GEOZENT Eco®

TECHNICAL PLANNING MANUAL

HIGH-EFFICIENCY LARGE-SCALE HEAT PUMPS WITH INTEGRATED ENERGY CONTROL CENTER

Benefit from our experience

Zent-Frenger Energy Solutions provide comprehensive energy solutions and construction project support from initial planning to facility use.

Our solutions for building temperature control, energy supply and energy distribution ensure the best possible atmosphere for living and work spaces, offer cost optimization, and help to reduce energy consumption and CO_2 emissions – we work for sustainable and healthy environments.

Zent-Frenger Energy Solutions guarantee excellent quality and easy integration in the construction process.

We supply reliable and efficient installation technology for heating/cooling and domestic water systems. Technology that guarantees the sustainable and smooth operation of your building in the long term – with minimal maintenance costs.

- Sustainable and energy-efficient solutions
- Maximum user friendliness for an ideal working environment
- Easy system integration in the building process
- Maximum reliability and low maintenance costs
- Technical support from initial planning to installation and facility use

1. Feasibility study

We examine the individual customer requirements in terms of efficiency, sustainability and energy efficiency to advise on the most suitable solutions for a building.

2. Solutions

We use the latest engineering software to develop proposals that meet our customers' requirements and take account of the specific operating environment.

3. Technical planning

We transform ideas into engineering systems in line with all relevant data and the applicable standards. The Zent-Frenger planning experts working on your specific project have years of experience in the field.

4. Installation and project management

We support your project team in planning, organization and resource management. We work in close consultation with the other teams and specialists to ensure the best possible flow of materials and smooth and efficient installation.

5. Commissioning and handover

We run extensive tests on and commission the systems before they are handed over to you.

6. Customer services

To ensure long-term system availability, we offer professional inspection and maintenance for our systems, and quality control services using the latest testing techniques such as thermography, pressure tests, leak testing and water quality analysis.

GEOZENT Eco® – compact heat pump units for demanding applications

Quiet, efficient, compact and high-performance

Achieving maximum performance in these areas was the driving force in the development of our heat pumps. Many years of experience, innovation and cutting-edge technology are behind these high-performance series with excellent COPs and an extremely compact design.

Flexible use

GEOZENT Eco heat pumps are designed to meet the high demands of use in commercial and industrial facilities and housing developments. The detailed range of models covers a total of 7 output levels. In brine-to-water operation, these cover an output range of 80 to 320 kW. Multiple devices can be combined into a unit, so that the GEOZENT Eco series can be used to generate more than 1,000 kW through cascading.

Possible applications and fields:

General
- Heat reservoirs
- Cold reservoirs
- Domestic hot water

Industry
- Logistics
- Chemical industry (waste heat recovery and cooling)
- Food industry
- Water industry (sludge drying)
- Production (production hall heating, cooling, ...)

Trade and commerce
- Air conditioning (hotel rooms, youth hostels, office buildings, ...)
- Catering (air conditioning)
- Public facilities (libraries, schools, kindergartens, hospitals, ...)
- Stadiums, sports areas, football pitches
- Preventing ice formation on roads

Residential sector
- Multi-family dwellings
- Residential blocks
- Apartments
- Housing development heating supply

Also suitable for hot water preparation

Efficient basic heating for domestic hot water is also possible thanks to outlet temperatures of up to 50 °C. A site water heating system is required only for thermal disinfection in accordance with the German Gas and Water Association guidelines DVGW Arbeitsblatt W 551 to prevent Legionella.

Easy operation and control

Zent-Frenger uses a proven high-end controller for controlling and monitoring the heat pump systems. User-friendly operation with an illuminated display and plain-text menu. Thanks to the flexible modular structure, functions such as remote system maintenance, cascading, bivalent operation, wired and wireless connection are practically unlimited.

Suitable for a wide range of energy sources

GEOZENT Eco heat pumps can be used with a wide range of energy sources. Geothermal sources, waste heat recovery or a whole range of other energy sources – GEOZENT Eco heat pumps are suitable for almost every system model.

Possible sources of energy:

Geothermal sources
- Energy piles
- Geothermal probes
- Wells
- Thermoactive foundations
- Horizontal collectors

Waste heat recovery
- Waste process heat in industry
- Waste heat from buildings through air conditioning systems
- Waste heat recovery in road tunnels
- Sewers

Innovative new sources
- Ice storage units (latent heat storage)
- Fire water tanks
- Recoolers as a heat source
- etc.

High-quality components for a reliable system

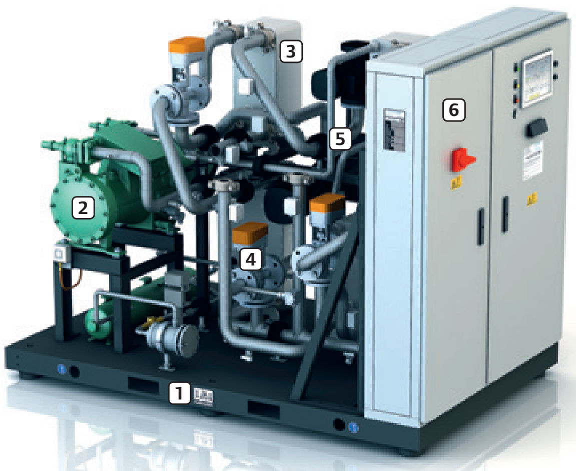
State-of-the art technology, for example electronic expansion valves, guarantee maximum efficiency. The quiet screw compressors optimize performance for seasonal fluctuations in temperature, ensuring a long service life and reliable operation.

Compact

All required components in one compact system: GEOZENT Eco heat pumps take up little space in the heating plant room. The modular design means that even larger devices can be delivered to your site. Stacker inserts and crane lugs ensure simple loading and unloading and the necessary ease of transport on the building site.

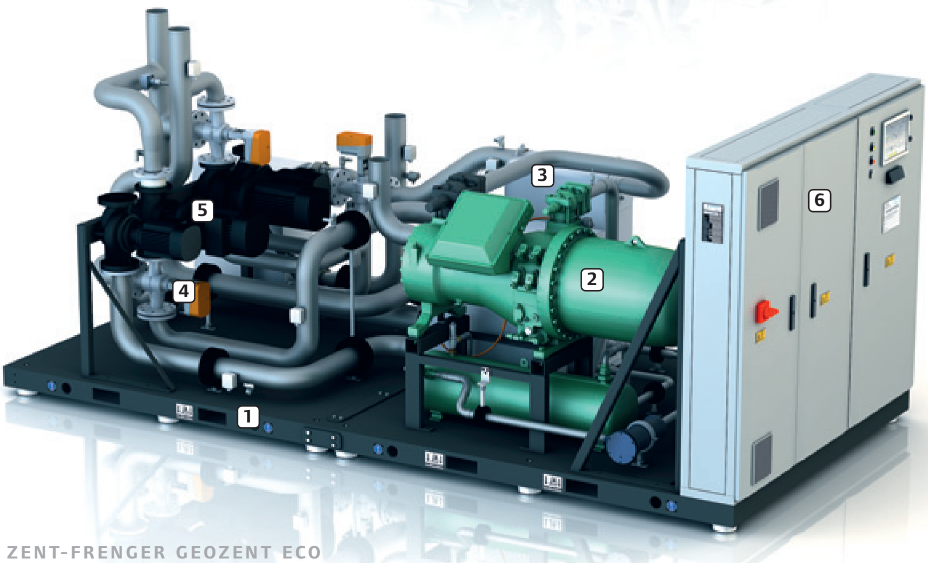
The benefits for you

- A wide range of applications for heating, cooling, dual operation, natural cooling and hot water preparation in commercial, industrial and residential buildings
- Practical output scaling up to a maximum of 320 kW, cascadable for higher output requirements
- Available as brine-to-water heat pump
- Optimum use of space thanks to compact dimensions
- Extremely quiet thanks to fully adjustable screw compressor
- Proven, intelligent control system
- User-friendly controls with touch display
- Modern commissioning + service concepts



Main components Example: Eco 80 (one module)
View without enclosure

1. Stable base frame with stacker inserts and crane lugs
2. Quiet and fully adjustable screw compressor
3. Stainless steel panel heat exchanger
4. Precision regulating valves
5. Speed-controlled quality circulation pumps for cold and brine circuits
6. Fully wired control cabinet with control electronics and touch display



Main components Example: Eco 320 (two modules)
View without enclosure

1. Stable base frame with stacker inserts and crane lugs
2. Quiet and fully adjustable screw compressor
3. Stainless steel panel heat exchanger
4. Precision regulating valves
5. Speed-controlled quality circulation pumps for cold and brine circuits
6. Fully wired control cabinet with control electronics and touchscreen

Planning basics

Heat pump design

Transport, installation, connection and commissioning

Planning basics

General planning information

Regulations and required permits

The planning and installation of heat pump systems is governed by the applicable binding regulations and guidelines (e.g. VDI 4640). You are advised to check what permits and approval may be needed at an early stage in the planning process.

Heat sources
The type of heat source connection, using water from public bodies of water, and installing/expanding geothermal probes (or geothermal collectors) requires approval from the concerned public authority. Whether or not that approval is granted depends on the geological conditions at the site.

Electricity suppliers
Each heat pump connection must be approved by the relevant electricity supplier, for example because the starting current is an important aspect for mains protection. The application to the electricity supplier must state the electrical data for the heat pump (see the technical data for the relevant pump). You should also check the peak, low and special tariffs, and in certain cases also off-grid times, at an early stage of planning.

Note on domestic hot water

The temperature of 50 °C that is often required for domestic hot water is at the upper threshold of the heat pump; however, meeting hot water requirements with the heat pump is possible in principle.

The use of a combined storage unit (calorifier) is a good solution for heating systems with a design temperature > 45 °C and with the use of a buffer tank. Additional heating for hot water can be provided either directly with an electrical component (heating element) or using solar collectors.

For heat pumps with higher rated outputs, a boiler with an external domestic water heat exchanger is required. The water quantity, temperature difference and condenser power of the heat pump must all be factored in.

Sound emissions

Avoid the transmission of structure-borne noise to the heating system and to the building with the use of flexible connections:

- Hoses or expansion joints for pipe connections
- Flexible mechanical connections
- With wall ducts, avoid direct contact between the pipes and the wall
- Anti-vibration mounts
- Optional enclosure with inside insulation

To reduce or avoid the transmission of structure-borne noise to the building through the floor, it is often useful to place the GEOZENT Eco heat pump on a concrete base, isolated to prevent impact noise.

Site components

Buffer tank

The use of heat reservoirs is a sensible option with large-scale heat pumps. The heating and cooling reservoir and buffer tank provide a hydraulic zero point and hydraulic separation of the heat supply circuit and heat demand circuit.

Buffer tanks have the following functions:

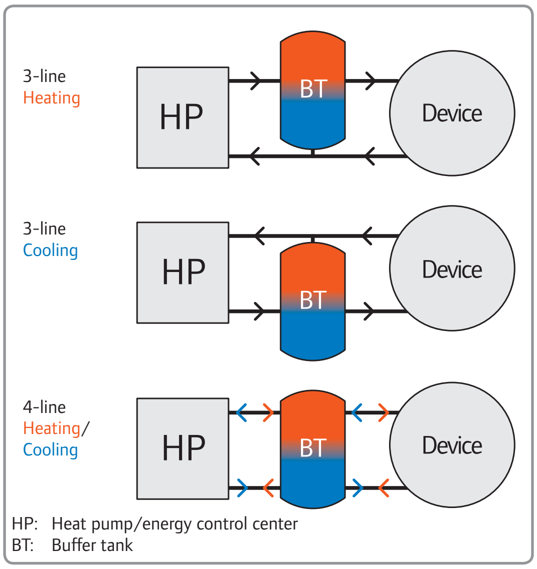
- Storing excess heat pump heat / cooling energy
- Terminal extension for additional heating / cooling circuits
- Preventing heat pump cycling at changing reservoir levels

A buffer tank is designed on the basis of the following conditions:

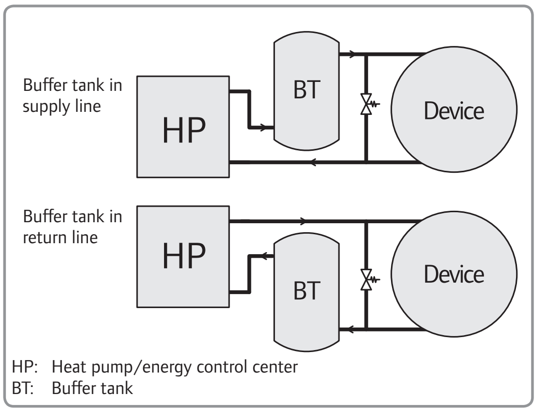
- Maximum delivery rate (supply side and output)
- Heat pump capacity

The maximum delivery rate is important for the design and dimensions of the buffer tank. It affects stratification in the tank or reservoir. To ensure accurate temperature measurement, there must be no cross flow (and therefore no mixing) in the tank or reservoir. Design should take account of the maximum delivery rate in the end device system to ensure the best possible intake. At maximum volume, the design should allow for a period of ca. 1 minute until the cold water flowing back reaches the upper tank outlet. This gives the fully adjustable heat pump time to respond to demand without resulting in the heatpump cycling.

Another important function of the buffer tank is to absorb heat in the on-off process. To avoid damage to individual components, immediate switch-off is only used for heat pumps in an emergency. Usually, the heat pump will gradually slow down and eventually switch off at a lower setting. As we are assuming individual output for a GEOZENT Eco of up to 320 kW, even a pump in the process of shutting down will still be operating with a considerable output. To avoid emergency switch-off, you should ensure a continuous flow at the demand side. The GEOZENT Eco controls have this function, and it must not be bypassed with externally controlled valves. The system for the end device should also be able to take excess heat without overheating in order to avoid the emergency switch-off described above. Both functions are ensured with a buffer tank connected in parallel. The above issues also apply to cooling.



Buffer tanks, connected in parallel



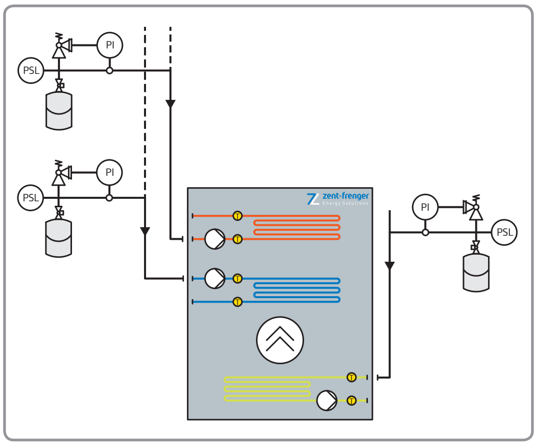
Buffer tanks connected in series where there is only one load circuit.

Expansion vessels

The expansion vessel is required in the device circuit and in the source circuit. The expansion vessel must be dimensioned to ensure compliance with the maximum and minimum pressure limits at the highest and lowest temperatures. If you are using a fluid other than water (for example an ethylene glycol and water mixture), you must remember that the expansion coefficient will be significantly higher than that of water and that the expansion vessel must therefore also be correspondingly larger.

