BOOSTHERM®
Heat Recovery Systems

SELECTION GUIDELINES

Table of contents

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)

Amount of heat recovered with DCT technology

HP · · · · · Condensation · · · · · · **Classic desuperheater**

Expansion · · · · · · · Compression

LP · · · · · Evaporation

Schematic diagram

Cold room or other application

Cooling unit

Compressor

Condenser

Evaporator

Heat recovery module

Boostherm Regulation

DCT

Temperature sensor

Plate heat exchanger

Pump

Pressure sensor   Temperature sensor

Hot water

Boostherm Hot water tank

BOOSTHERM ®

Boost heat resistance

55°C +

Preheated water

Cold water inlet

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:

Temperature (°C)

```
95
90                                                          REFRIGERANT INLET = 90°C
85   → WATER
80   → REFRIGERANT
75                                          DESUPERHEATING = 90 à 45°C
70
65
60
55                                                          WATER OUTLET = 55°C
50
45                    CONDENSATION = max 45°C
40   REFRIGERANT
35   OUTLET = 42°C
30
25
20
15
10
 5   WATER INLET
     = 12°C
 0
     SUBCOOLING          CONDENSATION              DESUPERHEAT
```
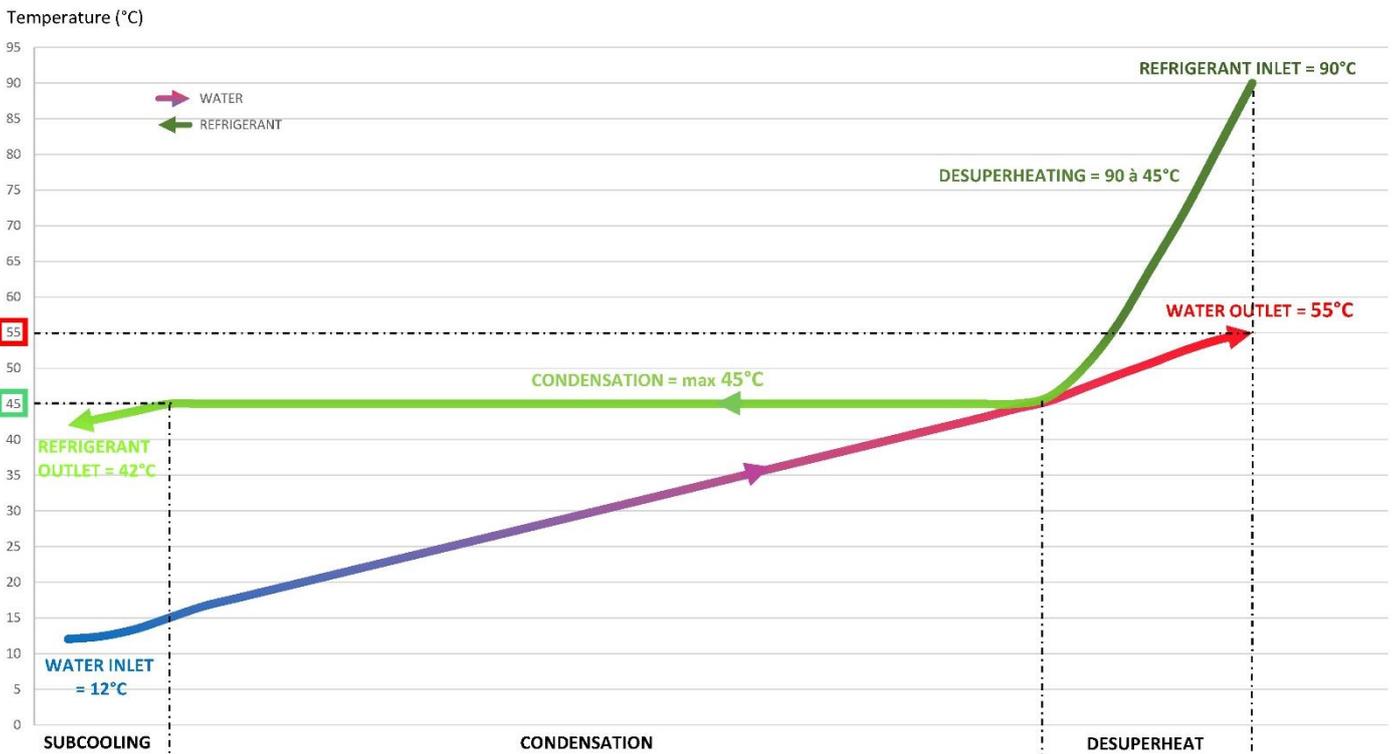
Water heating at **55°C in one pass in the heat exchanger** allows:

- 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.

➢ <u>**System securities:**</u>

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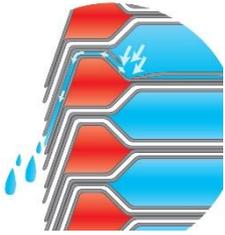
The brazed plate heat exchangers have 2 separation plates between refrigerant and water (unlike conventional brazed exchangers).

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.

➢ <u>**Sizing essential points :**</u>

- 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). SH = 10K 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:

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

Boostherm heat recovery systems

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**

Compressor	**4GE-20Y-40P**	
Capacity steps	100%	
Cooling capacity	39,2 kW	
Cooling capacity *	40,0 kW	
Evaporator capacity	39,2 kW	
Power input	13,40 kW	
Current (400V)	23,2 A	
Voltage range	380-420V	
Condenser Capacity	52,6 kW	
COP/EER	2,93	
COP/EER *	2,98	
Mass flow	1022 kg/h	
Operating mode	Standard	
Discharge gas temp. w/o cooling	75,1 °C	
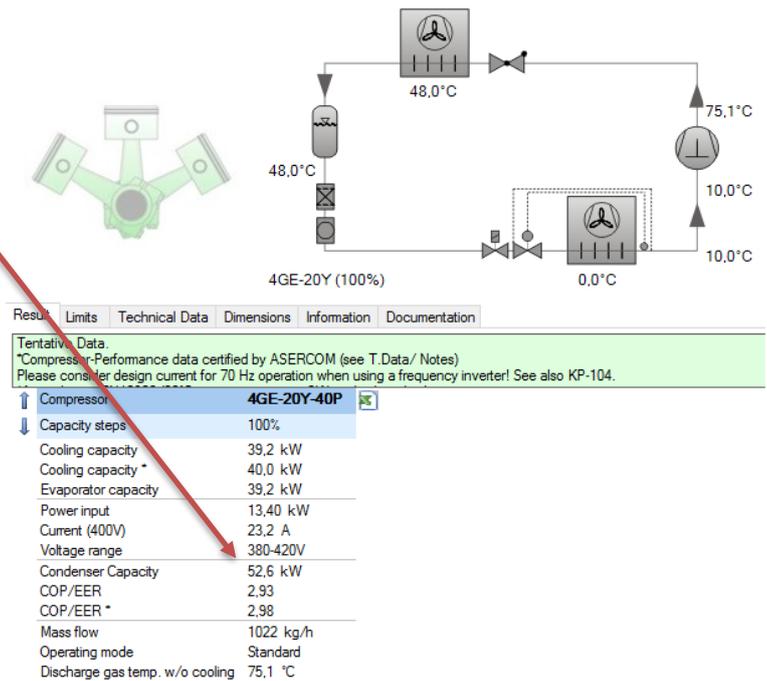
Example 2: Cooling unit equipped with a Tecumseh CAJ9513Z - 220/240V-50Hz R404a compressor (Positive refrigeration).

