hose should be mounted on the connector to prevent water spillage.



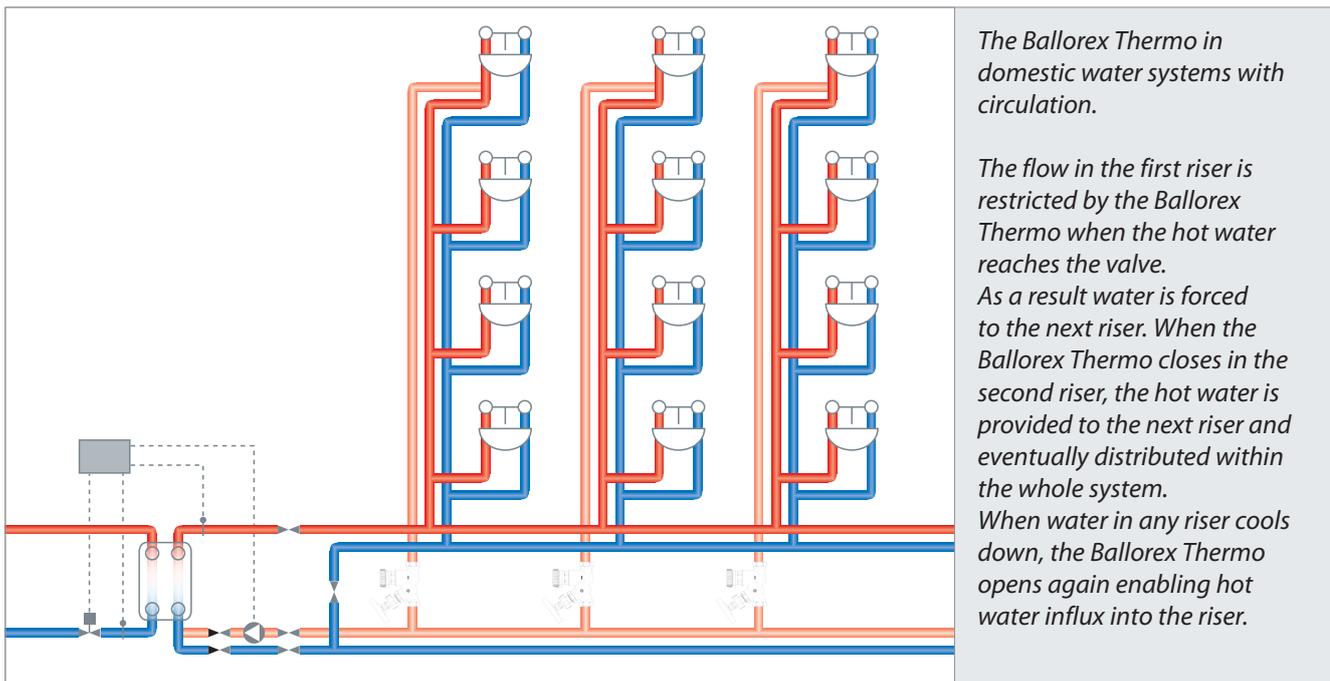
Ballorex Thermo operation

The Ballorex Thermo secures quick access to hot water in all water points by ensuring the required circulation flow throughout the domestic water system. This is achieved by setting the temperature at which the valve should restrict the flow in a riser or branch.

The circulation flow and the Ballorex Thermo temperature setting are calculated based on the pipe heat loss analysis. If, for instance, the required water temperature in the last water point of a riser is 55°C, and the heat loss from the circulation pipe will in this riser cause a cooling effect of 4°C, the Ballorex Thermo should be set at 51°C.

In a system with many risers hot water will first reach the pipes with the lowest resistance. As the circulation pump operates, water is provided to the first Ballorex Thermo valve. The valve starts restricting the flow when the temperature of water flowing through the valve is greater than the temperature setting of the Ballorex Thermo. The resistance of this circuit increases and the hot water is forced into the next riser. When the Ballorex Thermo in the second riser closes due to the hot water flow, the next risers are supplied with hot water in a similar way.

In addition to that the Ballorex Thermo ensures the option of balancing the flow in reference to the pressure distribution in the system by sizing the setting of the static valve. This function helps when the system starts operating or when the sizing flow is extremely low. During normal working conditions the system balancing is taken over by the thermostat unit of the Ballorex Thermo. If the system is not frequently switched on and off, and the flows are sufficient for the thermostatic element to take over control, the static valve of the Ballorex Thermo must remain fully open.



The operation of the domestic water system with the Ballorex Thermo resembles a heating system with thermostatic radiator valves. The risers can be compared to radiators whereas the Ballorex Thermo plays the role of a radiator thermostatic valve.

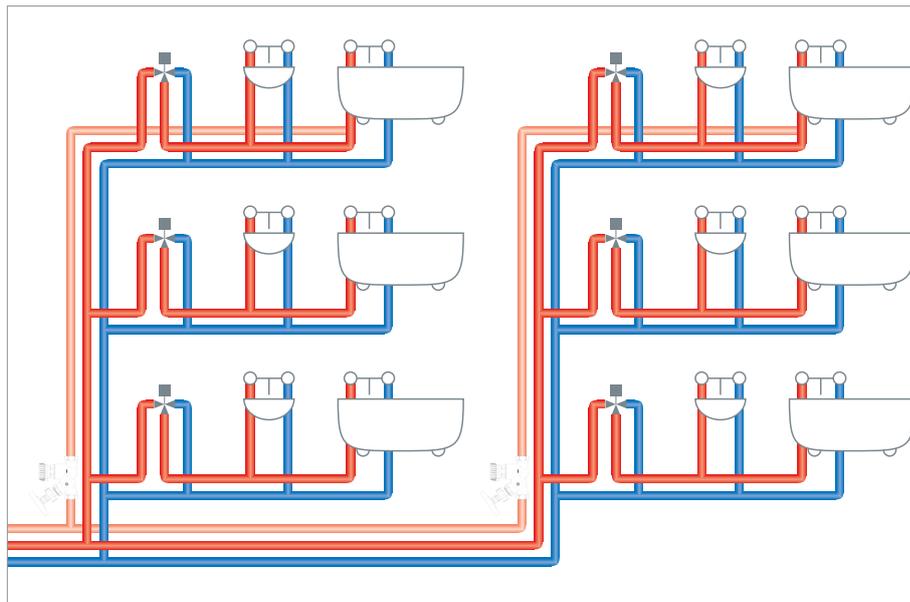
Due to this resemblance the pump should also operate as in a central heating system with thermostatic radiator valves. A variable speed pump must be provided and switched to proportional pressure mode. As Ballorex Thermo valves close, the pump should reduce flow and pressure to save energy and not counteract the closed Ballorex Thermo valves.

The thermal balancing of domestic water systems is effective and saves energy compared to traditionally balanced or non-balanced systems.

Ballorex Thermo system disinfection

Some regulations require that thermal disinfection is carried out by providing hot water of at least 70°C in the entire domestic hot water system. The Ballorex Thermo enables this type of disinfection by balancing the system also at that high temperature.

The thermal disinfection poses a risk of scalding when water is tapped. It is therefore recommended to apply thermostatic mixing valves e.g. Ballorex Thermix to protect the end user against this risk.



The Ballorex Thermo balances the domestic water system also during the thermal disinfection.

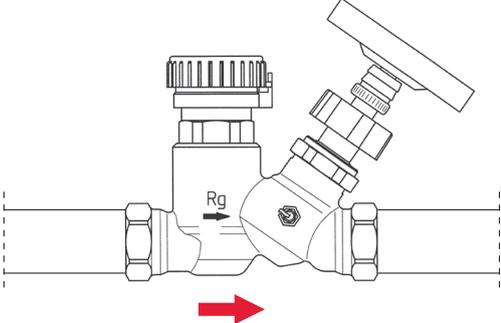
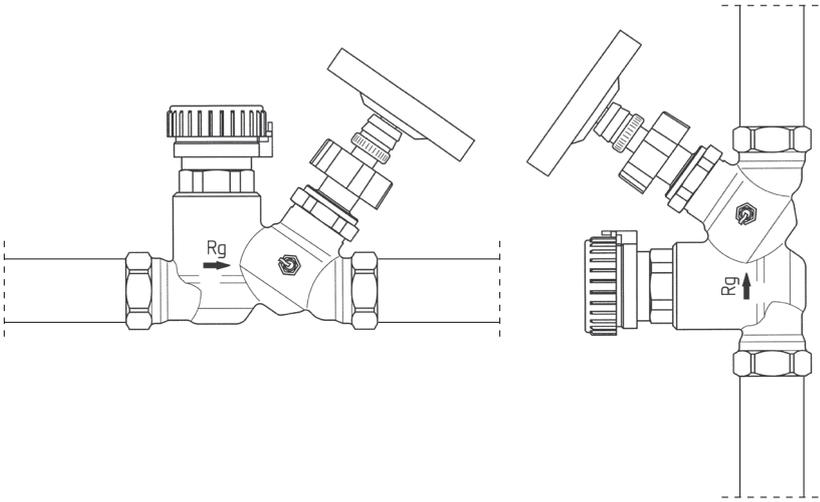
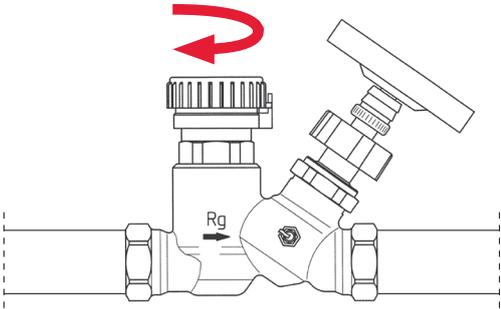
To protect the end user from scalding the thermostatic mixing valve Ballorex Thermix can be installed at the water point.

