BOOSTHERM®

Heat Recovery Systems

# • Selection guidelines

*v 2.9 - 01-2020*

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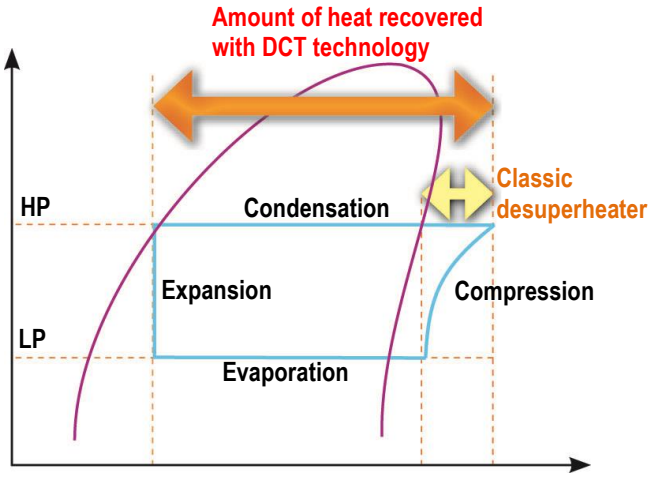
# 1. System presentation

The installation of a heat recovery system consists of inserting between the compressor and the air cooled condenser a heat exchanger refrigerant/water to heat up water using the heat extracted from the cold room during cooling. The refrigerant transports the heat from the cold room (evaporator) to the heat recovery module where it releases heat to the water. The heat exchanger is a brazed plate heat exchanger (the number of plates varies according to the power of the cooling unit).

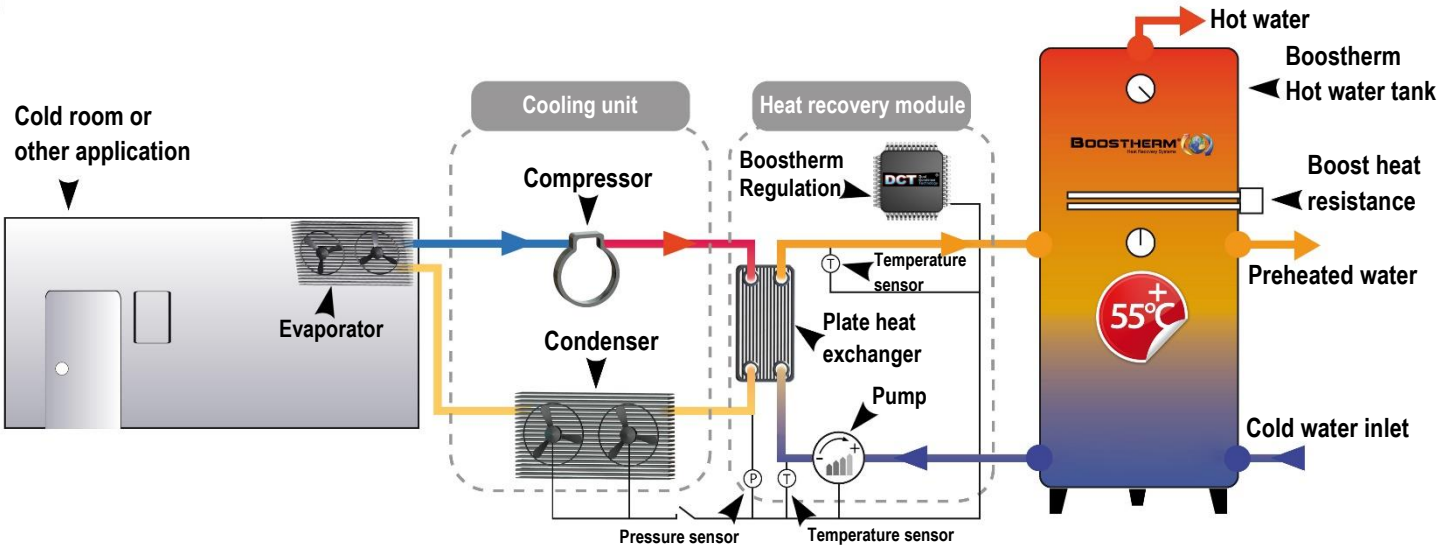
Traditional heat recovery systems only recover desuperheating phase from hot gases, which only represent about 15 to 20% of the total recoverable energy. In that case, the heat exchange temperature is not mastered: it is high in summer and low in winter.

Boostherm heat recovery system allows recovering all the condensation heat generated by the cooling unit. This enables to heat up water very quickly at a minimum temperature of 55°C even in difficult conditions.

Therefore the installation of a Boostherm heat recovery system can be considered even on small cooling capacity systems (minimum advised = 1kW)




**Schematic diagram**




Boostherm operates according to 2 successive functioning modes during the same refrigeration cycle.

1/ At the beginning of the cycle, the **"water condenser" mode** prioritises water heating and the global energy efficiency as long as the temperature of the water allows the condensation of the refrigerant in the heat recovery unit. The condenser is stopped: the heat extracted from the cold room and the heat generated by the compressor is entirely transferred to the water through the heat exchanger.
The Boostherm electronic board regulates the pump flow to obtain a water temperature of 55°C at the heat exchanger's outlet. The water tank is preheated very quickly regardless of the ambient temperature. Condensing pressure is monitored by the electronic board and an alert is triggered if any problem is detected (e.g. leak prevention).

2/ When all the water has been preheated, its temperature cannot condense the refrigerant in the heat recovery unit: The system switches to "**desuperheating" mode**. The Boostherm regulation activates the condenser. According to the ambient temperature and the type of refrigerant, the heat exchanger recovers a part of the heat and warms the water at a higher temperature (up to 65°C and more). The residual heat is evacuated by the condenser.

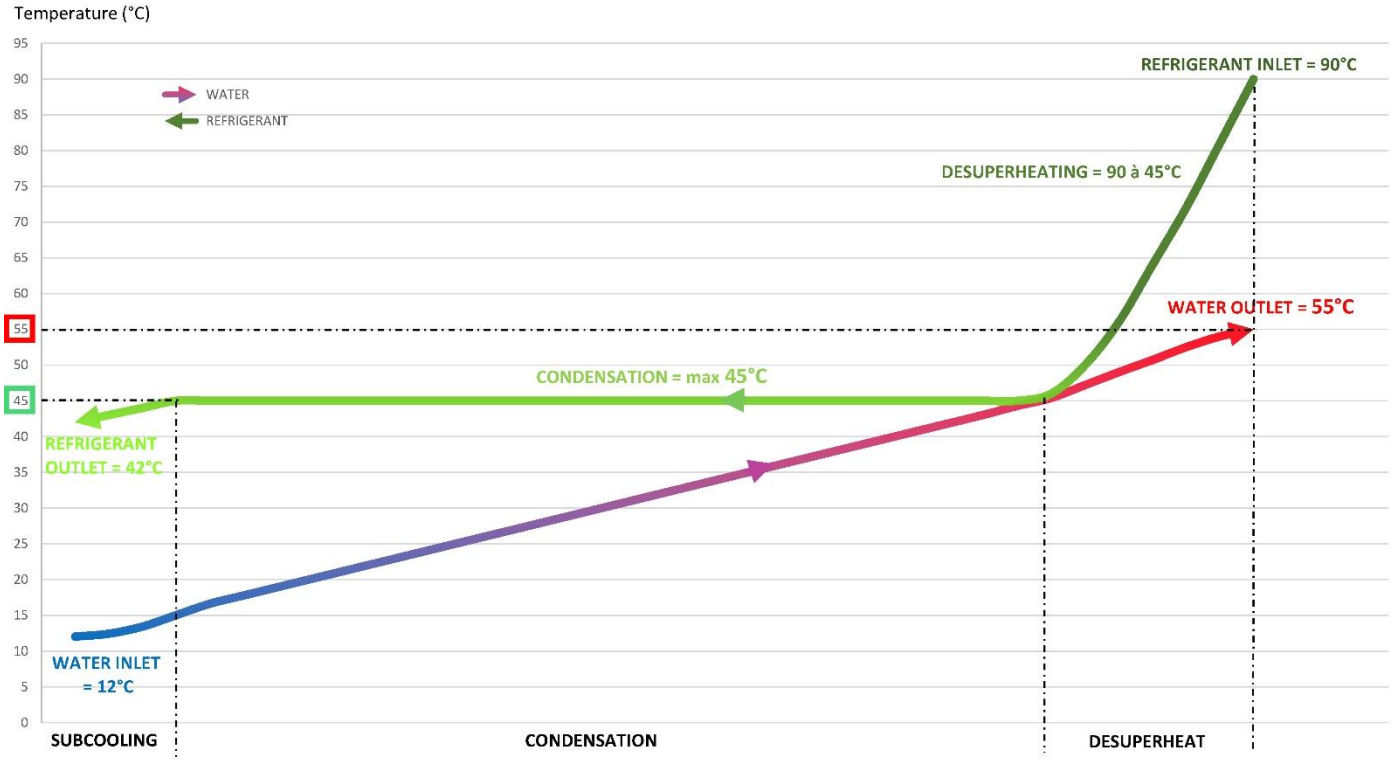
**One pass water heating through the heat exchanger: how and what for?**

The Boostherm operating principle called DCT® is based on the full condensation of the refrigerant allowing recovery of all the energy generated during desuperheating and condensation.

To achieve full condensation, Boostherm uses the cold water stored in the lower part of the water tank in counter flow with the refrigerant in the heat exchanger: "water condenser mode". Water heating to 55°C is obtained in one pass only in the heat exchanger using the latent heat of condensation and the sensible heat of desuperheating.

**The plate heat exchanger's performance combined with the counter flow enable water heating at a temperature higher than the condensation temperature.**

*The graph below shows the temperature levels in the heat recovery system equipping an R404a cooling unit of a negative cold room:*

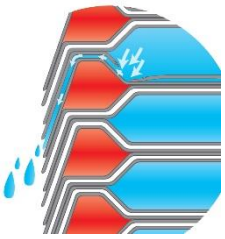



Water heating at **55°C in one pass in the heat exchanger** allows:

- Production of large volumes of water at a useful temperature (DHW or heating) and in a short time.
- Monitoring of the condensing temperature: as long as the "water condenser mode" is active, water is preheated to 55°C. The system works on a pressure/temperature level for which the heat exchanger is specifically sized; heat exchange is optimal and cooling performances are not penalized. The system always works within the compressor's operating range.
- A very positive energy balance : the condensation pressure increase which can be noted in winter is largely offset by the heat recovered:
  - The possible compressor over-consumption is fully recovered by Boostherm heat recovery system and is concentrated on a short time.
  - The global COP (cooling capacity + heat recovery / energy consumed) is excellent regardless of the period of the year: ambient temperature has no influence on the heat recovery performance.

➢ **System securities:**

**Double wall plate heat exchangers:**



The brazed plate heat exchangers have 2 separation plates between refrigerant and water (unlike conventional brazed exchangers).

Should an internal leak occur, the second wall in the heat exchanger will be a reliable barrier; this technical trick ensures that any possible leakage can be visually detected (external to the exchanger) in time to take corrective action immediately. Boostherm heat exchangers are designed for a pressure of 45 bar to improve reliability over time through a strong copper brazing and a robust plate design.