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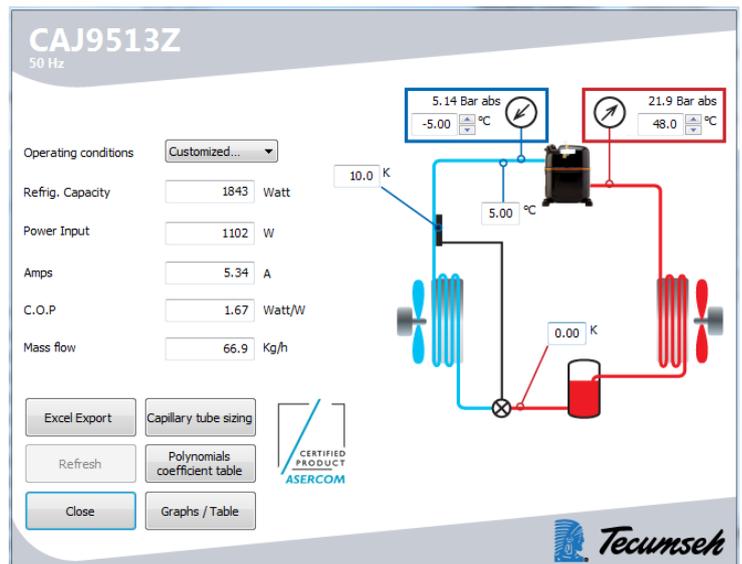
➢ **Particular case of central cooling plants:**

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:

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

- 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:

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

- 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:

$$ROI = \frac{Ic}{Sav * €kWh}$$

- $€kWh$: 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

High position: Resistance 1/3   ~ 1/3 H

Low position: Resistance 1/2   ~ 1/2 H

Hot water storage zone

Heat recovery Storage zone
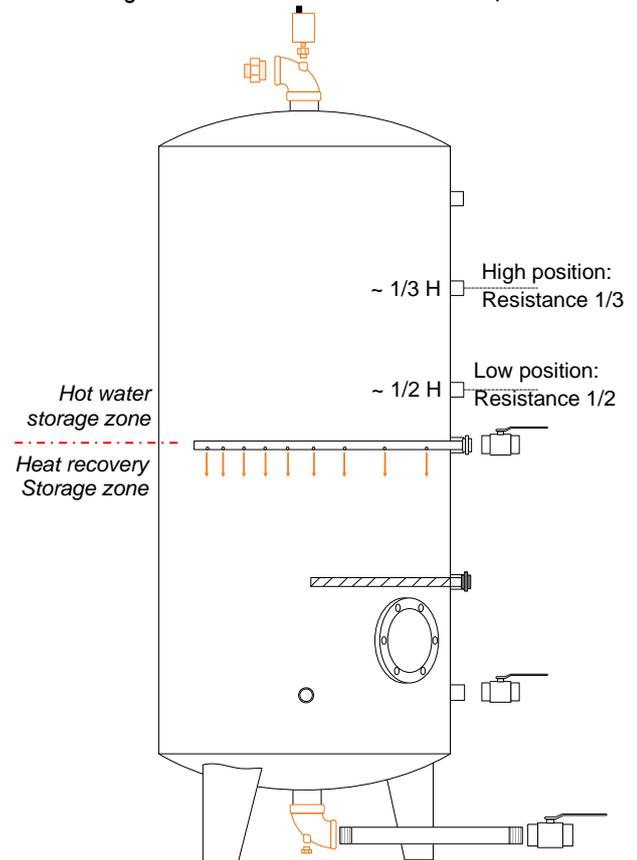
➤ *Electrical resistance power :*

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.

$$Prelect. = Vh * \Delta T * 1.16$$

- $Prelect.$: Electrical resistance minimum power (W).
- Vh : Volume to be heated per hour (L).
- ΔT : 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.

Boostherm heat recovery systems

4. DHW diagrams

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

HOT WATER

HOT WATER LOOP

HOT WATER AREA

PRE-HEATED WATER AREA

NON RETURN FLAP

HEAT RECOVERY CIRCULATION LOOP
INLET = MESH FILTER SIDE

HYDRAULIC SAFETY GROUP OR SAFETY VALVE + NON RETURN VALVE

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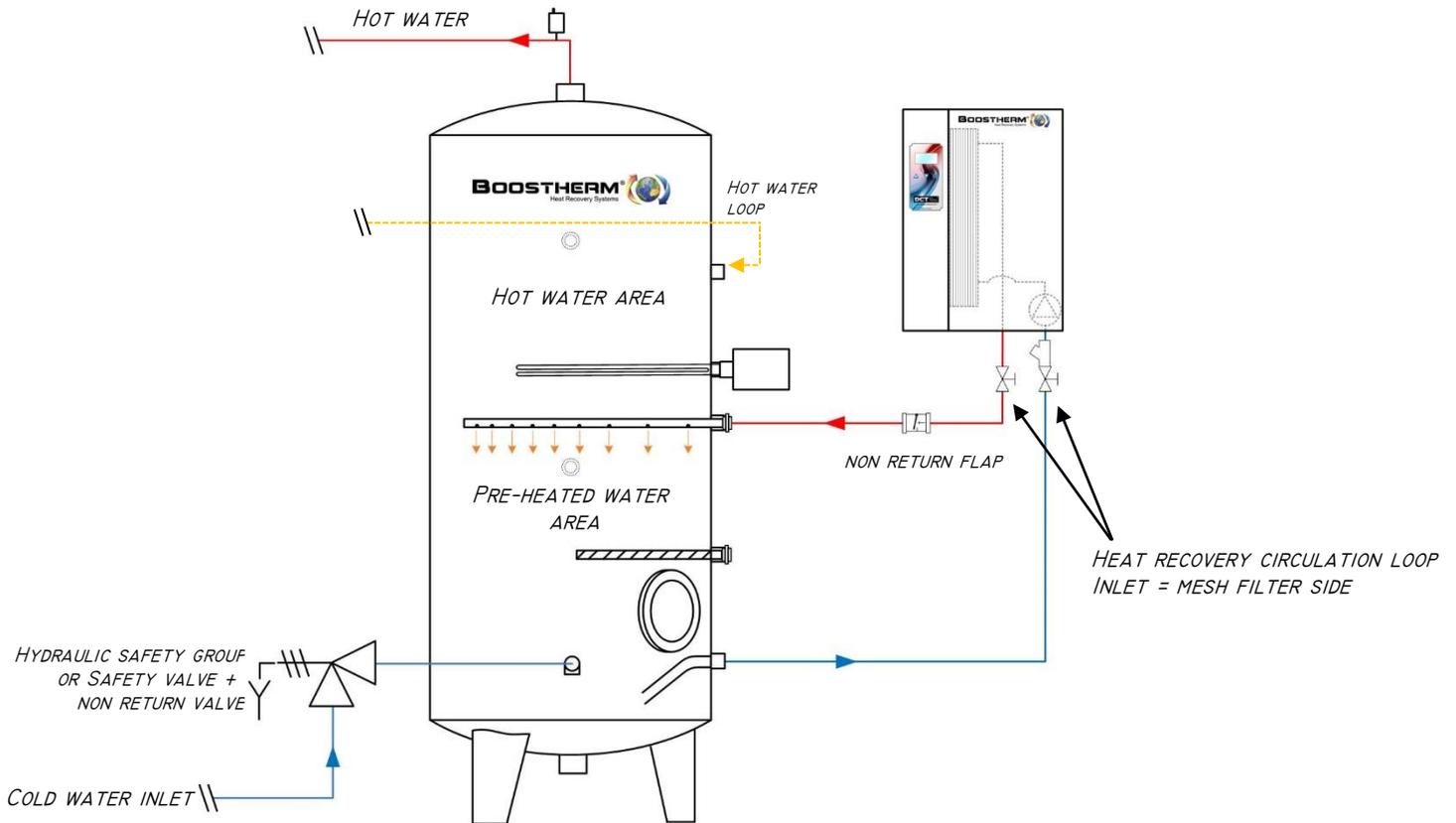
➤ *Assembly with a buffer tank in series with the installation water heater (or another DHW production station).*