This is particularly important in public service buildings like schools, kindergartens as well as hotels, etc.

Ballorex® Thermo

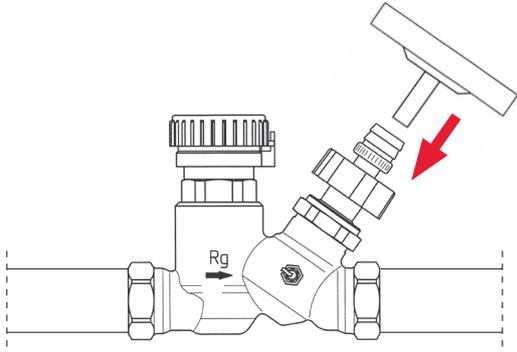
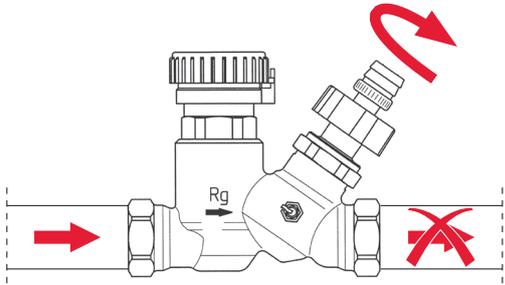
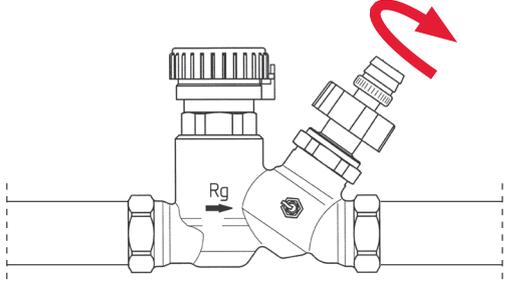
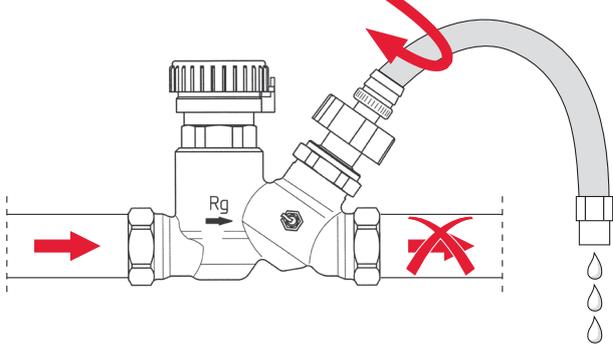
7.1 Mounting instructions

When installing the Ballorex Thermo in a system the following guidelines must be followed:

	<p>The Ballorex Thermo must be installed so that the flow direction marked on the valve is respected.</p>
	<p>The Ballorex Thermo may be installed in any position.</p>
 <p>T [°C]</p>	<p>The temperature setting is provided by rotating the red knob. A white reference mark on the collar underneath the knob indicates the current temperature setting.</p>

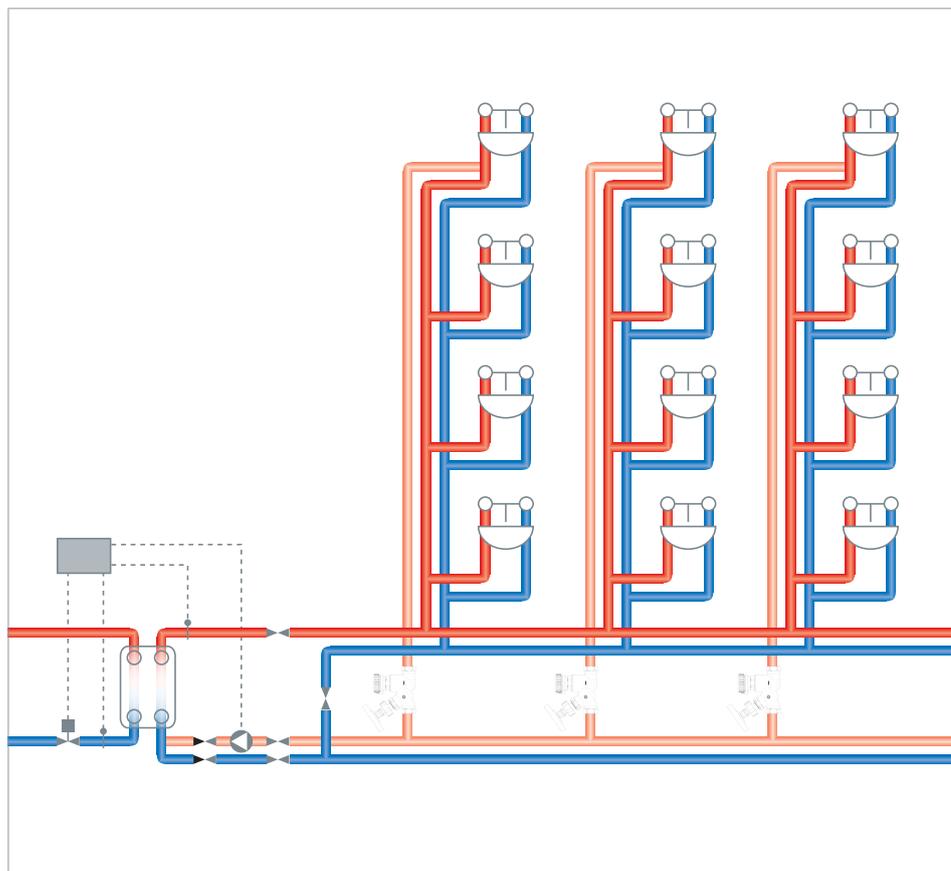
Ballorex® Thermo

7.1 Mounting instructions

	<p>The dedicated thermometer can be installed at any time without affecting the system tightness.</p>
	<p>The shut-off function is provided by turning the black knob clockwise.</p>
	<p>The flow setting is done by rotating the black knob. The number of turns should be counted to provide the sized Kv value.</p>
	<p>The draining function is activated by turning the hose connector counterclockwise.</p> <p>It is recommended to mount a hose to prevent water spillage.</p>

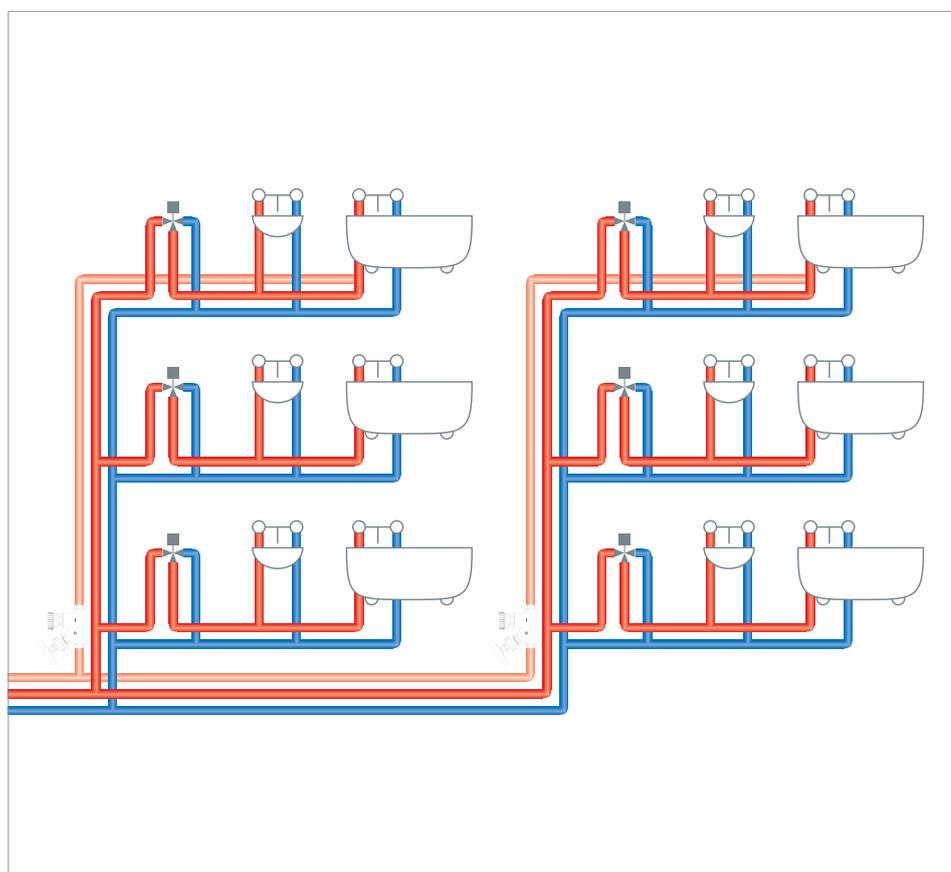
Ballorex® Thermo

7.1 Applications



Application 1 - Domestic water system with circulation

The Ballorex Thermo is used in domestic water systems with circulation. It is installed in the circulation pipe of each riser or a branch with several water points.