**High pressure safety:**

Boostherm heat recovery systems are equipped with a pressure sensor: It switches the fans(s) on in case of excessive pressure regardless of heat recovery conditions. For example, on an R404a air cooled condensing unit, if pressure exceeds 24bar during « water condenser » mode, the condenser's fan(s) are automatically reactivated.

This safety ensures refrigeration even in case of anomaly on the heat recovery system.

**"Normally closed" logic:**

Boostherm principle consist in deactivating the condenser fan(s) during « water condensation » mode: fan(s) power supply is controlled by NC contacts (normally-closed) and is always ensured when necessary. If the heat recovery system has no power supply, the cooling system works normally and Boostherm has no influence on the cooling unit. The electrical board is also protected by a fuse.

**Frost protection:**

Boostherm system is protected against risks related to water freezing; temperature sensors measure the ambient temperature and activate a forced circulation between Boostherm and the water tank. An NO contact is also available to monitor one or more heating cables.

**Leak detection:**

The control board monitors condensation pressure during « water condenser » mode. In case of refrigerant leakage, a too low condensation pressure is detected and an alarm is activated before the cooling unit low pressure switch stops refrigeration.

➢ **Sizing essential points :**

- Boostherm is designed to achieve the complete refrigerant condensation during the "water condenser" mode. Heat exchangers are also sized to minimize compressor discharge pressure drops (max 50kPa) during "desuperheating" mode (refrigerant in vapor state).
- Connection diameters are adapted to compressor discharge line diameters to be equipped.
- All components are PED certified.

# 2. Installation sizing

## *I. Boostherm heat recovery module selection:*

➢ ***About our online simulator:***

You can size easily and quickly your Boostherm module on: **http://boostherm.com/Simulator/**

The online simulator is design to guide the user during the sizing process of Boostherm heat recovery modules but also to conduct technical and economic study for your hot water production project. The user can edit the study as a PDF file.

Unlike the complete sizing method (see below), the simulator allows you to estimate the condensation capacity based on the cold room volume or the cooling capacity. You can also use the compressor tables if the brand and the model are known.

If you use a manufacturer's software to find the condensation power, respect the sizing conditions used by the simulator:

- **Positive refrigeration: condensation capacity specified for : Tk=48°C, Te= average Te, SR=0K, SH=10K**
- **Negative refrigeration: condensation capacity specified for : Tk=45°C, Te= average Te, SR=0K, SH=10K**

The simulator performs the sizing automatically by using the average evaporating temperature and the maximum evaporating temperature (°C) indicated by the user.

➢ ***Complete sizing method:***

1/ Determine the thermal capacity at the condenser of the cooling unit using the manufacturer's software.
a/ Start the software and select the compressor(s). Mind the refrigerant type, voltage and frequency.

b/ Depending on application, introduce the following data (Software used in "customized " mode):

| ***Positive refrigeration / medium temperature*** | ***Negative refrigeration / low temperature*** |
|---|---|
| **Tk = 48°C** | **Tk = 45°C** |
| **To** = **maximum** evaporating temperature in normal conditions. You can get a good approximation by subtracting 10°C of the target temperature in normal running conditions (Cold room temperature - 10°C).<br>**SH = 10K**<br>**SC = 0K** | |

c/ Note the thermal capacity at the condenser; if not available, add the cooling capacity to the power input.

2/ Check your refrigerant and select the corresponding Boostherm module:

| | **Permissible power range** | | | | |
|---|---|---|---|---|---|
| **Model** | **R404a, R407f, R450a, R452a and R22** | **R134a, R407a and R513a** | **R448a and R449a** | **R407c** | **R410a** |
| **Boostherm 5 kW** | 1 - 5 kW | 1 - 4kW | 1 - 4kW | 1 - 5 kW | 1 - 4 kW |
| **Boostherm 10 kW** | 5 - 10 kW | 4 - 8 kW | 4 - 9kW | 5 - 9 kW | 4 - 7 kW |
| **Boostherm 20 kW** | 10 - 20 kW | 8 - 16 kW | 9 - 18kW | 9 - 15 kW | 7 - 14 kW |
| **Boostherm 45 kW** | 20 - 45 kW | 16 - 36 kW | 18 - 41kW | 15 - 35 kW | 14 - 31 kW |
| **Boostherm 70 kW** | 45 - 70 kW | 36 - 56 kW | 41 - 64kW | 35 - 54 kW | 31 - 48 kW |
| **Boostherm 100 kW** | 70 - 100 kW | 56 - 80 kW | 64 - 91kW | 54 - 77 kW | 48 - 69 kW |

Nota :
When water is treated with glycol, apply a correction factor to the recoverable thermal power:

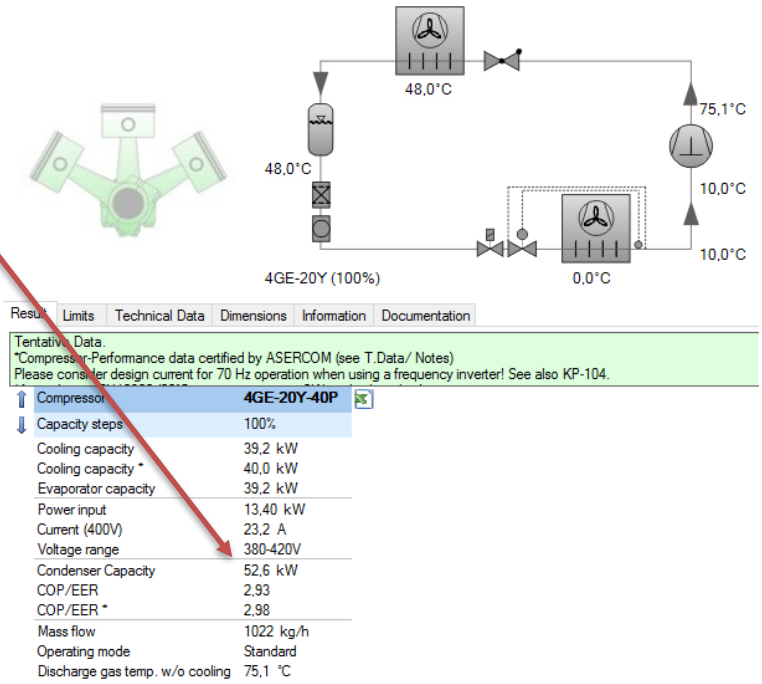
| **% Glycol** | **30%** | **40%** |
|---|---|---|
| **Correction factor** | 1,2 | 1,3 |

*Example 1: Cooling unit equipped with a semi hermetic compressor using R134a, (Positive refrigeration)*
*Tk=48°C, SR=0K et Sh=10K.*

*Don't care about the average evaporating temperature but take the maximum evaporating temperature. (like at the end of a defrost cycle) => Te max=0°C.*

*Recoverable thermal capacity = 52.60 kW*

*Check the previous page for R134a:*
*→* ***Boostherm module = 70 kW***

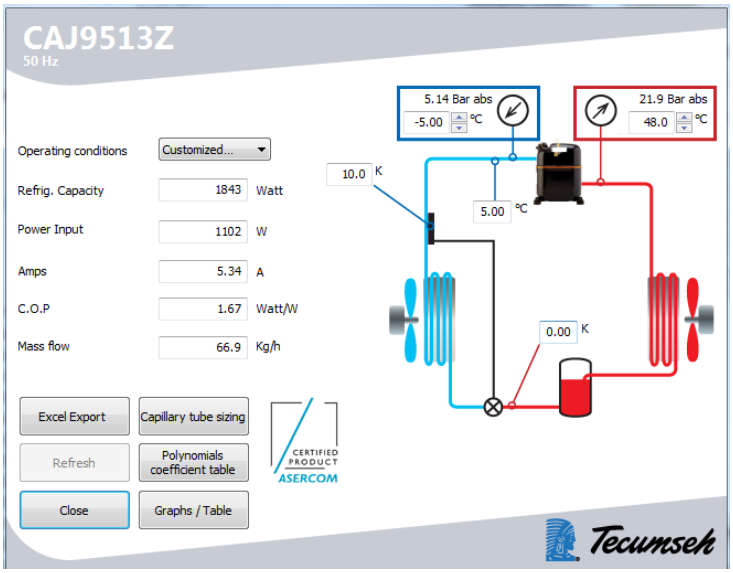



*Example 2: Cooling unit equipped with a Tecumseh CAJ9513Z - 220/240V-50Hz R404a compressor (Positive refrigeration).*

*Cold room set temperature = 2°C*
*Cold room max temperature = 5°C*
*Maximum evaporating temperature = -5°C*

*Recoverable thermal capacity?*
*= Cooling capacity + power input*
*= 1843+1102 =* ***2945 W***

*Check the previous page for R404a:*
*→* ***Boostherm module = 5 kW***




➢ ***Particular case of central cooling plants:***

Select the module at 100% of the central cooling plant thermal capacity.

If the thermal capacity is higher than 100kW, it is possible to consider a by-pass connection with modulating valves to recover a portion of the heat. See page 18-19. Contact us for more information.

Remember that you can size easily your Boostherm module on our online simulator: **http://boostherm.com/Simulator/**

## *II. Heat recovery performances / Return on investment calculation:*

You can size easily and quickly your Boostherm module on **http://boostherm.com/Simulator/**

➢ ***Heated water volumes :*** *(based on average evaporating temperature)*

| ***Thermal capacity* in W** | **Estimated volumes of water heated from 12 to 55°C (Litres)** | **Running time in hours** | | | |
|---|---|---|---|---|---|
| | | ***1*** | ***4*** | ***12*** | ***16*** |
| ***1 000*** | | 16 | 64 | 192 | 256 |
| ***2 000*** | | 32 | 128 | 385 | 514 |
| ***4 000*** | | 65 | 259 | 777 | 1 035 |
| ***5 000*** | | 81 | 325 | 974 | 1 299 |
| ***10 000*** | | 165 | 661 | 1 983 | 2 644 |
| ***20 000*** | | 342 | 1 368 | 4 105 | 5 474 |
| ***30 000*** | | 531 | 2 122 | 6 367 | 8 489 |
| ***40 000*** | | 731 | 2 922 | 8 767 | 11 690 |
| ***50 000*** | | 942 | 3 769 | 11 307 | 15 076 |
| ***70 000*** | | 1 400 | 5 601 | 16 804 | 22 406 |
| ***100 000*** | | 1 957 | 7 828 | 19 570 | 29 355 |

The heating potential must be compared to the daily hot water needs taking into account the consumption peaks if any. It is also necessary to evaluate the cooling units running time equipped with a heat recovery module. For central cooling plants, take into account the periods when some compressors are not running.

The heating potential from 12 to 55°C is determined by using the following formula:

$$\boldsymbol{Qm} = \frac{P * k}{(43 * 4185)} * 3600 = \boldsymbol{P * k * 0.02}$$

- $Qm$ : heating potential from 12 to 55°C in L/h.
- $P$ : Recoverable thermal capacity in Watts.
- $k$ : global heat losses correction factor = 0,8

*Example: Thermal capacity = 3500 W ➢ Qm = 3500 x 0.8 x 0.02 = 56* ➢ ***Heating potential 56 litres / hours***

➢ ***Estimated annual savings depending on hot water needs:***

| **Hot water needs (L/ day)** | 300 | 500 | 750 | 1 000 | 1 500 | 3 000 | 5 000 | 7 500 | 10 000 | 20 000 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Savings (kWh/year)** | 4 500 | 7 500 | 11 250 | 15 000 | 22 500 | 45 000 | 75 000 | 112 500 | 150 000 | 299 900 |

*Basis: 6 working days per week x 50 weeks.*

Potential savings calculation depending on hot water needs:

$$\boldsymbol{Sav} = (55 - 12) * V * \left(\frac{4{,}185}{3600}\right) * J = \boldsymbol{0.05 * V * J}$$

- $Sav$ : Estimated annual savings (kWh/year)
- $V$ : Hot water needs (L/day).
- $J$ : Days per year when $V$ volume is consumed (day).