HOT WATER LOOP

HOT WATER

PRE-HEATED WATER

NON RETURN FLAP

HEAT RECOVERY CIRCULATION LOOP
INLET = MESH FILTER SIDE

WATER HEATER OR ANOTHER HOT WATER PRODUCTION STATION

BOOSTHERM WATER TANK AS BUFFER TANK

HYDRAULIC SAFETY GROUP OR SAFETY VALVE + NON RETURN VALVE

F

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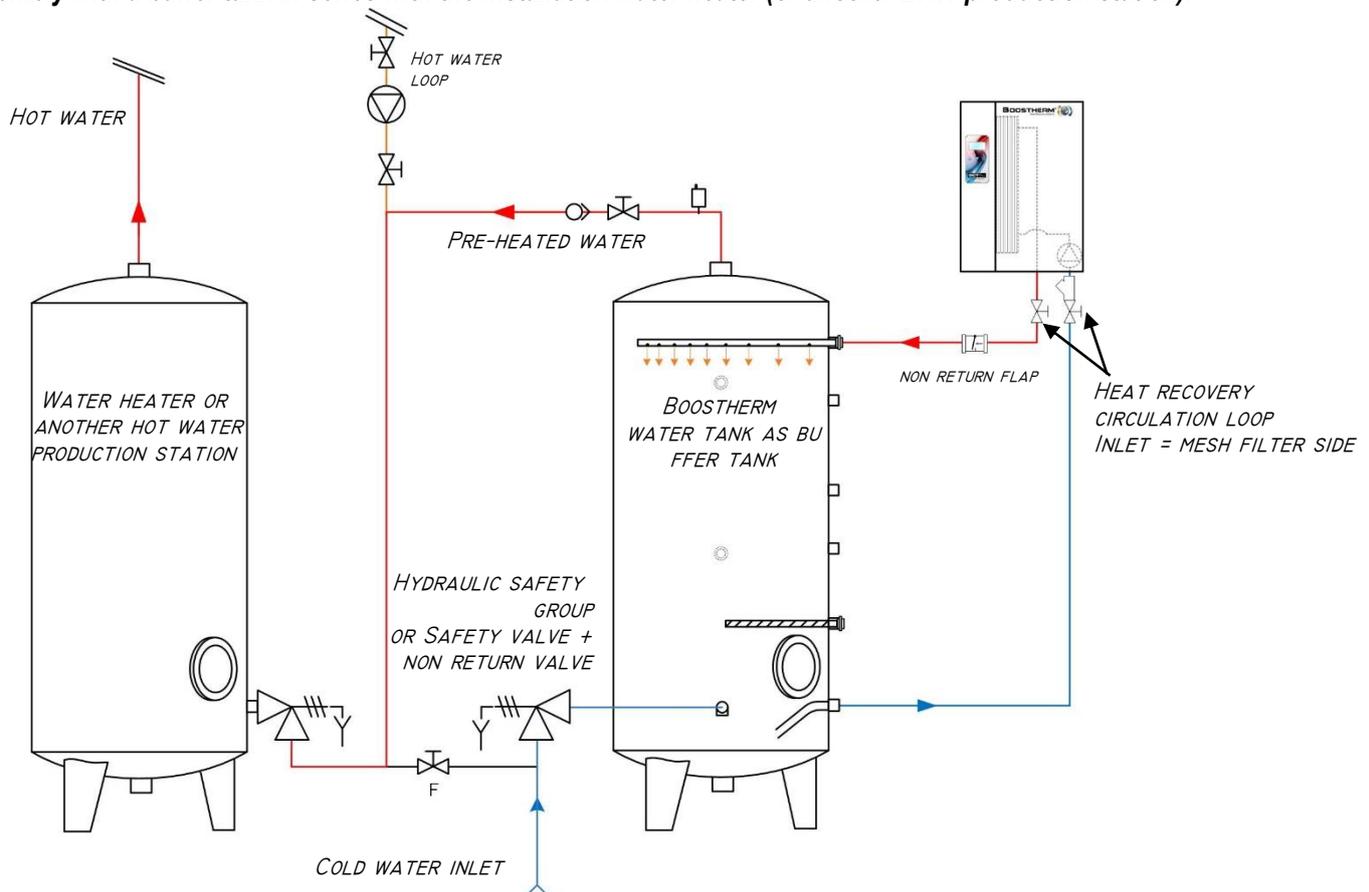
➢ *Assembly with 1 Boostherm tank used as combined tank with 2 heat recovery modules*

HOT WATER

BOOSTHERM TANK

PRE-HEATED WATER AREA

HYDRAULIC SAFETY GROUP
OR
SAFETY VALVE +
NON RETURN VALVE

COLD WATER INLET

NON RETURN FLAP:
ONE ON EACH RETURN LINE

MAIN CIRCULATION LOOP
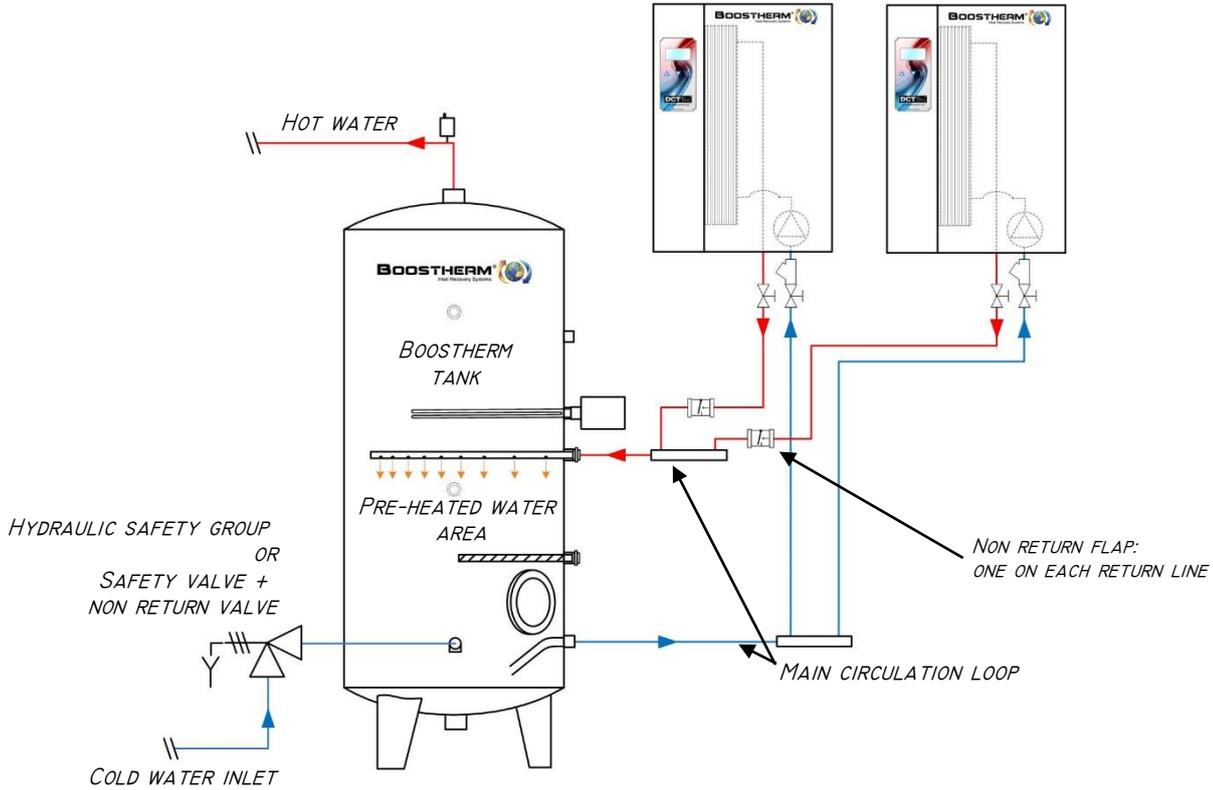
➢ *Assembly with 2 buffer tanks in parallel.*

