FLOWING EXPERTISE

COMPONENTS FOR HEAT PUMP SYSTEMS

CALEFFI
Hydronic Solutions

www.caleffi.com

THE CALEFFI GREEN

THIS IS OUR SUSTAINABLE COMMITMENT.
A BELIEF, A WAY OF LIFE AND A WAY OF DOING THINGS. THIS IS OUR TANGIBLE CONTRIBUTION TO ENVIRONMENTAL AND SOCIAL CHANGE.

We are building a more responsible future to meet the demands made by the **PEOPLE** of today and tomorrow, through **PRODUCTS** that will help them to save resources and that are designed to offer a more sustainable kind of comfort. To bring the perfect climate to life and have a positive impact on the **ENVIRONMENT**.

CALEFFI
Hydronic Solutions

GREEN REVOLUTION

SUPPORTING ENERGY TRANSITION

HEAT PUMP COMPONENTS

We encourage the use of innovative components which guarantee the utmost **EFFICIENCY**, **SAFETY** and **ENERGY SAVINGS**.

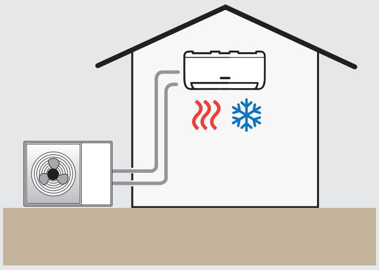
Our full range of products for **HEAT PUMP SYSTEMS** improve the operation and long-term durability of new heating and cooling technologies.

HEAT PUMP TYPES

Classification of heat pumps according to the heat source
Cool sources (or external sources) can be: outside air, groundwater or the earth.
Hot sources can be: air, when the heat pump heats/cools the air in the room directly, or water, when the heat pump heats/cools the water used as a thermal medium in heating and cooling circuits.

Aerothermal heat pump (air to air)

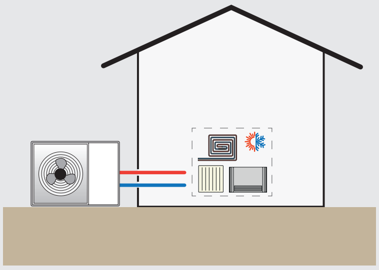
These heat pumps are fitted with air/refrigerant gas heat exchangers.
The cool source, outside air, is always available and at a variable temperature.
The heat exchanger is positioned inside the rooms in which heating/cooling is required, and is connected to the external unit by means of pipes containing refrigerant gas.



Aerothermal heat pump (air to water)

The air-water heat pump can be used to extract energy from the air and transfer it to the water in the form of heat.

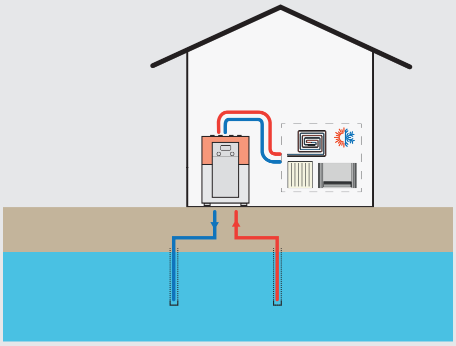
In contrast to the air to air pumps, the production of "technical" water serving a hydronic system offers a high degree of versatility in terms of system solutions (with radiators, fan-coils, radiant floor panels, etc.).



Geothermal heat pump (water to water)

In water to water heat pumps, the cool side removes energy from the water (generally taken from subsoil groundwater; in this case we are talking about geothermal groundwater HPs).

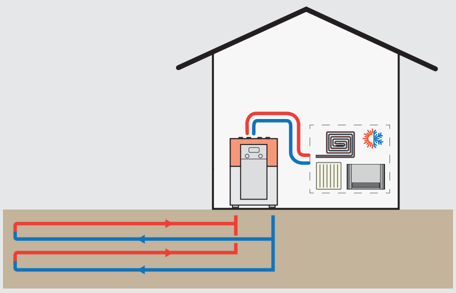
The advantages of these machines include operating stability and excellent efficiency.



Geothermal heat pump (ground to water)

In water to water HPs, also known as geothermal heat pumps, the cool source water is used as a thermal medium for energy exchange with the ground.

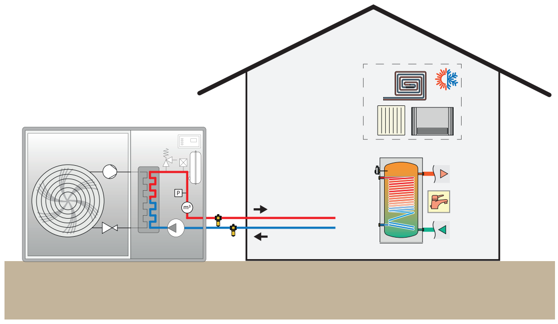
The heat exchangers consist of plastic pipes sunk into the ground (known as "geothermal probes"): they travel downwards (vertical probes) or along the surface (horizontal probes).



The products in this document have been categorised according to the solutions considered most suitable and effective for the system application types described. However, this guide is not in any way intended to exclude the use of other Caleffi products with similar specifications in these systems.
Caleffi S.p.A. declines any responsibility deriving from improper use of the data provided in this document. This document should not be considered as a replacement for the technical heating design.

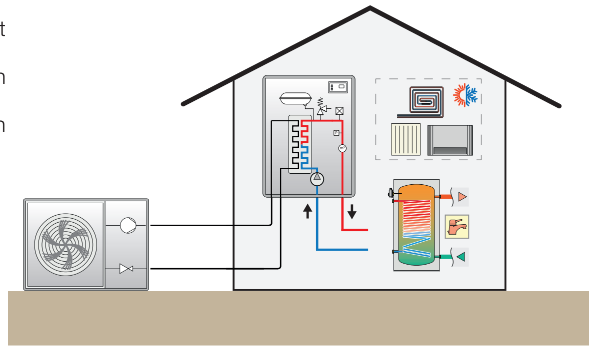
Monobloc aerothermal heat pump (air to water)

The monobloc heat pump consists of a single piece of equipment containing all the cooling circuit elements within it: the water/refrigerant plate heat exchanger, the compressor, the expansion valve and the fan that allows the air/refrigerant heat exchange to take place in the evaporator.
Several hydraulic circuit elements can be built into the machine, such as the circulator, the flow switch, the expansion vessel, the air vent and the safety relief valve.
The unit, positioned outside, is directly connected to the system via the pipes channelling the "technical" water from the machine to the building.



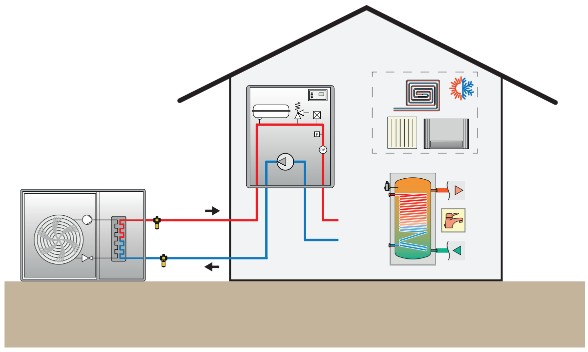
Refrigerant-split aerothermal heat pump (air to water)

The refrigerant-split heat pump consists of a hydronic module positioned inside the building and an external unit which exchanges heat with the air.
The main components used in the internal unit are: the water/refrigerant plate heat exchanger, circulator, flow switch, expansion vessel, air vent and safety relief valve.
The external unit, meanwhile, houses the compressor, expansion valve and fan which exchanges heat with the refrigerant medium via the outside air.
The advantage of the refrigerant-split is the lack of external hydronic pipes, which eliminates the risk of freezing and breakage of the components.



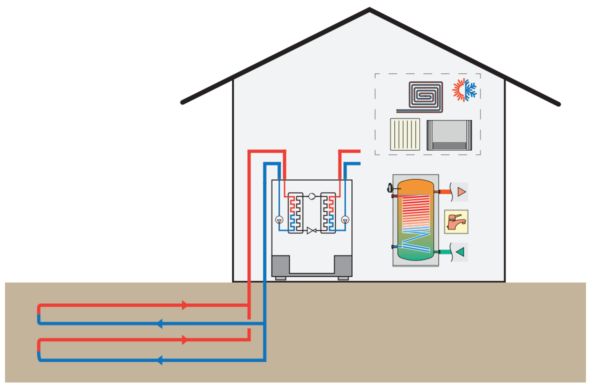
Hydro-split aerothermal heat pump (air to water)

In the hydro-split version the entire gas circuit is sealed in the external unit, meaning there are no gas pipes inside the dwelling; however, it has the disadvantage of the hydronic lines being positioned outside and therefore at risk of freezing.
It consists of a hydronic module positioned inside the building and an external unit which exchanges heat with the air.
The main components of the internal unit are: the circulator, expansion vessel, flow switch, air vent and safety relief valve.
The external unit houses the compressor, expansion valve, the fan which exchanges heat with the refrigerant medium via the outside air and the water/refrigerant plate heat exchanger.



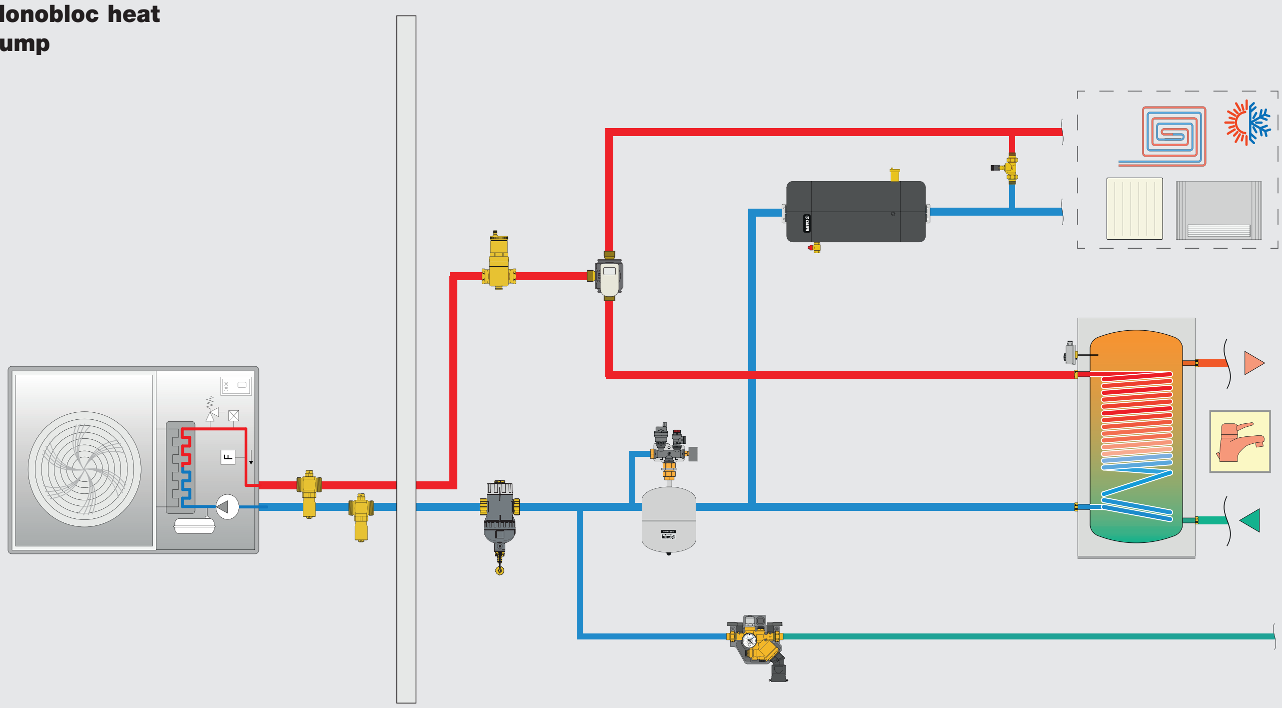
Geothermal heat pump (ground to water)

The geothermal heat pump has a very stable output throughout the year as all the elements in the system are protected from bad weather; it is particularly suitable for use in colder climates.
In addition to all the components found in the other types of heat pump mentioned previously, geothermal systems also have manifolds for cool source probes.
These manifolds must have the elements required for proper hydraulic balancing of the medium sent to the probes.