*Example: Consumption of 1500 litres / day x 300 day x 0.05 = 22 500* ➢ ***Annual savings estimation = 22 500 kWh***
*Nota : The calculation does not take into account the additional heat recovered during desuperheating mode.*

➢ ***Return on investment:***

The return on investment calculation is the same whatever energy is used to produce hot water:

$$\boldsymbol{ROI} = \frac{\boldsymbol{Ic}}{\boldsymbol{Sav * €kWh}}$$

- $€kWh$ *: energy cost in € / kWh*
- $Ic$ *: Investment (€)*

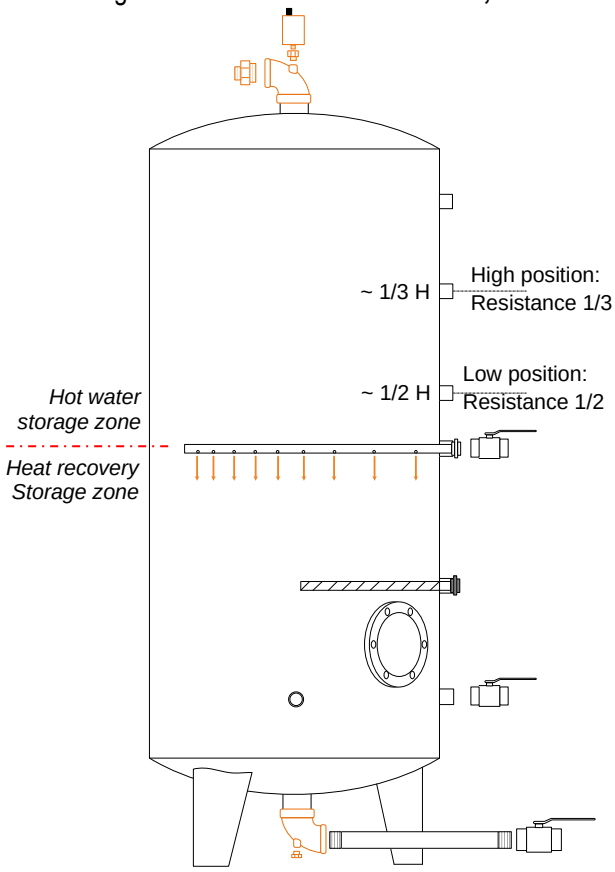
***ROI :*** *Return on investment in years*

### *III. Hot water tank selection and electrical resistance sizing:*

To control the temperature of the water required for cleaning operations, we advise to choose a Boostherm water tank allowing simultaneous access to two distinct temperature levels: pre-heated water (55°C min) and hot water (up to 75°C depending on the set point) with an electrical resistance installed in the upper third or half height of the water tank.
**Important note:** stainless steel tanks are recommended for particularly aggressive water (TH <8 ° fH), chlorides content must be less than 30 mg / liter.

Another solution is to put a standard water heater for storing preheated water produced by the heat recovery system that can be added in series to an existing water heater. It is also possible to use the existing water heater. **For more details, refer to chapter 4.**

The minimum buffer volumes are listed below:




➢ ***Minimum tank volume***

| Model | Buffer tank * | Boostherm tank |
|---|---|---|
| **5 kW** | 100 | 300 |
| **10 kW** | 200 | 500 |
| **20 kW** | 300 | 500 |
| **45 kW** | 500 | 750 |
| **70 kW** | 750 | 1000 |
| **100 kW** | 1500 | 2000 |

** It is possible to use the following le ratio: 15L / kW recovered*

➢ ***Volumes heated by the electrical resistance***

| Capacity | Heated water volume position 1/2 (L) | Heated water volume position 1/3 (L) |
|---|---|---|
| **300L** | 135 | x |
| **500L** | 205 | 133 |
| **750L** | 342 | 237 |
| **1000L** | 450 | 312 |
| **1500L** | 676 | 468 |
| **2000L** | 877 | 600 |
| **3000L** | 1460 | 970 |
| **5000L** | 2514 | 1542 |

➢ ***Electrical resistance power :***

It is possible to determine the minimum power of the electrical resistance knowing the hot water consumption profiles and the temperature requirements.
Warning: to apply this formula, make sure the heat recovery potential is sufficient to supply the hot water storage zone permanently with preheated water.

$$\boxed{Prelect. = Vh * \Delta T * 1.16}$$

- $Prelect.$ : Electrical resistance minimum power (W).
- $Vh$ : Volume to be heated per hour (L).
- $\Delta T$ : Hot water temperature target - 55°C.

*Example: 700L hot water at 65°C required per hour. Heat recovery potential 1300L/h >> 700L/h.*
*Prelect. = 700 x (65-55)*1.16 = 8120W* ➢ ***Electrical resistance = 9kW***

➢ ***Extra control via Boostherm:***

Boostherm comes with a dry contact (NO) to drive an extra (heat resistance for example). The extra must have an independent power supply and be able to independently manage the heating temperature (thermostat). Several modes are available:

- Forced operation for a fixed delay.
- Adjustable daily working time of the extra (with a start time preselection to match a typical range-peak hours).
- Extra in alternance with heat recovery operation (no extra when heat recovery is active).

# 3. Specifications

## Boostherm module:

| Model | Connections | | Circulation pump | | Maximum power input (W) | Cutting capacity of fans relays (A/V AC)* | Scope** | Dimensions HxWxD / Weight (mm) / (kg) | Code |
|---|---|---|---|---|---|---|---|---|---|
| | Refri. | Water | Max height (mCE at 0m3/h) | Max flow (l/h) | | | | | |
| **BOOSTHERM 5 KW** | 1/2" | 1/2" (15/21) | 3 | 200 | 35 | 16A/250V AC | SHW | 472x325x186 / 13,6 | **812305** |
| **BOOSTHERM 10 KW** | 5/8" | 1/2" (15/21) | 3 | 400 | 35 | 16A/250V AC | SHW | 472x325x186 / 14,4 | **812310** |
| **BOOSTHERM 20 KW** | 5/8" | 3/4" (20/27) | 7 | 600 | 55 | 16A/250V AC | SHW | 580x380x245 / 20,7 | **812320** |
| **BOOSTHERM 45 KW** | 7/8" | 3/4" (20/27) | 7 | 1400 | 55 | 16A/250V AC | SHW | 580x380x245 / 26,8 | **812345** |
| **BOOSTHERM 60 KW CH** | 1"1/8 | 1"1/4 (33/42) | 8 | 2600 | 75 | 16A/250V AC | L.T. Heating | 580x380x245 / 32.2 | **812560** |
| **BOOSTHERM 70 KW** | 1"1/8 | 1" (26/34) | 7 | 2200 | 55 | 16A/250V AC | SHW | 580x380x245 / 32,2 | **812370** |
| **BOOSTHERM 100 KW ECS** | 1"3/8 | 1"1/4 (33/42) | 8 | 3100 | 135 | 16A/250V AC | SHW | 775x480x245 / 40 | **812399** |
| **BOOSTHERM 100 KW CH** | 1"3/8 | 1"1/4 (33/42) | 12 | 4000 | 315 | 16A/250V AC | L.T. Heating | 775x480x245 / 40 | **812599** |

**** 2 NC contacts available. **SHW = sanitary hot water / L.T. heating = low temperature heating***

## Boostherm water tanks:

| Model | Cold water inlet | Hot water outlet | Recovery loop (3) | Preheated water (3) | Tank Dimensions (mm) | | Weight (kg) Powder Coated Steel / Stainless Steel | Code PCS version | Code SS version (4) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ht (1) | Ø (2) | | | |
| **BOOSTHERM 300L** | M3/4" | M3/4" or F1" | 2 x M3/4" | Tee 3F 3/4" | 1570 | 550 | 75 / 75 | **810303** | **810503** |
| **BOOSTHERM 500L** | M3/4" | M3/4" or F1" | 2 x M1" | Tee 3F 1" | 1790 | 650 | 100 / 110 | **810305** | **810505** |
| **BOOSTHERM 750L** | M3/4" | M3/4" or F1" | 2 x M1" | Tee 3F 1" | 1925 | 800 | 135 / 120 | **810307** | **810507** |
| **BOOSTHERM 1000L** | M3/4" or F1"1/4 | M3/4" or F1" | 2 x M1" | Tee 3F 1" | 2255 | 800 | 160 / 145 | **810310** | **810510** |
| **BOOSTHERM 1500L** | F1"1/4 | F1" or M2" | 2 x M1"1/4 | Tee 3F 1"1/4 | 2290 | 1000 | 220 / 200 | **810315** | **810515** |
| **BOOSTHERM 2000L** | F1"1/4 | F1" or M2" | 2 x M1"1/4 | Tee 3F 1"1/4 | 2035 | 1250 | 330 / 295 | **810320** | **810520** |
| **BOOSTHERM 3000L** | F1"1/2 | F1"1/4 ou M2" | 2 x M1"1/4 | Té 3F 1"1/4 | 2785 | 1250 | 430 | **810330** | **-** |
| **BOOSTHERM 5000L** | F1"1/2 | F1"1/4 ou M2" | 2 x M1"1/4 | Té 3F 1"1/4 | 3365 | 1500 | 740 | **810350** | **-** |

(1) Height without upper elbow or air vent: total height = height + 200 mm
(2) Diameter without insulation jacket : total diameter = tank diameter + 100 mm for 300 to 1 000L tanks. + 200 mm for 1 500 to 5 000L. M3 insulation class as standard. M1 and M0 insulation class on demand.
(3) Supplied with the fittings kit.
(4) Stainless steel tanks are recommended for particularly aggressive water (TH <8 ° fH)

## Electrical resistances: (With regulation and safety thermostat)

| Model | Supply voltage | Set range (°C) | Safety thermostat (°C) | Ø connection on the tank | Pin length (mm) | Code |
|---|---|---|---|---|---|---|
| **Resistance 3kW IP54** | 1Ph / 3Ph 400V | 30-75 | 95 | 1"1/2 | 300 | **820103** |
| **Resistance 6kW IP54** | 3Ph 400V | 30-75 | 95 | 1"1/2 | 500 | **821006** |
| **Resistance 9kW IP54** | 3Ph 400V | 30-75 | 95 | 1"1/2 | 700 | **821009** |
| **Resistance 12kW IP54** | 3Ph 400V | 30-75 | 95 | 1"1/2 | 800 | **821012** |

## Anti-scale systems: (see water quality issues at chapter 1 of the instruction manual)

| Model | Ø connection | Filtration capacity of the filter | Max flow (l/h) | Max pressure (bar) | Code |
|---|---|---|---|---|---|
| **Anti-scale & filtration station** | 3/4"FF | 25 µ | about 2000 | 8 | **820201** |