Expansion vessel dimensions must take account of the following:

- The volume of fluid in the integrated circuit
- The lowest and highest temperature of the fluid
- The cubic expansion coefficient of the fluid
- The maximum unit pressure



Position of expansion vessels in source and device circuits

The most common form of pressure expansion vessel is a diaphragm expansion vessel. Alongside the conventional expansion vessel, there are also active pressure maintenance systems. These operate with their own pumps and maintain a constant pressure. In the area of the source, the expansion vessel should always be positioned in the return line to the heat pump (geothermal field supply line). At the load side, the expansion vessel should also be connected to the heat pump return line (return line from heating and cooling system). The manufacturers provide design programs free of charge for accurate expansion vessel design.

Overflow valves

An overflow valve should only be installed with a buffer tank with a series connection. If there is no buffer tank, you should avoid using overflow valves with heat pumps of this size for the following reasons: When a overflow valve is used, the fluid has a much shorter route back to the heat pump inlet, and flows to the inlet without being able to give off the heat generated. As the heat pump is generally not able to shut down fast enough in the event of overheating, the safety pressure switch may be triggered following a high pressure fault. The switch can only be reset by an engineer following an inspection of the system. If an overflow valve is used without a buffer tank in a cooling system, there is also a risk of the evaporator freezing.

Design information

Heat pump operating modes

A brine-to-water heat pump is usually used in a monovalent heating system. If the heat pump and geothermal probe are correctly dimensioned, the geothermal source provides relatively constant heat. This ensures good operating conditions for the heat pump and therefore a high output.

Operation for base load heat is also a good option. This requires long and continuous operation, which is ideal for achieving a good heat pump COP. Conventional heating sources can then be used for short periods to cover peak loads. This approach ensures optimum use of the various different resources.

Monovalent operation
In monovalent operation, the heat pump provides 100 % of the required average building heating at minimum outside air temperatures and maximum supply temperatures.

If the heat pump is operated in monovalent mode (without additional heating sources), the following basic data must be carefully calculated/checked:

- Calculate the heating requirements or establish heating requirements on the basis of energy consumption to date.
- Calculate the maximum supply temperature required for the heating system.

Monoenergetic operation
Monoenergetic operation is the use of two heat generators which use the same primary energy. For example, a heat pump and an electric heating element. Both use electricity as their primary energy. This model is often used in smaller, domestic heat pumps: heat pumps in this segment often have an integrated electric heating element for hot water.

Bivalent operation
Bivalent operation, unlike monoenergetic operation, uses a number of different types of primary energy. For example, fossil fuel combustion is often used as the second source of energy alongside electricity for the heat pump.

If the heat pump is operated in bivalent mode (with additional heat generation), the following basic data must be carefully calculated/checked:

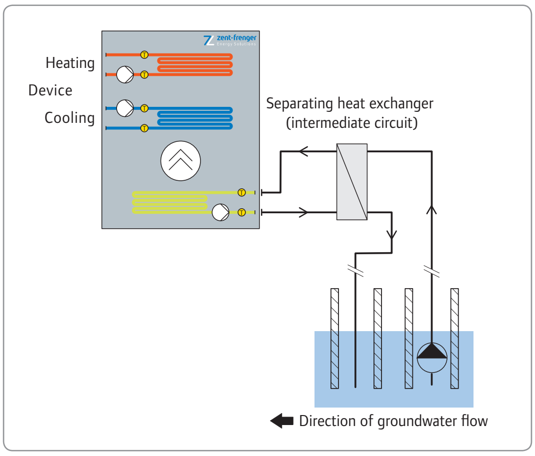
- Calculate the heating requirements or establish heating requirements on the basis of energy consumption to date.
- Calculate the maximum supply temperature required for the heating system.
- Calculate the bivalence point (switching threshold).

For bivalent mode (the simultaneous operation of two heat generators), the geothermal probes must be dimensioned by a certified engineering firm.

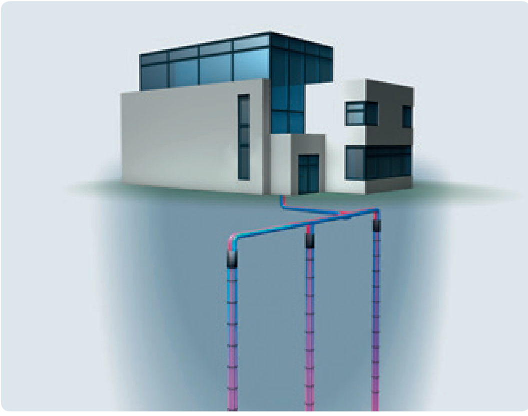
Sources for energy recovery / heat extraction

Indirect groundwater use

The use of surface waters (river, lake and stream water) generally does not allow monovalent operation with direct use. The heat exchangers required for indirect use in the intermediate circuit must be non-corroding and easy to clean. Please remember that the temperature of the intermediate circuit can, depending on the heat source, fall below freezing point (protect intermediate circuit from freezing). The concentration of the heat transfer fluid in the intermediate circuit should therefore be set for the lowest possible evaporation temperature.



Geothermal heat with geothermal probes



General information

The design of the geothermal probes has a significant influence on the mean annual coefficient of performance (annual COP) of a heat pump. The cooling output of the heat pump at the design point, the location and position and the length of the geothermal probes must all be considered in dimensioning. The extraction output can vary in line with the geographical location and the ground and soil properties (geological survey). When installing geothermal probes, always check the drilling and installation specifications of the installation firm.

The geothermal probes come in single-U pipe, double-U pipe and coaxial models. They have a diameter of 130 – 200 mm and are installed at a depth of 50 – 140 m. To optimize the ground connection, the borehole is grouted with a conductive material.

Geothermal probes are extremely difficult if not impossible to access in the event of a leak after they have been installed. A pressure test beforehand is therefore essential. The pressure test is to be conducted in accordance with the Association of German Engineers standard regulations VDI 4640, sheet 2 and the German Gas and Water Association standard DVGW-Arbeitsblatt W400-2 / DIN EN 805. The following pressure tests are either mandatory or recommended:

- Factory testing for the probes before delivery
- Pressure testing before grouting recommended
- Functional testing of grouted probes in accordance with VDI. Test pressure VDI min. 6 bar, max. fall in pressure 0.2 bar
- System pressure test before commissioning with 1.5 x operating pressure

Thermal regeneration of the ground

Like an accumulator, the ground in which the geothermal heat exchangers are installed has only a limited heat capacity. At a high extraction rate, the ground cools down more quickly, i.e. the greater the extraction output, the shorter the maximum possible period of extraction.

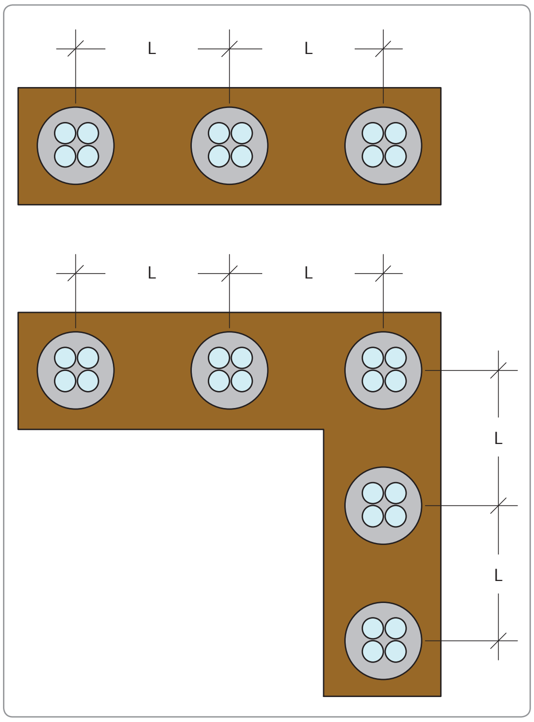
The thermal regeneration of the ground is extremely important for sustainable system operation, both in technical terms and in the light of water regulations. Thermal regeneration depends on the geological conditions (rock properties and groundwater conditions), and on the mode of operation of the heat pump system (heating and/or cooling). Remember that heat is extracted from the ground in heating mode and transferred to the ground in cooling mode.

A test probe is generally sunk for measuring the ground properties (conductivity λ, specific heat capacity c, temperature of undisturbed ground T0). This test probe is used to conduct a geothermal response test (GRT). Possible groundwater implications can also be detected by comparing the temperature profiles before and after the GRT. The results of the GRT and the energy and input values in the ground are important input data for geothermal simulation. With systems with a total heat pump output of >30 kW and systems in with an annual operating time of more than 2400 hours, a useful geothermal simulation is required to prove that system has been correctly designed in accordance with VDI 4640, sheet 2.

The groundwater conditions at the site are key to the geothermal potential of the ground:

I. Flowing groundwater: relatively rapid, natural regeneration of the ground.
   ➔ The ground can be used as required as a source of heat and/or cooling.
II. No groundwater flow: natural regeneration takes significantly longer. In this case, you need to ensure a good energy balance in the ground (i.e. extraction ≈ input) to ensure sustainable system operation.
   ➔ The ground can be used as a seasonal heat reservoir.

Position of multiple geothermal probes



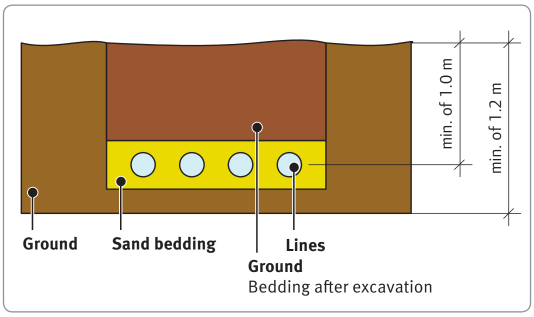
Minimum distances between multiple geothermal probes

Probe length [m]	Min. distance between lines L [m]
Up to 50	5 (VDI 4660)
Up to 100	6 (VDI 4660)
Empirical values from this level on	
Up to 120	7
Up to 130	8

Please note

The drill may travel during boring. We recommend using the spacing above between each bore point to ensure that there is still a sufficient distance between the geothermal probes. The deeper you bore, the greater the distance you must leave between the probes to compensate for drill travel.

Laying lines in the ground

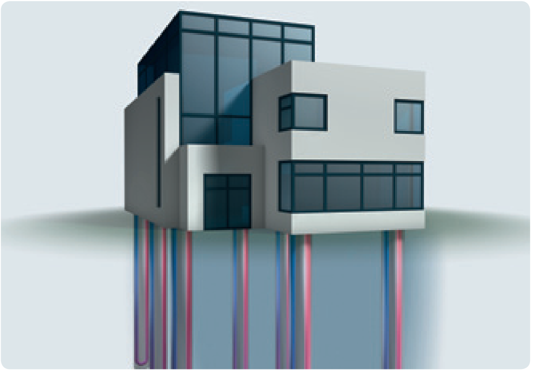


Connecting lines

Geothermal probes are usually connected individually to one central distributor. It must be possible to disconnect each geothermal probe individually at the distributor.

The connecting lines should be kept as short as possible to avoid pressure losses. The complete connection system including all connection components must be suitable for and approved by the manufacturer for use with brine as the heat transfer fluid.

Geothermal heat with energy piles



General points
The structural and statics requirements for the building foundations are generally the most important consideration for energy piles. This means that the number and dimensions, for example the length, of the foundation piles that can be thermally activated are dictated by the structural specifications and statics of the building. Standard foundation piles are ca. 10 – 30m long. Temperatures in the top layer of soil vary with the seasons. These fluctuations are reduced considerably the further down you go. From a depth of ca. 15m down, the ground has a largely constant temperature.

Operation
An energy pile system should be operated as an alternating storage unit (seasonal alternation between heating and cooling). This ensures the optimum specific extraction rate both for heating and for cooling. The temperature conditions for the energy pile system can be kept stable over the long term. A more or less even thermal balance over the years minimizes thermal interference between neighboring energy piles.

From experience, base load operation is the most efficient for medium-sized and large energy pile systems. When dimensioning, you should seek to ensure and specify the best possible heat to work ratio.

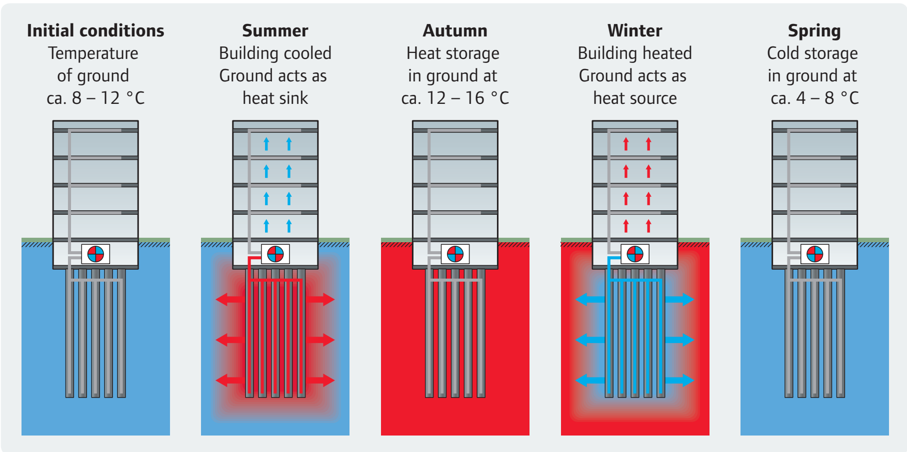
Supplementary (geothermal, fossil fuel or solar) energy sources may be required to deal with peak heating and cooling loads for the building and for heating domestic water (see the sample calculations on page 28 below).

Statics
The building engineer must check and approve the planned positioning of heat exchanger pipes to be installed in the concrete foundation piles. To prevent affecting the load-bearing capacity of an energy pile in operation, it must be protected from freezing by securely limiting the minimum temperature of transfer fluid (brine).

Legal basis

All energy pile systems must comply with the applicable local regulations, for example VDI 4640 and the German Water Management Act [Wasserhaushaltsgesetz] (D), SIA D 0190, SIA D 0179 and the implementation guidelines from the Federal Office for the Environment [BAFU-Vollzugsrichtlinie] (CH), the Austrian Water Act [Wasserrechtsgesetz], Industrial Code [Gewerbeordnung] and Trade Regulations [Bauordnung] (A).

Energy piles: Ground as a thermal heat source



Ground regeneration: alternating heating/ cooling

Design of energy piles
How the energy piles should be dimensioned depends on a range of factors including the power requirements, the mode of operation of the heat pump, the ground and soil properties and the number, position, length, diameter and material properties of the thermally activated foundation piles. The thermal resistance from the surrounding ground to the heat transfer fluid in the pipes must be factored into the calculations.