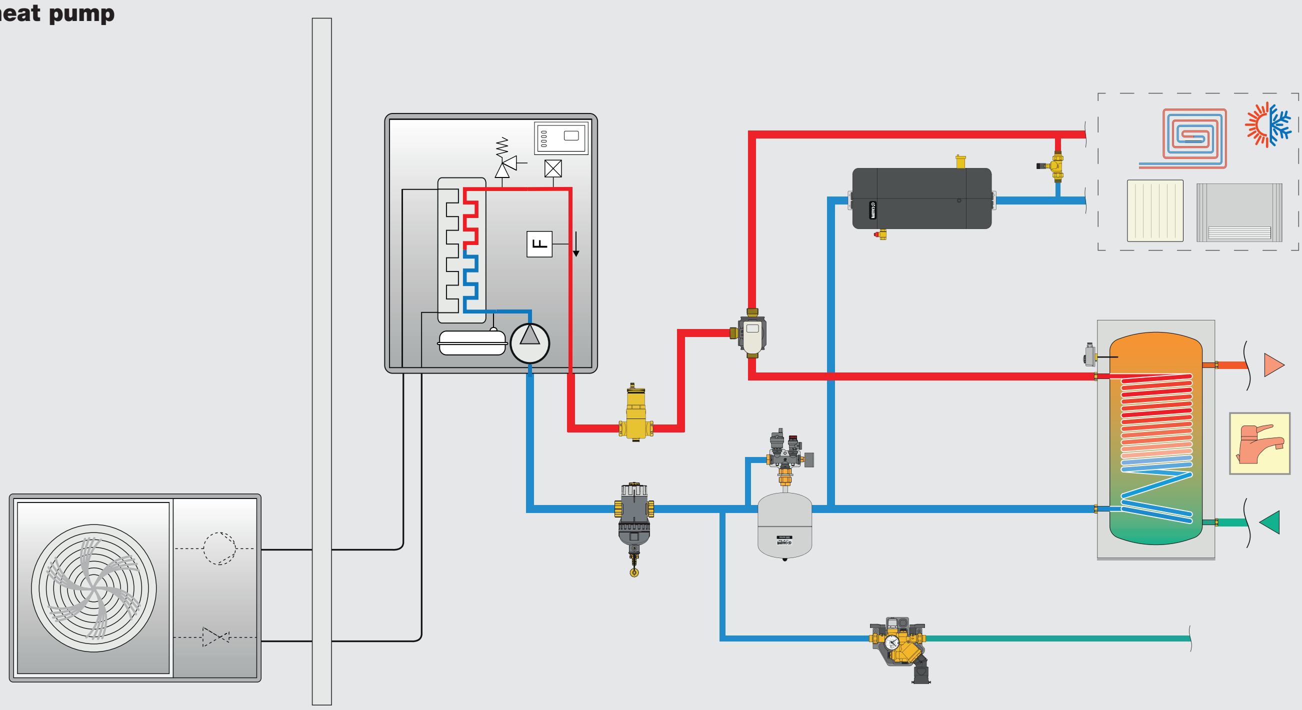


AIR TO WATER HEAT PUMP SYSTEMS

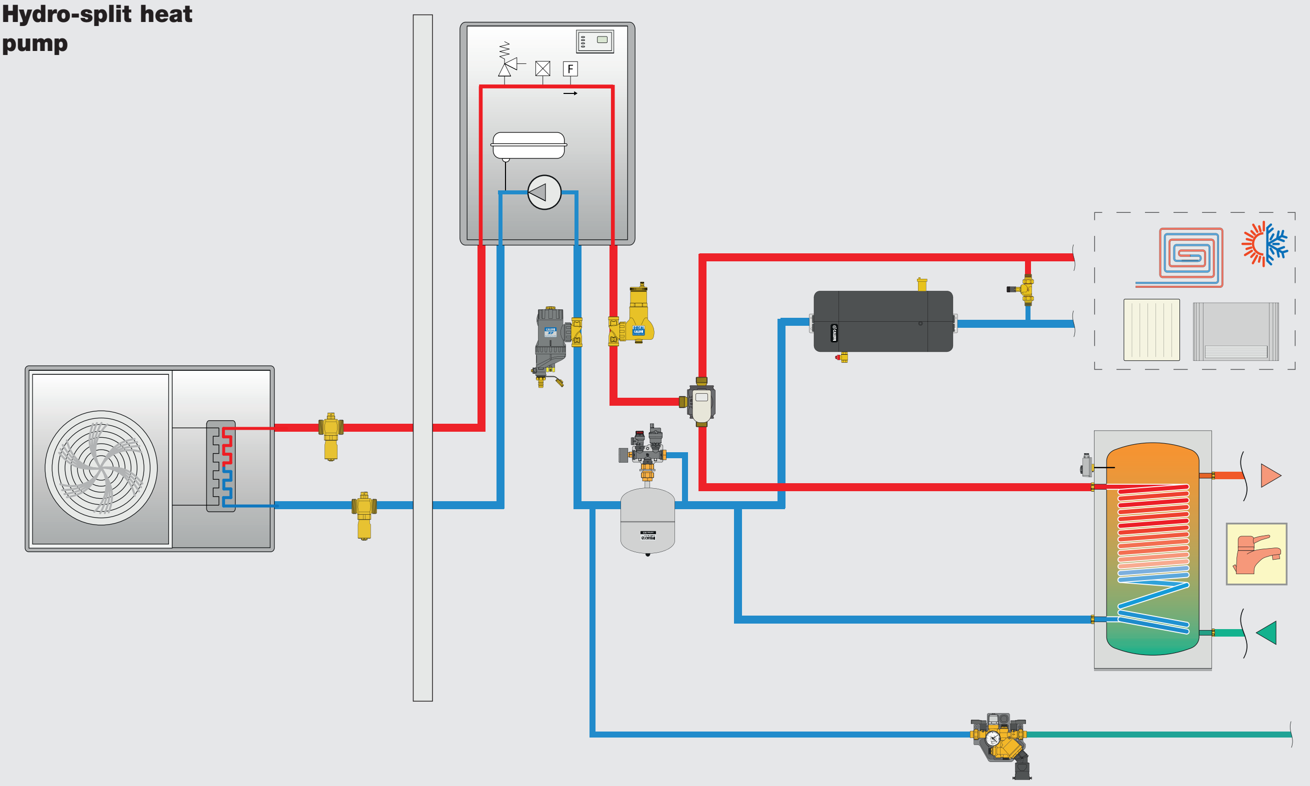
Monobloc heat pump



Refrigerant-split heat pump



Hydro-split heat pump



GROUND TO WATER HEAT PUMP SYSTEMS

Ground to water heat pump

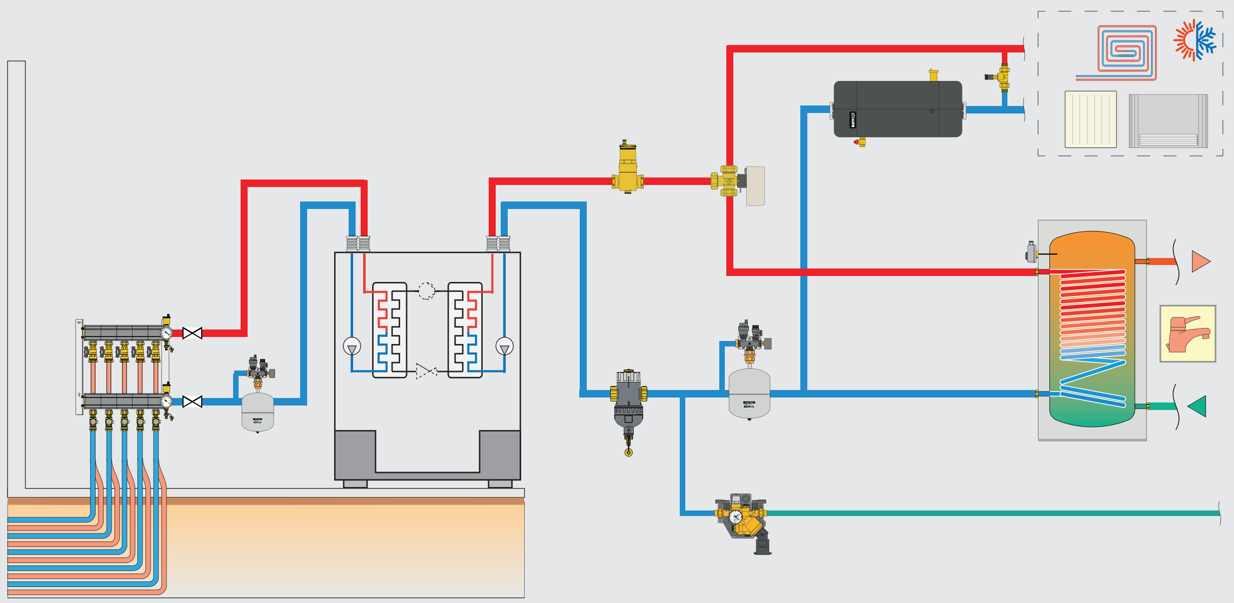


TABLE FOR SIZING COMPONENTS
FOR HEAT PUMP SYSTEMS

	Nominal power HP [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
	Max. set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
	Nominal pipe diameter*	3/4”	3/4”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”	1 1/2”
iStop®		108301 (Ø 28)												-		
iStop®		108601 (1”)								108701 (1 1/4”)				108801 (1 1/2”)		
iStop®		108611 (1”)								108711 (1 1/4”)						
DIRTMAGPLUS®		545372 (Ø 22)		545373 (Ø 28)			-									
DIRTMAGPLUS®	Δp** [kPa]	0,59	1,05	1,65	2,37	3,23	-									
DIRTMAGPLUS®		545375 (3/4”)		545376 (1”)			545377 (1 1/4”)					-				
DIRTMAGPLUS®	Δp** [kPa]	0,59	1,05	1,65	2,37	3,23	2,06	2,6	3,21	3,88	4,62	-				
CALEFFI XF		577200 (Ø 22)		577300 (Ø 28)						-						
CALEFFI XF	Δp** [kPa]	0,33	0,58	0,67	0,97	1,31	1,71	2,17	2,66	-						
CALEFFI XF		577500 (3/4”)		577600 (1”)						577700 (1 1/4”)				577800 (1 1/2”)		
CALEFFI XF	Δp** [kPa] (100 %)	0,25	0,45	0,65	0,93	1,27	1,66	2,09	2,58	3,13	3,73	5,06	6,61	1,81	2,7	3,5
CALEFFI XF	Δp** [kPa] (50 %)	-												0,6	0,89	1,16
DISCAL®		551702 (Ø 22)		551703 (Ø 28)								-				
DISCAL®	Δp [kPa]	0,59	1,05	1,65	2,37	3,23	2,06	2,6	3,21	3,88	4,62	-				
DISCAL®		551705 (3/4” F)		551706/ 551716 (1” F/1” M)								-				
DISCAL®	Δp [kPa]	0,59	1,05	1,65	2,37	3,23	2,06	2,6	3,21	3,88	4,62	-				
DISCAL®		551005 (3/4”)		551006 (1”)						551007 (1 1/4”)				551008 (1 1/2”)		
DISCAL®	Δp [kPa]	0,25	0,45	0,65	0,93	1,27	1,66	2,09	2,58	3,13	3,73	5,06	6,61	1,81	2,7	3,5