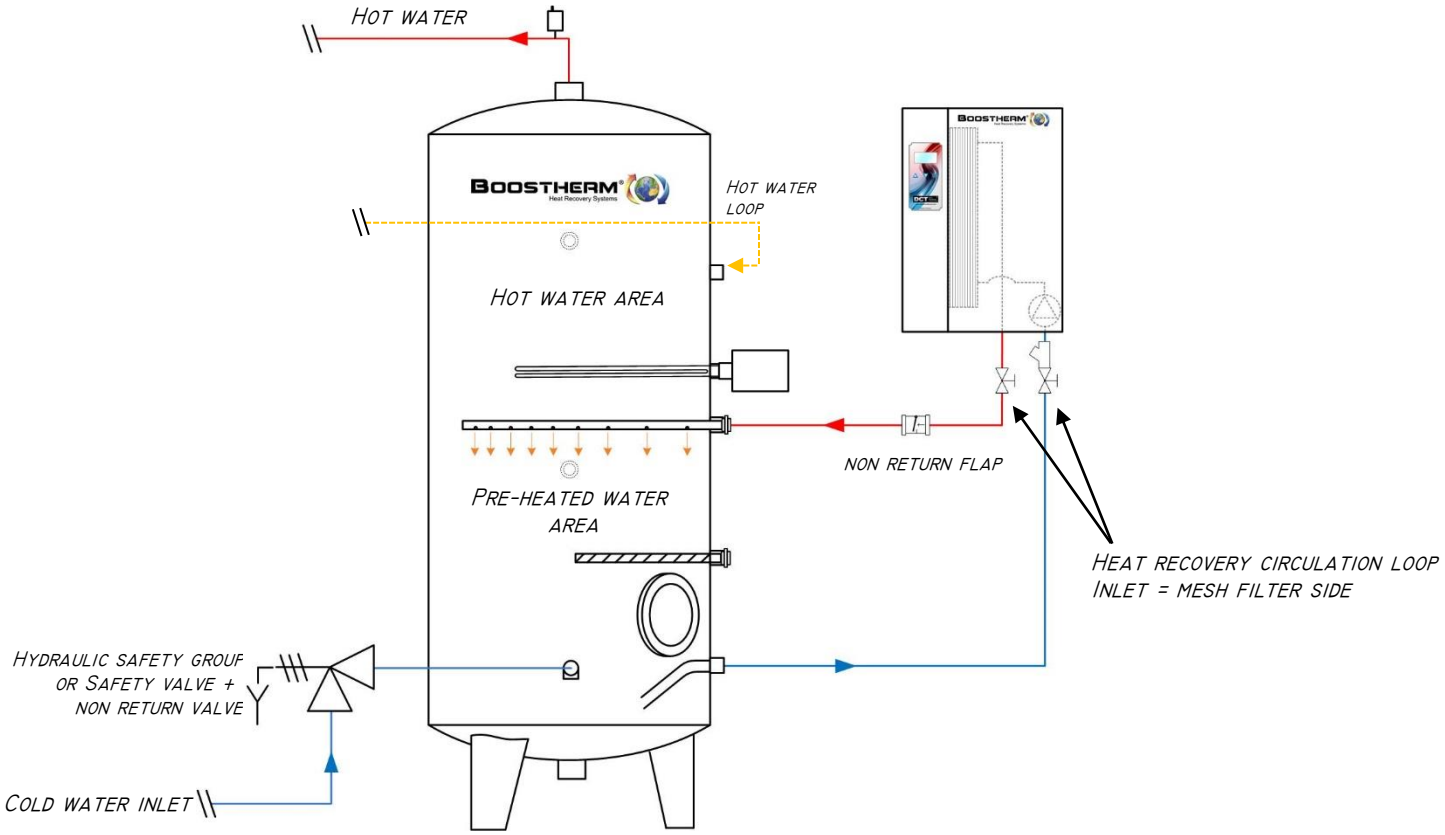
## Performances evaluation / meters: (see our catalog for more references)

| Model | Ø connection / length (mm) | Nominal flow (l/h) | mini/maxi flow (l/h) | Pressure drop at nominal flow (mbar) | Max pressure (bar) | Code |
|---|---|---|---|---|---|---|
| **Thermal energy meter DN15** | 3/4"MM / 110 | 1500 | 6 / 3000 | 75 | 16 | **829801** |
| **Thermal energy meter DN25** | 1"1/4MM / 260 | 3500 | 35 / - | 150 | 16 | **829808** |
| **Cold water meter DN15** | 3/4"MM / 110 | 1500 | 5000 | - | 16 | **829804** |
| **Cold water meter DN25** | 1"1/4 MM / 260 | 6300 | 78 / 7800 | 350 | 16 | **829805** |

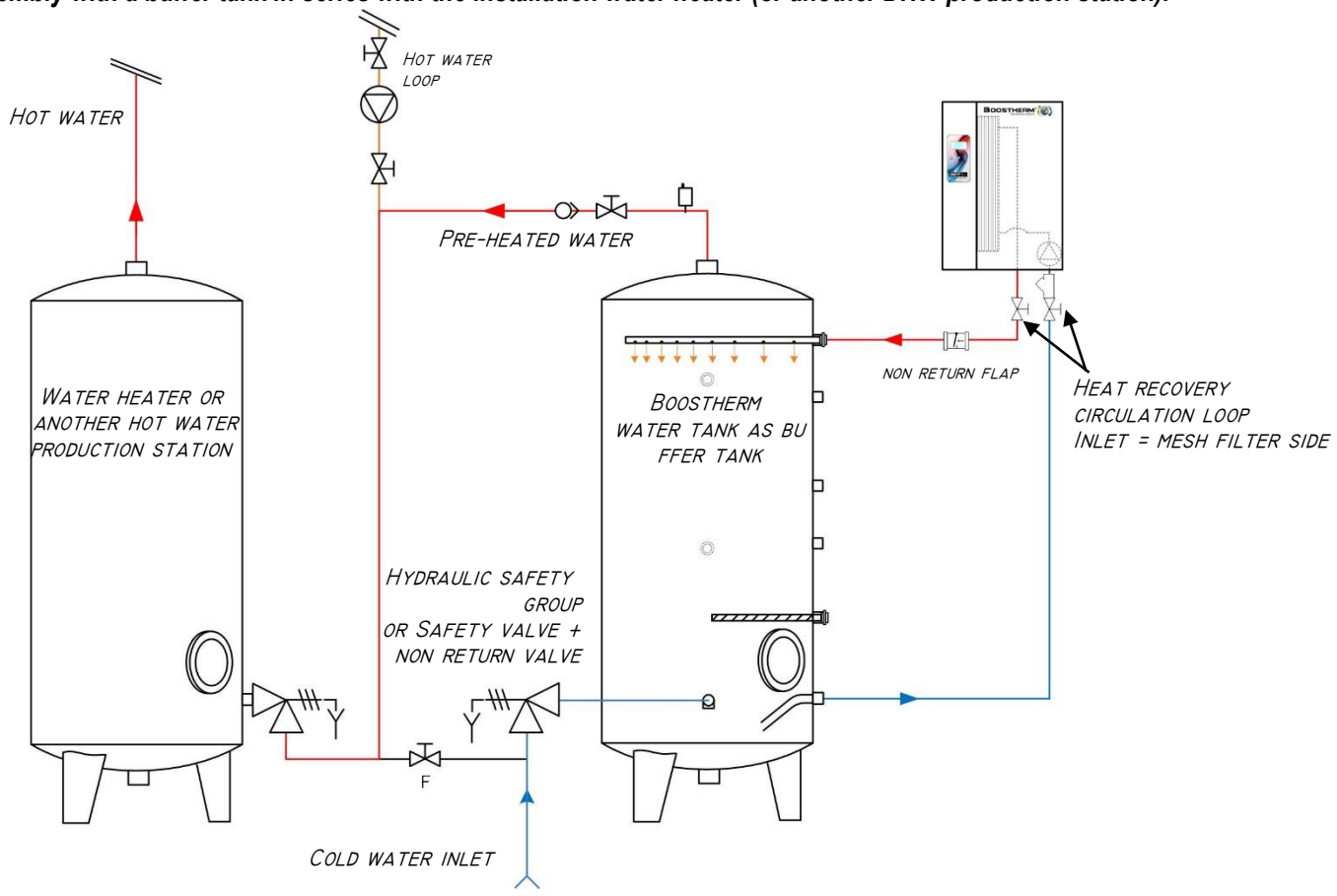
*Ultrasound thermal energy meter: measures the energy savings with kWh accumulation. Installed on the heat recovery water loop between inlet and outlet. IP54 LCD display can be installed remote from the meter. Additional measures: instant flow, inlet and outlet temperature, instant power… Available for higher flows and diameters on demand.

# 4. DHW diagrams

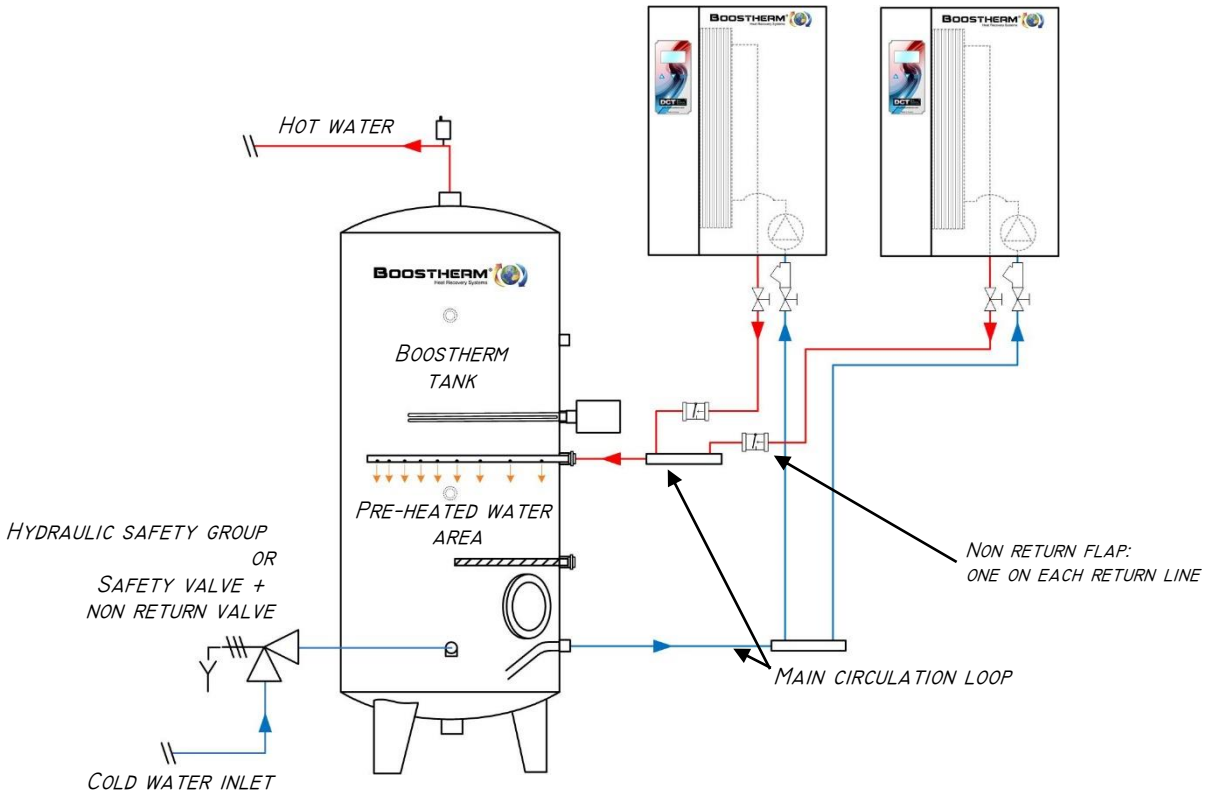
➢ ***Assembly with a Boostherm water tank used as combined tank (Preheated water & top up).***