Thermal resistance
The lower the thermal resistance RE of the energy pile, the better the heat transfer. The bored pile diameter, the conductivity of the pile material and the type of energy pile are the key aspects for thermal resistance. The thermal resistance of the energy pile R_E is a product of the transfer resistance of the individual elements and the specific material resistance.

$$R_E = R_c + R_R + R_P \qquad [W/(m^2K)]$$

R_C = heat transfer coefficient, heat transfer fluid/pipe
R_S = heat transfer coefficient, loops
R_P = heat transfer coefficient, pile material

Collector pipe lengths
The necessary length of collector pipes L in the energy piles is based on the specific extraction q_E from the ground and the cooling output Q_O of the brine-to-water heat pump.

$$L = \frac{Q_O}{q_E} \qquad [m]$$

The cooling output is equivalent to the proportion of the heat pump power extracted from the surroundings and is the difference between the heating output Q_H and the wattage P_{el}.

$$Q_O = Q_H - P_{el} \qquad [W]$$

Ground and soil properties
It is important for the design of the energy pile system to know the thermal properties of the ground. It is theoretically possible to calculate conductivity from undisturbed bore core samples from a sample bore; however this is an extremely complicated and labor-intensive method. The design of energy pile systems with corresponding simulation programs, however, requires knowledge of the effective thermal conductivity of the ground for the entire length of the borehole. This information is calculated in practice on site with the geothermal response test (GRT).

Geothermal response test
The geothermal response test is conducted using a completed energy pile. A constant thermal load is applied to or extracted from the energy pile and the data is evaluated using Kelvin's line source theory. The result indicates the exact geological conditions at the site for the entire length of the energy pile and in typical operating conditions, including the effect of any flow of groundwater.

Coordinated interdisciplinary planning with all teams
In the light of the complex geological and hydrogeological conditions for energy pile dimensioning and the need to dimension in accordance with the heating and cooling requirements of the building, energy pile systems should only ever be designed, simulated and installed by qualified specialist companies.

Specific extraction q_E per meter of pile depth

Ground	Specific extraction qE per m pile depth for heating output of up to 30 kW	
	1800 h/a	**2400 h/a**
Poor ground, dry sediment	25 W/m	20 W/m
Normal hard rock and saturated sediment	60 W/m	50 W/m
Hard rock, high conductivity	84 W/m	70 W/m

For pumps which run for prolonged periods of time, the specific annual extraction work is also to be considered as well as the specific extraction output.

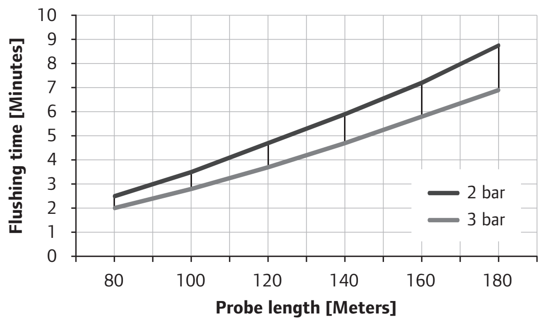
Source VDI 4640

Flushing and filling the brine circuit

Flushing the brine circuit

Before the primary circuit is filled with brine, it has to be flushed out thoroughly. Pressurized filtered tap water is used first to flush out the circulating pump of the primary circuit and the evaporator to remove any welding beads, grit, dirt, etc. For systems with geothermal probes, each geothermal probe circuit is then flushed individually. For example, a 140-meter-long probe with a diameter of 32mm will have to be flushed at 2 bars for at least 6 minutes, as shown in the diagram below.

Minimum flushing time for 32 mm probes



Important information for filling the brine circuit

Once flushing is complete, fill the entire brine circuit including all feed lines with the prepared brine. The brine circuit must be correctly and carefully added to ensure that a brine-to-water heat pump system can reliably provide the required output, and to ensure that the system operates smoothly.

To ensure that the heat pump system functions smoothly, the following points are essential for filling the brine circuit:

- Clean mixture
- Correct concentration
- Homogeneous mixture

Absolutely clean primary circuit
Sand, grit, etc. can cause serious damage, especially to geothermal probes and energy piles, and can indeed cause them to fail. Dirt can also lead to decomposition of the heat transfer fluid, resulting in sludge. Care must therefore be taken to ensure that no dirt gets into the pipe during installation and that all pipe ends are well sealed by the competent installation firm immediately after installation (PE sealed cap). Geothermal probes must never be flushed out with air; they must be filled with fluid at all times. It is also extremely important that only clean water (tap water) with the required proportion of antifreeze is used for mixing with the brine.

Correct brine-water concentration
The brine circuit requires the use of environmentally friendly antifreeze (e.g. Antifrogen N). The concentration specifications must be complied with and regularly checked. If there is too little antifreeze in the brine fluid in the primary circuit, it will not provide enough protection and frost damage may occur. If the brine solution is not sufficiently concentrated, it will develop corrosive properties and can cause corrosion damage. Additives would be needed to prevent this. However, additives are potentially hazardous and can increase the water hazard class, and result in the machine not qualifying for approval. For the above reasons, there must be a minimum concentration of 20 % for monoethylene and 25 % for propylene glycol.

Even mixture of the brine solution
If the calculated amount of antifreeze concentrate is added straight to the circuit without a suitable mixing device, the viscosity of the concentrate can cause problems, for example by blocking individual lines in a geothermal probe system. Blocked lines would no longer operate, and the calculated output could no longer be achieved. The fact that the solution was not properly mixed would also mean an insufficient brine concentration in the remaining lines to ensure smooth operation of the heat pump.

It is therefore essential to mix the brine solution in the required concentration and with appropriate equipment in accordance with manufacturer instructions.

Alternatively, ready-mixed products with the required concentration can be used.

Filling with brine solution (Example: geothermal probes)

Each probe in a geothermal probe system must be filled separately. The necessary volume can be calculated in line with dimensions using the information in the table below. The existing pressure in the expansion vessel (0.5 to 1.0 bar) must always be checked before a probe is filled.

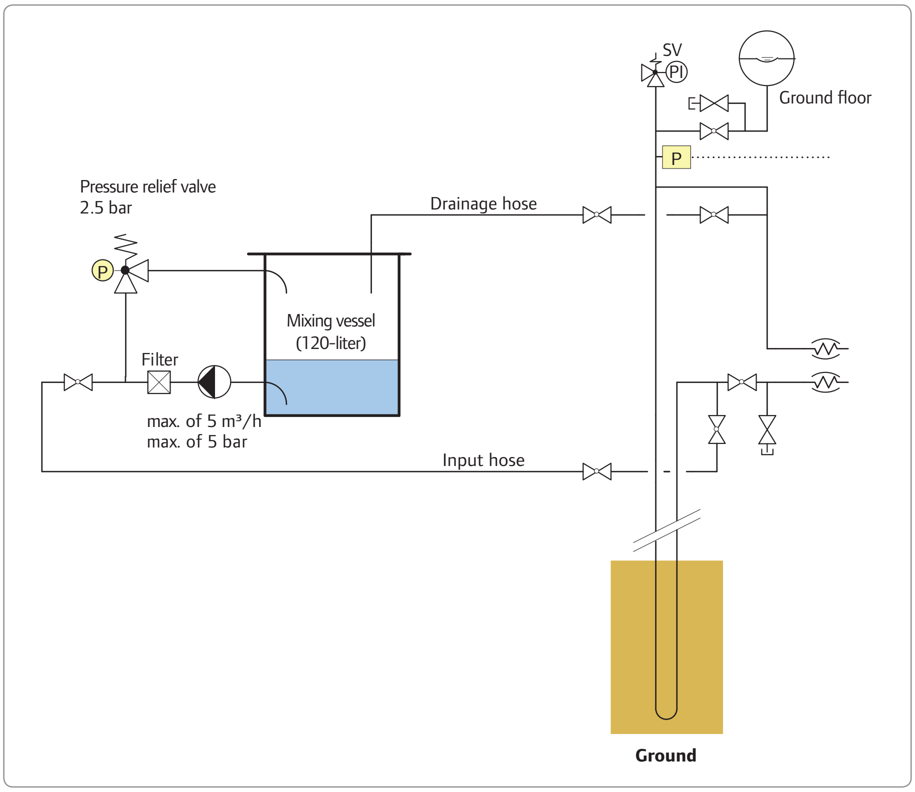
Equipment required for filling:

- Mixing/filling vessel
- Jet pump
- Pressure relief valve

Pipe diameter (outside x wall thickness)	Content per meter of pipe
Geothermal probe (2 circuits/4 pipes)	
32 mm (32 x 2.9 mm)	2.16 liters (4 x 0.539 liters)
40 mm (40 x 3.7 mm)	3.36 liters (4 x 0.838 liters)
Ground collector	
25 mm (25 x 2.3mm)	0.327 liters per m
32 mm (32 x 2.9mm)	0.539 liters per m
40 mm (40 x 3.7mm)	0.838 liters per m

Please note

These instructions also apply as relevant for systems with energy piles and ground collectors.



Schematic diagram of a filling system for the primary circuit with an ethylene / glycol mixture.

Example: Procedure for filling a double-U pipe geothermal probe

140 m-long double-U pipe geothermal probe with a diameter of 32 mm. Required concentration = 25 %. Mixing with 100 % antifreeze concentrate is required, as detailed below.

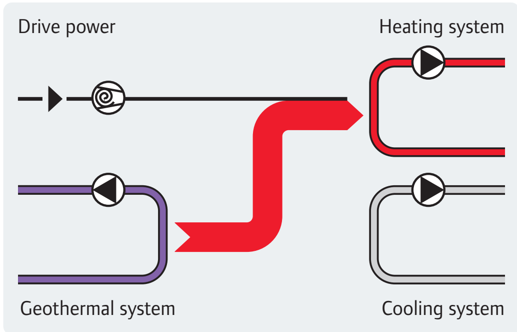
1. Calculate the volume of one geothermal probe circuit. One double-U pipe geothermal probe has two circuits! One geothermal probe circuit with one supply and one return line has a volume of 302.4 liters (140m x 2.16 liters per m).
2. Amount of antifreeze concentrate required: 75.6 liters (25 % of 302.4 liters).
3. To ensure that the concentrate can be mixed in the vessel, an additional 40 liters of the mixture should added to the vessel (10 liters of concentrate and 30 liters of water). Clearly legible volume marks should marked on the vessel as a guide.
4. Add the antifreeze concentrate provided to the mixing vessel in accordance with 2.
5. Close the slide valves in the connection to the evaporator.
6. Open the slide valve for one line (not both lines of the geothermal probe).
7. Remove the drainage hose from the vessel and direct into a drain.
8. Switch on the input pump (a jet pump with a sufficient power rating) and run it until there are only 40 liters left in the vessel. Switch off the input pump immediately. During this process, the excess mains water runs out of the drainage hose and into the drain.
9. Insert the drainage hose into the vessel, and switch the input pump on again and run it until the antifreeze concentrate and water are well mixed. This will take around 6 times the flushing time.
10. Close the filling cocks in the drainage hose and then in the geothermal probe distributor. The excess mixture will flow back into the vessel through the pressure relief valve (2.5 bar). Switch off the input pump. The vessel still contains ca. 40 liters of the mixture. Some has run off as a result of expansion of the geothermal probes.
11. Prepare the mixture for each other circuit of a geothermal probe in the same 2 way. Top up the mixture to 40 liters in accordance with 3 , and then add the antifreeze concentrate for the quantity in the line (see 4)
12. Once all geothermal probes have been filled, the connection lines to the heat pump and the heat pump evaporator must also be filled. Close all the slide valves to the geothermal probes and open the slide valves to the evaporator. The rest of the mixture should now be carefully pumped in through the slide valve at the input hose. The water in the evaporator will drain out through the drainage hose. Close the cock as soon as antifreeze mixture starts running out of the drainage hose. Fill the expansion vessel to 2.5 bars with pump pressure. Finally, close the cock in the input hose. The geothermal probe is now free from dirt, is filled with the correct concentration and is at the correct operating pressure.

Modes

A number of factors should be considered when selecting a heat pump for geothermal use. These include the required heating and cooling output and the system design. The following modes are possible with the GEOZENT Eco:

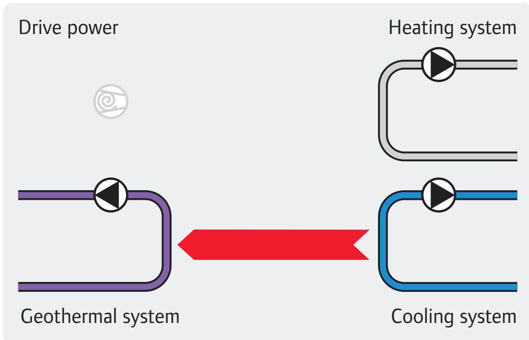
Heating

The geothermal system acts as a heat source. The heat pump raises the temperature of the fluid to a useful level for the building and supplies this heat to the heating system at the required supply temperature.



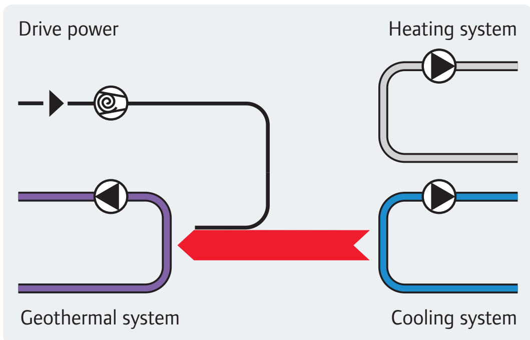
Natural cooling

The geothermal system acts as a heat sink. When cooling is required, the controls checks whether the temperature in the geothermal system is sufficient for natural cooling. If it is, the cooling output provided by the geothermal system is supplied straight to the cooling system without activating the compressor. Simultaneous heating is not possible in this mode. The operating costs of the system are extremely low in this mode, as the only power required is that for driving the circulation pumps.



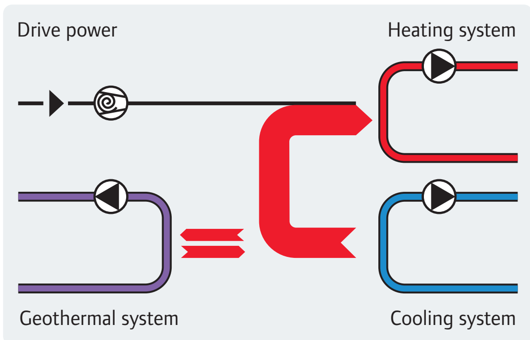
Mechanical cooling

The geothermal system acts as a heat sink. When the temperature in the geothermal system is no longer sufficient for natural cooling, the system as a whole switches to mechanical cooling (refrigerating machine operation) and the building is supplied with cooling energy at the required supply temperature. Simultaneous heating is possible.



Dual operation

If cooling and heating are required at the same time, the system checks whether the building has a net heat requirement or net excess heat. The geothermal system is then used either as an additional heat source or as a heat sink depending on the balance of energy.



Natural cooling (passive cooling; free cooling)

Stricter requirements for structural heat insulation have changed the balance of heating to cooling requirements. In the past, the main focus was on heating. Now, it is on cooling and reducing inside temperatures in the hot months. Structural measures such as shading windows on the outside are not usually enough to prevent inside temperatures rising above the maximum working room temperature (acceptable temperature) of 26 °C.

Passive geothermal cooling systems offer an efficient and inexpensive way to reduce temperatures. Passive geothermal cooling transfers excess heat from the building to the cold ground through piping and ground heat exchangers (probes). Passive geothermal cooling is most effective when used in combination with panel heating/cooling systems (e.g. radiant cooling panels, concrete core activation, etc.)