Application 2 - Domestic water system with circulation and thermostatic mixing valves

The Ballorex Thermo is used in domestic water systems with circulation where thermal disinfection is carried out. The valve is installed in the circulation pipe of each riser or in a branch with several water points.

The end user is protected against scalding by the thermostatic mixing valve Ballorex Thermix.

Regulations specifying the volume of hot water pipes without circulation must be observed when installing thermostatic mixing valves!

Ballorex® Thermo

7.1 Product data sheet

Ballorex Thermo

DN 15 female/female



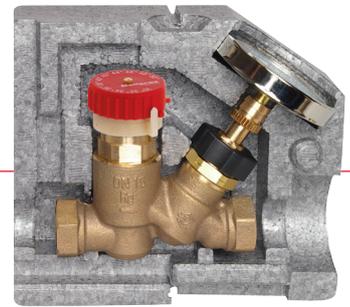
Dimensions	Specifications
	<p>Max. temperature 90°C Max. pressure 10 bar Accuracy ±2K Marking on valve (Handle) valve name, temperature scale (Valve body) DN, flow arrow</p> <p>Connection Female thread ISO 7/1 parallel Valve housing Bronze (gunmetal) DIN EN-1982 Spindle Brass DIN50930 part 6 Sealing EPDM</p>

Valve	Article	Dimension	Nom. Inch	Setting range °C	Kvs m ³ /h	Valve dimensions mm
	83530050-000008	DN 15	1/2"	50-60	1.30	A = 57 B = 75 C = 98 D = 136 E = 63 WS = 27
	83530030-000008	DN 15	1/2"	30-50	1.30	

Accessories	Article	Dimension	Description
	9380160	Ø 63 mm	Bimetal thermometer 0°C - 120°C
	1206430	143 × 82 × 162	EPP insulation jackets for Ballorex Thermo DN 15
	6300400	-	Thermostatic element with pre-setting scale 50-60°C for Ballorex Thermo DN 15
	6300410	-	Thermostatic element with pre-setting scale 30-50°C for Ballorex Thermo DN 15
	6300480	-	Static valve with drain for Ballorex Thermo DN 15 - 25

Ballorex® Thermo

7.1 Product data sheet



Ballorex Thermo

DN 15 female/female with insulation jacket and thermometer

Dimensions	Specifications
	<p> Max. temperature 90°C Max. pressure 10 bar Accuracy ±2K Marking on valve (Handle) valve name, temperature scale (Valve body) DN, flow arrow Connection Female thread ISO 7/1 parallel Valve housing Bronze (gunmetal) DIN EN-1982 Spindle Brass DIN50930 part 6 Sealing EPDM Insulation jacket EPP Thermometer Bimetal </p>

Valve	Article	Dimension	Nom. Inch	Setting range °C	Kvs m³/h	Valve dimensions mm
	83531050-000008	DN 15	1/2"	50-60	1.30	A = 162 B = 82 C = 143 D = 41
	83531030-000008	DN 15	1/2"	30-50	1.30	

Accessories	Article	Dimension	Description
	6300400	-	Thermostatic element with pre-setting scale 50-60°C for Ballorex Thermo DN 15
	6300410	-	Thermostatic element with pre-setting scale 30-50°C for Ballorex Thermo DN 15
	6300480	-	Static valve with drain for Ballorex Thermo DN 15 - 25

Ballorex® Thermo

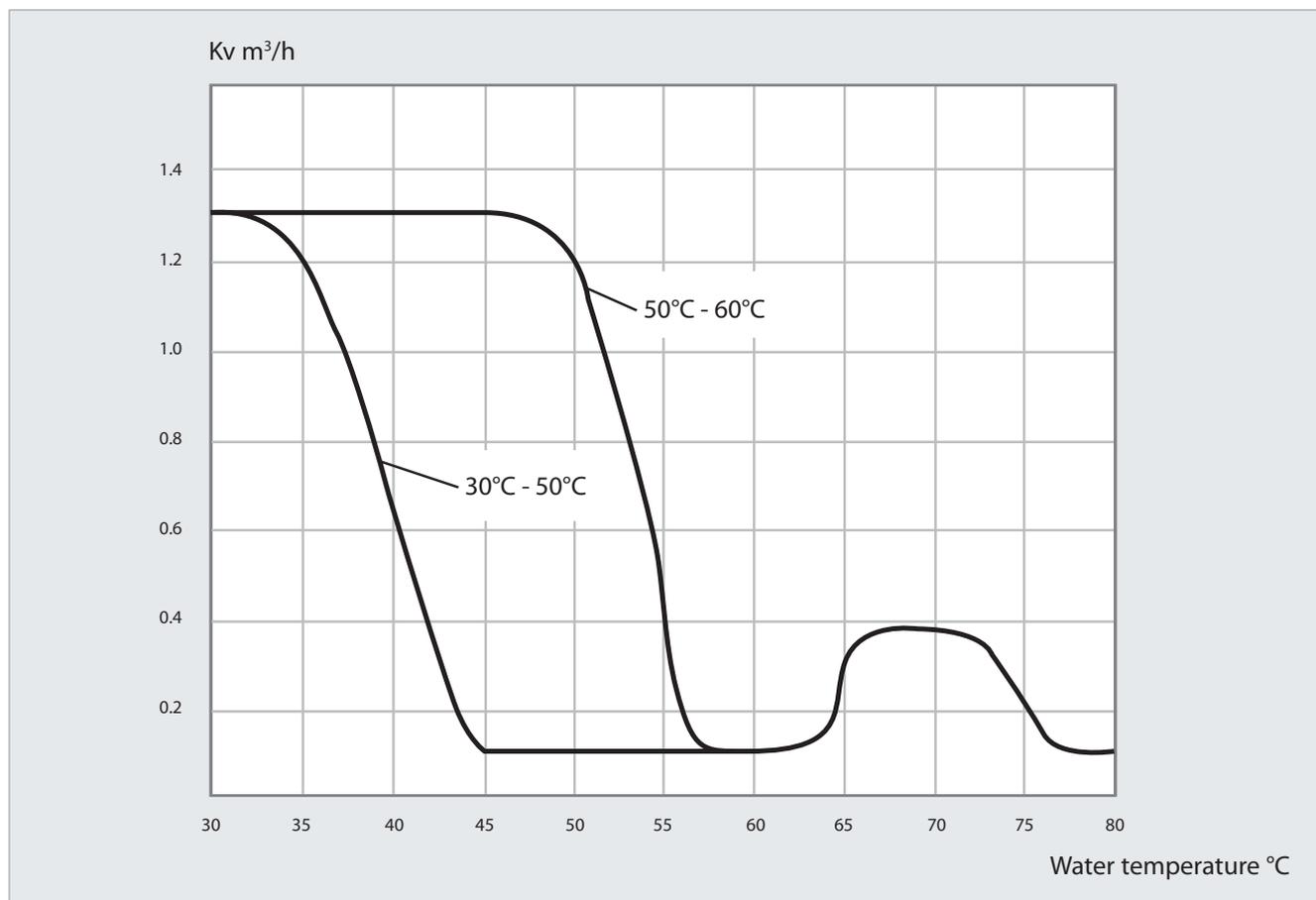
7.1 Product data sheet

Ballorex Thermo

DN 15 female/female

Regulating characteristics of the Ballorex Thermo:

- » Ballorex thermo with the control range of 30-50°C and at the temperature setting of 43°C
- » Ballorex thermo with the control range of 50-60°C and at the temperature setting of 57°C



The maximum flow restriction is achieved when the water temperature is equal to or higher than the temperature setting on the Ballorex Thermo.

The Ballorex Thermo opens for thermal disinfection at a water temperature of 65°C and closes when the temperature reaches 75°C.