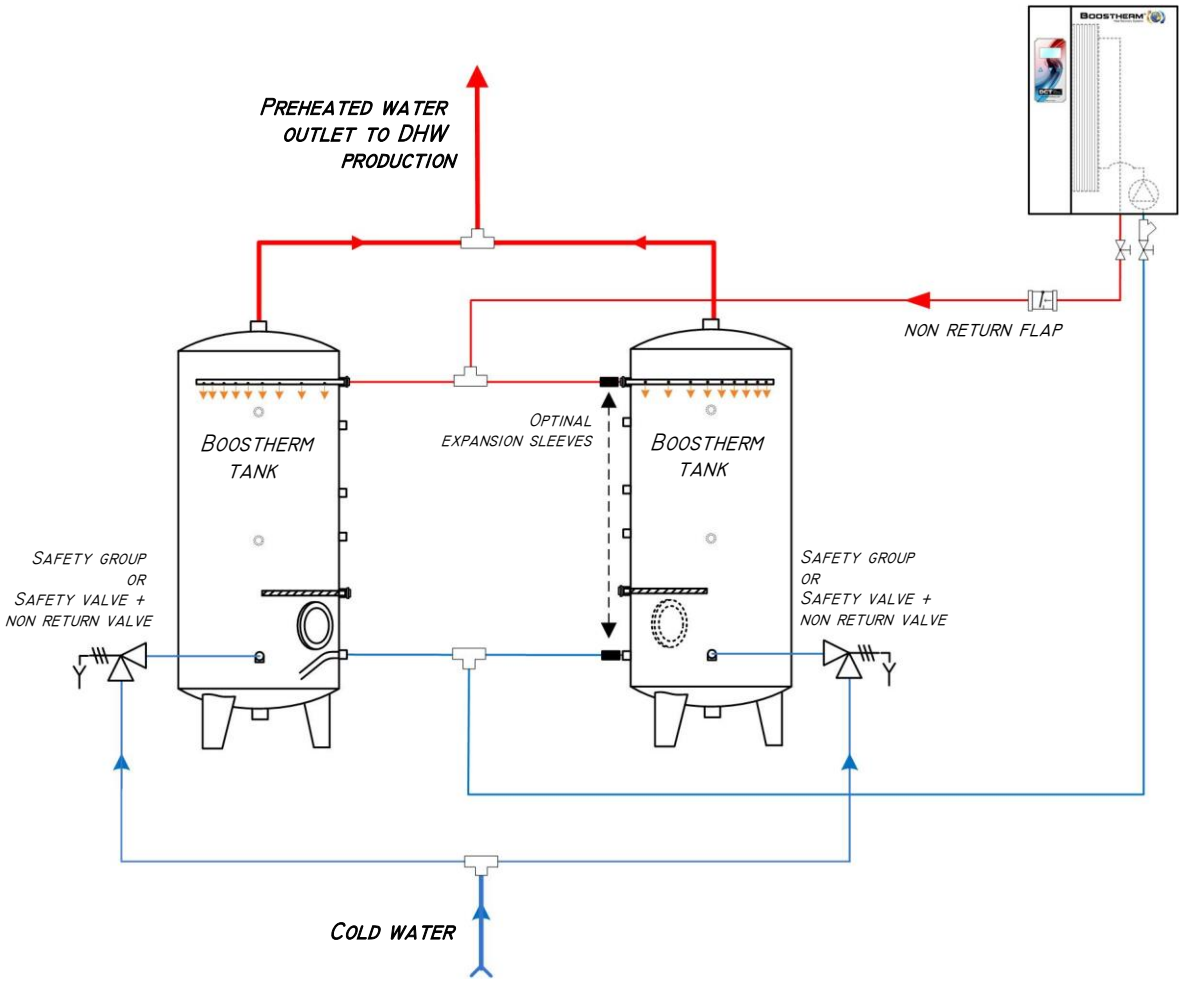

➢ ***Assembly with a buffer tank in series with the installation water heater (or another DHW production station).***



➢ ***Assembly with 1 Boostherm tank used as combined tank with 2 heat recovery modules***




➢ ***Assembly with 2 buffer tanks in parallel.***



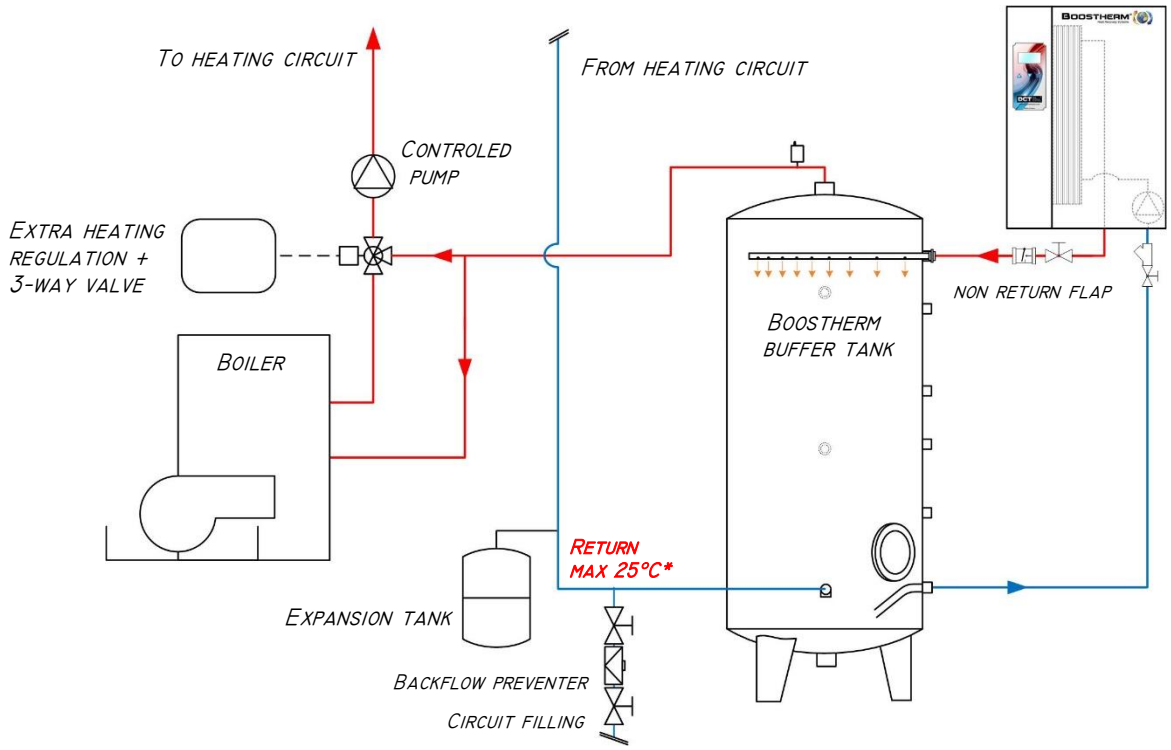
➢ ***Piping specifications:***

| Maximum thermal capacity | Copper tube | | Multi-layer composite pipe | |
|---|---|---|---|---|
| | Ø mini advised (mm) * | Max length for the Ø mini (m) | Ø mini advised (mm) * | Max length for the Ø mini (m) |
| 5 kW | 10/12 | 2 x 15 | 10/12 | 2 x 15 |
| 10 kW | 12/14 | 2 x 15 | 13/16 | 2 x 15 |
| 20 kW | 16/18 | 2 x 20 | 16/20 | 2 x 20 |
| 45 kW | 20/22 | 2 x 15 | 20/22 | 2 x 15 |
| 70 kW | 26/28 | 2 x 10 | 26/32 | 2 x 10 |
| 100 kW | 26/28 | 2 x 15 | 26/32 | 2 x 15 |

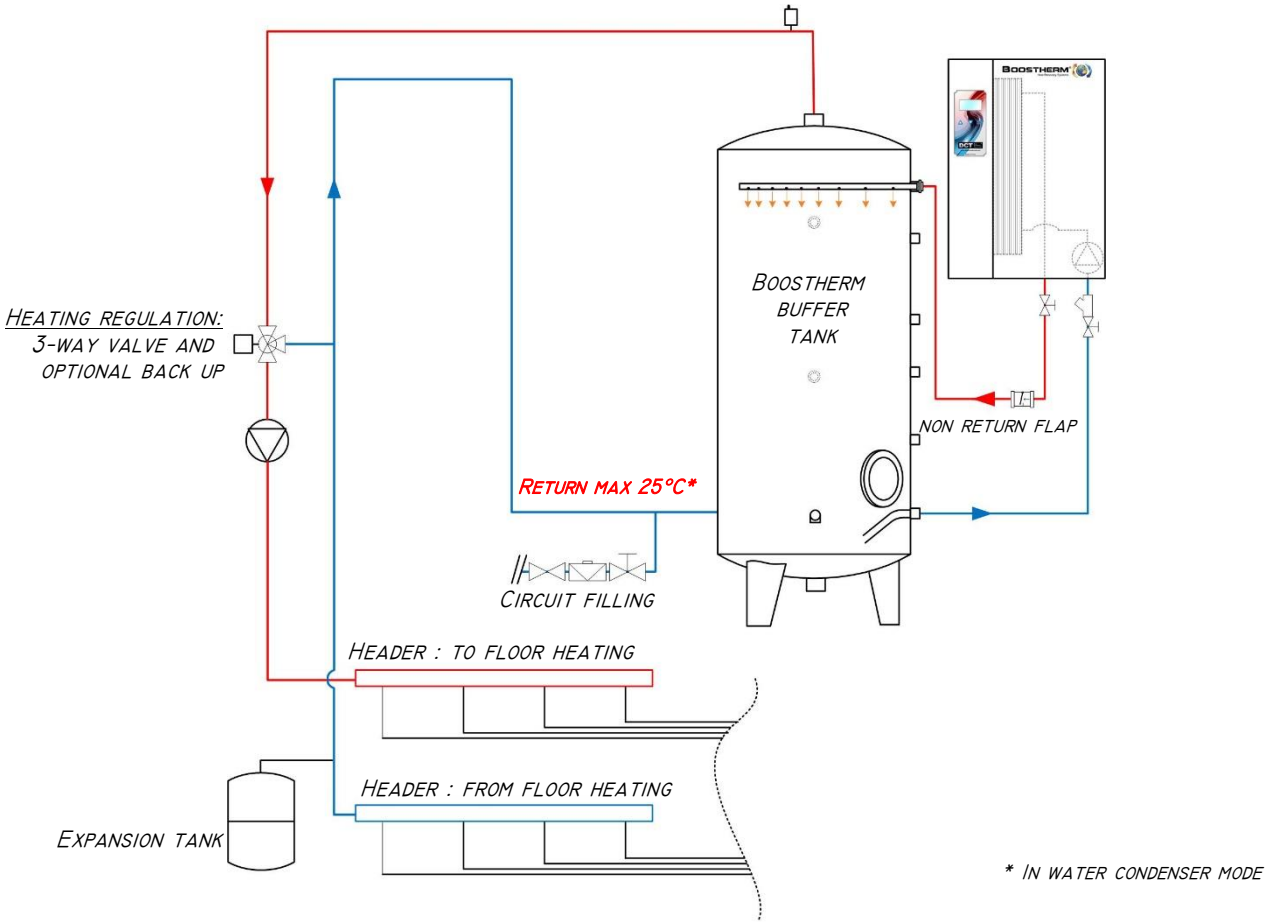
* For larger diameters or smaller powers, the maximum lengths may be larger.
For special cases, please contact us.