Unlike active cooling with ventilation systems where the required supply temperature of ca. 6 – 9 °C must be generated in a cooling process, panel systems can directly harness the ground temperatures of ca. 10 – 16 °C for inside cooling without the use of compressors. This significantly reduces operating costs, as the only power required for cooling is the energy to drive the heating circulation pump(s) and the primary circuit brine circulation pump.

Benefits of passive cooling

- A more comfortable office thanks to pleasant room temperatures all year round
- Improved annual COP for the heat pump with ground regeneration
- Only minimal additional investment costs
- Extremely low operating costs
- Saves resources and is environmentally friendly

Sample calculation: comparison of illustrative annual costs of passive and active cooling with an operating time of 800 h and € 0.20 per kWh (electricity)

		Active cooling	Passive cooling
Brine circulation pumps	Electrical power	3 kW	3 kW
	Annual energy requirements	2,400 kWh	2,400 kWh
	Annual energy costs	€ 480	€ 480
Heat circulation pumps	Electrical power	2 kW	2 kW
	Annual energy requirements	1,600 kWh	1,600 kWh
	Annual energy costs	€ 320	€ 320
Compressor	Electrical power	43 kW	–
	Annual energy requirements	34,400 kWh	–
	Annual energy costs	€ 6,880	–
Total energy costs		€ 7,680	€ 800
Annual savings			**€ 6,880**

Dual operation

Dual operation is an innovative function offered by our heat pumps. They provide the option of simultaneous heating and cooling where required. This function requires the correct hydraulic connection for the cooling and heating devices so that they can be activated simultaneously instead of alternately (e.g. two separate reservoirs, hot and cold). In dual mode, the other reservoir is used as the heat source (cold reservoir) or heat sink (heat reservoir) for the cooling process. The actual source (geothermal system, …) is only used as a backup to ensure the correct balance (excess heat transferred to ground or cooling from ground).

This mode offers the following benefits for users and the environment:

- Reduced use of the source (geothermal field)
- Highly efficient operation in the spring and autumn despite temperatures in the geothermal field, for example, not being good for the COP.
- Simultaneously meets heating and cooling requirements without heat pump cycling
- More accurate temperature control thanks to continuous operation without standstill or idle times (as usually occur in the switch from cooling to heating mode)

Extremely high COPs can be achieved in dual mode. This is because both the heat emitting heating part and the heat supplying cooling part appear on the benefit side.

$$COP_{integrated} = \frac{Q_{benefit}}{Q_{Cost}} = \frac{(Q_{Heating} + Q_{Cooling})}{Q_{Cost}}$$

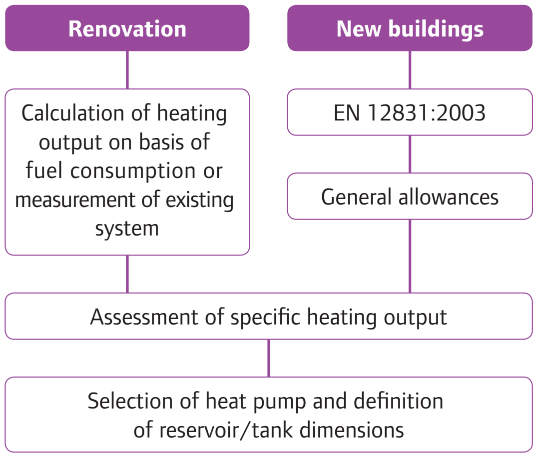
A COP of up to 10 is possible. The exact COP depends on the conditions required on the cold and hot side.

Dual mode is particularly suitable for use in buildings with year-round cooling and heating loads, for example with air conditioning systems with dehumidification. In the cooler months, dual mode is often used in buildings with server rooms. These must also be kept cool in winter, while the offices in the same building require heating.

Heat pump design

Calculating the heating output

A professionally designed heating system is highly energy-efficient, and this has a positive long-term effect on operating costs. Accurate calculation of the precise heat load is extremely important if the heating system is to be correctly dimensioned, and energy-optimized operation is to be possible. The diagram below illustrates the procedure for calculating the heat load and selecting the right heat source.



Calculation of design heat load for renovations

Design heat load on the basis of fuel consumption

To calculate the design heat load on the basis of fuel consumption, you must know the specific calorific value H_o of the heating medium, the annual capacity factor η and the full load hours t_{full}. The amount of energy for a period of heating can be generated by the heating system in a set number of hours. This is called full load hours. As the standard outside temperature falls by 0.5 K for every 100 meters in height, the number of full load hours increases with the altitude of the site.

Typical full load hours by building type

Requirement	Building type	Location (altitude)	Full load hours (t_{full})
Room heating with drop at weekend	Schools, industry, trade, office space	Sea level	1,800 h/a
		from 800 m above sea level	2,100 h/a
Room heating	Building	Sea level	2,000 h/a
		from 800 m above sea level	2,300 h/a
Room heating/hot water	Building	Sea level	2,300 h/a
		from 800 m above sea level	2,500 h/a

All data based on a room air temperature of 20 °C.

Formula for calculating the design heat load

$$\Phi_{HL} = \frac{\text{Consumption} \times H_o \times \eta}{t_{full}}$$

Sample calculation: oil heating

Calorific value H_o of oil
Fuel oil EL: 10.57 kWh/l
Fuel oil S: 11.27 kWh/l

Annual capacity factor η
New boiler: 85 to 95 % (condensing)
Old boiler: 80 to 85 % (non-condensing)

Sample calculation
(heating and hot water)
Full load hours t_{full}: 2,300 h/a
Oil consumption EL: 20,000 l/a
Calorific value H_o: 10.57 kWh/l
Annual capacity factor η: 90 %

$$\Phi_{HL} = \frac{20{,}000 \times 10.57 \times 0.9}{2{,}300} = 82.7 \text{ kW}$$

Sample calculation: gas heating

Calorific value H_o of gas
Fuel gas: 11.3 kWh/nm³
Propane: 28.1 kWh/nm³

Annual capacity factor η
New boiler: 85 to 95 % (condensing)
Old boiler: 80 to 85 % (non-condensing)

Sample calculation
(heating and hot water)
Full load hours t_{full}: 2,300 h/a
Fuel gas: 20,000 nm³/a
Calorific value H_o: 11.3 kWh/nm³
Annual capacity factor η: 95 %

$$\Phi_{HL} = \frac{20.000 \times 11{,}3 \times 0{,}95}{2300} = 93{,}3 \text{ kW}$$

Calculation of design heat load with capacity use measurement (renovation)

Capacity use measurements for an existing, still functional system provide detailed data for dimensioning heating boilers (characteristic curve). This applies in particular in cases where the design heat load cannot usefully be calculated on the basis of annual fuel consumption. For more exact data, burner capacity use α must be recorded over at least two weeks in conjunction with the outside air temperature. There should be as wide as possible a fluctuation in the outside air temperature (e.g. -5 to +10 °C). This method is most commonly used for large buildings with heating outputs of > 100 kW, for example schools, hospitals, industrial facilities and administrative buildings.

Rule of thumb for calculating heating output on the basis of existing consumption data

System at sea level

With water heating

$$\dot{Q}_{HP}\,[\text{kW}] = \frac{\text{Av. annual consumption}^{*}}{300}$$

Without water heating

$$\dot{Q}_{HP}\,[\text{kW}] = \frac{\text{Av. annual consumption}^{*}}{265}$$

System from 800 m above sea level

With water heating

$$\dot{Q}_{HP}\,[\text{kW}] = \frac{\text{Av. annual consumption}^{*}}{330}$$

Without water heating

$$\dot{Q}_{HP}\,[\text{kW}] = \frac{\text{Av. annual consumption}^{*}}{300}$$

$\dot{Q}_{HP}$ = Required heating output for design temperature of heatpump [kW]

* oil consumption in liters (1kg of oil equals ca. 1.19 l and 1 standard m³ of gas equals ca. 0.93 l oil)

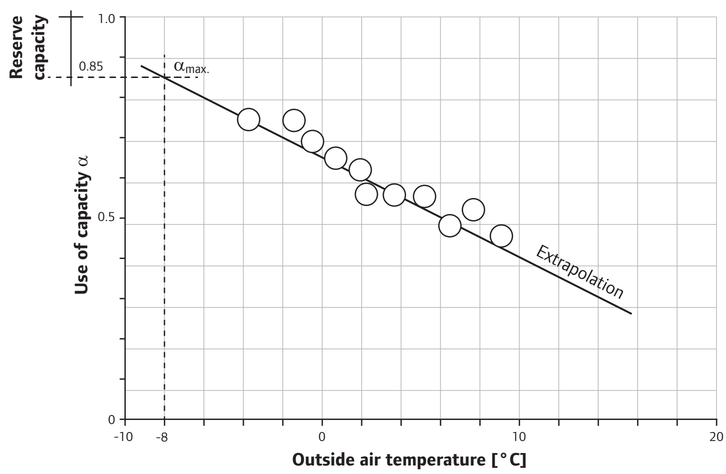
Calculation of design heat load for new buildings

Design heat load in accordance with EN 12831:2003, heating systems in buildings

The method for calculating the design heat load (heat requirements) in accordance with EN12831:2003 is used for new buildings and for large-scale modernizations of building heating systems. The required heating output is calculated separately for each heated room. This calculation is needed for dimensioning the system using the heat supplied (underfloor heating, heaters, thermoactive components, air heating). The design heat load for the building as a whole is calculated on the basis of the heat load for the individual rooms.

Method of calculation

- Calculate the design outside temperatures and the average annual outside temperature.
- Establish the design inside temperatures for each heated room.
- Calculate the coefficient for the design transmission heat loss. The design temperature difference is multiplied by this coefficient to product the design transmission heat loss.
- Add together all the design transmission heat loss figures for all heated rooms, disregarding heat loss between the heated rooms. This produces the design transmission heat loss for the building as a whole.
- Calculate the coefficient for the design ventilation heat loss. The design temperature difference is multiplied by this coefficient to product the design ventilation heat loss.
- Add together all the design ventilation heat loss figures for all heated rooms, disregarding the transfer of heat between the heated rooms. This produces the design ventilation heat loss for the building as a whole.
- Add together the design transmission heat loss figures and ventilation heat loss figures.
- Calculate the design heat load for the building, with a correction factor for additional heating output required to maintain heating for the entire building.



Characteristic curve from capacity use measurement. The example shows the measured capacity use of a well-dimensioned system. This system still has a reserve capacity of 15% for heating after a prolonged fall in temperature, even at very low outside temperatures. This power is sufficient, as in extremely cold periods, the reduced temperature phase can be disregarded.

Calculating the heating requirements; thermal energy in civil engineering

The heating requirement [MJ/m²] is the heat that must be supplied to a heated room over a year (or a calculation period of 1 month) to maintain the setpoint inside temperature. The value is based on the heated useful area [m²]. There are various programs available for calculating heating requirements. Some programs also provide an estimate of the design heat load.

The following data is required for calculating the heating requirements:

- Information on use
- Climate data for the site
- Detailed heated useful area data
- Data on flat components (areas, U-values, inside temperature of neighboring rooms, temperature increase for component heating and heaters at windows and doors, reduction factors for unheated rooms and ground)
- Data on thermal bridges
- Data on the windows (g-value, shading factors, etc.)
- Data on the heat storage capacity and the type inside temperature control

General allowances to add to heating requirements

The general allowances to be added to the design heat load Φ_h [kW] are as follows:

- Reserve for heating an area again after a fall in the room air temperature
- Allowance for heat distribution loss
- Heat output for ventilation systems or process heat

Aspects specific to residential buildings

In housing estates and multi-family dwellings, unlike in commercial and industrial buildings, a significant proportion of power is used for heating water. The amount of power used for domestic water can be estimated at ca. 0.3 kW per person. Consumption for domestic water has risen as a result of the wider use of water-intensive devices (rain shower, …). The demand for cooling has also risen as higher energy efficiency classes require a ventilation system. The conventional solution in the residential construction sector is separate reservoirs for heating, cooling and hot water. This can mean that the heat pump is alternating between supplying three different devices. The design of the heat pump must allow for the switchover times, heating up, and heat distribution losses. One option here is a calorifier or integrated heat exchanger for heating water. This avoids switches between and the additional power required for heating and hot water. A separate electric heating element in the domestic water supply for each dwelling unit should be fitted for ensuring weekly Legionella prevention processes and greater user friendliness. Dual mode would cover the cooling requirements at the same time.

Please note

In residential buildings, an allowance of 10 % to 15 % should be added to the calculated heat output to cover heating up and heat distribution losses.

Checking results

The results are checked on the basis of the specific heating output. This is calculated by dividing the design heat load by the heated useful area. The values should be approximately the same as those in the table.

Building	Test value [W/m²]
Existing building with insufficient insulation	50 to 70
Existing building with good insulation	40 to 50
New building complying with current regulations	30 to 40
Low-energy houses	25 to 30
Passive houses	8 to 13

Note on energy saving

Carefully insulating the heat distribution lines will increase the reserve capacity.

The control parameters set should be recorded in the system documentation. A heat meter is an easy way to monitor the heat output.

Please note

The specific heating output is only a rough guide. Dimensioning should follow the methods detailed above.

Important!

The information on heat load calculation is purely illustrative. Heat load calculations should always be conducted by a professional engineering firm or energy consultant.

Heat pump dimensions

The area of application and efficiency of a heat pump depends in particular on the heat source and heat use temperatures.

The smaller the difference between the heat use and heat source temperature, the more efficiently the system can operate. The designer or heating installation engineer must consider the prevailing conditions at the site when dimensioning the system to ensure that the operating limit of the heat pump is never exceeded.

Allowances to be added to required heating output

The heat pump dimensions must allow not only for the general allowances to be added to the design heat load Φ_{HL}, but also for heat pump off-grid periods (see Calculating the design heat load Design must compensate for off-grid times set by the electricity supplier with an additional heating output allowance for the heat pump.

Heat pump selection

Alongside the technical requirements for heat pump installation, you must also consider and check the electricity connection, space requirements and the options for using one or more heat sources. The functional scope of the heat pump must also be established in advance.

Guide values for design

Heat pumps should be designed to achieve as high as possible an annual coefficient of performance (COP). The annual COP is the ratio of heating provided over the year to the energy consumed.

Recommended target annual COPs for heating and hot water in new buildings

	COP target
Air-to-water heat pump (heat source: outside air)	3
Brine-to-water heat pump (heat source: ground)	4
Water-to-water heat pump (heat source: groundwater)	4.5

Important!

Heat pumps with geothermal probes or energy piles are not suitable for construction drying.

Heat source selection

With the exception of outside air, the use of any natural heat sources requires approval by the competent public authority. This is usually the energy and water management authority. Which heat source should be used depends on the design heat load required and the conditions at the site:

- Geothermal collectors require a large area (30 to 60 m² per kWth heating output). Sufficient soil moisture and a good thermal connection for the collector are important with this option. The area should therefore not be sealed. If the area is not overbuilt/sealed, operation below freezing is also possible. Seasonal.
- Geothermal probes: requires several vertical probes installed in boreholes down to a depth of around 150 m (ca. 50 W per meter of probe and an annual maximum of 100 kWh/m).
- Waste heat from industrial processes: this option must be planned in terms of timing so that the waste heat produced at certain times can fully meet the heat requirements in other areas, or a sufficiently large buffer tank must be included to bridge the gap.
- Groundwater: this option requires a sufficient quantity of water (150 to 200 ltr/h per kWth heating output). Factor in well spacing and the direction of groundwater flow.
- Surface water: this option requires a sufficient quantity of water (300 to 400 ltr/h per kWth heating output).
- Waste water: this option requires a sufficient quantity of water (ca. 100 to 150 ltr/h per kWth heating output).
- Thermoactive ground plate: No regeneration from precipitation, can be run with just a reservoir. For structural reasons, cannot be operated at temperatures below freezing.
- Energy piles: Usually down to a depth of as much as 30 m; because of shelter from the building, there is little or no regeneration from precipitation - as with the thermoactive ground plates. For structural reasons, cannot be operated at temperatures below freezing.