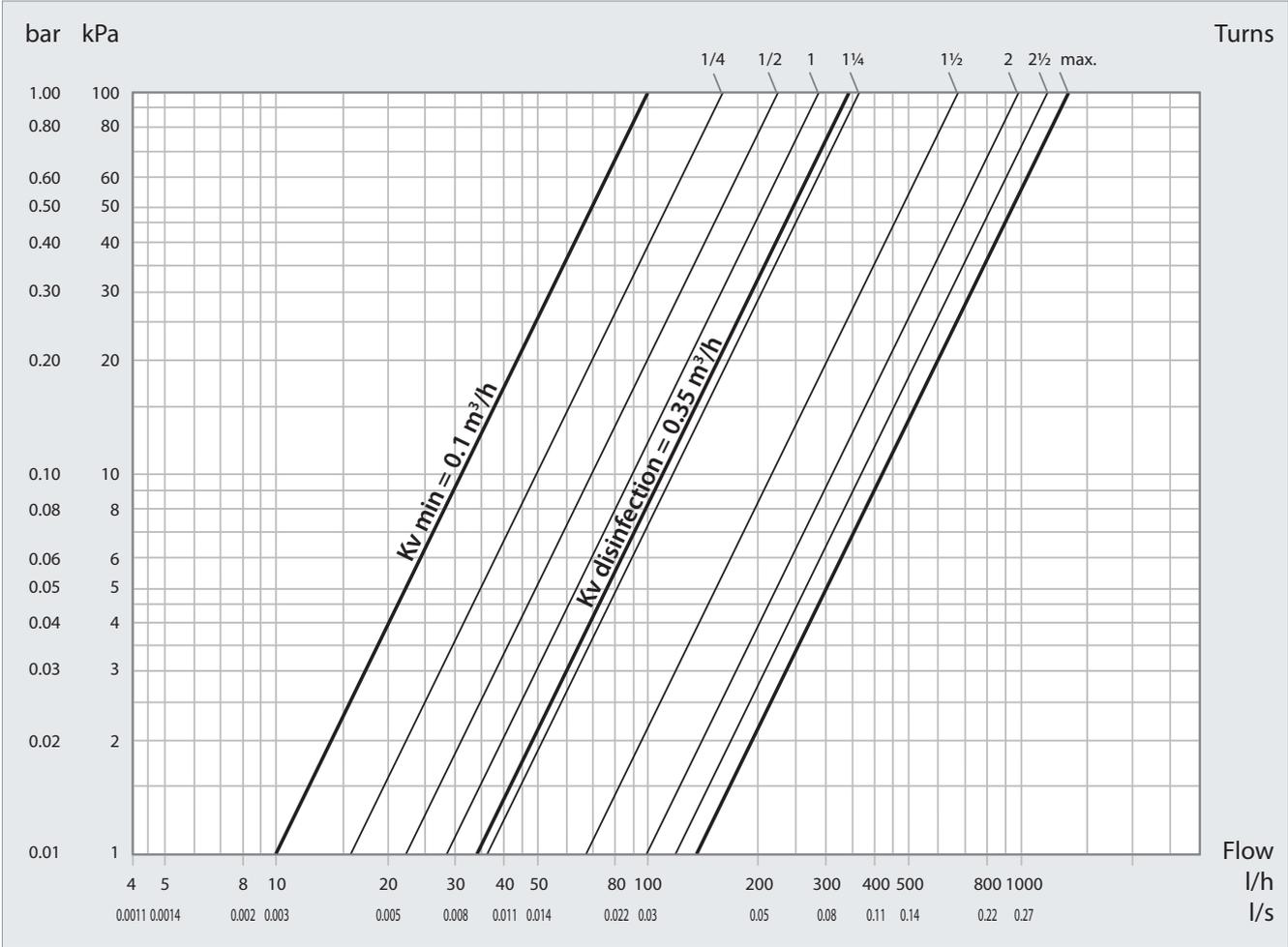
Ballorex® Thermo

7.1 Product data sheet

Ballorex Thermo

DN 15 female/female

The below graph is used to specify the setting of the Ballorex Thermo static balancing valve.
 The Kv value depends on the number of turns of the flow setting knob.
 The turns are counted from the fully closed position.



Ballorex® Thermo

7.1 Product data sheet

Ballorex Thermo

DN 20 female/female



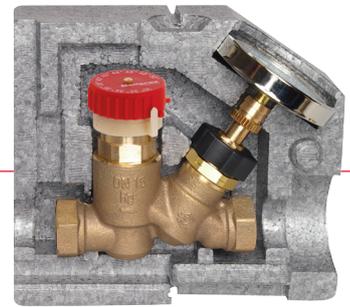
Dimensions	Specifications
	<p>Max. temperature 90°C Max. pressure 10 bar Accuracy ±2K Marking on valve (Handle) valve name, temperature scale (Valve body) DN, flow arrow</p> <p>Connection Female thread ISO 7/1 parallel Valve housing Bronze (gunmetal) DIN EN-1982 Spindle Brass DIN50930 part 6 Sealing EPDM</p>

Valve	Article	Dimension	Nom. Inch	Setting range °C	Kvs m³/h	Valve dimensions mm
	84530050-000008	DN 20	3/4"	50-60	1.85	A = 57 B = 75 C = 125 D = 147 E = 63 WS = 34
	84530030-000008	DN 20	3/4"	30-50	1.85	

Accessories	Article	Dimension	Description
	9380160	Ø 63 mm	Bimetal thermometer 0°C - 120°C
	1206431	143 × 90 × 162	EPP insulation jackets for Ballorex Thermo DN 20
	6300420	-	Thermostatic element with pre-setting scale 50-60°C for Ballorex Thermo DN 20
	6300430	-	Thermostatic element with pre-setting scale 30-50°C for Ballorex Thermo DN 20
	6300480	-	Static valve with drain for Ballorex Thermo DN 15 - 25

Ballorex® Thermo

7.1 Product data sheet



Ballorex Thermo

DN 20 female/female with insulation jacket and thermometer

Dimensions	Specifications
	<p> Max. temperature 90°C Max. pressure 10 bar Accuracy ±2K Marking on valve (Handle) valve name, temperature scale (Valve body) DN, flow arrow Connection Female thread ISO 7/1 parallel Valve housing Bronze (gunmetal) DIN EN-1982 Spindle Brass DIN50930 part 6 Sealing EPDM Insulation jacket EPP Thermometer Bimetal </p>

Valve	Article	Dimension	Nom. Inch	Setting range °C	Kvs m³/h	Valve dimensions mm
	84531050-000008	DN 20	3/4"	50-60	1.85	A = 162 B = 90 C = 143 D = 41
	84531030-000008	DN 20	3/4"	30-50	1.85	

Accessories	Article	Dimension	Description
	6300420	-	Thermostatic element with pre-setting scale 50-60°C for Ballorex Thermo DN 20
	6300430	-	Thermostatic element with pre-setting scale 30-50°C for Ballorex Thermo DN 20
	6300480	-	Static valve with drain for Ballorex Thermo DN 15 - 25