* Pipe pressure drop r ~ 20-22 mm w.g./m (50 °C)

** With clean filter

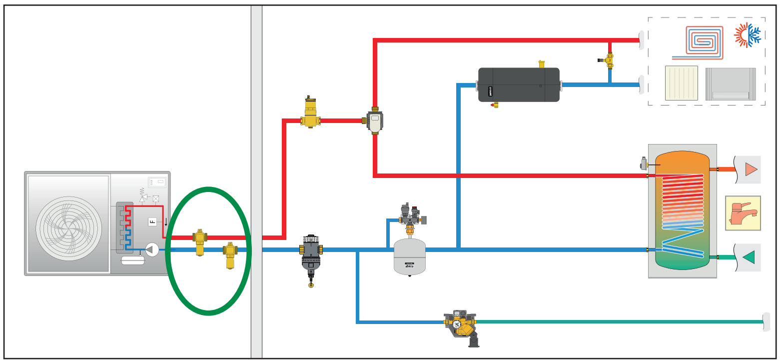
TABLE FOR SIZING COMPONENTS FOR HEAT PUMP SYSTEMS

HP nominal power [kW]		3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
Max, set flow rate [l/h] (ΔT = 5 °C)		516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
Nominal pipe diameter*		3/4"	3/4"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"
DISCALDIRTMAG®		546402 (Ø 22)		546403 (Ø 28)				-								
	Δp [kPa]	0,24	0,43	0,67	0,97	1,31	1,72	-								
		546405 (3/4")		546406 (1")				546407 (1 1/4")				-				
	Δp [kPa]	0,24	0,43	0,67	0,97	1,31	1,72	2,17	2,68	3,25	3,86	-				
5485		548520		548525				548530				548550				
556		-					See page 19									
6445		644562/66								-						
	Δp [kPa]	0,33	0,58	0,91	1,31	1,79	2,34	2,94	3,65	-						
638		-								638373				638383		
	Δp [kPa]	-								0,59	0,7	0,95	1,24	0,43	0,65	0,84
519		519500 (3/4", 1–6 m w.g.) - 519504 (3/4", 10–40 m w.g.)														
		519015 (3/4", 1–6 m w.g.)													-	
518		518500 (3/4", 1–6 m w.g.)													-	
		518002 (Ø22, 1–6 m w.g.)													-	
580		580011														

* Pipe pressure drop r ~ 20-22 mm w.g./m (50 °C)

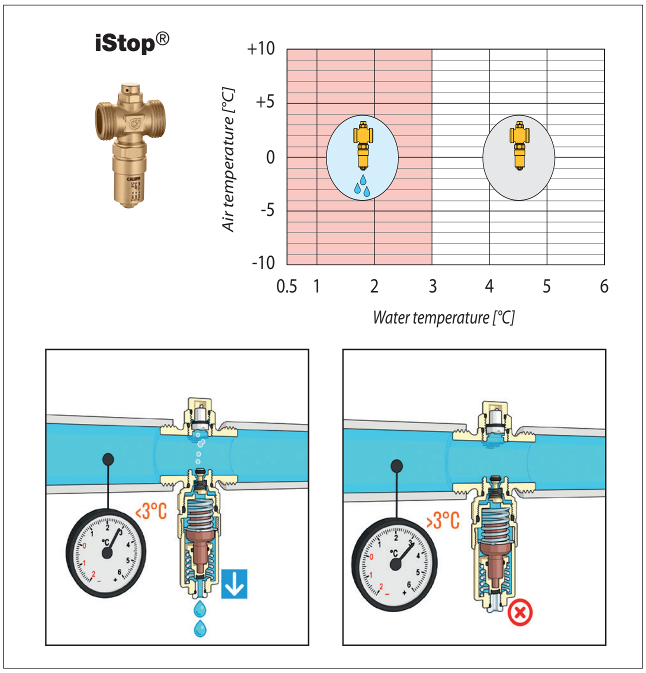
HEAT PUMP PROTECTION DEVICES

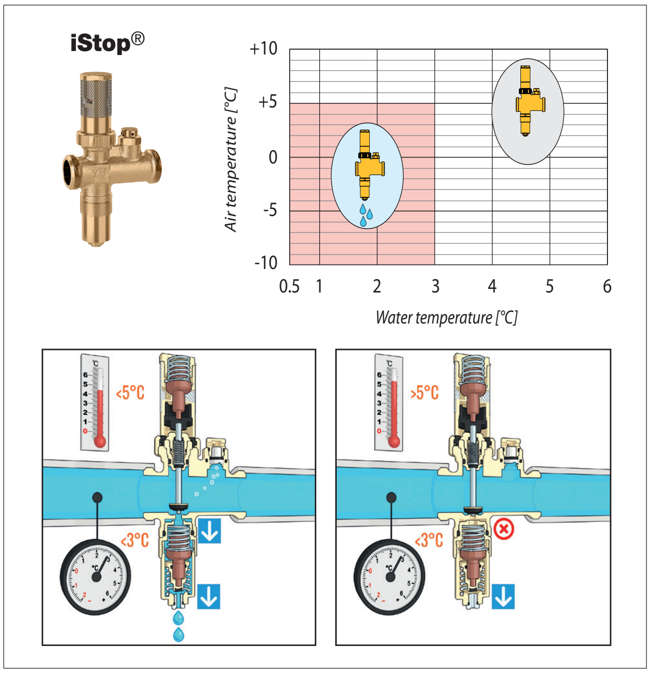
ANTIFREEZE VALVES



OPERATING PRINCIPLE

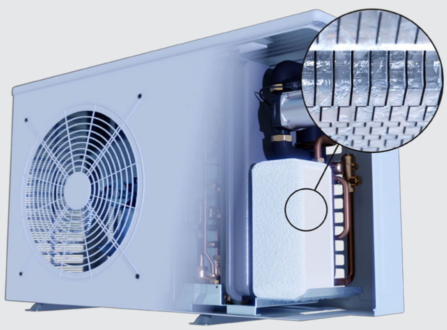
The antifreeze valve allows the medium in the system serving the heat pump to be drained from the circuit when its temperature reaches an average value of 3 °C. This prevents ice from forming, thereby avoiding potential damage to the machine and pipes.
The version with air sensor allows system operation in cooling mode, even when the temperature of the water is around 3 °C.
In these conditions the air sensor cuts in to prevent water drainage.





THE FORMATION OF ICE IN HEAT PUMP SYSTEMS

In monobloc and hydro-split systems, the hydraulic circuit has an external section which connects the heat pump to the rest of the system.
This section, although short and well insulated, may be at risk of frost in certain sub-zero temperature conditions.
In the event of simultaneous frost-blackout conditions, this may cause significant damage to the gas/water heat exchanger in the machine. Manufacturers request that glycol is added to the water in the system, or that special antifreeze valves are used.
Using glycol can be financially demanding and presents a series of disadvantages (see box opposite).
An antifreeze valve is a mechanical protection system offering an alternative to the use of glycol.



SIZING

The valve is sized according to the diameter of the pipe.
The device must only be installed in a vertical position at the bottom of pipes.
Two valves must be installed, one on the flow line and one on the return line, as close as possible to the heat pump, in order to protect the heat exchanger in the machine and the system.

iStop®

Code	Connections	Kv [m³/h]
108601	1”	55
108301	Ø 28	64
108701	1 1/4”	70
108801	1 1/2”	72

iStop®

Code	Connections	Kv [m³/h]
108611	1”	55
108711	1 1/4”	70

<table>
<tr><th colspan="2">Nominal power HP [kW]</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>14</th><th>16</th><th>18</th><th>22</th><th>25</th></tr>
<tr><td colspan="2">Max. set flow rate [l/h] (ΔT = 5 °C)</td><td>516</td><td>688</td><td>860</td><td>1.032</td><td>1.204</td><td>1.376</td><td>1.548</td><td>1.720</td><td>1.892</td><td>2.064</td><td>2.408</td><td>2.752</td><td>3.096</td><td>3.784</td><td>4.300</td></tr>
<tr><td colspan="2">Nominal pipe diameter*</td><td>3/4”</td><td>3/4”</td><td>1”</td><td>1”</td><td>1”</td><td>1”</td><td>1”</td><td>1”</td><td>1 1/4”</td><td>1 1/4”</td><td>1 1/4”</td><td>1 1/4”</td><td>1 1/2”</td><td>1 1/2”</td><td>1 1/2”</td></tr>
<tr><td>iStop®</td><td></td><td colspan="12">108301
(Ø 28)</td><td colspan="3">-</td></tr>
<tr><td>iStop®</td><td></td><td colspan="8">108601
(1”)</td><td colspan="4">108701
(1 1/4”)</td><td colspan="3">108801
(1 1/2”)</td></tr>
<tr><td>iStop®</td><td></td><td colspan="8">108611
(1”)</td><td colspan="7">108711
(1 1/4”)</td></tr>
</table>

** Pressure drop r ~ 20-22 mm w.g./m (50 °C)*

GLYCOL IN HEATING AND COOLING SYSTEMS

Glycol is a chemical additive used in closed circuit systems to prevent ice from forming and avoid the damage that may occur as a result.

It is mixed at a certain percentage with the total volume of water in the system, thereby lowering the freezing temperature of the resulting mixture.

Glycol presents numerous disadvantages, including:

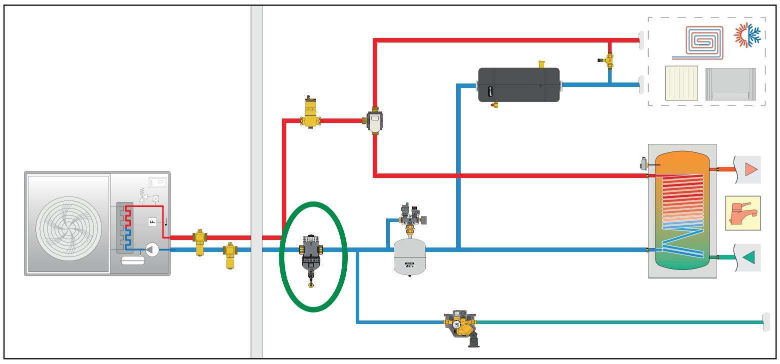
- High purchasing and maintenance costs.
- The percentage of glycol in the system must be checked regularly: an incorrect concentration may lead to malfunctioning and serious problems.
- Over time, glycol loses its characteristics and needs to be replaced, which also causes disposal problems because it is a polluting additive.