Sample calculation 1: Ground conditions not constant

Building requirements:
320,000 kWh heating,
170,000 kWh cooling.
Example with GEOZENT Eco 320, heating with supply temperature of 35 °C, cooling with supply temperature of 6 °C.

COP (heating) B4/W35: 4.95
EER (cooling) B30/W6: 5.05

Extraction output
320,000 kWh / 4.95 = 64,646 kWh
➔ 320,000 kWh - 64,646 kWh = 255,354 kWh
255,354 kWh extraction output in heating mode

170,000 kWh / 5.05 = 33,663 kWh
➔ 170,000 kWh + 33,663 kWh = 203,663 kWh
203,663 kWh transfer input in cooling mode

255,354 kWh - 203,663 kWh = 51,691 kWh

Annual energy difference of 51.691 kWh.

As regards regeneration for geothermal sources, you should calculate whether the annual energy difference can be balanced out. If there is no regeneration, the temperature of the ground will (in this case) rise over the years and the cooling potential will therefore fall.

Sample calculation 2: Stable ground conditions for reliable long-term operation

Building requirements:
200,000 kWh heating,
130,000 kWh cooling.
Example with GEOZENT Eco 210, heating with supply temperature of 35 °C, cooling with supply temperature of 6 °C.

COP (heating) B4/W35: 4.70
EER (cooling) B30/W6: 4.78

Extraction output
200,000 kWh / 4.7 = 42,553 kWh
➔ 200,000 kWh - 42,553 kWh = 157,447 kWh
157,447 kWh extraction output in heating mode

130,000 kWh / 4.78 = 27,196 kWh
➔ 130,000 kWh + 27,196 kWh = 157,196 kWh
157,196 kWh transfer input in cooling mode

157,447 kWh - 157,196 kWh = 251 kWh

Annual energy difference of 251 kWh.

Good energy balance in the ground. Ideal for using the ground as reservoir. Additional cooling or heating output required can be provided by recoolers or solar-thermal energy.

Choice of heat utilization system (heating and cooling systems)

The heat pump can in principle be used in any heat utilization system. Low-temperature heating systems such as underfloor heating, concrete core activation and heating and cooling ceilings are particularly suited to heat pumps. Depending on the system temperature and heat source, monovalent operation of the heat pump (the heat pump as the only heat generator) may be an option. For systems with higher system temperatures, it is often useful to have a supplementary heat generator (for example an existing boiler) in bivalent mode. As the annual coefficient of performance (annual COP) increases significantly as the supply temperature falls, the heat utilization system should generally be designed for a low supply temperature. In new buildings, the supply temperature at the design point should if possible not be higher than 35 °C. If a heating is replaced by a heat pump, the actual supply temperature in the existing heat utilization system at the design point should not be higher than 50 °C. Higher supply temperatures can be reduced with heat insulation or by extending the heat emitting surface, for example.

Please note

Reducing the supply temperature by 5 °C improves the annual COP by around 10 %.

Tips and information for official permits and approvals (Germany)

Information and contact details/competent authorities for official permits and approvals

The feasibility of the project should also be assessed for the design of the heat pump and the sources. Feasibility depends not only on technical feasibility, but also on the applicable regulations. Official assessment is required for geothermal energy sources in particular. This assessment can vary greatly from region to region. Key factors include how power-intensive the system is, any water protection areas, and the specific geology of the project site.

The official requirements and conditions must be considered at an early stage of planning. The authorities could, for example, require an independent expert to be present when the first or when each borehole in a field is sunk.

The competent authorities for your project and the relevant contact details can be found on websites such as the following:

www.Kreisnavigator.de

For geothermal projects, the local water authority should always be the first point of contact. The **local water authorities** [Untere Wasserberhörden] are part of the district administration [Landratsämter der Kreise]. They are responsible for most matters relating to approval and assessment/inspection. The local water authorities will also direct you to all other authorities relevant for your project. In some cases, you may need to contact the **geological district authorities** [geologische Landesämter]; the local water authorities can, however, also organize this. Geological profiles for the region in question can be requested from the geological authorities.

Initial telephone and e-mail inquiries about any basic problems such as contamination in the project area, or about the type of heat exchanger to be used, are generally free of charge. The drilling application required will incur costs in line with the scope, and must be submitted by the drilling and installation firm in good time. The permit from the water authorities with exact details of the geothermal system and conditions for the heat pump (monitoring, volume measurements, temperature limits,...) is also issued by the above authorities above and must be applied for by the site owner.

Zent-Frenger can provide help and advice on obtaining and assessing approval from the water authorities.

Transport, installation, connection and commissioning

Transport and installation

Transport to and at the construction site

GEOZENT Eco large-scale heat pumps must be protected from moisture and damage in transport and during installation. The stacker inserts and crane lugs in the base frame are to be used for lifting and transport. Heavy duty casters should be used for manual transport. Fittings and equipment for unloading and transport to the heating plant room must be available at the site.

Installation in the heating plant room

General requirements
The installation area must be dry and protected from frost. Rooms with a high ambient humidity are only suitable in some cases. The safety clearances for maintenance and operation must be complied with (see dimensions and safety clearances for all devices from page 65 on).

Structural requirements
Generally, the only specific requirements for the installation area for heat pump operation concern noise reduction. The floor for interior installation should be sound-proof or with impact noise isolation. Floating screed and concrete bases isolated for sound reduction are good options here.

Below are the most important regulations and standards for designing and installing heat pumps:

- DIN 4109 Sound insulation in buildings
- BImSchG Bundesimmissionsschutzgesetz [German Federal Immission Control Act]
- TA Lärm [German technical regulations on noise control]
- VDE 0100 Erection of power installations, with rated voltages up to 1000 V
- VDI 2050 Central heating installations – Engineering principles for planning and design
- DVGW W101 Guidelines on drinking water protection areas - Part 1: Groundwater protection areas
- DIN 8960 Refrigerants - Requirements and symbols
- DIN 8975 Refrigerating plants; safety principles for design, equipment and installation; design
- DIN 1988 Codes of practice for drinking water installations

Connection and commissioning

Hydraulic connection to the source and device system

Before the heat pump is connected, the complete system has to be thoroughly flushed; this applies both in renovation work and to new buildings. Residue in the heating pipes or the geothermal probes/ground collector pipes can cause damage to the heat exchangers and pump malfunction.

We recommend the installation of dirt traps. Hydraulic balancing must also be carried out in both the heating system and the source system. Over the first few weeks and months after commissioning, the filters installed on site should be checked for residue and cleaned.

In warm rooms, there is a risk of condensate. This risk must be prevented by using steam-tight insulation material. Alternatively, any condensate that is formed can be drained off through a drip drain. The installation must be protected from corrosion (choice of materials). A pressure monitor should be installed in the brine circuit (or in the heat pump itself) to detect leaks.

Electrical connection

The heat pumps are to be fused and connected in accordance with the terminal diagram provided. There must be no trial run after wiring is complete. The heat pump electrical circuit should be secured to prevent unauthorized activation. All electrical work must be carried out by a certified professional.

The energy supplier must be notified that you are planning to connect a heat pump to the supply network. This should be done as early as possible in planning to ensure that all relevant aspects of the connection can be dealt with in time. Energy suppliers are generally seeking even distribution of power consumption. They therefore usually offer special low rates for heat pumps with set connection times. Heat pump unit installation must comply with the technical connection requirements [technische Anschlussbedingungen, TAB] and supplementary conditions of the energy supplier. A three-phase AC connection and possibly also a starting current limiter will be required for connecting the heat pump to the electricity supply.

Commissioning

Commissioning is done in three stages (provisional acceptance and checking source hydraulic balancing; heat pump commissioning; adjustment) and may only be carried out by our specialists or by trained staff from partner firms of Zent-Frenger GmbH; the factory warranty will automatically be void if commissioning is done by any other party. Hydraulic balancing of the source must be carried out with us during commissioning.

Conditions for commissioning the GEOZENT Eco heat pump:

- The system must be connected at the heat source and demand side, and completely filled and vented
- The GEOZENT Eco heat pump must be correctly connected by a qualified professional to the electricity supply
- An electrician and a heating installation engineer must be present at commissioning
- The system must not be commissioned for the purposes of construction drying

Important!

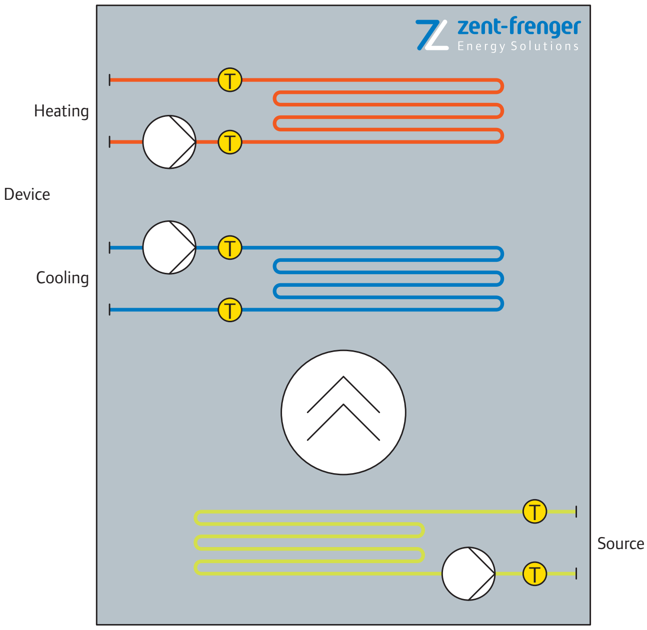
A person authorized to approve and accept the system must be present at commissioning.

Applications and examples

Main connections for a GEOZENT Eco heat pump

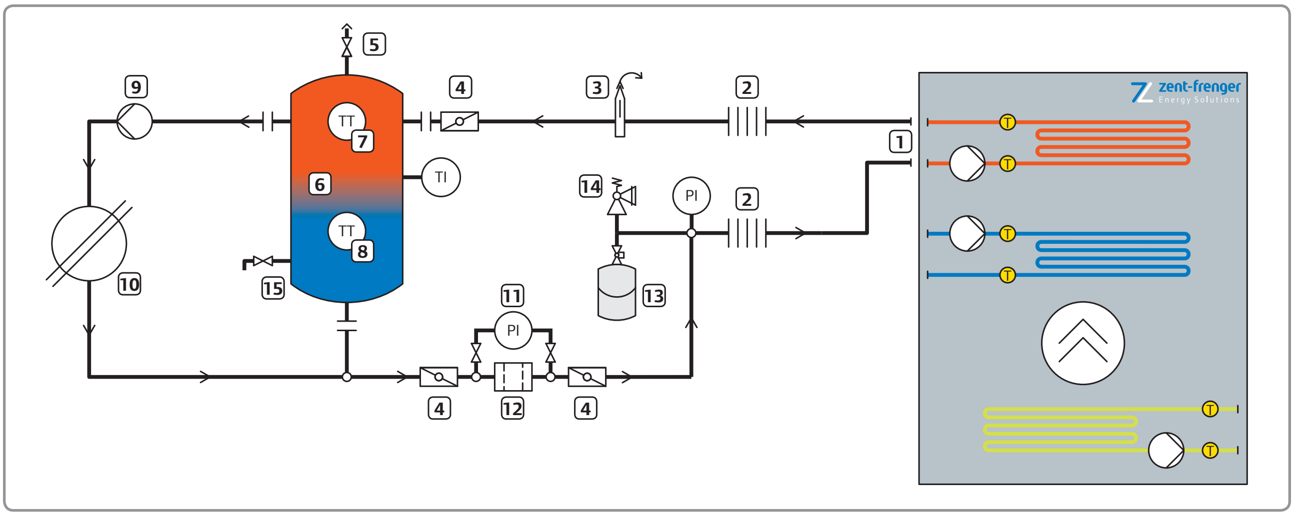
1 Heating circuit connections
2 Cooling circuit connections
3 Source connections
4 Current and voltage supply
5 Control:
   Setpoint specification
   Enable
   System messages
   Warnings
   Alarms

GEOZENT Eco 80 with hydraulic connections



Simplified hydraulics diagram for Geozent Eco 80 – 320

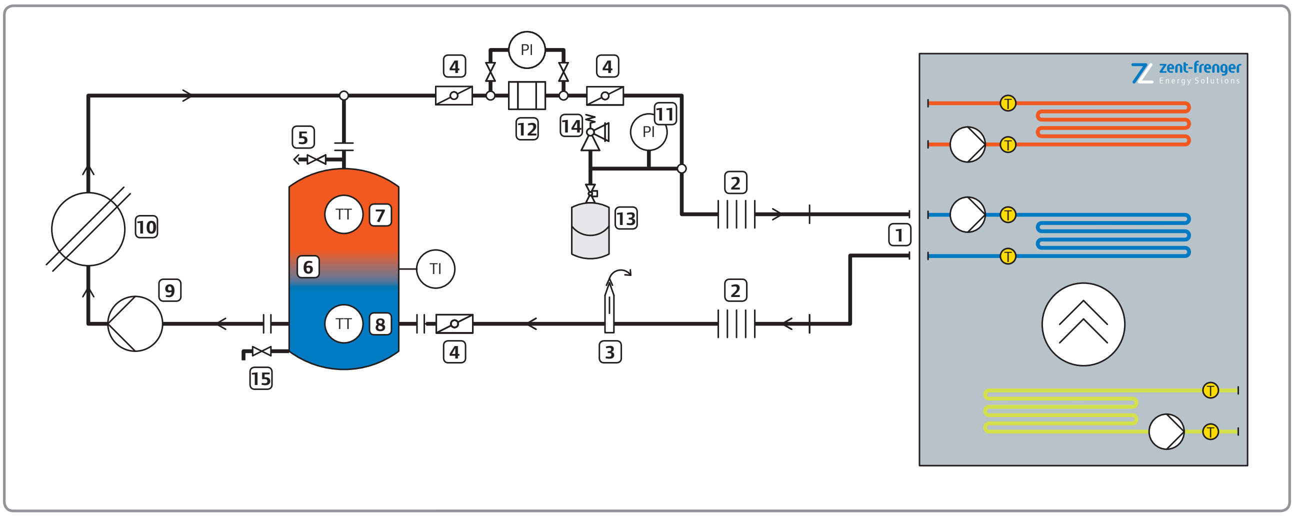
Connecting a heat reservoir to the GEOZENT Eco heat pump