# 5. Heating diagrams

➢ ***Assembly with boiler extra heating***

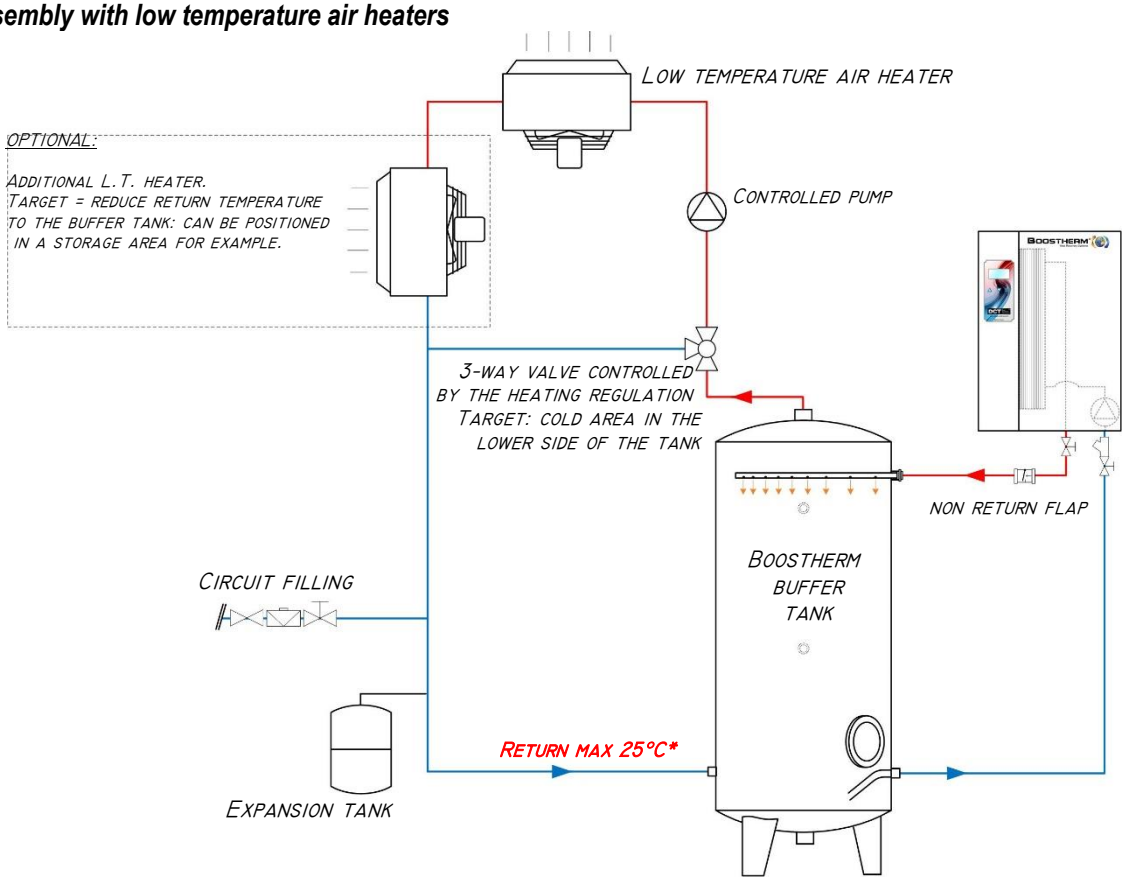



➢ ***Assembly for floor heating***

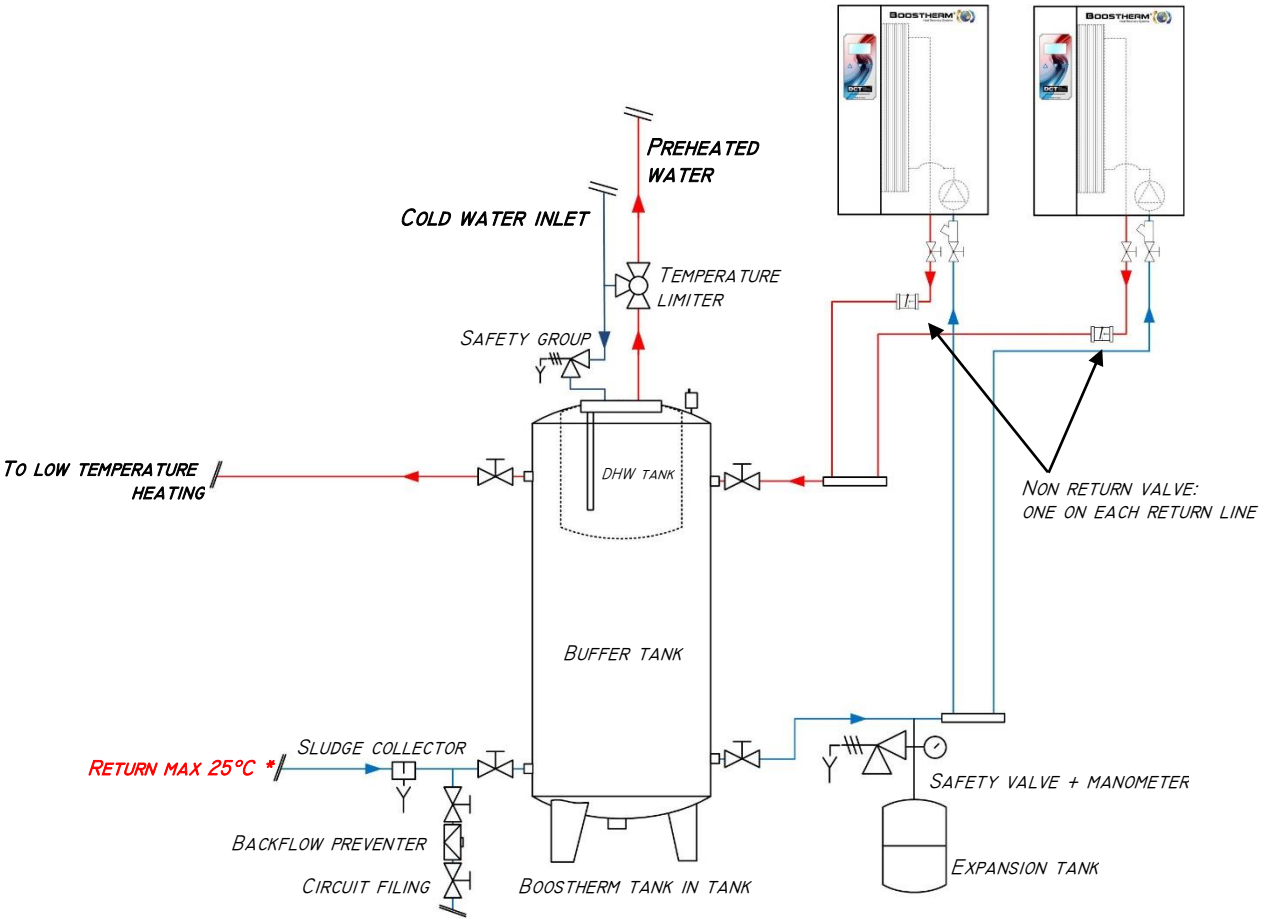



* IN WATER CONDENSER MODE

## ➢ Assembly with low temperature air heaters



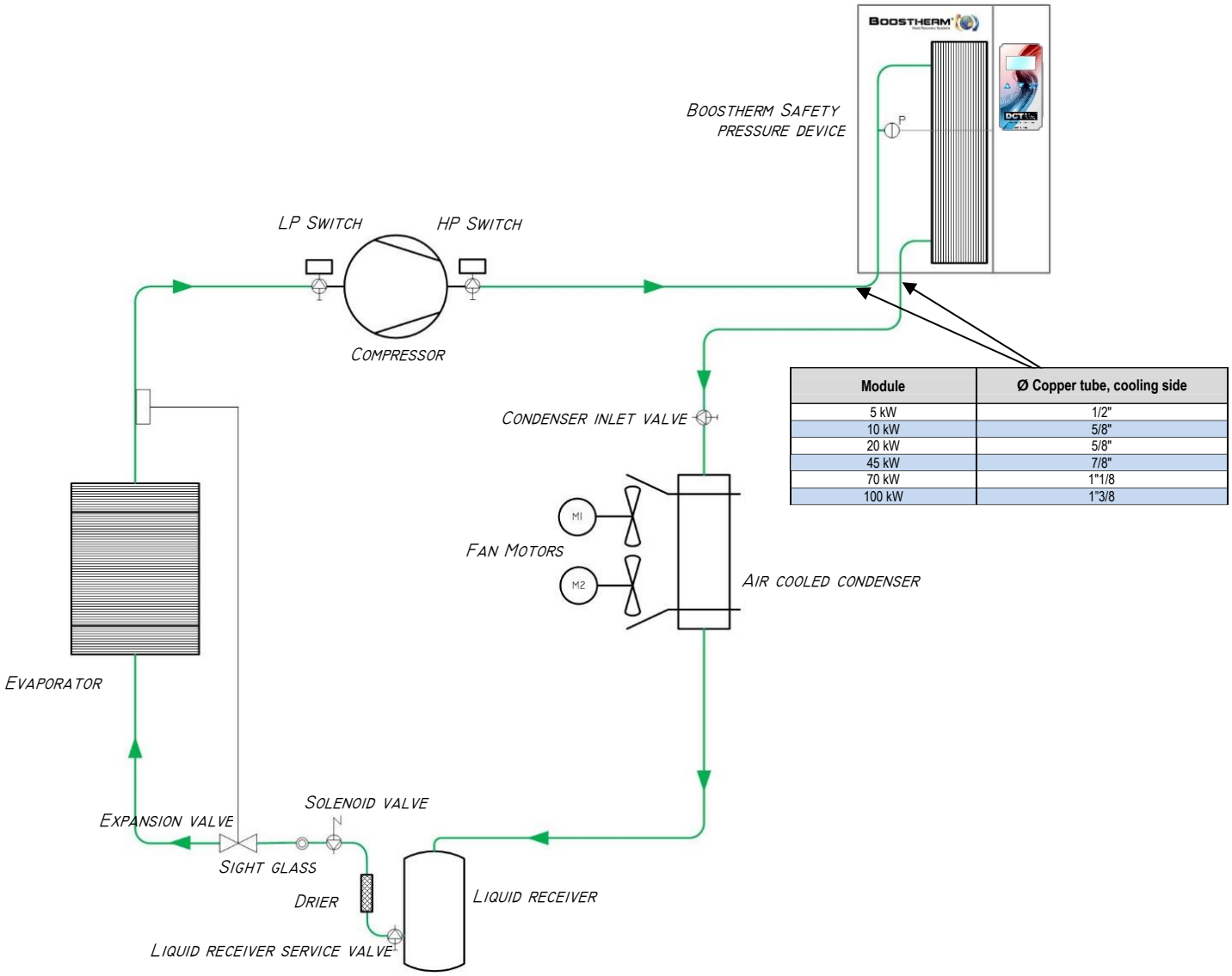

## ➢ Assembly for combined low temperature heating and DHW production




* IN WATER CONDENSER MODE

# 6. Cooling diagrams

➢ ***Standard assembly: heat recovery module between the compressor discharge and the condenser :***




| Module | Ø Copper tube, cooling side |
|---|---|
| 5 kW | 1/2" |
| 10 kW | 5/8" |
| 20 kW | 5/8" |
| 45 kW | 7/8" |
| 70 kW | 1"1/8 |
| 100 kW | 1"3/8 |

***Recommendations :***

The connection pipe between the compressor and the heat recovery system inlet must be insulated with insulating shield (Armaflex type). For safety reasons (burning risk) the connection pipe between the heat exchanger outlet and the condenser must also be insulated.