% PROPYLENE/ETHYLENE GLYCOL	FREEZING POINT °C
0	0
10	-3
20	-7
30	-15
40	-27

The water-glycol solution reduces the heat exchange capacity of the medium, which leads to a necessary increase in circulating flow rates to achieve the required thermal comfort level and greater power consumption by the heat pump compressor as it brings the solution to the ideal distribution temperature.

Minimum concentration of monopropylene glycol [%]	*10*	*10 < G < 20*	*20 < G < 30*	*30 < G < 45*
Pressure drop	+ 8 %	+ 14 %	+ 27 %	+ 60 %
Water flow rate	+ 0.5 %	+ 3 %	+ 6 %	+ 13 %
Thermodynamic power	- 1 %	- 2 %	- 4 %	- 9%

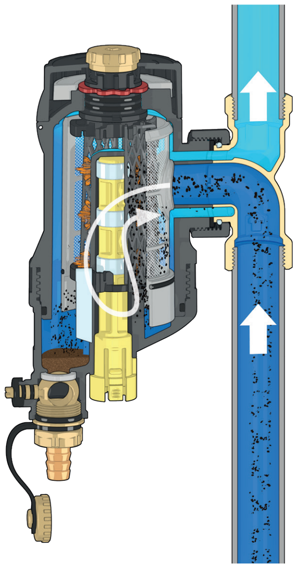
MAGNETIC FILTERS



OPERATING PRINCIPLE

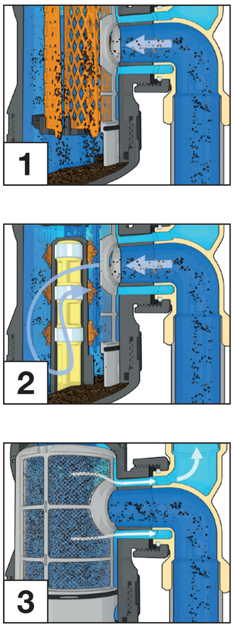
The impurity separating action of the magnetic filter is based on the combined action of several components:

- an internal mesh element (1), which carries out dirt separation;
- magnets fitted directly in the flow path (2), which capture and retain ferrous impurities;
- a metal filter mesh (3), which separates off the impurities by means of mechanical selection.



The filter mesh is characterised by various parameters, one the most important being the mesh size (or filtering capacity), which indicates the minimum dimensions of the particles that the filter is able to intercept. Another concerns the filter mesh surface, with a larger surface area guaranteeing a lower degree of fouling.

Due to its passage through the filter mesh, a pressure drop is produced in the medium which increases as the degree of clogging increases.
In combined devices such as dirt separator filters, the filter mesh is better protected than that of a simple filter because some of the impurities fall into the dirt separator. This means there is less fouling than in normal filters within the same operating time.



IMPURITIES IN HEAT PUMP SYSTEMS

The components of a heating and cooling system are exposed to degradation caused by the impurities that circulate in the thermal medium. If the impurities are not removed as necessary, they may cause blockages and seizing of the pumps, lower efficiency of the heat exchangers, unreliable valve operation and insufficient heat exchange.

In the specific case of a heat pump system, the impurities may put the already small inner channels at risk of blockage, or prevent the internal adjustment devices from working properly.
As the heat pump is a generator employing low temperature differences, even small changes in flow rate may adversely affect its performance.
The greater the filtering action of the magnetic dirt separator filter, the longer the high efficiency of the heat pump systems will be maintained.

SIZING

DIRTMAGPLUS®

Sizing depends mainly on the speed at which the medium flows through the device.
To guarantee optimal operation, the **maximum speed** on entering the device should be ≤ **1 m/s**.
To remain within the speed limits specified above, the specific **maximum permissible flow rate** values for each size must not be exceeded.

In multi-function devices such as DIRTMAGPLUS®, the filter mesh is more protected as some of the impurities fall into the dirt separator. For this reason, sizing is mostly determined by the maximum flow rate.

Code	Connections	Max. flow rate [l/h]	Kv [m³/h]	Δp [kPa] (max. flow rate)
545375	3/4”	1,130	6.7	2.84
545372	Ø 22	1,130	6.7	2.84
545376	1”	1,130	6.7	2.84
545373	Ø 28	1,130	6.7	2.84
545377	1 1/4”	1,800	9.6	3.53

CALEFFI XF

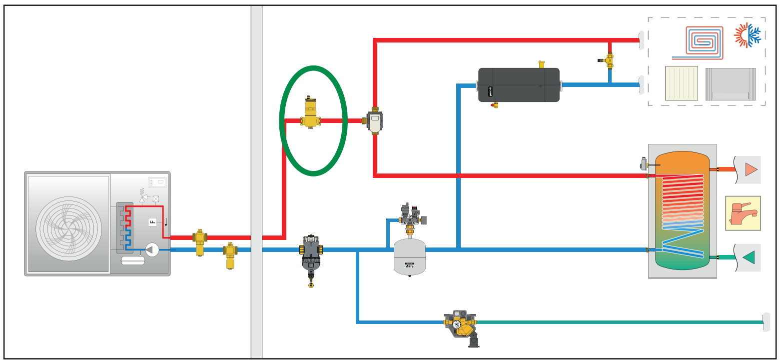
The main parameter to assess when sizing is the **pressure drop** generated in the circuit.

Code	Connections	Kv [m³/h] 100 % filtration	Kv [m³/h] 50 % filtration
577500	3/4”	10.3	
577200	Ø 22	9	
577600	1”	10.7	
577300	Ø 28	10.5	
577700	1 1/4”	10.7	
577800	1 1/2”	23	40
577900	2”	23	40

HP nominal power [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
Max, set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1,032	1,204	1,376	1,548	1,720	1,892	2,064	2,408	2,752	3,096	3,784	4,300
Nominal pipe diameter*	3/4”	3/4”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”	1 1/2”
DIRTMAGPLUS® 	545372 (Ø 22)		545373 (Ø 28)			-									
Δp** [kPa]	0,59	1,05	1,65	2,37	3,23	-									
DIRTMAGPLUS® 	545375 (3/4”)		545376 (1”)			545377 (1 1/4”)					-				
Δp** [kPa]	0,59	1,05	1,65	2,37	3,23	2,06	2,6	3,21	3,88	4,62	-				
CALEFFI XF 	577200 (Ø 22)		577300 (Ø 28)						-						
Δp** [kPa]	0,33	0,58	0,67	0,97	1,31	1,71	2,17	2,66	-						
CALEFFI XF 	577500 (3/4”)		577600 (1”)						577700 (1 1/4”)				577800 (1 1/2”)		
Δp** [kPa] (100 %)	0,25	0,45	0,65	0,93	1,27	1,66	2,09	2,58	3,13	3,73	5,06	6,61	1,81	2,7	3,5
Δp** [kPa] (50 %)	-												0,6	0,89	1,16

** Pipe pressure drop r ~ 20-22 mm w.g./m (50 °C)*
** With clean filter*

DEAERATORS



OPERATING PRINCIPLE

Deaerators are used to continuously remove the air contained in the hydraulic circuits of heating and cooling systems.
They are capable of automatically removing all the air present in the system down to micro-bubble level.
The fully deaerated medium allows systems to operate under optimal conditions, free from any noise, corrosion, localised overheating or mechanical damage.

SIZING

DISCAL®

Sizing depends on the speed at which the medium flows through the device. To guarantee optimal operation, the **maximum speed** at the inlet should be **1,2 m/s**. To remain within the speed limits specified above, the specific **maximum permissible flow rate** values for each size must not be exceeded.

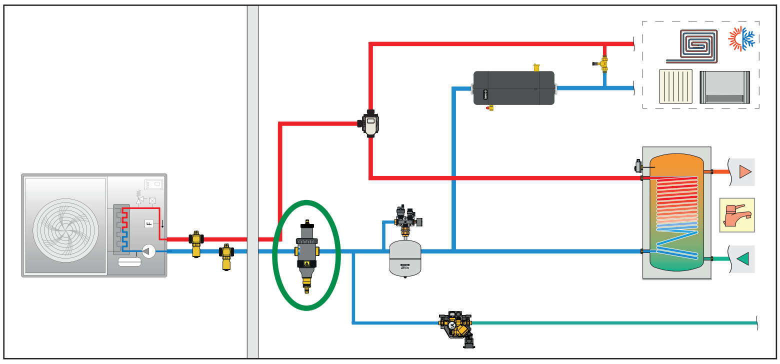
Code	Connections	Max. flow rate [l/h]	Kv [m³/h]	Δp [kPa] (max. flow rate)
551705	3/4" F	1.360	12	1,28
551702	Ø 22	1.360	12	1,28
551706	1" F	2.110	12	3,1
551703	Ø 28	2.110	12	3,1

Code	Connections	Max, flow rate [l/h]	Kv [m³/h]	Δp [kPa] (max, flow rate)
551005	3/4"	1.360	16,2	0,7
551006	1"	2.110	28,1	0,56
551007	1 1/4"	3.470	48,8	0,51
551008	1 1/2"	5.420	63,2	0,74
551009	2"	8.200	70	1,37

HP nominal power [kW]	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**14**	**16**	**18**	**22**	**25**
Max. set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
Nominal pipe diameter*	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"
DISCAL® 	**551**702 (Ø 22)		**551**703 (Ø 28)								-				
Δp [kPa]	0,59	1,05	1,65	2,37	3,23	2,06	2,6	3,21	3,88	4,62	-				
DISCAL® 	**551**705 (3/4" F)		**551**706/ **551**716 (1" F/1" M)								-				
Δp [kPa]	0,59	1,05	1,65	2,37	3,23	2,06	2,6	3,21	3,88	4,62	-				
DISCAL® 	**551**005 (3/4")		**551**006 (1")						**551**007 (1 1/4")				**551**008 (1 1/2")		
Δp [kPa]	0,25	0,45	0,65	0,93	1,27	1,66	2,09	2,58	3,13	3,73	5,06	6,61	1,81	2,7	3,5

* Pressure drop r ~ 20-22 mm w.g./m (50 °C)

DEAERATORS - DIRT SEPARATORS



OPERATING PRINCIPLE

Deaerators-dirt separators are used to continuously eliminate the air and dirt contained in the hydraulic circuits of heating and cooling systems.
They are capable of automatically removing all the air from the system down to micro-bubble level. At the same time they separate dirt and impurities contained in the water within the circuit and collect them in the lower part of the valve body, from which they may be discharged. The magnet separates ferrous impurities.
The circulation of fully deaerated medium enables the system to operate under optimum conditions, free from any noise, corrosion, localised overheating or mechanical damage.

SIZING

DISCALDIRTMAG®

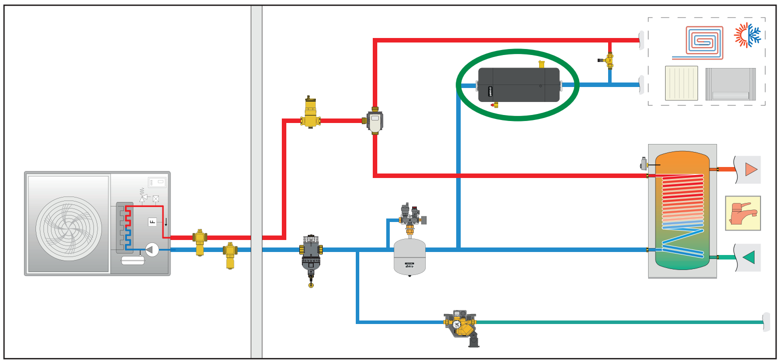
Sizing depends on the speed at which the medium flows through the device.
To guarantee optimal operation, the **maximum speed** on entering the device should be ≤ **1,2 m/s**.
To remain within the speed limits specified above, the specific **maximum permissible flow rate** values for each size must not be exceeded.