Example hydraulic system

1 Detachable connection
2 Pipe expansion joint
3 Microbubble separator
4 Shut-off valves (secured to prevent unintentional closure)
5 Vent cock
6 Heat reservoir
7 Temperature sensor, heat reservoir, top
8 Temperature sensor, heat reservoir, bottom
9 Heating circuit feed pump
10 Device system
11 Manometer
12 Filter
13 Expansion vessel
14 Safety valve
15 Drain cock

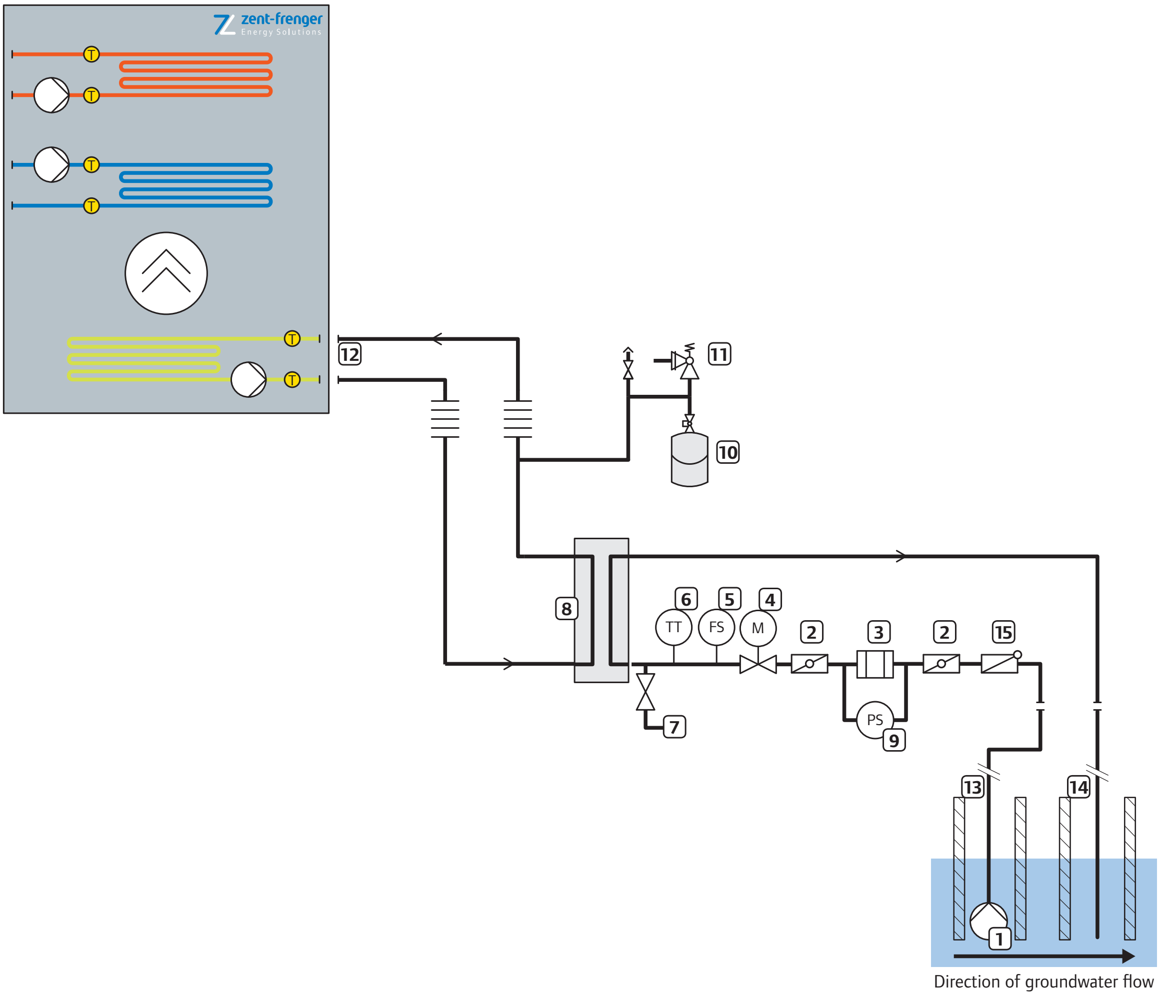
Connecting a cold reservoir to the GEOZENT Eco heat pump



Example hydraulic system

1 Detachable connection
2 Pipe expansion joint
3 Microbubble separator
4 Shut-off valves (secured to prevent unintentional closure)
5 Vent cock
6 Cold reservoir
7 Temperature sensor, cold reservoir, top
8 Temperature sensor, cold reservoir, bottom
9 Cooling circuit feed pump
10 Device system
11 Manometer
12 Filter
13 Expansion vessel
14 Safety valve
15 Drain cock

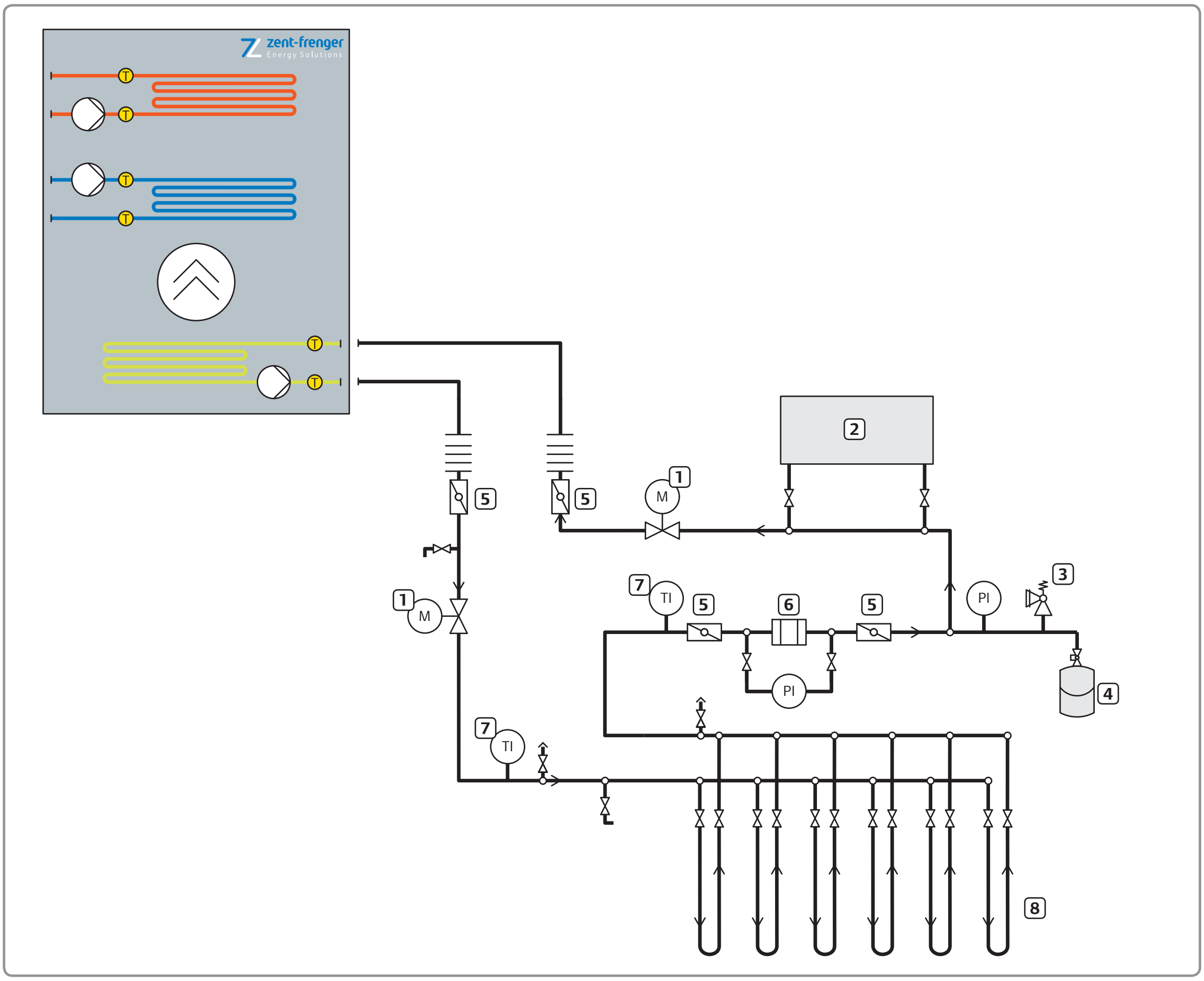
Source: wells with separating heat exchangers



Example hydraulic system

1 Feed pump (submersible)
2 Shut-off valve (secured to prevent unintentional closure)
3 Filter
4 Well circuit, controlled shut-off valve
5 Flow monitor
6 Temperature sensor
7 Drain cock
8 Separating heat exchanger
9 Differential pressure monitor
10 Expansion vessel
11 Safety component
12 Detachable connection
13 Extraction well
14 Injection well
15 Check valvea

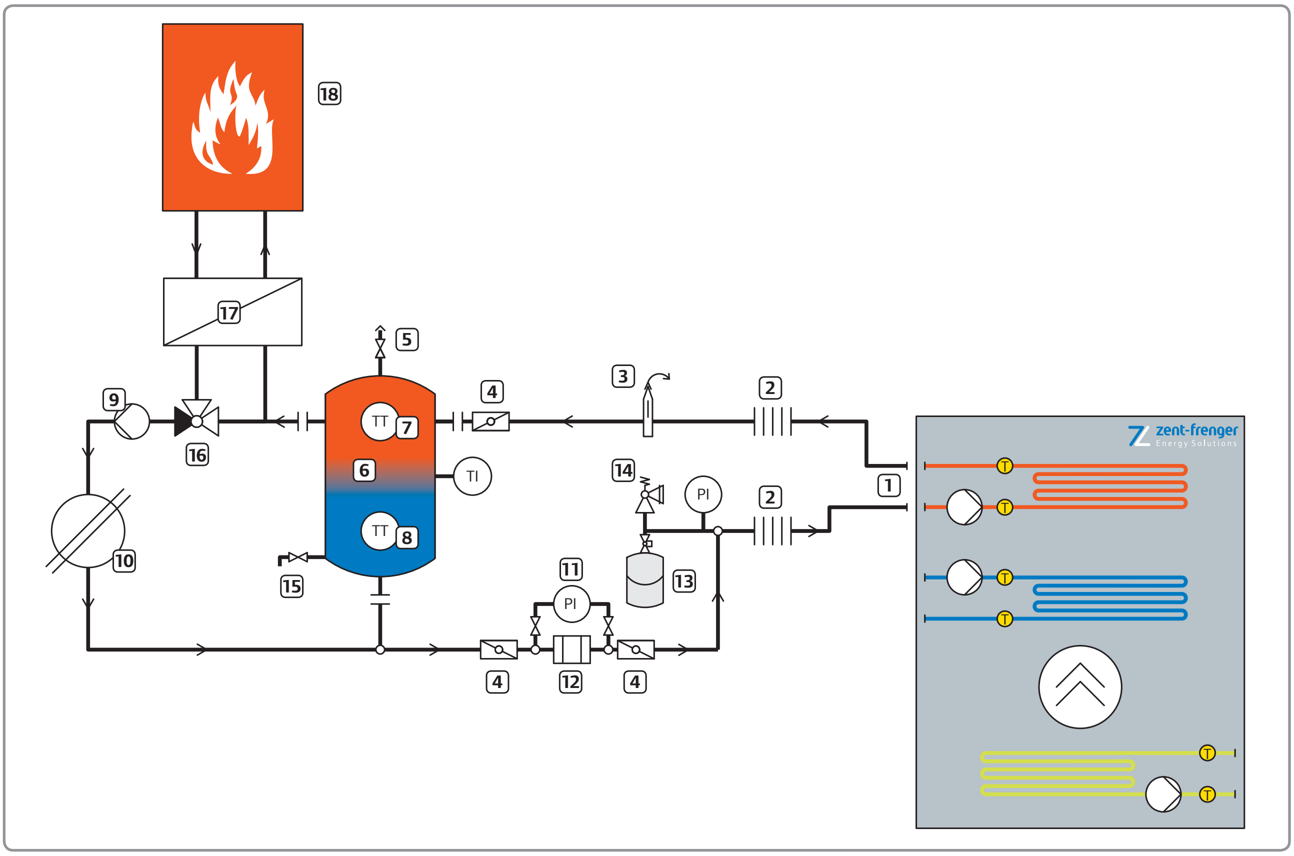
Source: geothermal borehole field, energy piles or horizontal collectors



Example hydraulic system

1 Shut-off valve (controlled)
2 Deaerator
3 Pressure relief valve
4 Expansion vessel
5 Shut-off valve (manual)
6 Filter
7 Temperature sensor
8 Borehole field

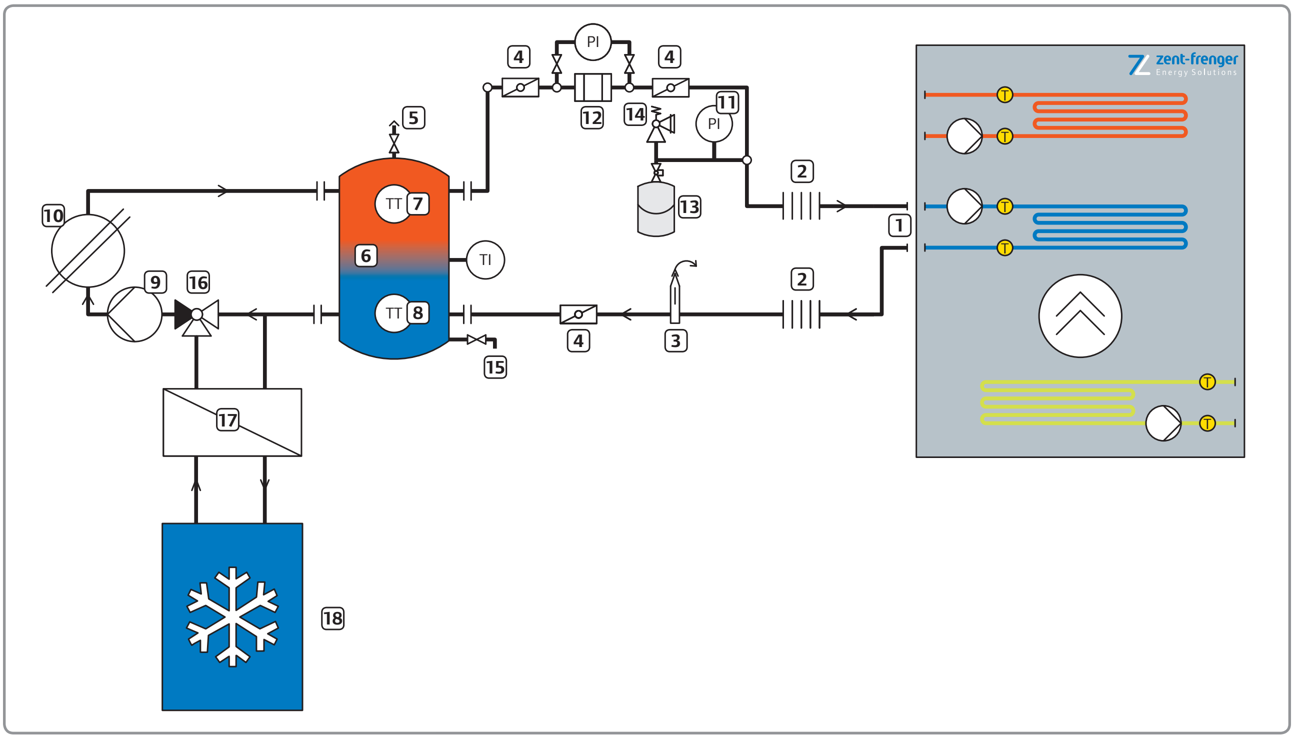
Bivalent or monoenergetic operation of the GEOZENT Eco heat pump to cover the base load in heating mode