Ballorex® Thermo

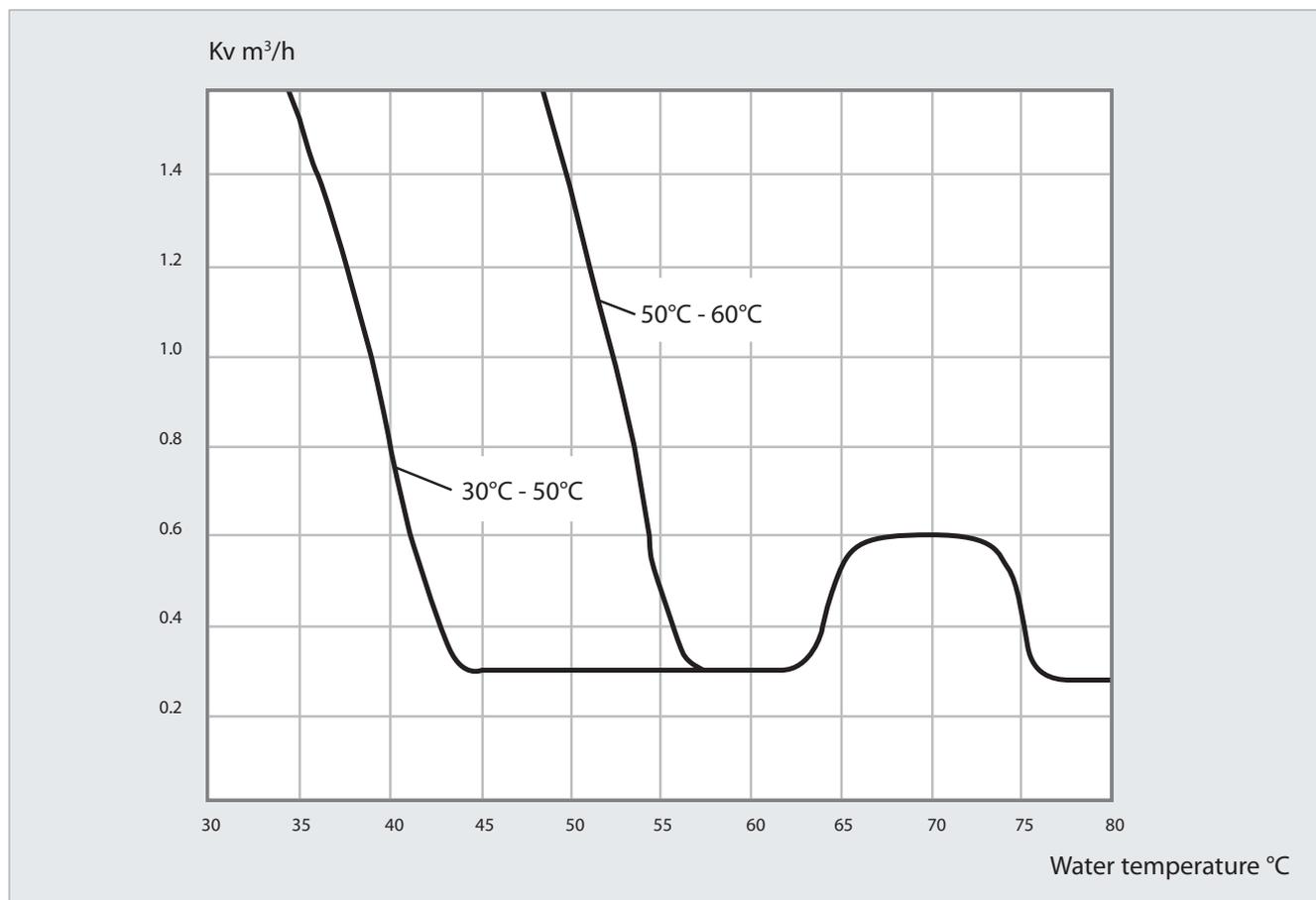
7.1 Product data sheet

Ballorex Thermo

DN 20 female/female

Regulating characteristics of the Ballorex Thermo:

- » Ballorex thermo with the control range of 30-50°C and at the temperature setting of 43°C
- » Ballorex thermo with the control range of 50-60°C and at the temperature setting of 57°C



The maximum flow restriction is achieved when the water temperature is equal to or higher than the temperature setting on the Ballorex Thermo.

The Ballorex Thermo opens for thermal disinfection at a water temperature of 65°C and closes when the temperature reaches 75°C.

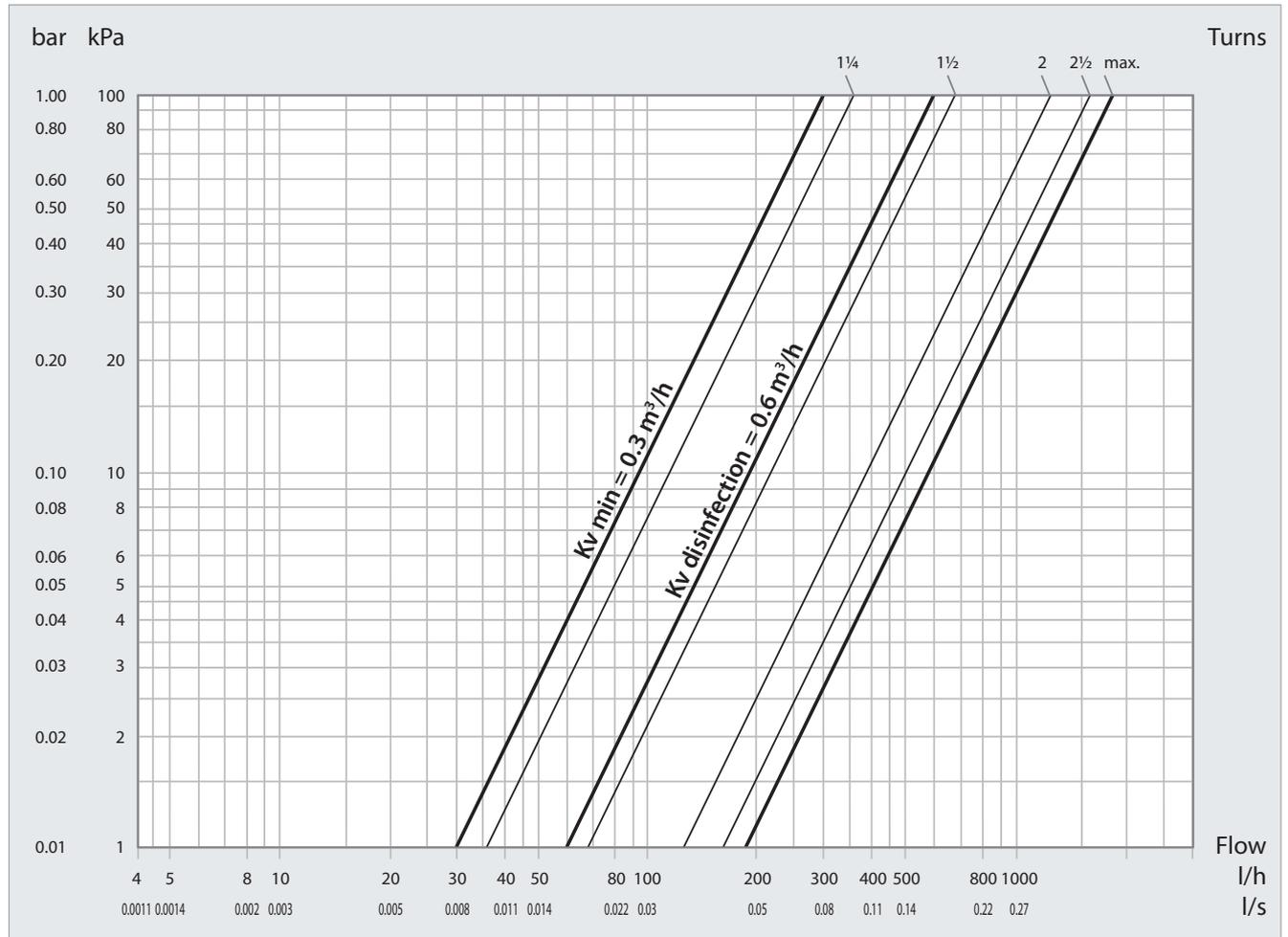
Ballorex® Thermo

7.1 Product data sheet

Ballorex Thermo

DN 20 female/female

The below graph is used to specify the setting of the Ballorex Thermo static balancing valve.
The Kv value depends on the number of turns of the flow setting knob.
The turns are counted from the fully closed position.



Ballorex® Thermo

7.1 Product data sheet

Ballorex Thermo

DN 25 female/female



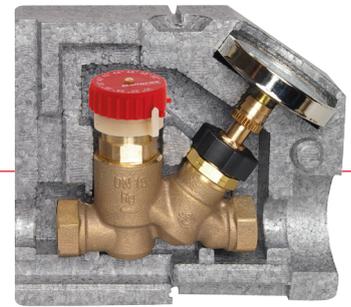
Dimensions	Specifications
	<p>Max. temperature 90°C Max. pressure 10 bar Accuracy ±2K Marking on valve (Handle) valve name, temperature scale (Valve body) DN, flow arrow</p> <p>Connection Female thread ISO 7/1 parallel Valve housing Bronze (gunmetal) DIN EN-1982 Spindle Brass DIN50930 part 6 Sealing EPDM</p>

Valve	Article	Dimension	Nom. Inch	Setting range °C	Kvs m ³ /h	Valve dimensions mm
	85530050-000008	DN 25	1"	50-60	2.10	A = 57 B = 75 C = 136 D = 150 E = 63 WS = 42

Accessories	Article	Dimension	Description
	9380160	Ø 63 mm	Bimetal thermometer 0°C - 120°C
	1206432	157 × 110 × 162	EPP insulation jackets for Ballorex Thermo DN 25
	6300440	-	Thermostatic element with pre-setting scale 50-60°C for Ballorex Thermo DN 25
	6300480	-	Static valve with drain for Ballorex Thermo DN 15 - 25

Ballorex® Thermo

7.1 Product data sheet



Ballorex Thermo

DN 25 female/female with insulation jacket and thermometer

Dimensions	Specifications
	<p> Max. temperature 90°C Max. pressure 10 bar Accuracy ±2K Marking on valve (Handle) valve name, temperature scale (Valve body) DN, flow arrow Connection Female thread ISO 7/1 parallel Valve housing Bronze (gunmetal) DIN EN-1982 Spindle Brass DIN50930 part 6 Sealing EPDM Insulation jacket EPP Thermometer Bimetal </p>

Valve	Article	Dimension	Nom. Inch	Setting range °C	Kvs m³/h	Valve dimensions mm
	85531050-000008	DN 25	1"	50-60	2.10	A = 162 B = 110 C = 157 D = 55