Code	*Connections*	*Max. flow rate [l/h]*	*Kv [m³/h]*	*Δp [kPa] (max. flow rate)*
546405	*3/4”*	*1.300*	*10,5*	*1,53*
546402	*Ø 22*	*1.300*	*10,5*	*1,53*
546406	*1”*	*1.300*	*10,5*	*1,53*
546403	*Ø 28*	*1.300*	*10,5*	*1,53*
546407	*1 1/4”*	*1.900*	*10,5*	*3,27*

HP nominal power [kW]		*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*14*	*16*	*18*	*22*	*25*
Max. set flow rate [l/h] (ΔT = 5 °C)		*516*	*688*	*860*	*1.032*	*1.204*	*1.376*	*1.548*	*1.720*	*1.892*	*2.064*	*2.408*	*2.752*	*3.096*	*3.784*	*4.300*
*Nominal pipe diameter**		*3/4”*	*3/4”*	*1”*	*1”*	*1”*	*1”*	*1”*	*1”*	*1 1/4”*	*1 1/4”*	*1 1/4”*	*1 1/4”*	*1 1/2”*	*1 1/2”*	*1 1/2”*
DISCALDIRTMAG®		*546402 (Ø 22)*		*546403 (Ø 28)*				-								
	Δp [kPa]	*0,24*	*0,43*	*0,67*	*0,97*	*1,31*	*1,72*	-								
DISCALDIRTMAG®		*546405 (3/4”)*		*546406 (1”)*				*546407 (1 1/4”)*				-				
	Δp [kPa]	*0,24*	*0,43*	*0,67*	*0,97*	*1,31*	*1,72*	*2,17*	*2,68*	*3,25*	*3,86*	-				

** Pressure drop r ~ 20-22 mm w.g./m (50 °C)*

BUFFER TANK-HYDRAULIC SEPARATOR FOR HEAT PUMPS



OPERATING PRINCIPLE

In some operating modes the heat pump needs to dispose of the energy in the machine compressor utilising the circulation of the medium, or it has to perform a heat exchanger defrost cycle in specific outside ambient conditions.
In these cases the machine needs an amount of thermal energy to always be available and a minimal water flow rate which would be less in the event that the zone valves in the secondary circuit are closed.
An inertial storage installed in line within the system can be used to guarantee the required thermal energy. To ensure the minimum flow rate in this configuration, a by-pass valve must be fitted between the flow and return. The alternative is to have a built-in volume in the separator itself, which also guarantees the minimum flow rate required.

SIZING

The buffer tank-hydraulic separator should be sized in accordance with the **maximum recommended flow rate value** at the inlet. The selected value should be the **sum of the primary circuit flow rates** or the sum of the secondary circuit flow rates, whichever is greater.
The inertial volume, however, depends on the **minimum volume of water** required by the manufacturer to guarantee proper machine operation even in defrosting phases.
The minimum volume of water available is influenced by the features of the system i.e its extension and the management method, and should be guaranteed regardless of the water content of the heat pump and the delivery system: for example, with two-way zone regulation the water content of the delivery system should be excluded from the total volume of the system when the ambient temperature is reached.

Generally, with more modern heat pumps, it can assume an average value calculated on the basis of the machine power, which varies from **2.5 to 3.5 litres/kWt**.

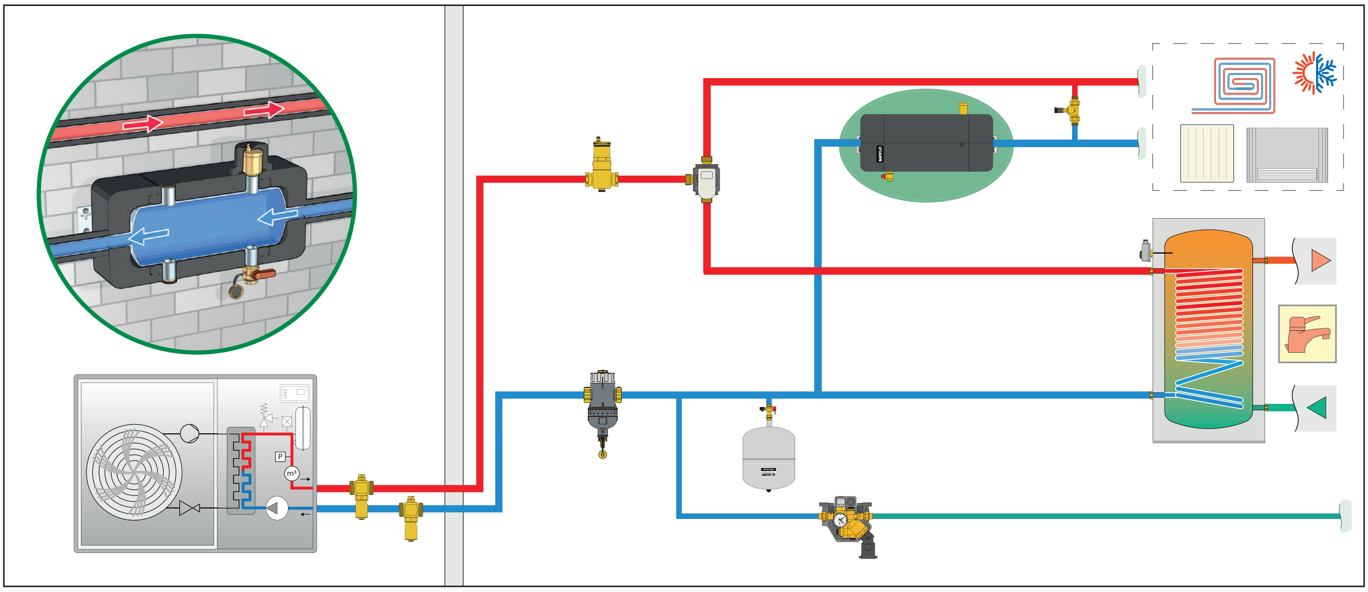
Code	Volume	Connections	Max, flow rate [m³/h]	HP nominal power
548515	15 litres	1”	3,5	3-5 kWt
548520	20 litres	1”	3,5	
548525	25 litres	1”	3,5	6-8 kWt
548530	30 litres	1”	3,5	9-12 kWt
548550	50 litres	1 1/4”	5,5	13-25 kWt

HP nominal power [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
Max. set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
Nominal pipe diameter*	3/4”	3/4”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”	1 1/2”
	**5485**20		**5485**25				**5485**30				**5485**50				

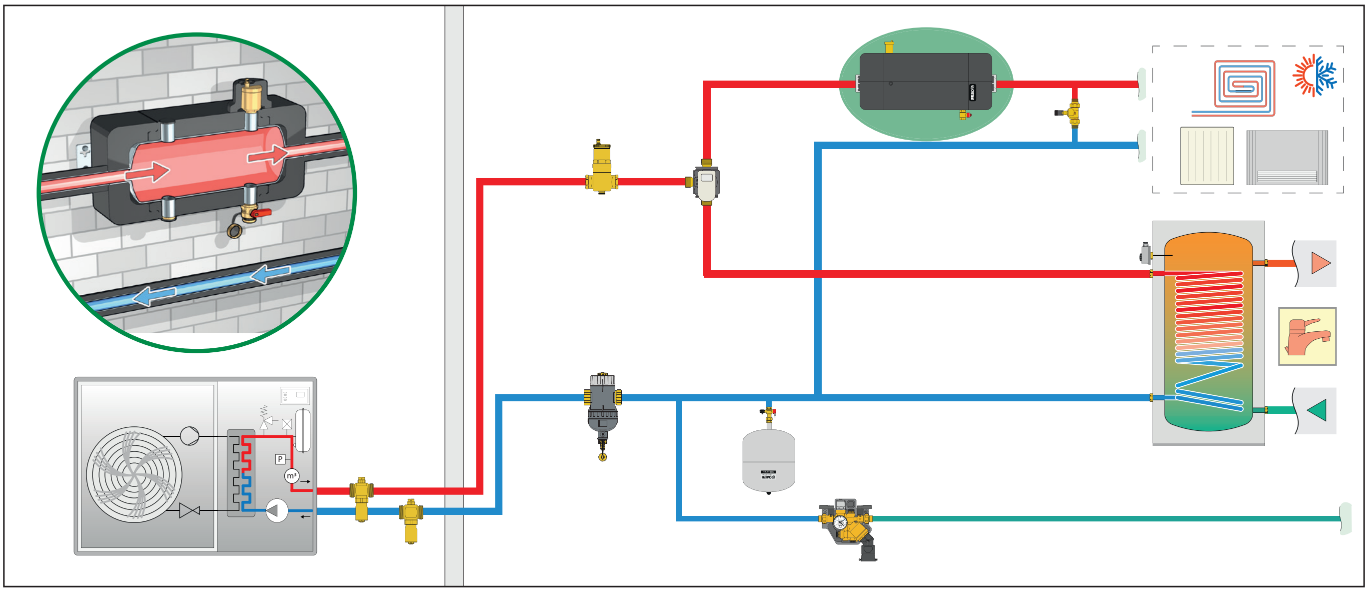
* Pressure drop r ~ 20-22 mm w.g./m (50 °C)

INSTALLATION

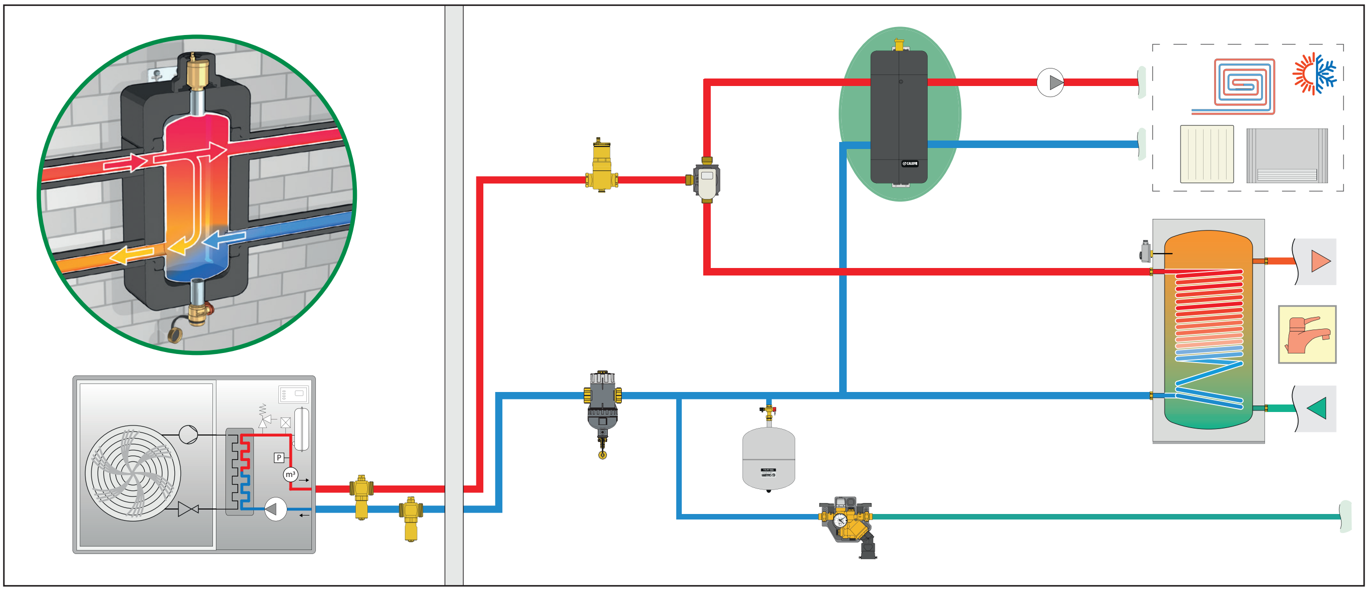
Installation on the return as inertial storage