PREHEATED WATER
OUTLET TO DHW
PRODUCTION

NON RETURN FLAP

BOOSTHERM TANK

OPTINAL
EXPANSION SLEEVES

BOOSTHERM TANK

SAFETY GROUP
OR
SAFETY VALVE +
NON RETURN VALVE

SAFETY GROUP
OR
SAFETY VALVE +
NON RETURN VALVE

COLD WATER

Boostherm heat recovery systems
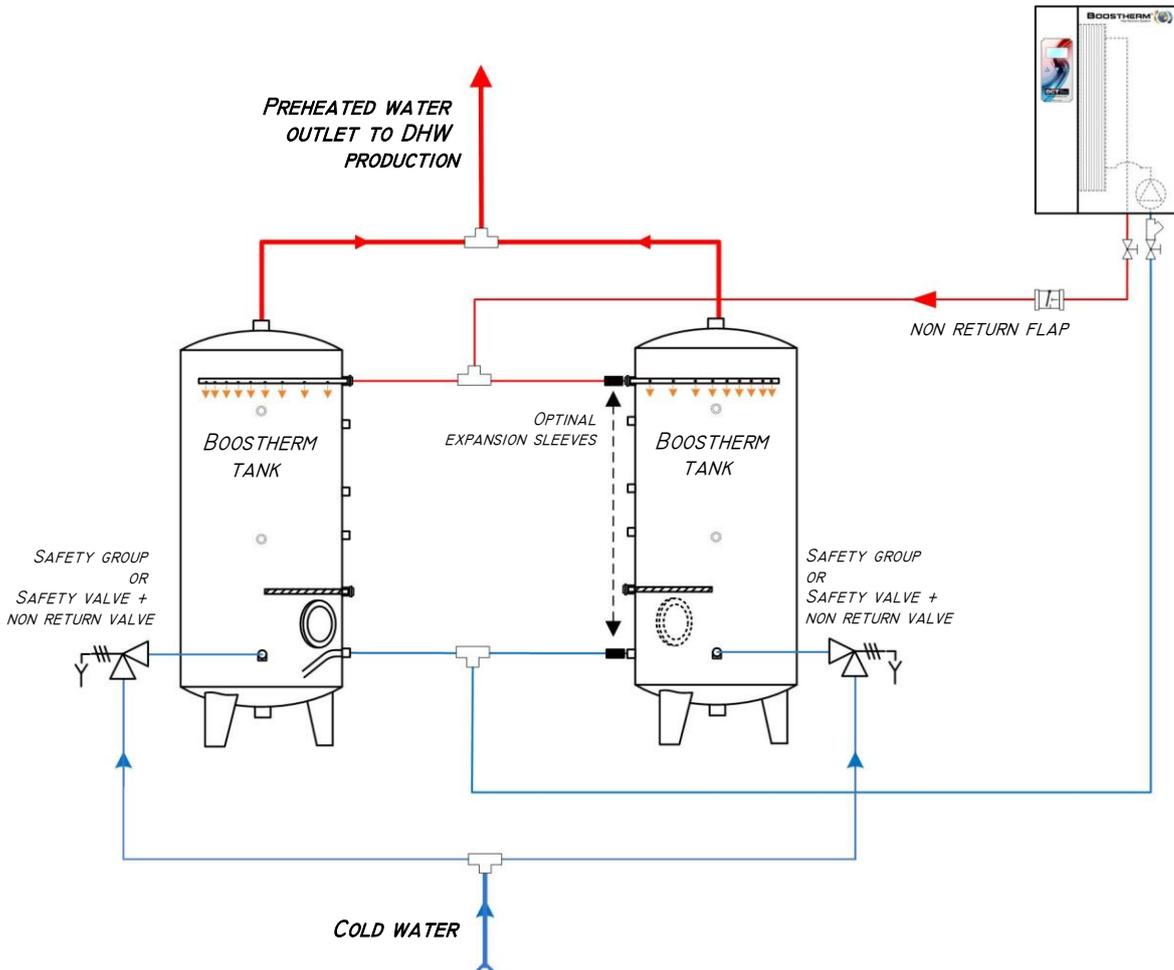
➢ *Piping specifications:*

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*

TO HEATING CIRCUIT

FROM HEATING CIRCUIT

CONTROLED PUMP

EXTRA HEATING REGULATION + 3-WAY VALVE

BOILER

BOOSTHERM BUFFER TANK

NON RETURN FLAP

RETURN MAX 25°C*

EXPANSION TANK

BACKFLOW PREVENTER

CIRCUIT FILLING
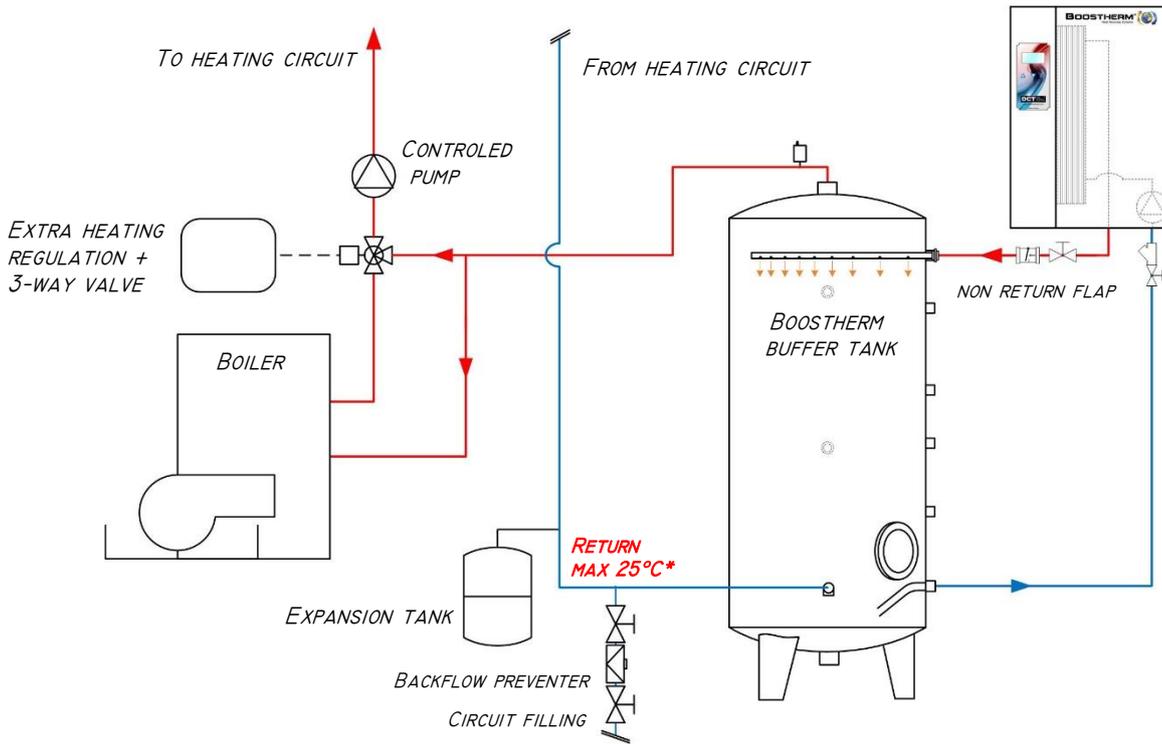
➤ *Assembly for floor heating*