Accessories	Article	Dimension	Description
	6300440	-	Thermostatic element with pre-setting scale 50-60°C for Ballorex Thermo DN 25
	6300480	-	Static valve with drain for Ballorex Thermo DN 15 - 25

Ballorex® Thermo

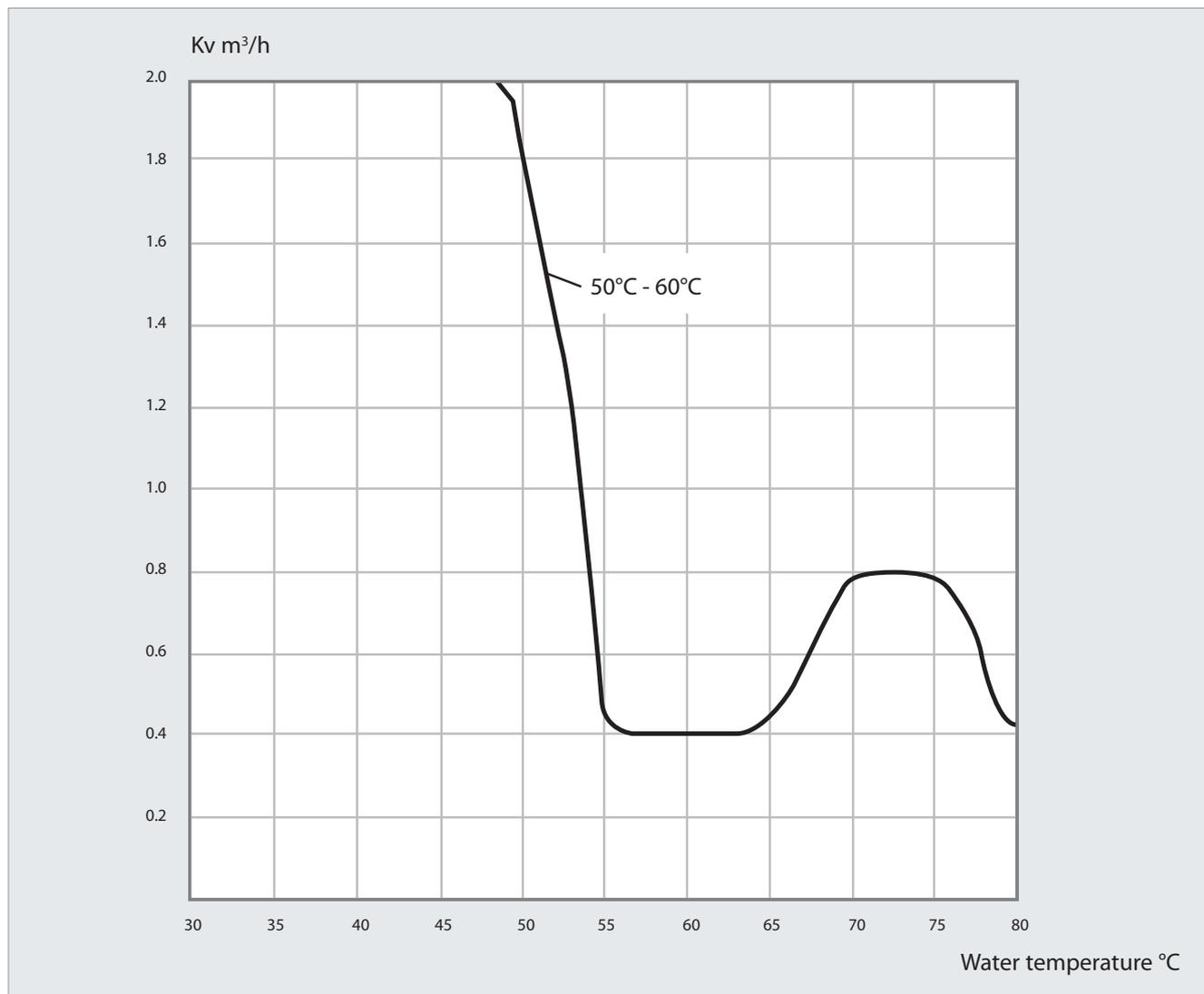
7.1 Product data sheet

Ballorex Thermo

DN 25 female/female

Regulating characteristics of the Ballorex Thermo:

» Ballorex thermo with the control range of 50-60°C and at the temperature setting of 57°C



The maximum flow restriction is achieved when the water temperature is equal to or higher than the temperature setting on the Ballorex Thermo.

The Ballorex Thermo opens for thermal disinfection at a water temperature of 65°C and closes when the temperature reaches 75°C.

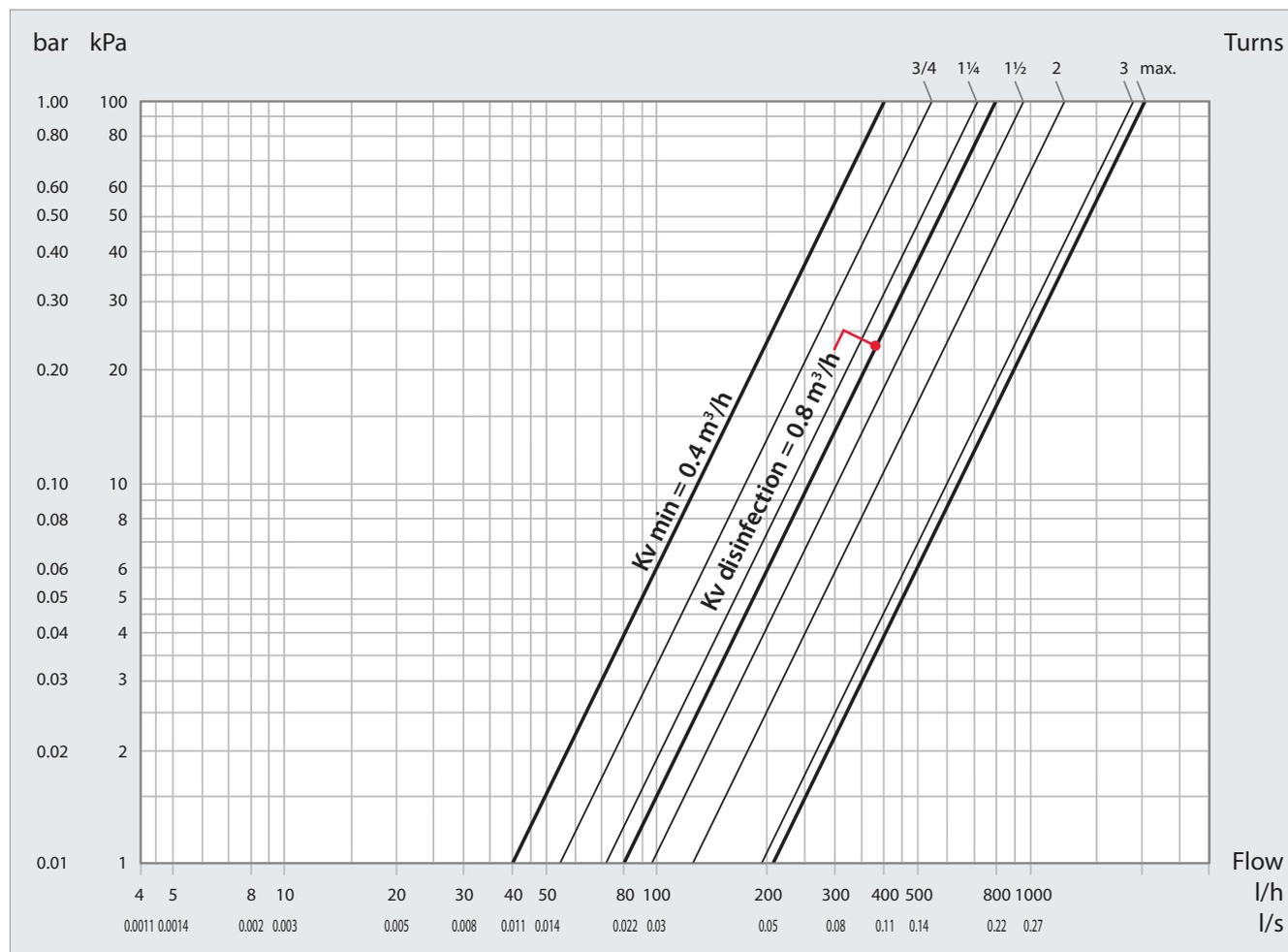
Ballorex® Thermo

7.1 Product data sheet

Ballorex Thermo

DN 25 female/female

The below graph is used to specify the setting of the Ballorex Thermo static balancing valve.
The Kv value depends on the number of turns of the flow setting knob.
The turns are counted from the fully closed position.