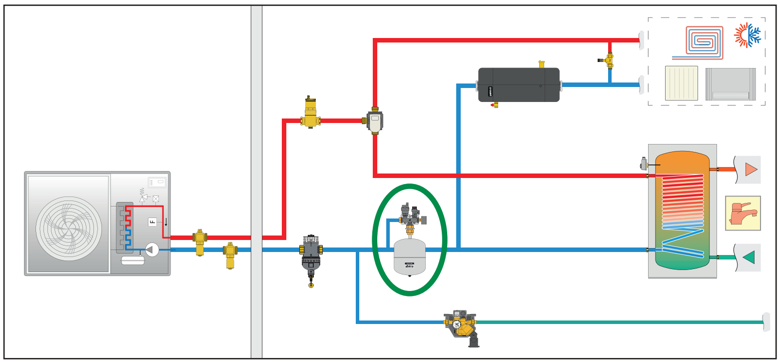
Installation on the flow as inertial storage



Installation as a hydraulic separator



INSTRUMENT HOLDER AND EXPANSION VESSELS



SIZING

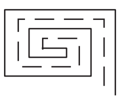
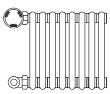
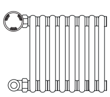
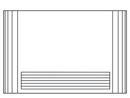
In systems with a heat pump, it is possible to calculate an approximate size of the **volume required for expansion, considering the latter as around 5 % of the maximum volume of the system**.
A value of 5 % has been calculated for the following scenarios:

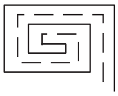
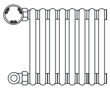
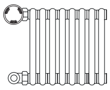
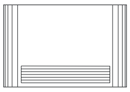
- safety relief valve setting = 2.5 bar
- expansion vessel pre-charge pressure = 0.9 bar
- maximum temperature = 65 °C (physical limit of the machine) where the water does not contain glycol
- estimated water content for the type of system.

To make the calculation more straightforward, you can refer to the table below, which lists the minimum volume required for the expansion vessel.
The machine usually houses a vessel with a capacity of 6-8 litres. If this capacity is insufficient, an additional vessel should be installed in the system to cover the difference.

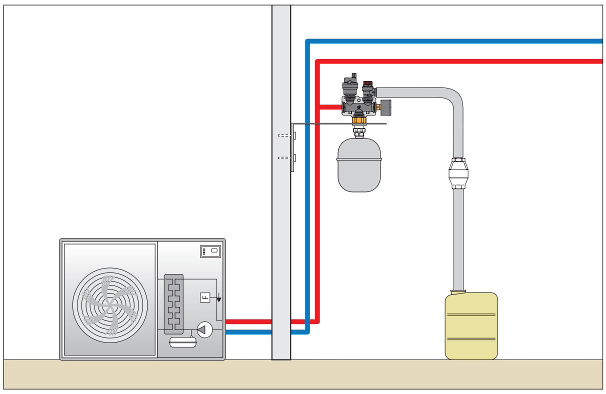
$$V_{minimum} = V_{machine\ vessel} + V_{additional\ vessel}$$

Caution: if additional resistors are present, the volume required for expansion is approximately 10 % of the maximum volume of the system. The maximum calculation temperature should, in fact, be assumed as 100 °C. In any case, to calculate the minimum volume of the expansion vessel, it is wise to refer to the heat pump manufacturer's instructions.

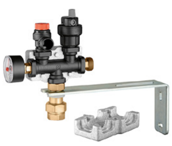
TERMINAL TYPE	HP nominal power [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
 Radiant panels	$V_{minimum}$ exp. ves. [litres]	4	5	6	7	8	9	10	11	12	13	16	18	20	24	27
 Cast iron radiators	$V_{minimum}$ exp. ves. [litres]	2	3	4	4	5	6	6	7	8	8	10	11	12	15	17
 Steel radiators	$V_{minimum}$ exp. ves. [litres]	2	3	3	4	4	5	5	6	6	7	8	9	10	12	13
 Fan-coils	$V_{minimum}$ exp. ves. [litres]	2	2	2	3	3	3	4	4	5	5	6	6	7	9	10

TERMINAL TYPE	HP nominal power [kW]	3 – 7	8	9	10	11	12	14	16	18	22	25
 Radiant panels		-	556008						556012		556018	
 Cast iron radiators		-						556008				556012
 Steel radiators		-							556008			556012
 Fan-coils		-									556008	

Application diagrams for
305 series instrument holder

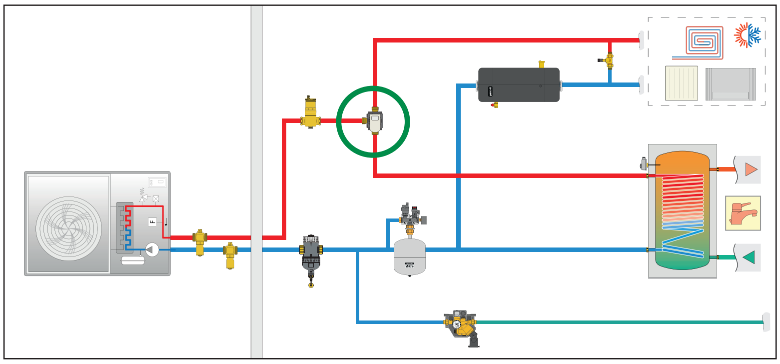


Code	Volume	Connection
556008	8	3/4”
556012	12	3/4”
556018	18	3/4”
556025	25	3/4”

HP nominal power [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
Max. set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
Nominal pipe diameter*	3/4”	3/4”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”	1 1/2”
	305663														
	305503														

* Pressure drop r ~ 20-22 mm w.g./m (50 °C)

DIVERTER VALVES

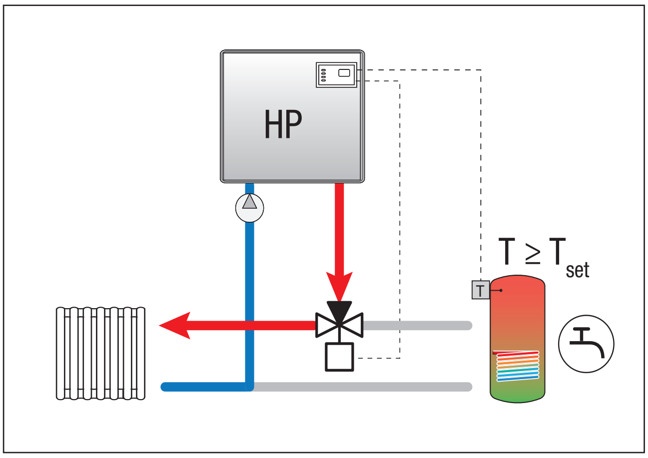


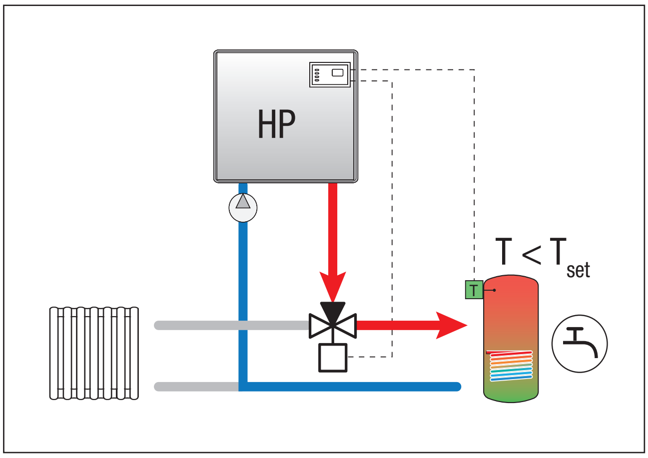
OPERATING PRINCIPLE

Motorised diverter valves are used to manage the flow between the heating and cooling system and the domestic water system. Management is generally entrusted to the electronics of heat pump, via a probe installed on the domestic water boiler.

Diverting the flow is completely effective when **there is no leakage** and when the operating time is short. For this very reason, three-way ball diverter valves are preferable to those with pistons due to their shape.

The motorised valve must have an **operating time** no greater than 50 seconds, in order to optimise DHW production processes.





SIZING

As it is a diverter valve, it should be **sized according to the Kv**, the only relevant value, so that the pressure drop is suitable for the available value within the system.

Code	Connections	Kv
644562/66	1”	9
638373	1 1/4”	24,7
638383	1 1/2”	47

HP nominal power [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
Max. set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
Nominal pipe diameter*	3/4”	3/4”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”	1 1/2”
	644562/66								-						
Δp [kPa]	0,33	0,58	0,91	1,31	1,79	2,34	2,94	3,65	-						
	-								638373				638383		
Δp [kPa]	-								0,59	0,7	0,95	1,24	0,43	0,65	0,84

* Pressure drop r ~ 20-22 mm w.g./m (50 °C)

DIVERTER VALVE OPERATING PHASES

The three-way diverter valve works to prioritise domestic hot water production with storage. It is directly controlled by the heat pump according to the incoming signal from a thermostat positioned on the boiler itself.

If there is no request from the domestic water boiler, the valve is positioned so that the machine is connected to the heating and cooling circuit. The heat pump is switched on if the room thermostat requests heat from the system (Figure 1).

If there is a domestic hot water production request, the valve rotates so as to connect the heat pump circuit and the storage heat exchange coil. If the heating thermostat is currently requesting heat, the domestic water request takes priority and the supply of heat to the rooms is paused.
The machine circulation pump is not usually stopped. For this reason, the control channel should always be connected to an open channel and circulation of the thermal medium should never be stopped. The figure shows how the configuration of the diverter device, in this case a ball, places the three channels in contact with one another during the transient phase. The required rotation time, in general, is short (Figure 2).

When it has finished rotating, the heat pump is connected to the domestic water coil and can start hot water production. The machine automatically increases the flow temperature to values in excess of 50-60 °C (Figure 3).