HEATING REGULATION: 3-WAY VALVE AND OPTIONAL BACK UP

BOOSTHERM BUFFER TANK

NON RETURN FLAP

RETURN MAX 25°C*

CIRCUIT FILLING

HEADER : TO FLOOR HEATING

HEADER : FROM FLOOR HEATING

EXPANSION TANK

* IN WATER CONDENSER MODE

Boostherm heat recovery systems
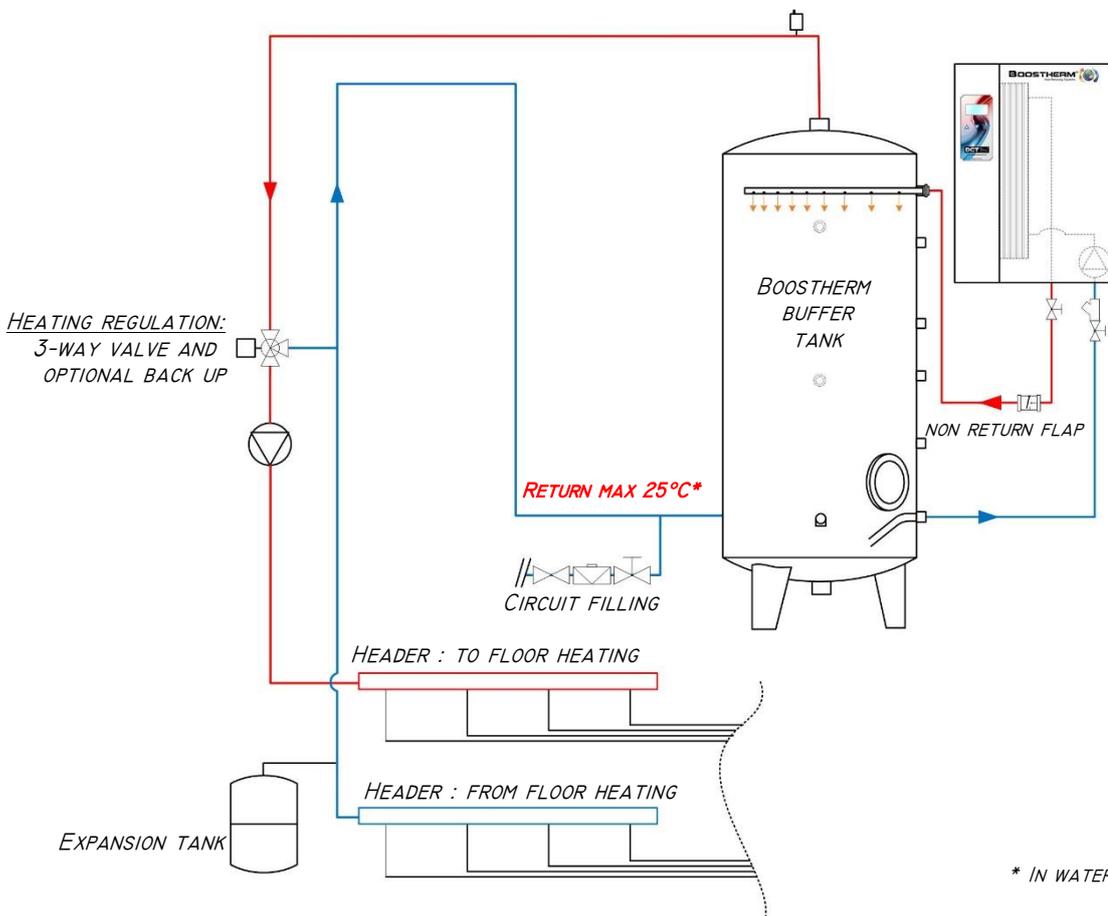
➤ **Assembly with low temperature air heaters**

LOW TEMPERATURE AIR HEATER

OPTIONAL:

ADDITIONAL L.T. HEATER.
TARGET = REDUCE RETURN TEMPERATURE
TO THE BUFFER TANK: CAN BE POSITIONED
IN A STORAGE AREA FOR EXAMPLE.

CONTROLLED PUMP

3-WAY VALVE CONTROLLED
BY THE HEATING REGULATION
TARGET: COLD AREA IN THE
LOWER SIDE OF THE TANK

NON RETURN FLAP

CIRCUIT FILLING

BOOSTHERM
BUFFER
TANK

RETURN MAX 25°C*

EXPANSION TANK
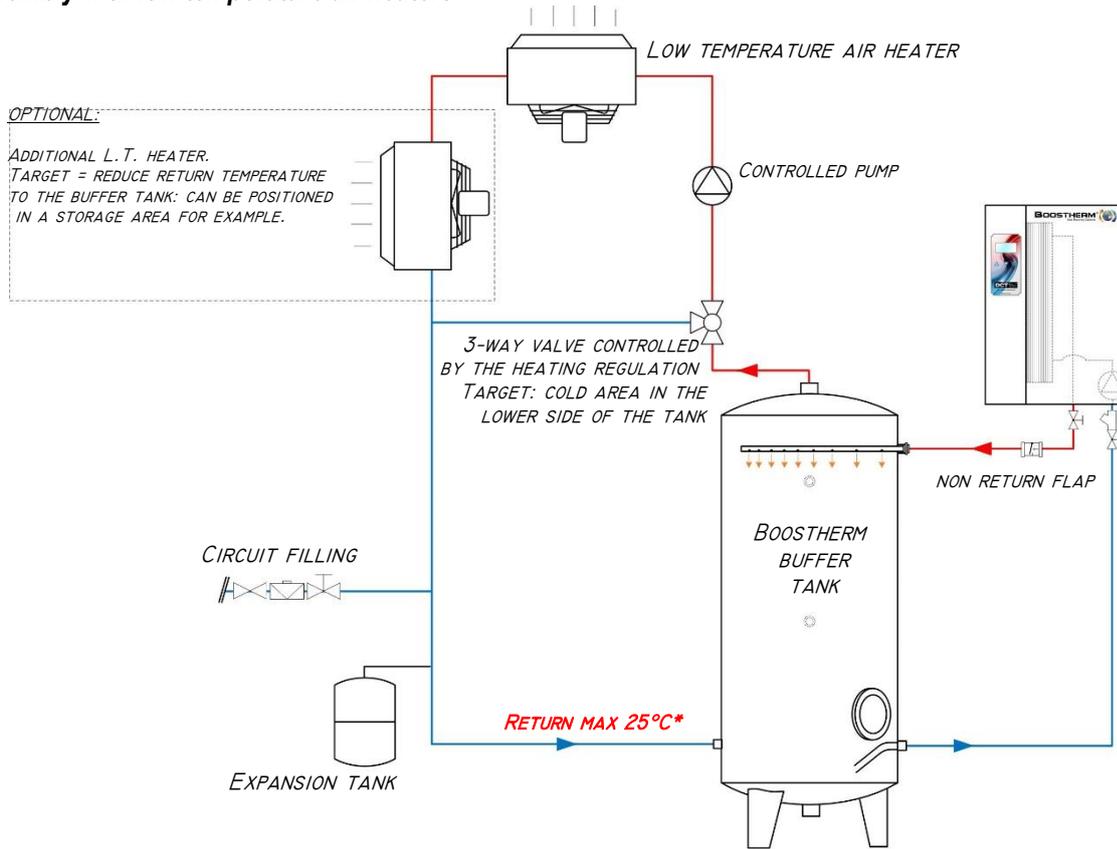
➤ **Assembly for combined low temperature heating and DHW production**