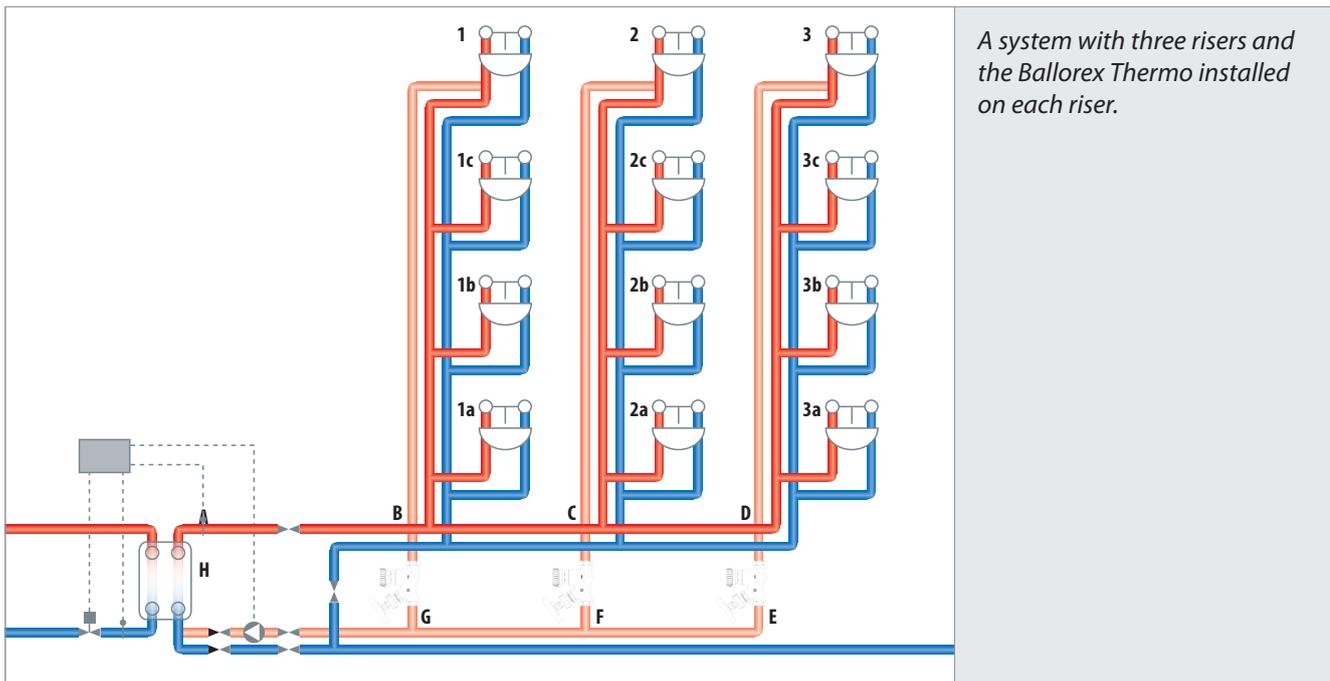


Ballorex® Thermo

7.1 Sizing examples

Ballorex Thermo for block of flats domestic water system balancing

The Ballorex Thermo should be sized for a block of flats domestic water system comprising three risers. Water temperature at each water point should be at least 55°C. The hot water temperature is 60°C at the heat exchanger outlet and thus the maximum water temperature difference in the system is 5°C (water temperature in the horizontal circulation lines – from the place the index Ballorex Thermo is installed (E) to the heat exchanger (H) – is never taken into account).



Temperature setting on all Ballorex Thermo valves should be calculated and the circulation pump should be sized. Flows in the domestic water system are calculated based on heat loss from the pipes. Heat loss from a pipe is calculated based on the formula:

$$P = \pi D_e L K \left[\frac{(t_b + t_e) - t_a}{2} \right] (1 - \eta) \text{ [W]}$$

D_e – external diameter of the pipe [m]

L – length of pipe [m]

K – heat transfer coefficient [$\text{W}/\text{m}^2 \text{K}$]

t_b – water temperature at the beginning of the pipe [$^{\circ}\text{C}$]

t_e – water temperature at the end of the pipe [$^{\circ}\text{C}$]

t_a – ambient temperature [$^{\circ}\text{C}$]

η – isolation efficiency

Ballorex® Thermo

7.1 Sizing examples

Pipes lengths and diameters are as follow:

Pipe	A-B	B-C	C-D	B-1	1-G	C-2	2-F	D-3	3-E
L [m]	14.0	8.0	10.0	10.5	10.5	14.0	14.0	10.0	10.0
De [mm]	35	28	22	22	15	22	15	22	15

The heat transfer coefficient is set to the following values:

$K_H = 17 \text{ W/m}^2\text{K}$ – for horizontal distribution and circulation lines (pipes in basement without heating) at ambient temperature of 5°C,

$K_R = 11 \text{ W/m}^2\text{K}$ – for risers (pipes in shafts where heating is provided), at ambient temperature of 20°C.

Heat transfer coefficients K_H and K_R depend on the pipe and insulation material as well as on other factors and should be specified each time a domestic water system is sized.

The water temperature distribution is based on some assumptions. Knowing the maximum water temperature difference, between the heat exchanger outlet and the index water point it is possible to assess the average temperature drop in one meter of pipe by the following formula:

$$\delta t_{AV} = \frac{\Delta t_{max}}{L_{AB} + L_{BC} + L_{CD} + L_{D3}}$$

δt_{AV} – average water temperature drop in one meter of pipe

Δt_{max} – maximum water temperature difference, between the heat exchanger outlet and the index water point (3).

$$\delta t_{AV} = \frac{5}{14 + 8 + 10 + 10} = 0.12 \text{ K/m}$$

Due to the fact that the horizontal distribution pipe is in basement without heating the water temperature drop per meter of the pipe should be higher compared to the water temperature drop in risers.

$$\Delta t_{max} = \delta t_H \times (L_{AB} + L_{BC} + L_{CD}) + \delta t_{D3} \times L_{D3}$$

$\delta t_H = 0.125 \text{ K/m}$ – assumed water temperature drop in one meter of horizontal distribution pipe

$$\delta t_{D3} = \frac{\Delta t_{max} - \delta t_H \times (L_{AB} + L_{BC} + L_{CD})}{L_{D3}} = \frac{5 - 0.125 \times (14 + 8 + 10)}{10} = 0.100 \text{ K/m}$$

$\delta t_{D3} = 0.100 \text{ K/m}$ – temperature drop in one meter of riser D-3, (3-E).

$t_A = 60^\circ\text{C}$ temperature in point A

$t_B = t_A - L_{AB} \times \delta t_H = 60 - 14 \times 0.125 = 58.3^\circ\text{C}$ - temperature in point B

$t_C = t_B - L_{BC} \times \delta t_H = 58.3 - 8 \times 0.125 = 57.3^\circ\text{C}$ - temperature in point C

$t_D = t_C - L_{CD} \times \delta t_H = 57.3 - 10 \times 0.125 = 56.0^\circ\text{C}$ - temperature in point D

The minimum water temperature in the index water point (3) should be at least 55°C.

Due to the operation of the Ballorex Thermo it is possible to achieve the same water temperature also in water points 1 and 2. As a result the whole system can be sized in a way so that the water temperature in all water points on top of each riser is 55°C.

$t_1 = 55.0^\circ\text{C}$ temperature in water point 1

$t_2 = 55.0^\circ\text{C}$ temperature in water point 2

$t_3 = 55.0^\circ\text{C}$ temperature in water point 3

7.1 Sizing examples

$$t_E = t_3 - L_{3E} \times \delta t_R = 55.0 - 10 \times 0.10 = 54.0^\circ\text{C} \text{ temperature at Ballorex Thermo in point E}$$

$$\delta t_{C2} = \frac{t_C - t_2}{L_{C2}} = \frac{57.3 - 55}{14} = 0.160\text{K/m} - \text{temperature drop in one meter of riser C-2, (2-F)}$$

$$t_F = t_2 - L_{C2} \times \delta t_{C2} = 55.0 - 14 \times 0.160 = 52.8^\circ\text{C} \text{ temperature at Ballorex Thermo in point F}$$

$$\delta t_{B1} = \frac{t_B - t_1}{L_{B1}} = \frac{58.3 - 55}{10.5} = 0.310 \text{ K/m} - \text{temperature drop in one meter of riser B-1, (1-G)}$$

$$t_G = t_1 - L_{1G} \times \delta t_{B1} = 55.0 - 10.5 \times 0.310 = 51.8^\circ\text{C} \text{ temperature at Ballorex Thermo in point G}$$

In order to size the circulation flow the heat losses from the distribution pipes and the risers are calculated.