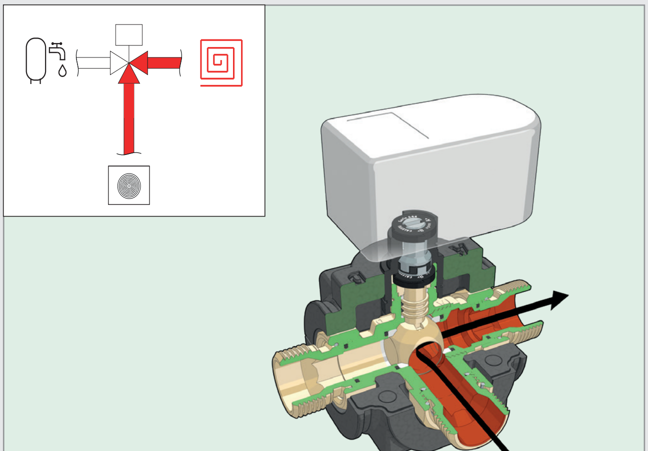


Figure 1
Heating/Cooling

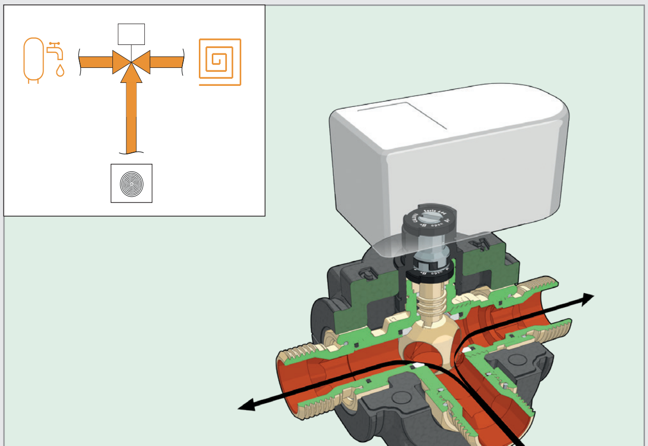


Figure 2
Transient phase

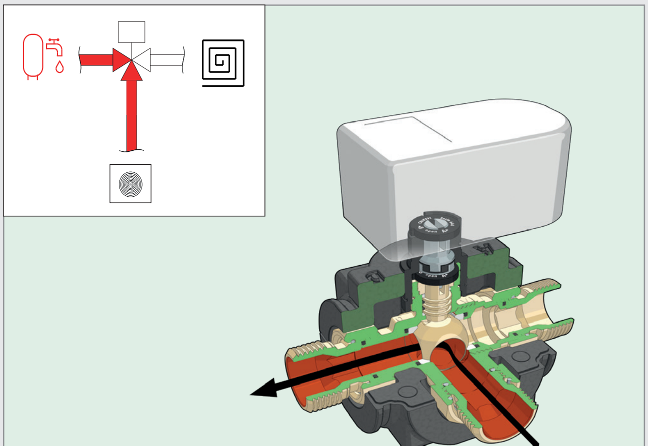
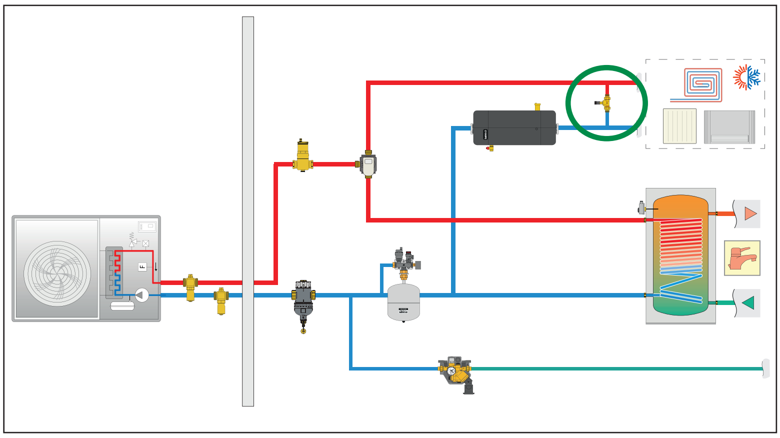


Figure 3
Production of domestic hot water

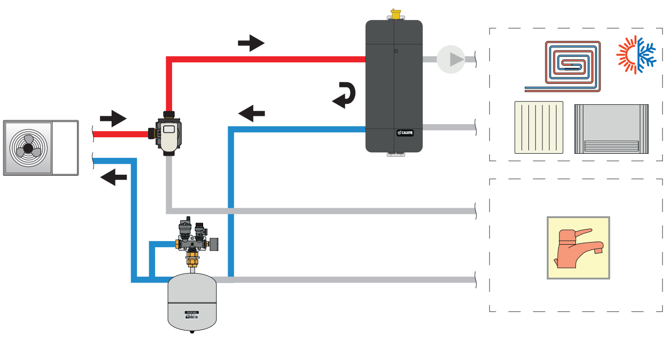
DIFFERENTIAL BY-PASS VALVES



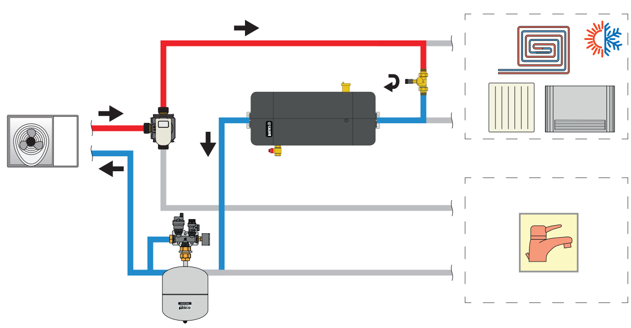
OPERATING PRINCIPLE

In heat pump systems, the circulation of a minimum flow rate must always be guaranteed.
If the system is divided into a primary and secondary circuit, this flow rate is guaranteed by the hydraulic separator. In other cases a by-pass valve (or differential by-pass valve) is typically used, fitted at the end of the line before any potential shut-off points (zone valves) controlled by the thermostats.
The valve must be installed after the inertial storage so that it can always utilise the thermal energy required when the machine is working.

System with primary-secondary circuit



System without secondary circuit

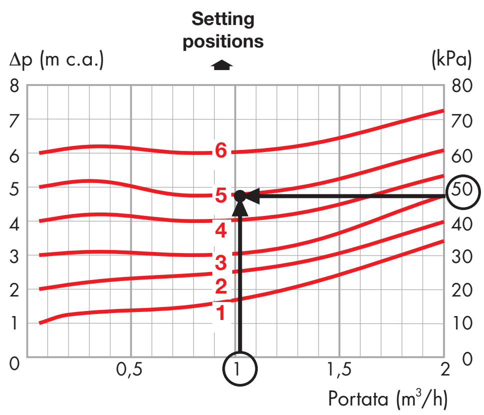


SIZING

Sizing, on a project level, takes place by selecting a setting value for the valve which has a differential pressure slightly higher than that of the circuit and a flow rate the same as the minimum flow rate required by the heat pump.

Example: minimum flow rate required 1 m^3/h and a differential pressure of 50 kPa, using the hydraulic characteristics diagram shown opposite, to identify the setting value curve for the valve where the two values meet (in this case it is position 5).

Heat pump manufacturers require minimum flow rates that are always available to the machine.
Average values can be expressed as a percentage in relation to the nominal flow rate.



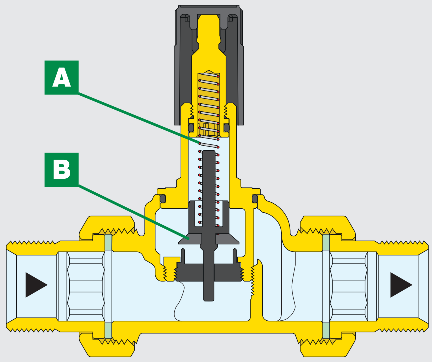
HP nominal power [kW]	*3-4*	*5-6*	*7-8*	*9-10*	*11-12*	*14-16*	*18-25*
Minimum flow rate as a percentage in relation to the nominal flow rate	*80 %*	*70 %*	*60 %*	*55 %*	*50 %*	*45 %*	*40 %*

HP nominal power [kW]	3	4	5	6	7	8	9	10	11	12	14	16	18	22	25
Max. set flow rate [l/h] (ΔT = 5 °C)	516	688	860	1.032	1.204	1.376	1.548	1.720	1.892	2.064	2.408	2.752	3.096	3.784	4.300
Min. set flow rate [l/h] (ΔT = 5 °C)	415	550	600	720	720	825	850	945	945	1.030	1.085	1.240	1.240	1.515	1.720
Nominal pipe diameter*	3/4”	3/4”	1”	1”	1”	1”	1”	1”	1 1/4”	1 1/4”	1 1/4”	1 1/4”	1 1/2”	1 1/2”	1 1/2”
	**519500** (3/4”, 1–6 m w.g.) - **519504** (3/4”, 10–40 m w.g.)														
	**519015** (3/4”, 1–6 m w.g.)													-	
	**518500** (3/4”, 1–6 m w.g.)													-	
	**518002** (Ø22, 1–6 m w.g.)													-	

* Pressure drop r ~ 20-22 mm w.g./m (50 °C)

SETTING

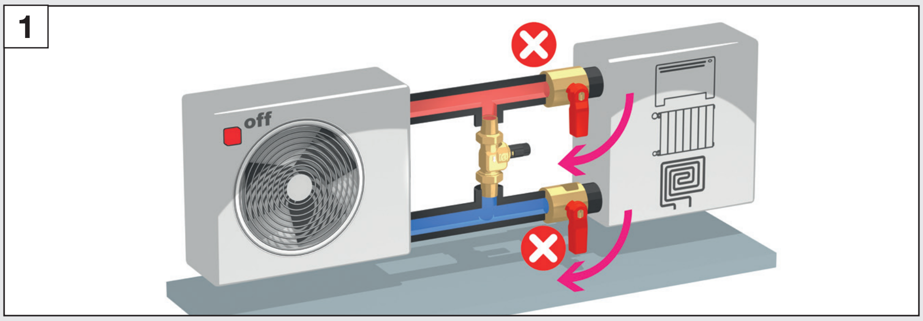
In the by-pass valve, when the compression spring (A) is adjusted, the force acting on the obturator (B) changes, thus modifying the trigger pressure value of the valve.
The obturator only opens, activating the by-pass circuit, when it is subjected to a differential pressure sufficient to generate a greater thrust than that exerted by the counter-spring. This allows the passage (by-pass) of an amount of thermal medium from the flow circuit to the return circuit.
Sizing, on a project level, takes place by selecting a setting value for the valve which has a differential pressure slightly higher than that of the circuit.

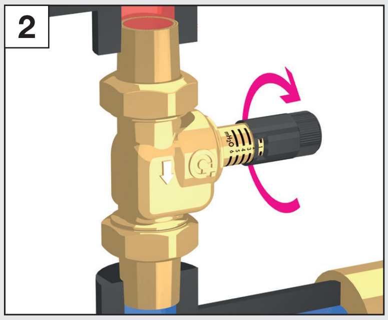


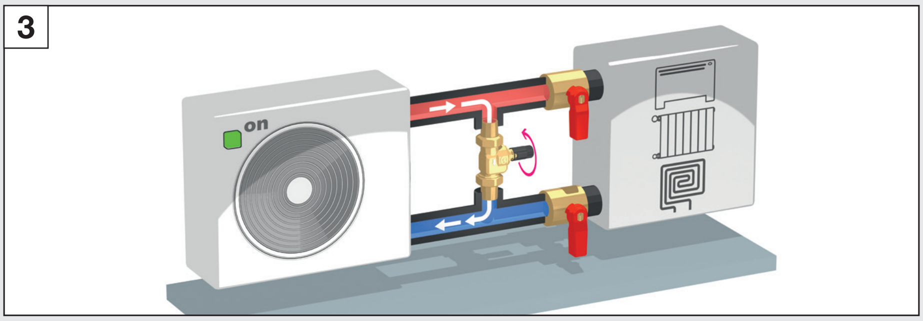
In practice, setting can take place via the steps below:

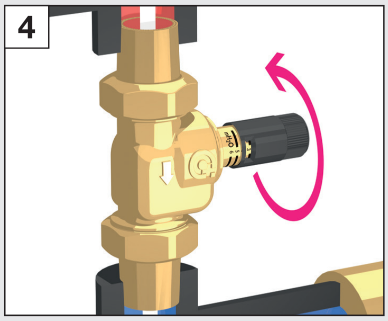
1. while the heat pump is off, close off all secondary circuits;
2. adjust the by-pass valve to the minimum setting value (fully open);
3. start running the heat pump and check the circuit flow rate using the electronics on board the machine or a special flow meter installed on the line;
4. increase the valve setting value until you obtain the “minimum” flow rate required as indicated by the machine manufacturer;

open all the secondary circuits.