PREHEATED
WATER

COLD WATER INLET

TEMPERATURE
LIMITER

SAFETY GROUP

TO LOW TEMPERATURE
HEATING

DHW TANK

NON RETURN VALVE:
ONE ON EACH RETURN LINE

BUFFER TANK

RETURN MAX 25°C *

SLUDGE COLLECTOR

SAFETY VALVE + MANOMETER

BACKFLOW PREVENTER

CIRCUIT FILING

BOOSTHERM TANK IN TANK

EXPANSION TANK
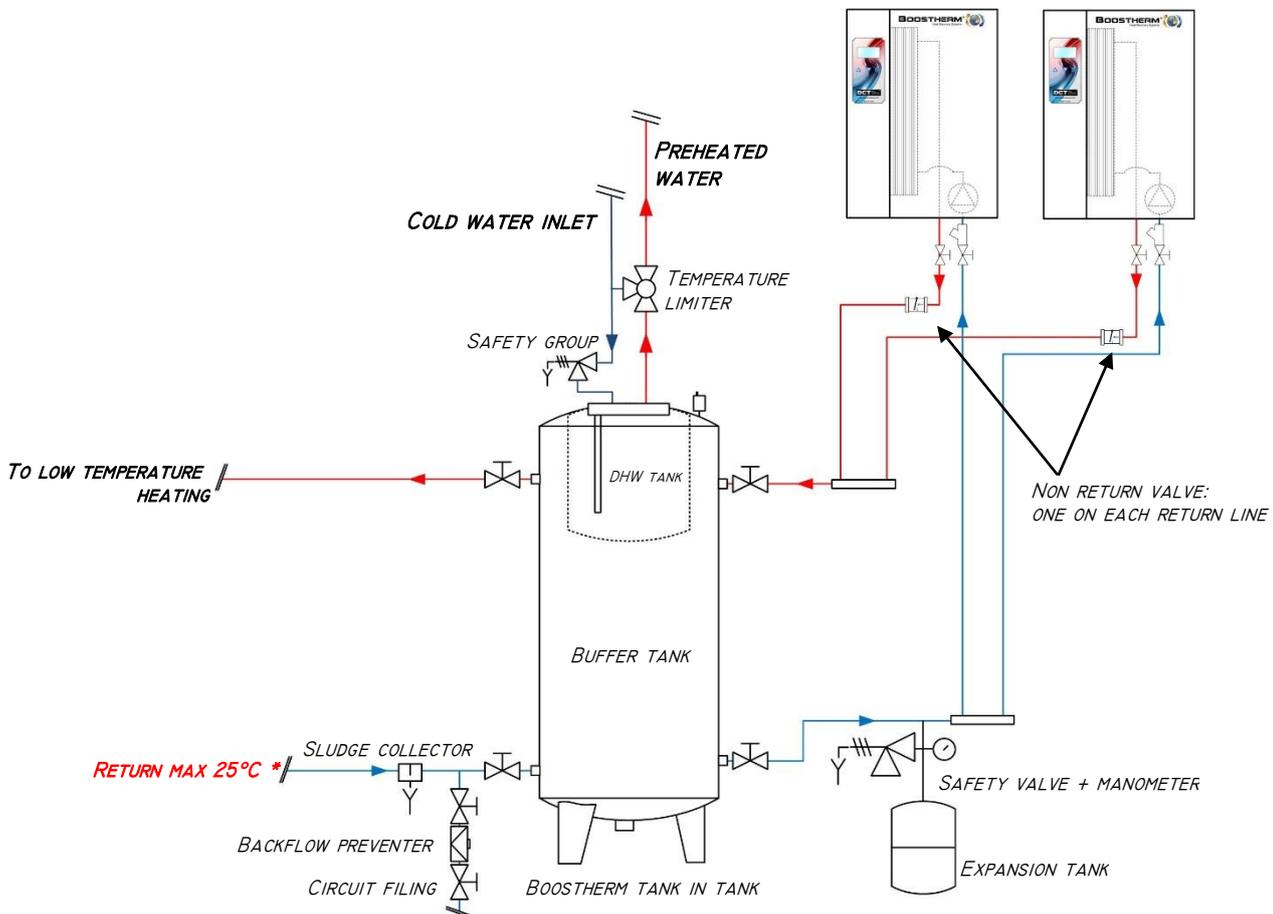
* IN WATER CONDENSER MODE

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
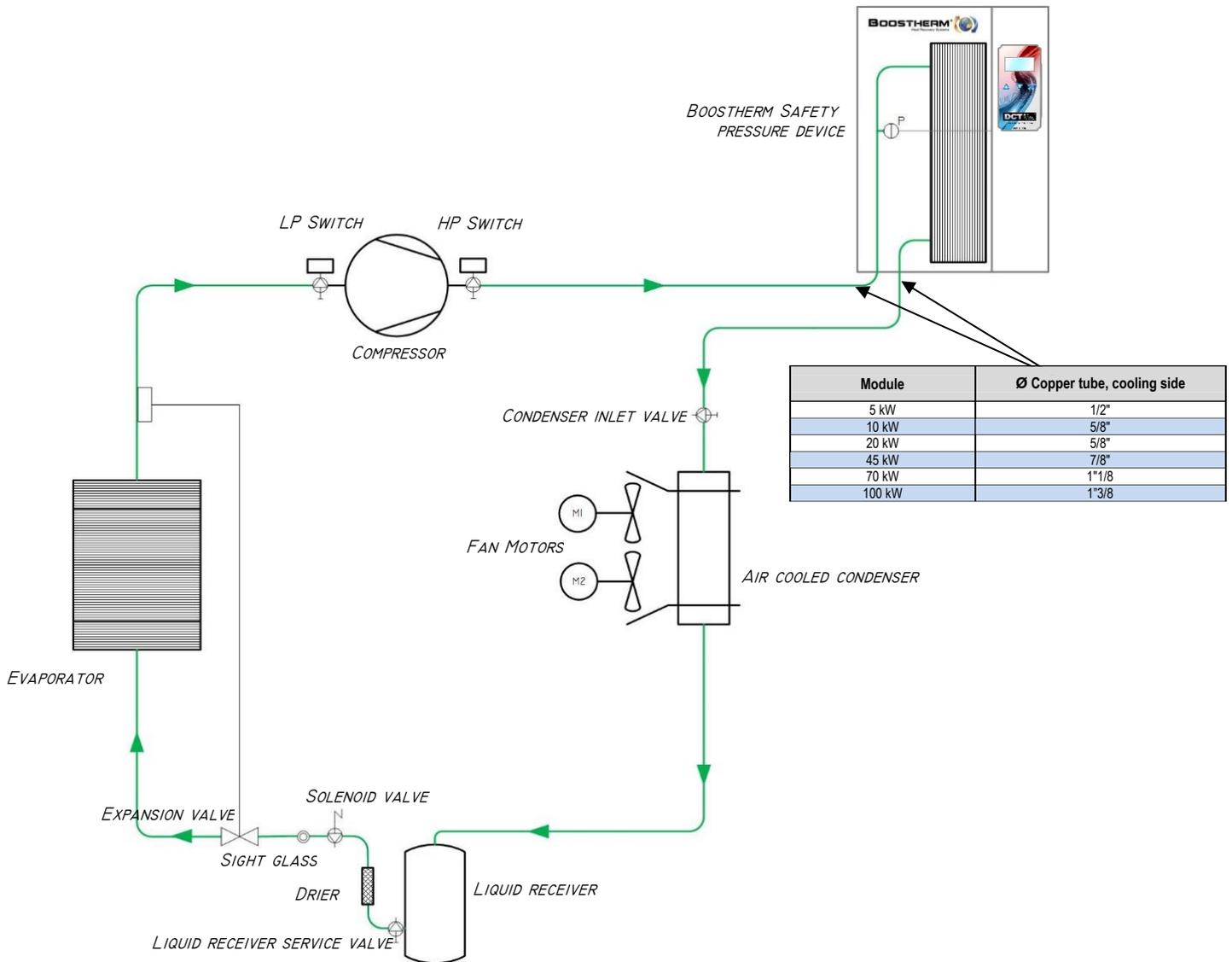
Recommendations :

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).

HP regulation valve (downstream)
To be positioned above any liquid level.