Isolation efficiency required for the calculations is based on an average value and is estimated: $\eta = 0.8$

$$P_{AB} = 3.14 \times 0.035 \times 14 \times 17 \times \left[\frac{60 + 58.3}{2} - 5 \right] \times (1 - 0.8) = 283.3 \text{ W}$$

heat loss in distribution pipe (calculated along the line A-B)

$$P_{BC} = 3.14 \times 0.028 \times 8 \times 17 \times \left[\frac{58.3 + 57.3}{2} - 5 \right] \times (1 - 0.8) = 126.3 \text{ W}$$

heat loss in distribution pipe (calculated along the line B-C)

$$P_{CD} = 3.14 \times 0.022 \times 10 \times 17 \times \left[\frac{57.3 + 56.0}{2} - 5 \right] \times (1 - 0.8) = 121.3 \text{ W}$$

heat loss in distribution pipe (calculated along the line C-D)

$$P_{RB1} = 3.14 \times 0.022 \times 10.5 \times 11 \times \left[\frac{58.3 + 55.0}{2} - 20 \right] \times (1 - 0.8) = 58.5 \text{ W}$$

heat loss in riser 1 (calculated along the line B-1a-1b-1c-1) W

$$P_{R1G} = 3.14 \times 0.015 \times 10.5 \times 11 \times \left[\frac{55.0 + 51.8}{2} - 20 \right] \times (1 - 0.8) = 36.3 \text{ W}$$

heat loss in riser 1 (calculated along the line 1-G)

$$P_{RC2} = 3.14 \times 0.022 \times 14.0 \times 11 \times \left[\frac{57.3 + 55.0}{2} - 20 \right] \times (1 - 0.8) = 76.9 \text{ W}$$

heat loss in riser 2 (calculated along the line C-2a-2b-2c-2)

$$P_{R2F} = 3.14 \times 0.015 \times 14.0 \times 11 \times \left[\frac{55.0 + 52.8}{2} - 20 \right] \times (1 - 0.8) = 49.2 \text{ W}$$

heat loss in riser 2 (calculated along the line 2-F)

$$P_{RD3} = 3.14 \times 0.022 \times 10.0 \times 11 \times \left[\frac{56.00 + 55.00}{2} - 20 \right] \times (1 - 0.8) = 54.0 \text{ W}$$

heat loss in riser 2 (calculated along the line C-2a-2b-2c-2)

$$P_{R3E} = 3.14 \times 0.015 \times 10.0 \times 11 \times \left[\frac{55.00 + 54.00}{2} - 20 \right] \times (1 - 0.8) = 35.8 \text{ W}$$

heat loss in riser 2 (calculated along the line 2-F)

$$P_{TS} = P_{AB} + P_{BC} + P_{CD} + P_{RB1} + P_{R1G} + P_{RC2} + P_{R2F} + P_{RD3} + P_{R3E}$$

$$P_{TS} = 283.3 + 126.3 + 121.3 + 58.5 + 36.3 + 76.9 + 49.2 + 54.0 + 35.8 = 841.6 \text{ W}$$

total heat loss in the domestic water system at circulation flow.

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7.1 Sizing examples

Total circulation flow is calculated based on the formula:

$$Q_{TS} = \frac{P_{TS}}{\rho c_w \Delta t_w} \text{ [m}^3\text{/s]}$$

ρ – water density – 1000 kg/m³

c_w – specific heat of water – 4190 J/kg K

Δt_w – water temperature difference at the heat exchanger outlet (A) and at the index water point (3), 5°C

$$Q_{TS} = \frac{841.6}{1000 \times 4190 \times 5} = 4.01 \times 10^{-5} \text{ m}^3\text{/s} = 144.6 \text{ l/h}$$

Circulation water flow in riser 1 is calculated based on the formula:

$$Q_{R1} = \frac{Q_{TS} (P_{RB1} + P_{R1G})}{(P_{RB1} + P_{R1G}) + P_{p1}} \text{ [m}^3\text{/s]}$$

P_{p1} – heat loss from pipes after the riser 1 (calculated along the line B-C-D and in risers: P_{RC2} , P_{R2F} and P_{RD3} , P_{R3E}) [W]

$$P_{p1} = P_{BC} + P_{CD} + P_{RC2} + P_{R2F} + P_{RD3} + P_{R3E} = 126.3 + 121.3 + 76.9 + 49.2 + 54.0 + 35.8 = 463.5 \text{ W}$$

$$Q_{R1} = \frac{144.6 \times (58.5 + 36.3)}{58.5 + 36.3 + 463.5} = 24.6 \text{ l/h}$$

Circulation water flow in riser 2 is calculated based on the formula:

$$Q_{R2} = \frac{Q_{TS} (P_{RC2} + P_{R2F})}{(P_{RC2} + P_{R2F}) + P_{p2}} \text{ [m}^3\text{/s]}$$

P_{p2} – heat loss from pipes after the riser 2 (calculated along the line C-D and in riser P_{RD3} , P_{R3E}) [W]

$$P_{p2} = P_{CD} + P_{RD3} + P_{R3E} = 121.3 + 54.0 + 35.8 = 211.1 \text{ W}$$

$$Q_{R2} = \frac{144.6 \times (76.9 + 49.2)}{76.9 + 49.2 + 211.1} = 54.1 \text{ l/h}$$

Circulation water flow in riser 3 is calculated based on the formula:

$$Q_{R3} = Q_{TS} - Q_{R1} - Q_{R2} \text{ [m}^3\text{/s]}$$

$$Q_{R3} = 144.6 - 24.6 - 54.1 = 65.9 \text{ l/h}$$

It should be noticed that the closer the Ballorex Thermo is installed to the water point the less circulation flow is required in the system.

The Ballorex Thermo temperature setting should be as follows:

Ballorex Thermo G: 52°C

Ballorex Thermo F: 53°C

Ballorex Thermo E: 54°C

Ballorex® Thermo

7.1 Sizing examples

Circulation pump head is calculated as a sum of pressure loss:

- Δp_{AB} in pipes A-B at flow Q_{TS}
- Δp_{BC} in pipes B-C at flow $Q_{TS} - Q_{R1}$
- Δp_{CF} in pipes C-D-3a-3b-3c-3-E-F at flow $Q_{TS} - Q_{R1} - Q_{R2}$
- Δp_{FG} in pipes F-G at flow $Q_{TS} - Q_{R1}$
- Δp_{GH} in pipes G-H at flow Q_{TS}
- Δp_H in the heat exchanger H-A, at flow Q_{TS}
- Δp_{Thermo} across the index Ballorex Thermo installed in riser 3 (E), at flow Q_{R3}

Based on the calculations:

$$\Delta p_{AB} = 0.7 \text{ kPa,}$$

$$\Delta p_{BC} = 0.4 \text{ kPa,}$$

$$\Delta p_{CF} = 7.5 \text{ kPa,}$$

$$\Delta p_{FG} = 2.5 \text{ kPa,}$$

$$\Delta p_{GH} = 2.0 \text{ kPa,}$$

$$\Delta p_H = 1.0 \text{ kPa}$$

Pressure loss across the Ballorex Thermo is always calculated at:

$$K_v = 0.2 \text{ m}^3/\text{h} \text{ for Ballorex Thermo DN15,}$$

$$K_v = 0.4 \text{ m}^3/\text{h} \text{ for Ballorex Thermo DN20,}$$

$$K_v = 0.6 \text{ m}^3/\text{h} \text{ for Ballorex Thermo DN25,}$$

and thus at flow of $Q_{R3} = 65.9 \text{ l/h}$ across the Ballorex Thermo DN15, $\Delta p_{Thermo} = 10.9 \text{ kPa}$.

Total pressure loss is

$$\Delta p_{TS} = 0.7 + 0.4 + 7.5 + 2.5 + 2.0 + 1.0 + 10.9 = 25.0 \text{ kPa.}$$

The pump should be sized for:

$$Q_{TS} = 144.6 \text{ l/h, } \Delta p_{TS} = 25.0 \text{ kPa}$$

Note!

When thermal disinfection takes place heat loss from pipes becomes much greater and thus bigger circulation pump is required.

The calculations should be then made also for the thermal disinfection conditions to correctly size the circulation pump.

Ordering:

Ballorex Thermo DN 15, product no: 83530050-000008

Ballorex® Thermo

7.1 Specifications

Ballorex Thermo general specifications

1. Thermostatic circulation valve DN 15 - 25

1.1. The Contractor must install thermostatic circulation valves where indicated in drawings.

2. Valve Body

2.1. The valve body must be made of gunmetal according to EN-1982.

2.2. The pressure rating must be no less than PN10.

3. Functions

3.1. The valve must enable temperature setting in ranges from 30°C to 50°C or from 50°C to 60°C.

3.2. The valve must comprise a shut-off function.

3.3. The valve must have an built-in drain with hose connection.

3.4. The valve must enable Kv setting to limit the flow at a given differential pressure.

3.5. The valve must enable automatic thermal disinfection of the domestic water system in a water temperature range of 65°C to 75°C.

3.4. The valve must make it possible to insert a thermometer into the housing also during operating conditions without affecting the tightness of the system.