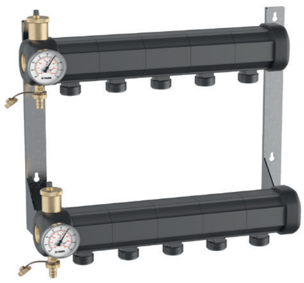


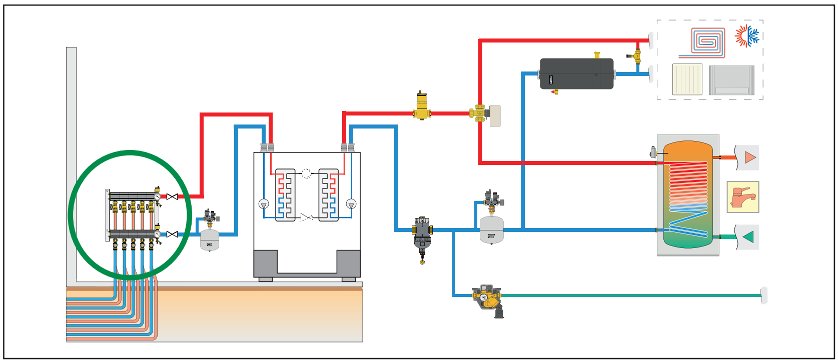






DISTRIBUTION MANIFOLD

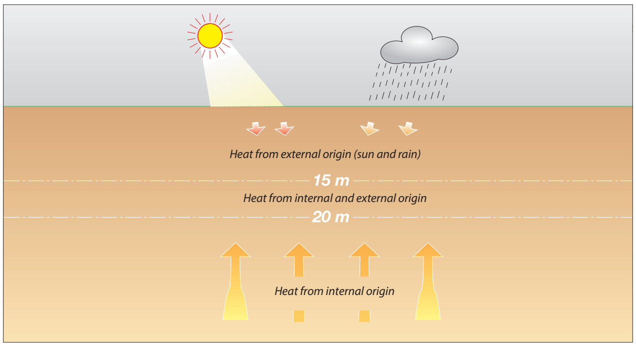




OPERATING PRINCIPLE

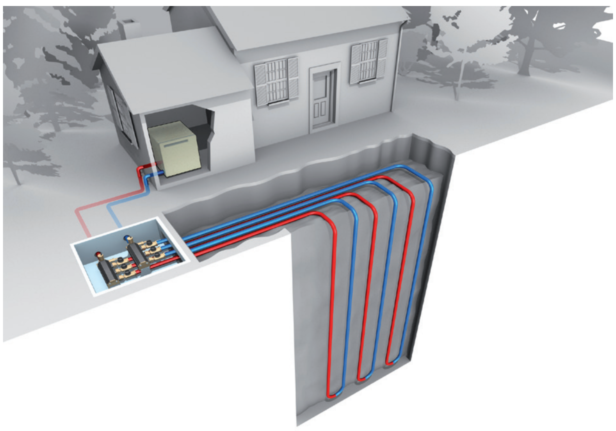
The ground contains a large amount of heat from two origins: one external and one internal.
Heat from external sources comes mainly from sun and rain and penetrates the outer layers of the earth up to a depth of 15 metres.
Heat from inside is generated by the nuclear decay of radioactive substances in rocks and the substratum: this is the source that heats the soil to a depth of more than 20 metres which can be defined as geothermal heat.

Geothermal heat pumps use this type of energy: the heat exchange between the ground and the system takes place via the closed circuit probes, which may be vertical or horizontal.



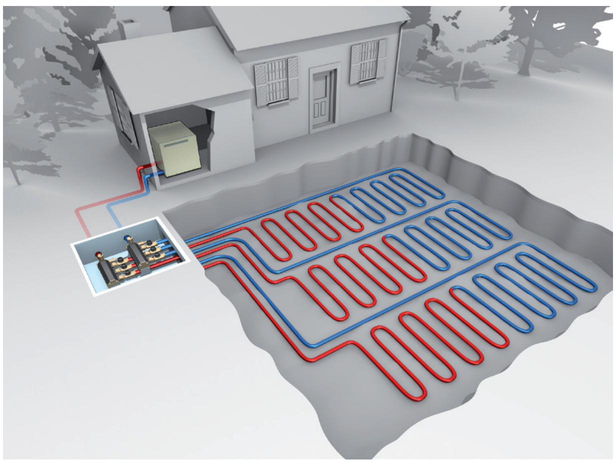
Vertical geothermal probe systems

Systems with vertical ground source probes are based on the fact that, below a depth of 20 metres, the temperature of the subsoil is constant and no longer depends on either daily or seasonal temperature changes: below this measurement, the temperature of the ground increases by approximately 3°C every 100 metres in depth.



Horizontal geothermal probe system

Heat pump systems with horizontal probes use the heat stored in the layers of the earth nearest to the surface (up to a depth of 15 m); this heat comes primarily from the sun and rain.
For this reason horizontal probes withstand fluctuations in surface temperature better and, to be installed, they need large areas clear of constructions, paving or vegetation that can prevent heat reaching the ground.



SIZING

Horizontal or vertical probes should be sized according to the thermal efficiency of the ground (in W/m² for horizontal probes and in W/m for vertical probes).

Starting with the following data:

Heat pump COP 4
Vertical probe system
Ground efficiency 40 W/m
Probe depth 70 m

Geothermal probes can be sized according to the machine power.

HP nominal power [kW]	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**14**	**16**	**18**	**22**	**25**
Ground source power to extract [kW]	2,25	3,00	3,75	4,50	5,25	6,00	6,75	7,50	8,25	9,00	10,50	12,00	13,50	16,50	18,75
Total vertical probe length [m]	56	75	94	113	131	150	169	188	206	225	263	300	338	413	469
Number of vertical probes	1	1	2	2	2	2	3	3	3	3	4	4	5	6	7
Single probe flow rate	650	850	550	650	750	850	650	700	800	850	750	850	750	800	750

The flow rate extracted from the individual probes is calculated taking a temperature difference of 3 °C into account.
Balancing of the individual probes guarantees uniformity in heat exchange with the ground and maintenance of a correct temperature difference.

HP nominal power [kW]	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**14**	**16**	**18**	**22**	**25**
	-	-	1107B5	1107B5	1107B5	1107B5	1107C5	1107C5	1107C5	1107C5	1107D5	1107D5	1107E5	1107F5	1107G5
	-	-	2x 1126	2x 1126	2x 1126	2x 1126	3x 1126	3x 1126	3x 1126	3x 1126	4x 1126	4x 1126	5x 1126	6x 1126	7x 1126

SPECIFIC THERMAL EFFICIENCY BY TYPE OF PROBE/GROUND

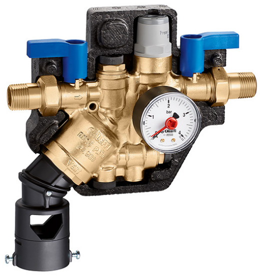
Vertical geothermal probe systems

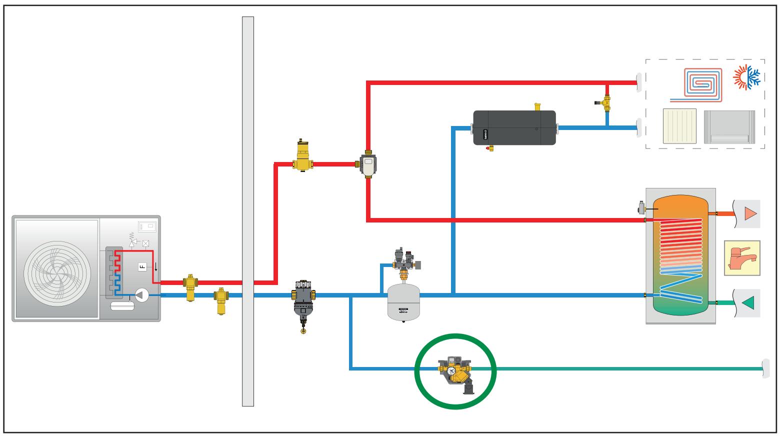
Ground type	***Extractable power [W/m]***
Dry gravel, sand	< 25
Wet (saturated) gravel, sand	65-80
Clay, moist soil	35-50
Limestone (solid)	55-70
Sandstone	65-80
High-silica igneous rock (e.g. granite)	65-85
Low-silica igneous rock (e.g. basalt)	40-65
Gneiss	70-85

Horizontal geothermal probe system

Ground type	***Extractable power [W/m²]***
Dry sandy ground	10-15
Damp sandy ground	15-20
Dry clay ground	20-25
Damp clay ground	25-30
Waterlogged ground	30-40

AUTOMATIC CHARGING UNIT WITH BACKFLOW PREVENTER





OPERATING PRINCIPLE

The charging unit and hydraulic backflow preventer assembly performs two combined actions which are required for the system to work:

1. it keeps the system pressure at an optimal level (charging unit), usually 1.5 bar;

2. it prevents the water in the system from returning inside the domestic hot water circuit (hydraulic backflow prevention).

Hydraulic backflow preventer usage is governed by reference standard EN 1717:2000 "*Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*". This standard classifies the water in the systems into five categories according to the level of risk it represents for human health.
The water contained in the thermal system in most cases may fall into category 3 ("*Medium presenting some hazard to human health due to the presence of one or more harmful substances*"), or category 4 ("*Medium presenting a hazard to human health due to the presence of one or more toxic or very toxic substances*").
According to this classification, suitable backflow prevention devices must be fitted in water distribution circuits.

HP nominal power [kW]	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***14***	***16***	***18***	***22***	***25***
Max. set flow rate [l/h] (ΔT = 5 °C)	***516***	***688***	***860***	***1.032***	***1.204***	***1.376***	***1.548***	***1.720***	***1.892***	***2.064***	***2.408***	***2.752***	***3.096***	***3.784***	***4.300***
Nominal pipe diameter*	***3/4"***	***3/4"***	***1"***	***1"***	***1"***	***1"***	***1"***	***1"***	***1 1/4"***	***1 1/4"***	***1 1/4"***	***1 1/4"***	***1 1/2"***	***1 1/2"***	***1 1/2"***
	***580***011														

** Pressure drop r ~ 20-22 mm w.g./m (50 °C)* www.caleffi.com

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