When the air condenser is located more than 3 meters above the heat recovery system outlet, it is advisable to create, at the base of the rising pipe, an oil trap. Also ensure that the slope of the pipes is in the flow direction (12mm per meter).

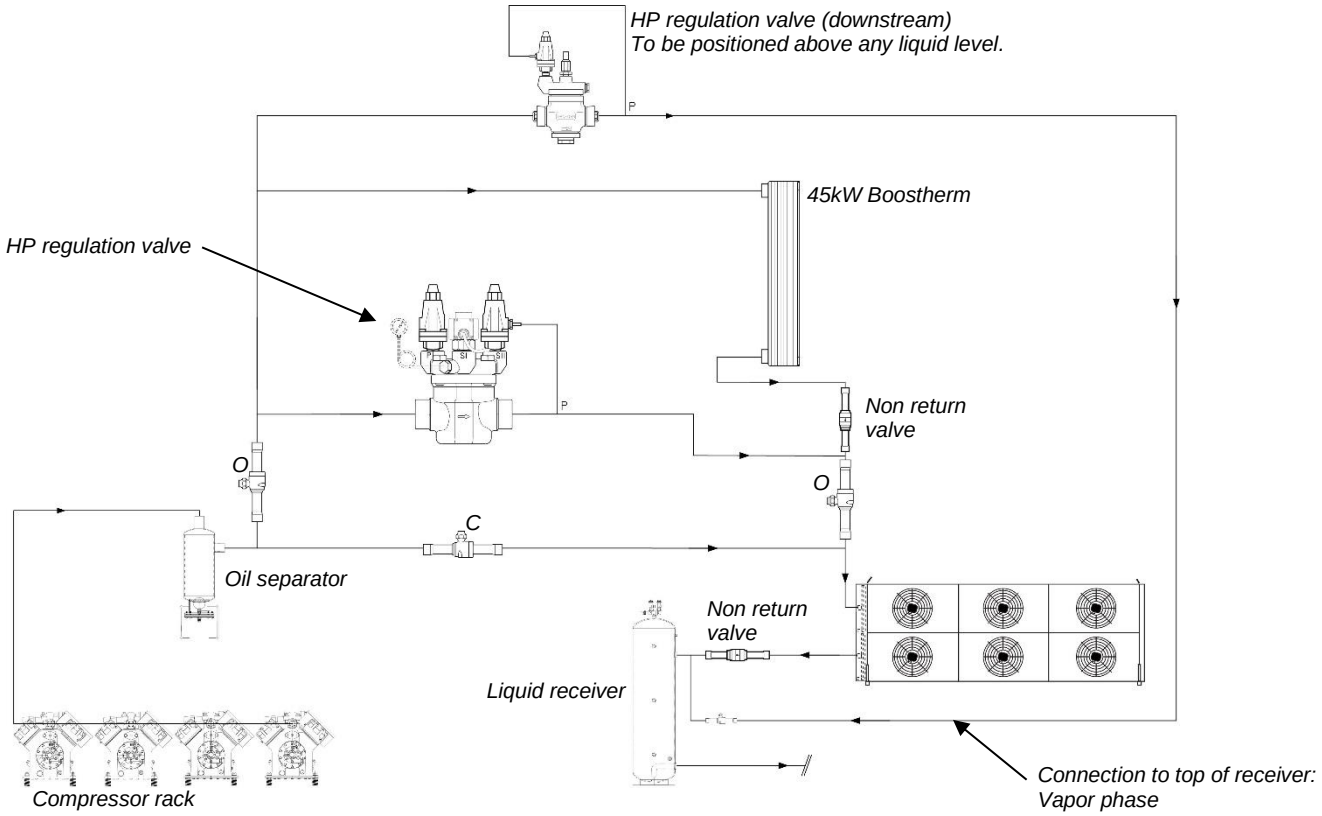
When the condenser alone is located on the roof, it is strongly recommended to install a non-return valve on the heat recovery module outlet and to shape a copper pipe siphon on the compressor discharge line, sized to store any return of liquid from the heat recovery system.

➢ ***Assembly with deviation of hot gases:*** ***when condensing capacity is higher than the HR module capacity.***

*Example 1:* Compressor rack with 4 compressors.
Cooling capacity: 200kW.
Condensing capacity: 290kW.
Average operating conditions: 5h at 50% and 3h at 75% per day.

Requirement: 6 to 7 000L of DHW per day ie approx. 350kWh per day (pre-heated from 12 to 55°C and consumption profile supposed to be spread on 8 hours).

Selection:
- 1 x 45kW Boostherm module. With 8 hours operation of the compressor rack: 360kWh recoverable per day.
- Hot gases deviation system (valve with HP regulation operator).




***Operating principle – deviation of hot gases on compressor rack discharge:***

**CYCLE 1: Heat recovery based on condensation in the heat recovery module.**
As long as cold water is available in the water tank, part of the hot gases is deviated through the heat recovery module and condensed to get up to 45 kW heat recovery. Deviation of hot gases is done by the modulating valve equipped with a HP regulation operator whose setting (P1) equals the pressure necessary to preheat the water at 55°C. The liquid flow controller maintains a higher condensing pressure in the heat recovery module than in the condenser. The downstream HP regulation valve maintains the P2 pressure level in the liquid receiver to ensure a constant supply of liquid refrigerant to the expansion valves whatever the operating conditions.

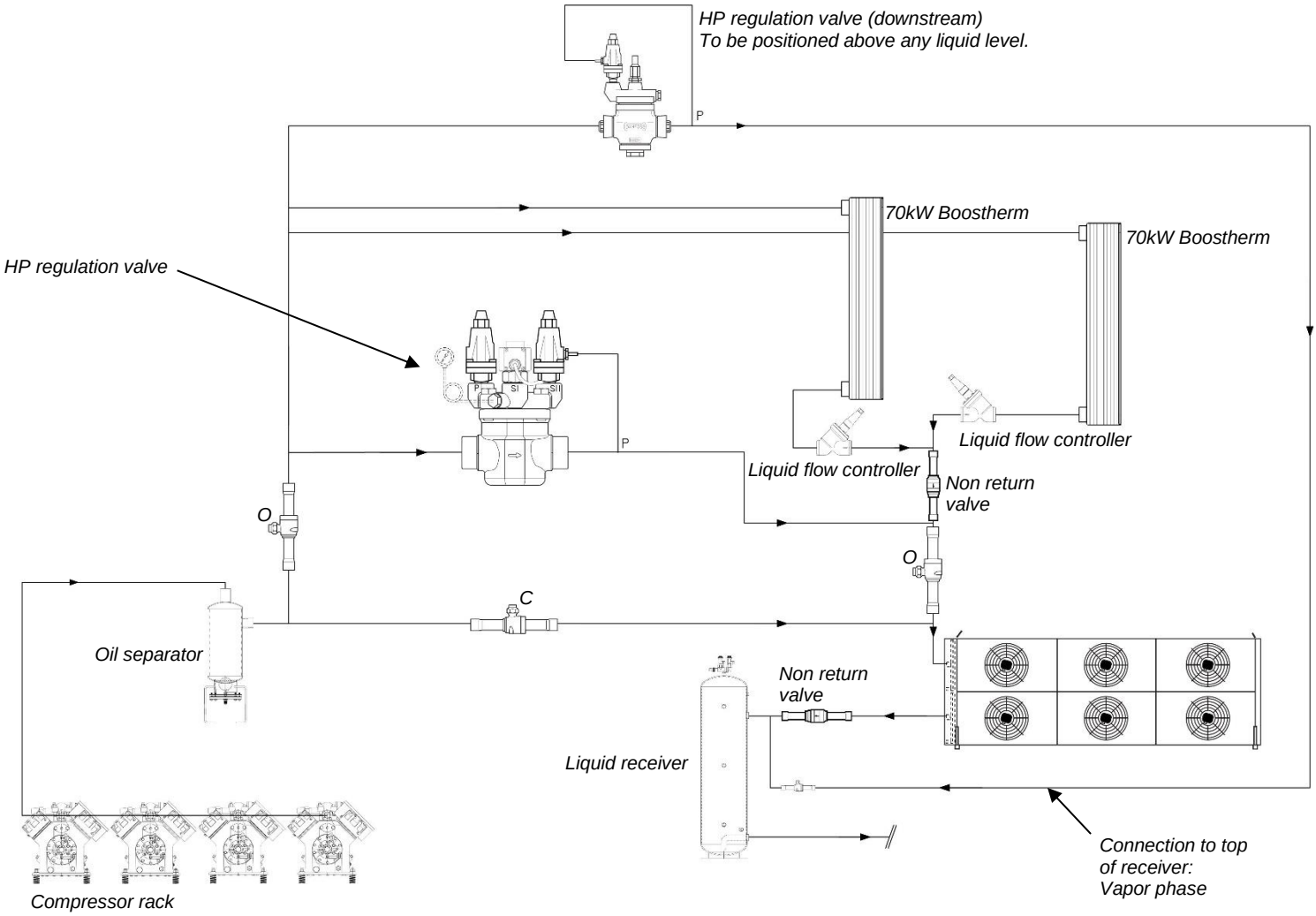
**CYCLE 2: Desuperheating.**
When all the water has been preheated (water return temperature above 35°C), the solenoid valve EVM1 controlled by the heat recovery module opens the HP regulating valve.

In this assembly case, the Boostherm control board does not control fans operation of the air cooled condenser. A NC contact of the control board is used to activate EVM1 solenoid valve in order to switch to desuperheating mode when all the water has been preheated. The second NC contact may be used to send a signal to a floating HP controller (heat recovery mode).

*Example 2:* Compressor rack with 4 compressors.
Cooling capacity: 200kW.
Condensing capacity: 290kW.
Average operating conditions: 5h at 50% and 3h at 75% per day.

Requirement: 20 000L of DHW per day ie approx. 1000kWh per day (pre-heated from 12 to 55°C and consumption profile supposed to be spread on 8 hours).

Selection:
- 2 x 70kW Boostherm module. With 8 hours operation of the compressor rack: 1120kWh recoverable per day.
- Hot gases deviation system (valve with HP regulation operator) and 2 liquid flow controllers.