HP regulation valve

45kW Boostherm

Non return valve

Oil separator

Non return valve

Liquid receiver

Compressor rack

Connection to top of receiver:
Vapor phase
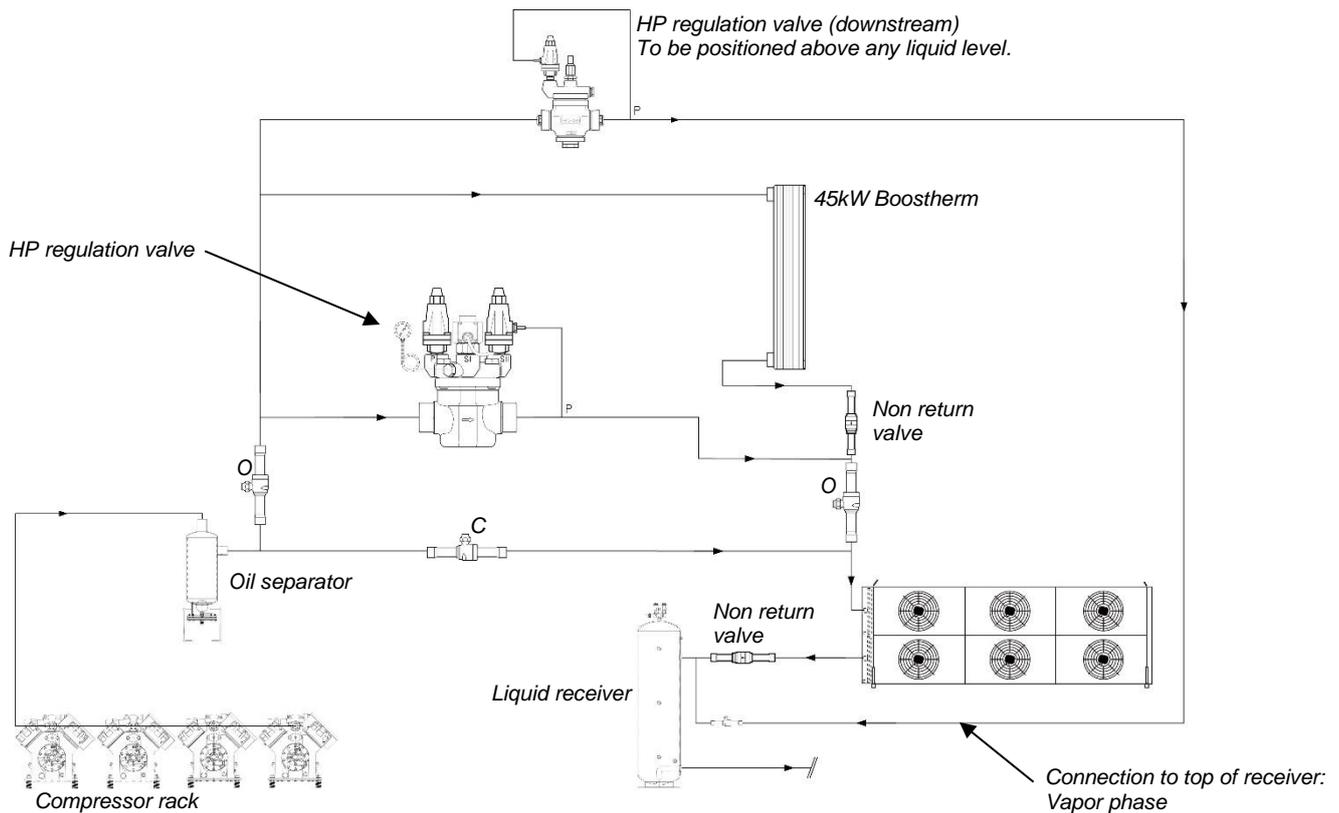
***Operating principle – deviation of hot gases on compressor rack discharge:***

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.

HP regulation valve (downstream)
To be positioned above any liquid level.

HP regulation valve

70kW Boostherm

70kW Boostherm

Liquid flow controller

Liquid flow controller

Non return valve

Oil separator

Non return valve

Liquid receiver

Connection to top of receiver:
Vapor phase
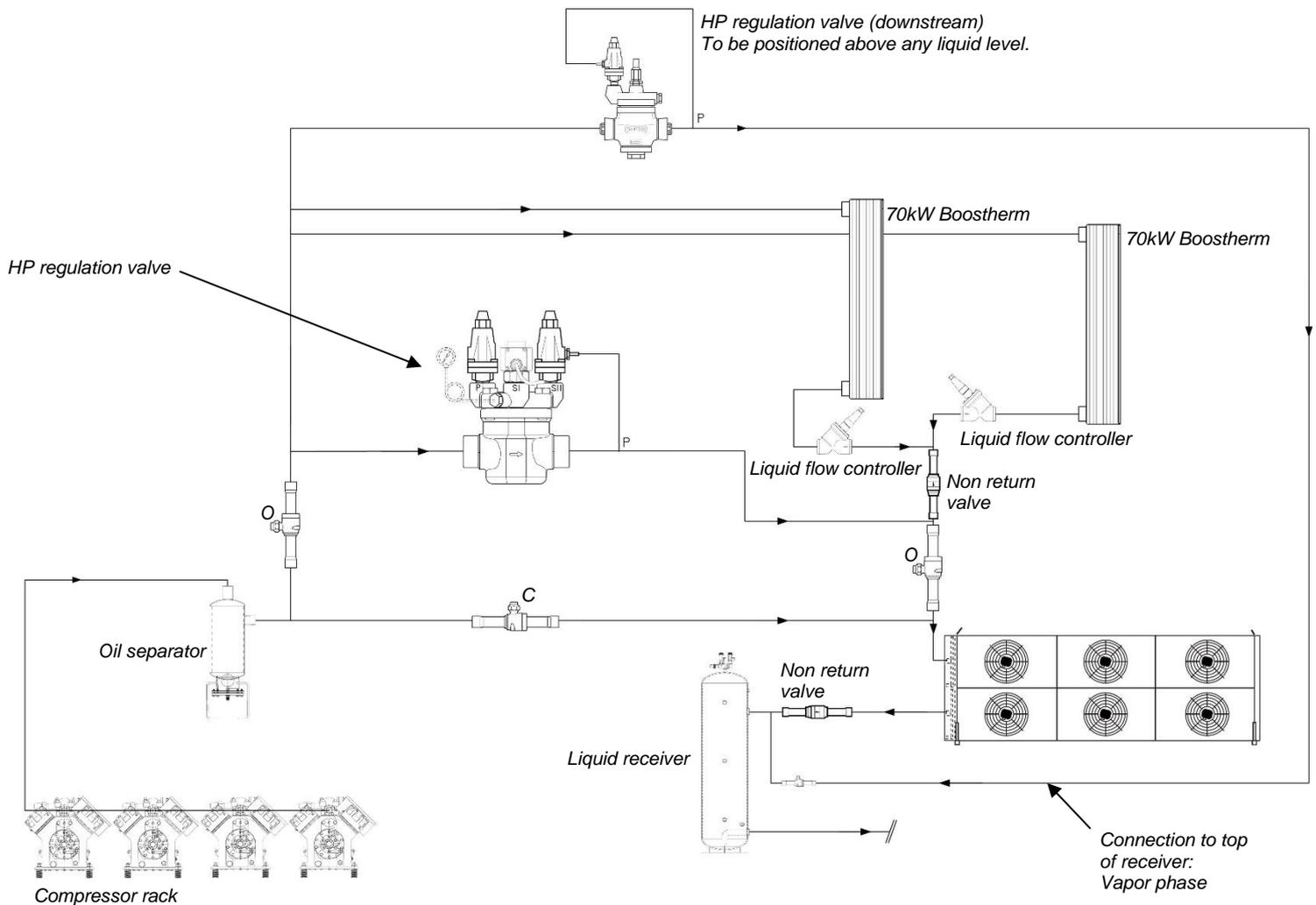
Compressor rack