Example hydraulic system

1 Detachable connection
2 Pipe expansion joint/noise protection
3 Microbubble separator
4 Shut-off valves (secured to prevent unintentional closure)
5 Vent cock
6 Heat reservoir
7 Temperature sensor, heat reservoir, top
8 Temperature sensor, heat reservoir, bottom
9 Heating circuit feed pump
10 Device system
11 Manometer
12 Filter
13 Expansion vessel
14 Safety valve
15 Drain cock
16 3-way valve (mixing valve)
17 Heat exchanger for the second heat source District heating system/fossil-fuel heating circuit

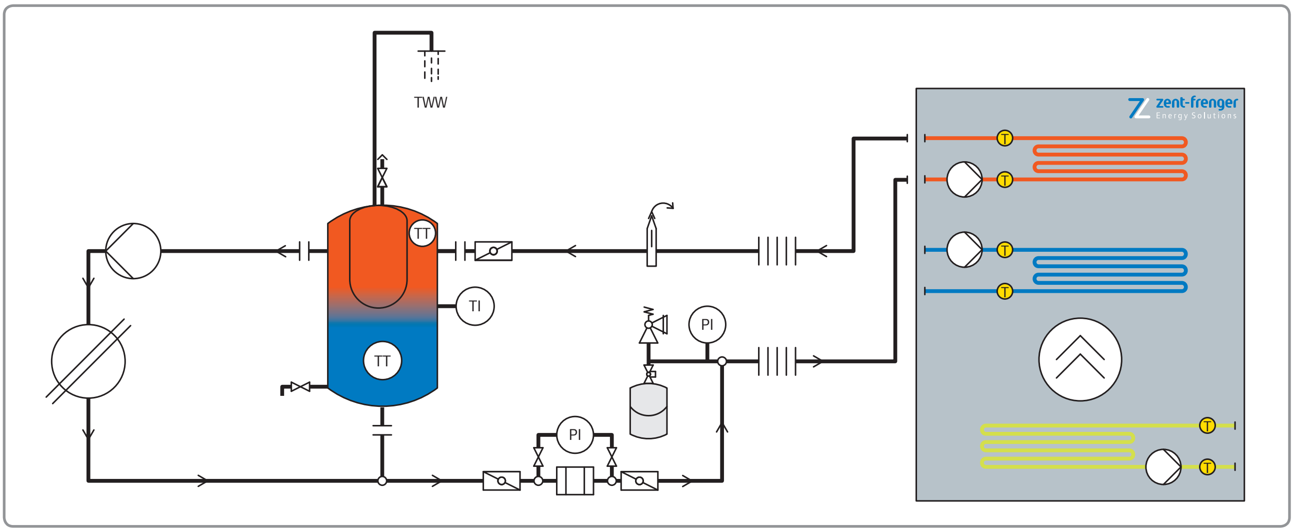
Bivalent or monoenergetic operation of the GEOZENT Eco heat pump to cover the base load in cooling mode



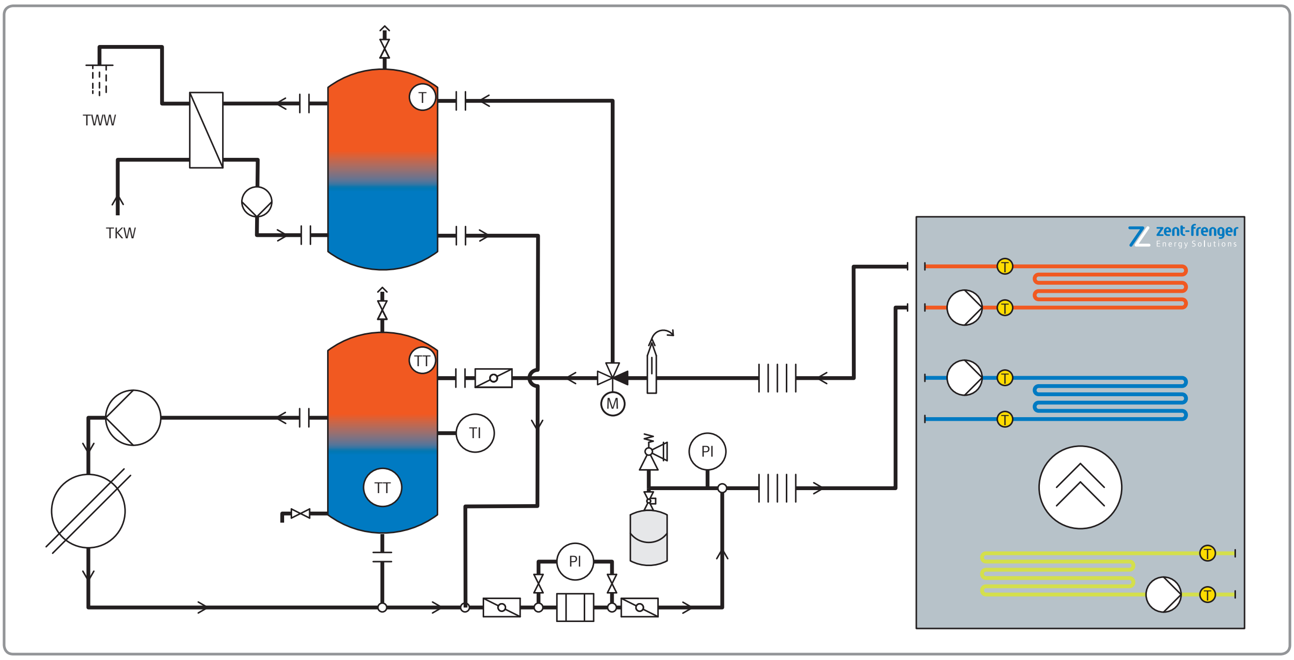
Example hydraulic system

1 Detachable connection
2 Pipe expansion joint/noise protection
3 Microbubble separator
4 Shut-off valves (secured to prevent unintentional closure)
5 Vent cock
6 Cold reservoir
7 Temperature sensor, cold reservoir, top
8 Temperature sensor, cold reservoir, bottom
9 Cooling circuit feed pump
10 Device system
11 Manometer
12 Filter
13 Expansion vessel
14 Safety valve
15 Drain cock
16 3-way valve (mixing valve)
17 Heat exchanger for the second cold source
18 Ice storage unit; other cold sources

Example models for heating domestic water with the GEOZENT Eco heat pump



Example hydraulic system **Reservoir with calorifier** Solution: ideal for high supply temperatures in the heating circuit (≥ 45 °C)



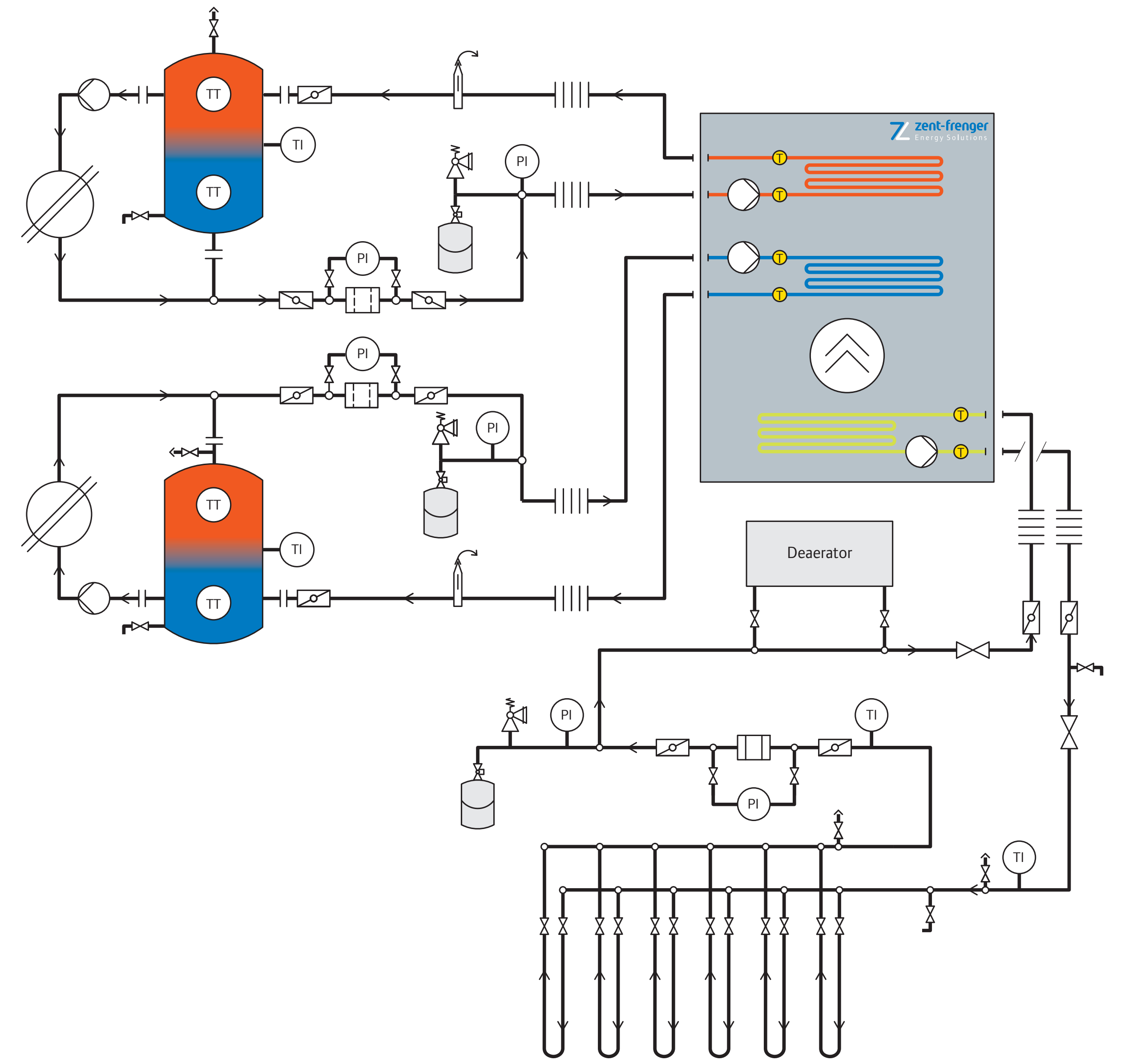
Example hydraulic system **2-reservoir** Solution for domestic water unit: ideal for low supply temperatures in the heating circuit (example hydraulic system)

Please note

As the GEOZENT Eco heat pump output is high, you should not use combined storage units which use coiled tubes to heat domestic water. There is a risk of the coils not transferring enough heat to the water for use, and the heating water flowing back to the heat pump at too high a temperature. This would result in the heat pump shutting down before the required temperature is reached in the water for use.

GEOZENT Eco with geothermal borehole field and heating and cooling requirements

The diagram below shows the full functional scope of the GEOZENT Eco heat pump (heating, cooling, natural cooling and dual operation). All components required are provided in the compact unit. That means that the GEOZENT Eco takes up little space in the engineering room. Integrated hydraulic components such as pumps and pipes minimize the risk of connection errors on site.

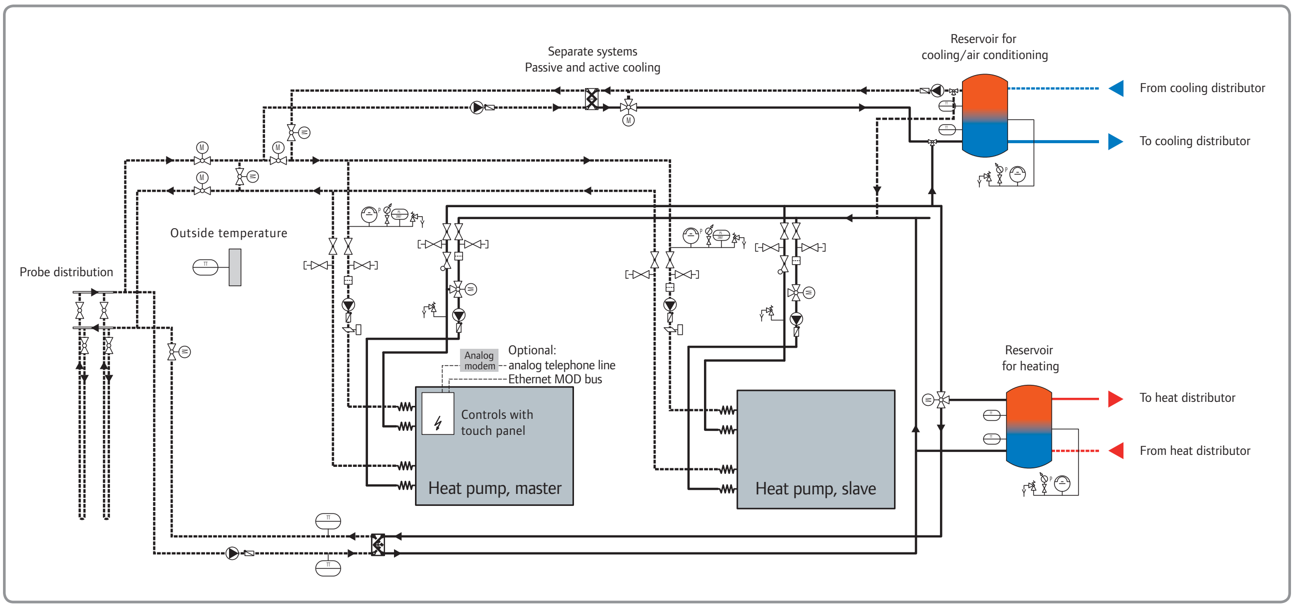


Example of a GEOZENT Eco heat pump unit (complete hydraulic system)

Comparison of systems: Individual component solution – GEOZENT Eco

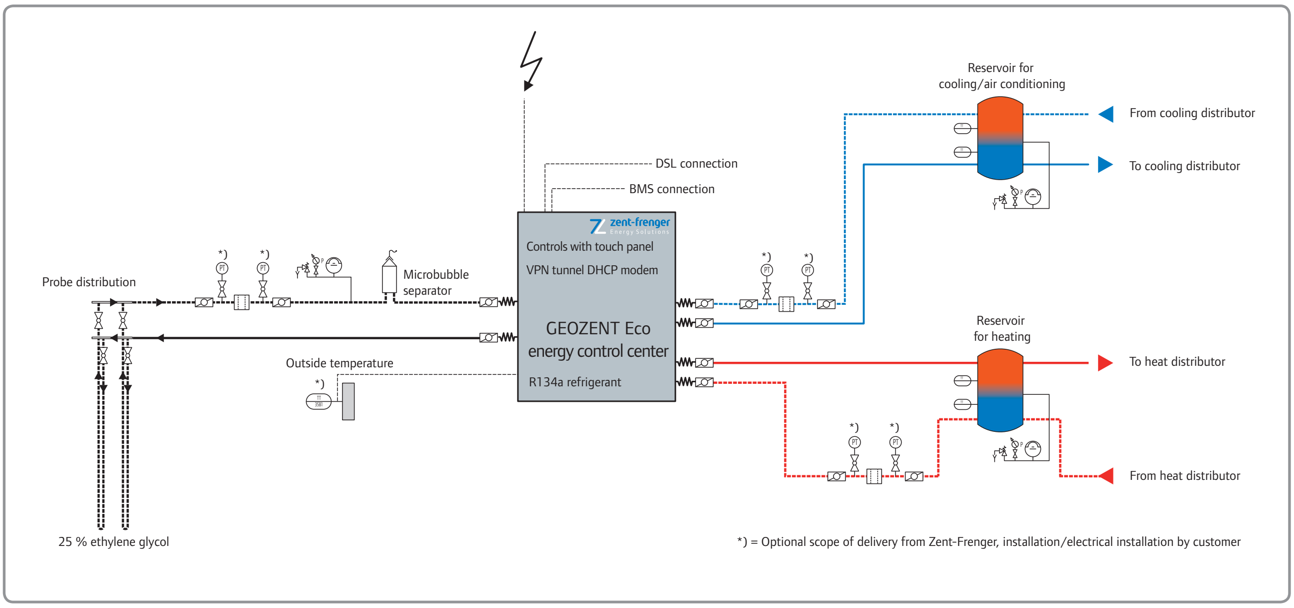
Conventional solution with individual components

In conventional systems, the components and modules required for the various functions are usually assembled at the installation site. Apart from the more complex planning and design process involved, this on-site procedure also poses a number of risks, for example if there are components missing or components do not fit. In such cases, it is often no longer possible to meet tight timescales or budgets.