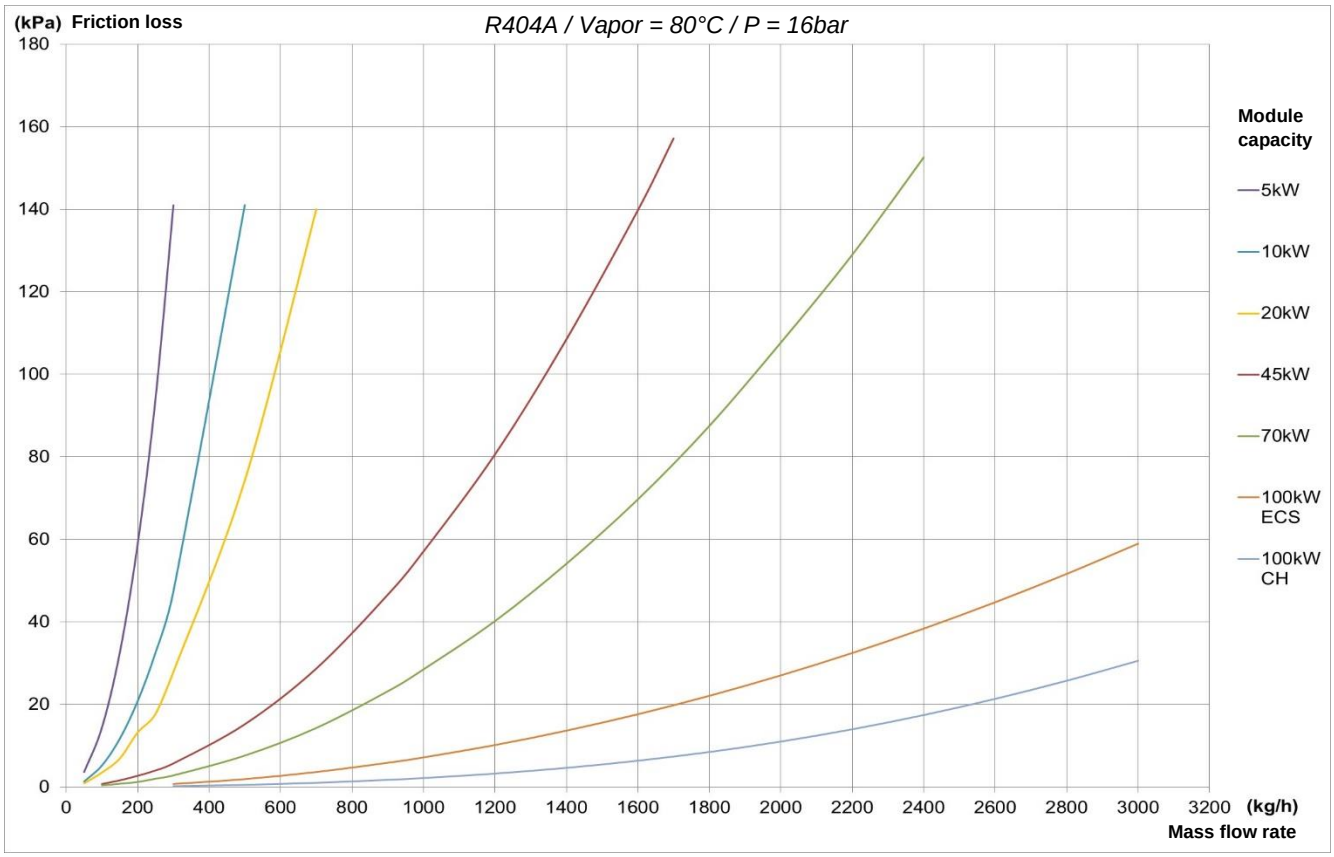

***Operating principle – deviation of hot gases on compressor rack discharge:***

See description on previous page.

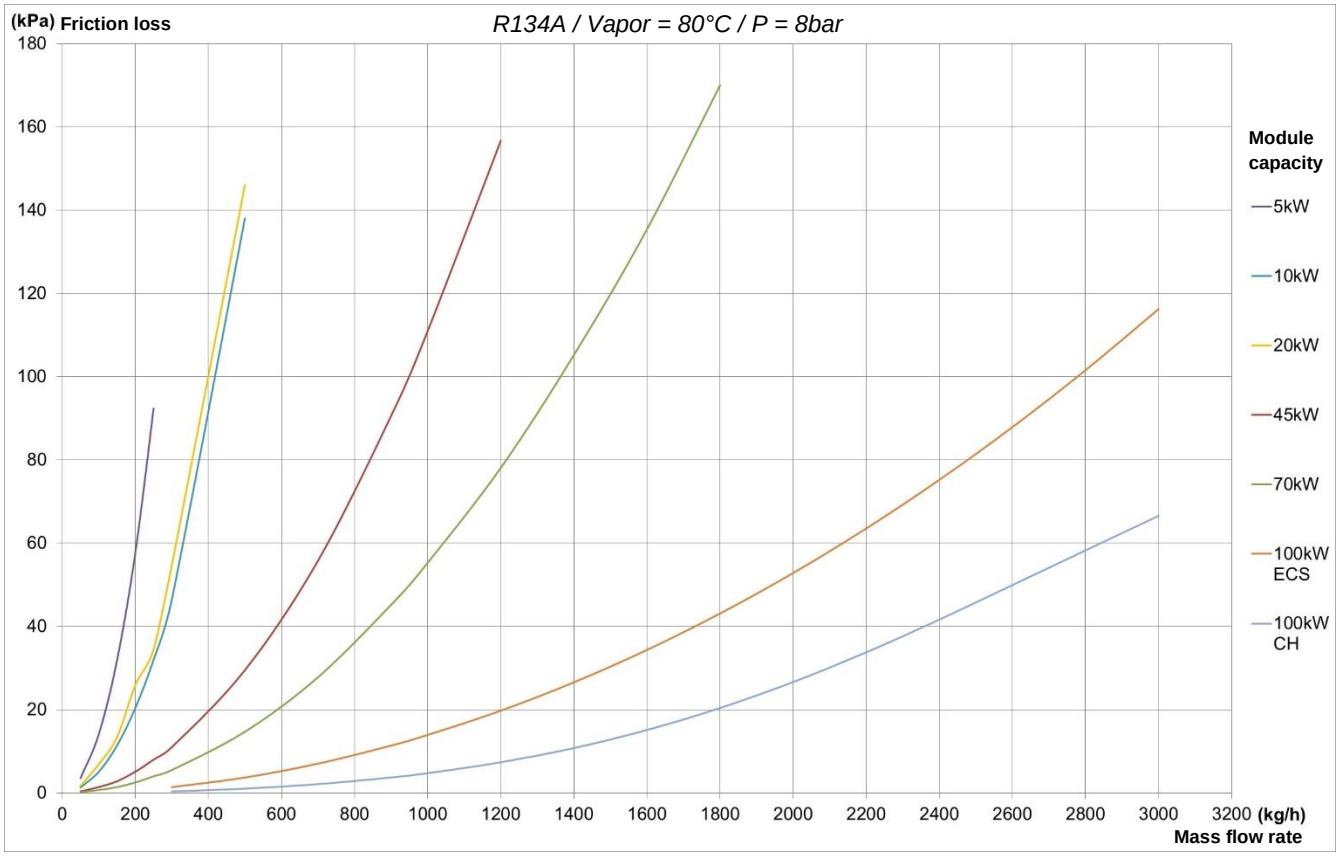
The liquid flow controllers distribute the refrigerant flow and compensate for any imbalances between the heat recovery modules.

# 7. Pressure drop in the heat exchangers

**Pressure drop (kPa) according to the mass flow rate of R404a in vapor state (kg/h)**




**Pressure drop (kPa) according to the mass flow rate of R134a in vapor state (kg/h)**



# 8. Installation costs

**Estimated installation times:**

(1) Module standard installation including: module fixing, cooling and electrical connections, starting up and settings:

- For 1 module 5 or 10 kW: 8 hours; 6 hours for each additional module.
- For 1 module 20 to 100 kW: 10-12 hours; 8 hours for each additional module.

(2) Boostherm water tanks installation including: assembly, installation, hydraulic connection to one module, electrical connection of the electrical resistance, starting up:

- For 1 Boostherm water tank 300 & 500 litres: 8 hours.
- For 1 Boostherm water tank 750 & 1000 litres: 10 hours.
- For 1 Boostherm water tank 1500 & 2000 litres: 12 hours.

Add 2 hours for the hydraulic connections of each additional module.
Note: provide appropriates handling equipment and 2 people for the assembly of water tanks ≥ 750 litres.

**Supplies to provide:** (non-exhaustive list)

- Equipment for module & piping fixation
- Copper tubes, insulation, brazing, refrigerant
- Electrical wires : heat recovery supply, fans control, electrical resistance
- Hydraulic connection: copper tube and brazing or multilayered and fittings, insulation, valves, air vent, fittings, consumables…

# 9. Additional information

### *A. Modules dimensions*

Refer to chapters 5 & 6 of the instructions manual for details on module fixation and implantation.

### *B. Boostherm water tanks implantation*

Refer to chapter 7 of the instructions manual for details on implantation (**Support base, clearance**…).

### *C. Hydraulic connection*

Refer to chapter 9 of the instructions manual for details on hydraulic connections (**diameters, tubes length, air vent**…)

### *D. Refrigeration connections*

Refer to chapter 10 of the instructions manual for details on cooling connections (**tubes diameters, additional refrigerant load, liquid receiver**…)

### *E. Electrical installation*

Refer to chapter 10 of the instructions manual for details on electrical installation (**Wiring options for electrical resistance, wiring module / cooling unit and fan control**…)

- Heat recovery module wiring: 3G1.5 power supply - independent line - 2A protection
  2G1.5 cooling unit or compressor rack start signal
- Fan control wiring: adapt the wire section to the fan power and cable length.
- Electrical resistance wiring: adapt the wire section to the resistance power and cable length.

- Calibrate the electrical resistance protection according to the voltage 230V or 400V.

➢ ***Calculate the current to select the fuse / circuit breaker***

230V 1 Ph: $I = \frac{P}{U} = \frac{P}{230}$

400V 3 Ph: $I = \frac{P}{U*\sqrt{3}} = \frac{P}{693}$

$I$ in Amperes (A)
$P$ in Watts (W)

➢ ***Wire sections for electrical resistances***

| 400V 3Ph Cosϕ = 0,8 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **POWER (kW)** | **CURRENT (A)** | **SECTIONS mm² / Max. length in m** | | | | | | | |
| | | **1,5** | **2,5** | **4** | **6** | **10** | **16** | **25** | **35** | **50** |
| **3** | **6** | 160 | 270 | 420 | 620 | | | | | |
| **6** | **12** | 79 | 135 | 210 | 315 | 525 | 810 | | | |
| **9** | **18** | | 92 | 145 | 215 | 355 | 550 | 850 | | |
| **12** | **23** | | | 110 | 160 | 265 | 415 | 640 | 880 | |

| 230V 1Ph Cosϕ = 1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **POWER (kW)** | **CURRENT (A)** | **SECTIONS mm² / Max. length in m** | | | | | | | |
| | | **1,5** | **2,5** | **4** | **6** | **10** | **16** | **25** | **35** | **50** |
| **3** | **13,5** | 17 | 29 | 45 | 66 | 110 | 180 | 285 | 395 | 520 |

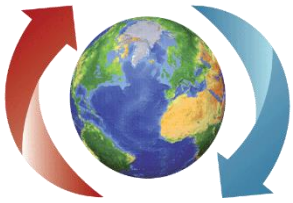
## *F. Warranty conditions / water quality*

Refer to chapter 1 of the instructions manual (**Warranty, water quality and treatment** …)

# NOTES

BOOSTHERM®

Heat Recovery Systems



*BOOSTHERM*
*CD 996 - ZA du Champ Pourceau*
*21 380 Messigny et Vantoux*
*FRANCE*