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)

R404A / Vapor = 80°C / P = 16bar
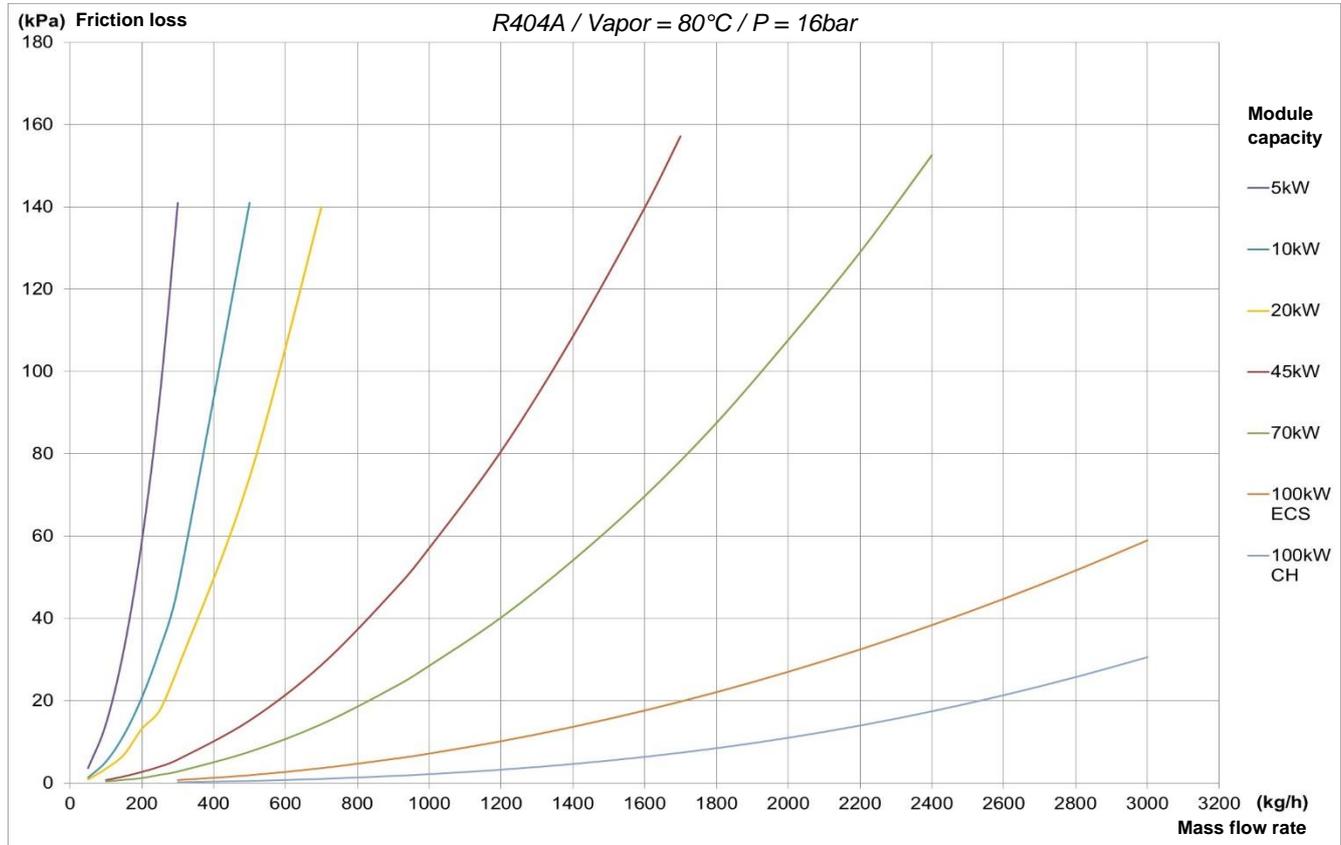
Pressure drop (kPa) according to the mass flow rate of R134a in vapor state (kg/h)

R134A / Vapor = 80°C / P = 8bar
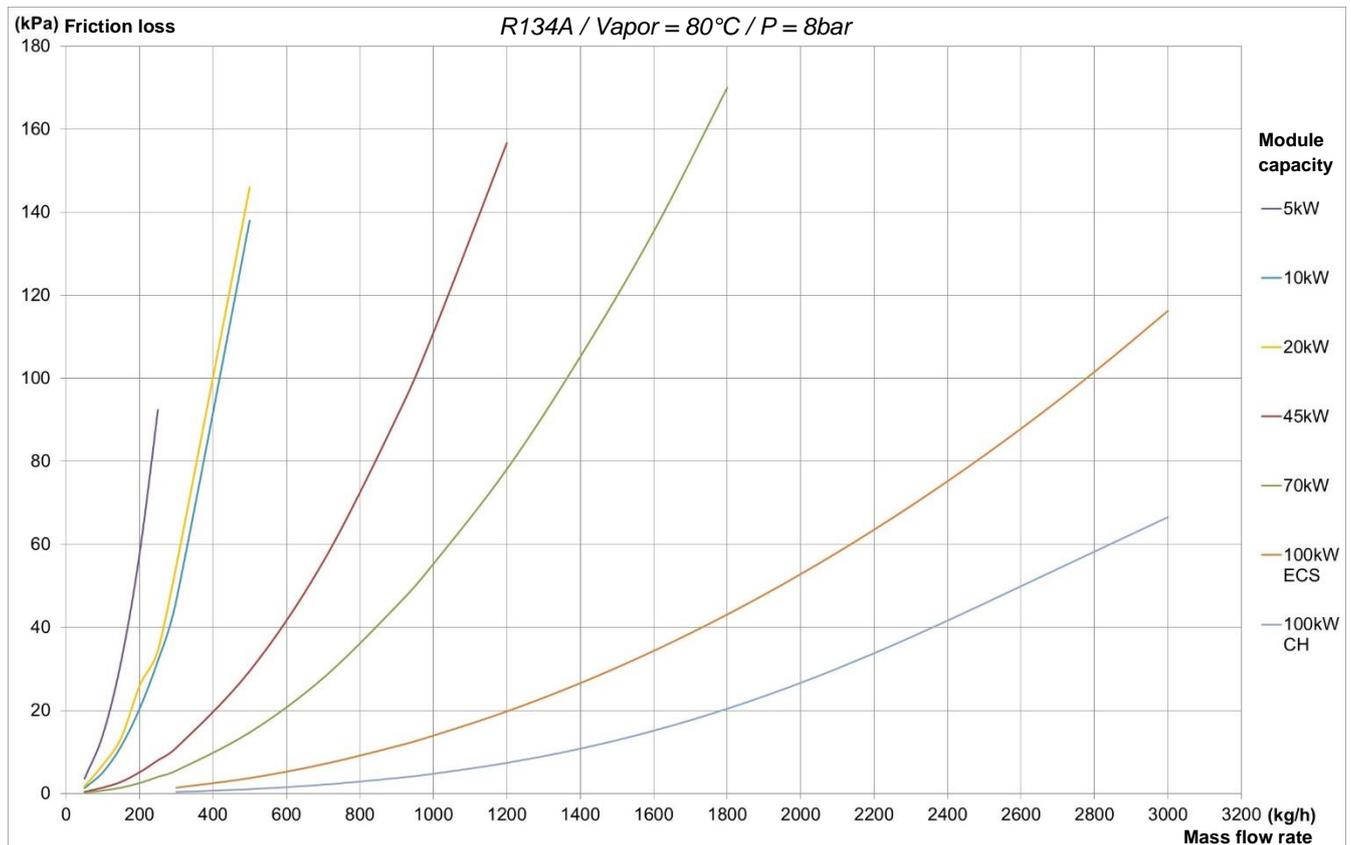
8. Installation costs

__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

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