Modular solution with GEOZENT Eco heat pumps

GEOZENT Eco heat pumps come with all functional system components already installed and tested. At the site, the heat pump then only needs to be connected to the source and device pipe system and to the electricity supply. This makes on-site installation considerably faster, more reliable and easier to plan than for conventional individual component solutions.



Notes

GEOZENT Eco technical data

Eco 80 – 320 technical data

	Eco 80	Eco 100	Eco 130	Eco 170	Eco 210	Eco 280	Eco 320
Heating							
Brine 4/0 °C; water 30/35 °C (B4/W35). [1]							
Rated heat output [kW]	80.4	101.2	130.5	175.0	210.9	287.0	317.5
Extraction output [kW]	63.6	80.3	104.0	138.2	166.0	230.5	253.4
Wattage [kW]	16.8	20.9	26.5	36.8	44.9	56.5	64.1
COP [-]	4.79	4.85	4.93	4.76	4.70	5.08	4.95
CO_2 energy savings compared to natural gas up to [t/a]	16.9	21.5	28.1	36.5	43.5	63.3	68.6
Heating							
Brine 4/0 °C; water 45/50 °C (B4/W50). [1]							
Rated heat output [kW]	73.0	91.4	117.4	163.5	198.8	255.2	291.1
Extraction output [kW]	50.5	63.5	82.7	113.3	137.8	179.5	205.6
Wattage [kW]	22.5	27.9	34.7	50.2	61.0	75.7	85.5
COP [-]	3.25	3.28	3.38	3.26	3.26	3.37	3.41
CO_2 energy savings compared to natural gas up to [t/a]	8.9	11.3	15.6	20.0	24.4	33.6	39.1
Cooling							
Brine 30/25 °C; water 12/6 °C (B30/W6). [2) 5)]							
Rated cooling output [kW]	79.0	99.8	129.1	172.2	206.7	273.7	312.4
Input [kW]	95.1	119.8	154.6	207.5	249.9	328.3	374.3
Wattage [kW]	16.1	20.0	25.5	35.3	43.2	54.6	61.9
EER [-]	4.89	4.99	5.07	4.88	4.78	5.01	5.05
CO_2 savings compared to conventional refrigerating machines [t/a]	2.70	3.67	5.02	5.74	6.28	10.24	12.00
Dual operation							
Water 12/6 °C; water 45/50 °C. [3) 5)]							
Rated heat output [kW]	83.1	104.0	133.7	182.9	223.7	291.6	331.4
Rated cooling output [kW]	59.8	75.1	97.9	131.6	161.2	214.0	242.7
Wattage [kW]	23.3	28.9	35.8	51.2	62.5	77.6	88.7
Dual operation - performance rate [-]	6.13	6.20	6.46	6.14	6.16	6.52	6.47
CO_2 savings compared to conventional refrigerating machines and natural gas [t/a]	12	15.2	20.5	26.5	32.5	45	50.8
Natural cooling							
Brine 10/4 °C; water 12/6 °C. [4) 5)]							
Rated cooling output [kW]	79.0	100.0	129.0	172.0	206.0	274.0	311.0
Wattage [kW]	1.9	2.3	3.3	4.1	4.5	5.5	7.0
CO_2 savings compared to conventional refrigerating machines [t/a]	13.2	16.9	21.5	28.8	34.8	46.7	52.4

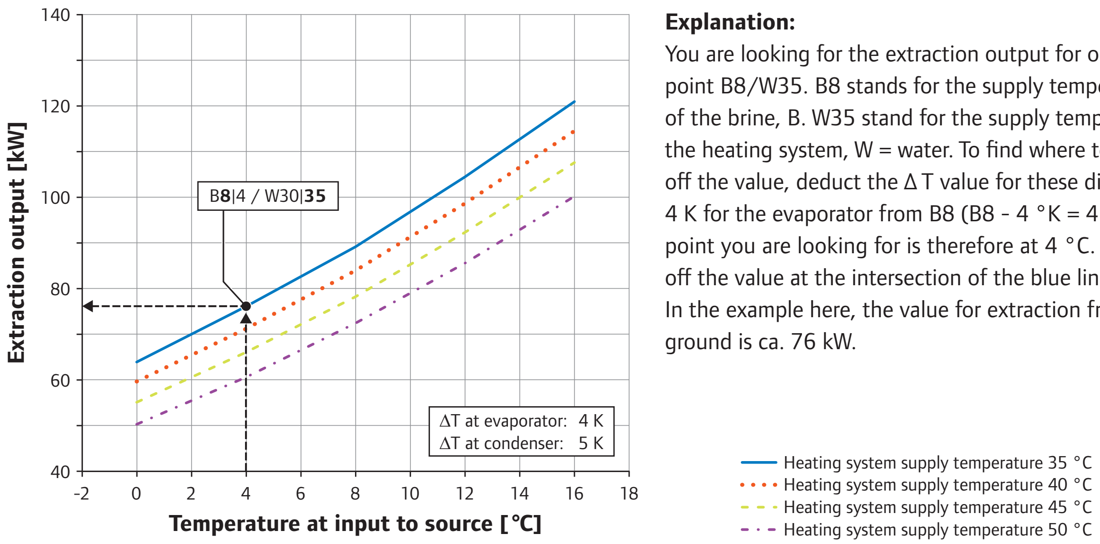
1) 1800 h heating per annum.
2) 1500 h cooling per annum.
3) 1000 h dual operation per annum.
4) 1500 h natural cooling per annum.
5) EER of refrigeration machine in comparison: 4

	Eco 80	Eco 100	Eco 130	Eco 170	Eco 210	Eco 280	Eco 320
Compressor [-]	CSH6553-50Y	CSH6563-60Y	CSH6593-60Y	CSH7583-80Y	CSH8563-90Y	CSH8583-125Y	CSH8593-140Y
Refrigerant [-]	R 134A	R 134A	R 134A	R 134A	R 134A	R 134A	R 134A
Refrigerant - quantity [kg]	26	34	43	60	71	120	136
Operating limits							
Heat source [°C]	-6 °C – 12 °C						
Heating and cooling water [°C]	6 °C – 50 °C						
Total dimensions							
Length [mm]	2225	2225	2225	3169	3169	4175	4175
Width [mm]	1400	1400	1400	1800	1800	2000	2000
Height of basic model/model with enclosure [mm]	1750/1845	1750/1845	1750/1845	1750/1845	1750/1845	1795/1845	1795/1845
Number of modules [-]	1	1	1	1	1	2	2
Empty weight (basic) ca. [kg]	1999	2051	2165	2656	3097	3477	3569
Empty weight (enclosure) ca. [kg]	2180	2237	2362	2946	3395	3892	3984
Operating weight (enclosure) ca. [kg]	2319	2412	2614	3264	3811	4540	4684
Sound pressure level [dB(A)]	75.5	81.5	80.7	79.9	83.9	84.1	84.5
Electrical connection							
Supply, operating voltage	3 P / N / PE / 400 V / 50 Hz						
Max. wattage, ca. [kW]	31.5	38	47.4	64.9	77.9	98.5	113.3
Max. operating current, ca. [A]	60.1	72.5	86.4	116.4	135	177.9	202.8
Max. starting current, ca. [A]	225	276	280	363	452	629	600
Max. starting current with PW[1], ca. [A][2]	135	166	168	290	271	377	360
Heating system dimensions [DN]	50	65	80	80	100	100	100
Cooling system dimensions [DN]	50	65	80	80	100	100	100
Geothermal system dimensions [DN]	50	65	80	80	100	100	100

[1] PW = Part winding
[2] Starting currents of the compressor with frequency inverter on request

GEOZENT Eco performance diagrams

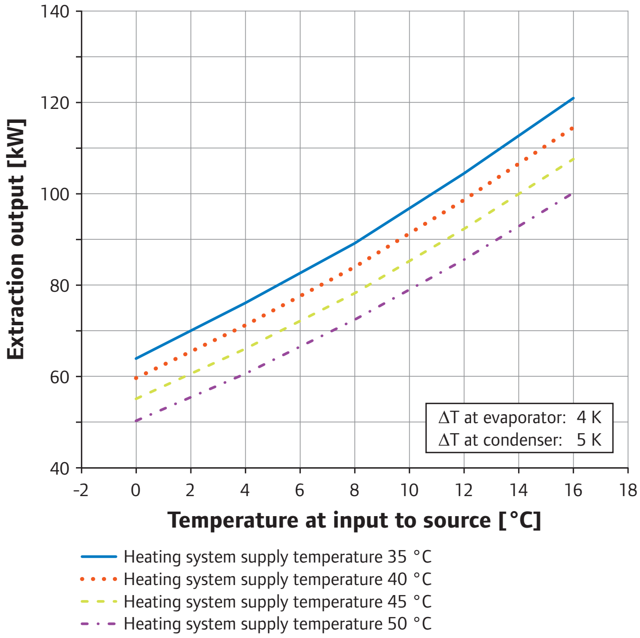
Using the diagrams



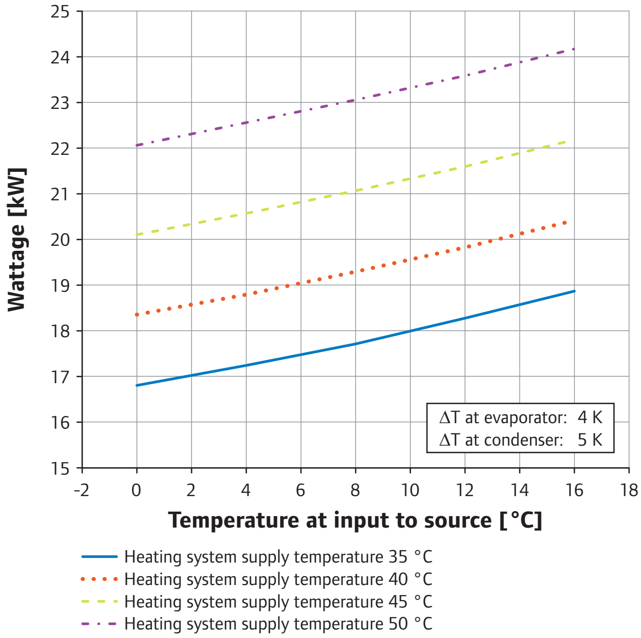
Explanation:
You are looking for the extraction output for operating point B8/W35. B8 stands for the supply temperature of the brine, B. W35 stand for the supply temperature in the heating system, W = water. To find where to read off the value, deduct the Δ T value for these diagrams of 4 K for the evaporator from B8 (B8 - 4 °K = 4 °C). The point you are looking for is therefore at 4 °C. Now, read off the value at the intersection of the blue line for W35. In the example here, the value for extraction from the ground is ca. 76 kW.

Eco 80 performance curves – heating mode

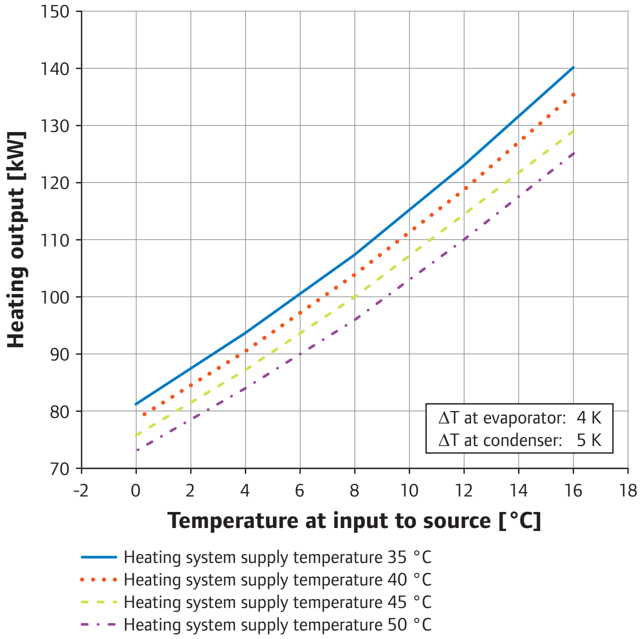
Extraction output from source, ΔT = 5 K



Wattage



Heating output



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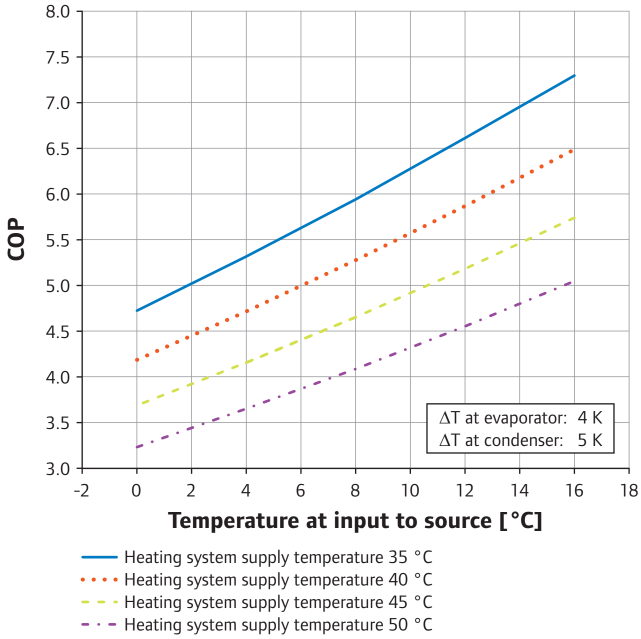
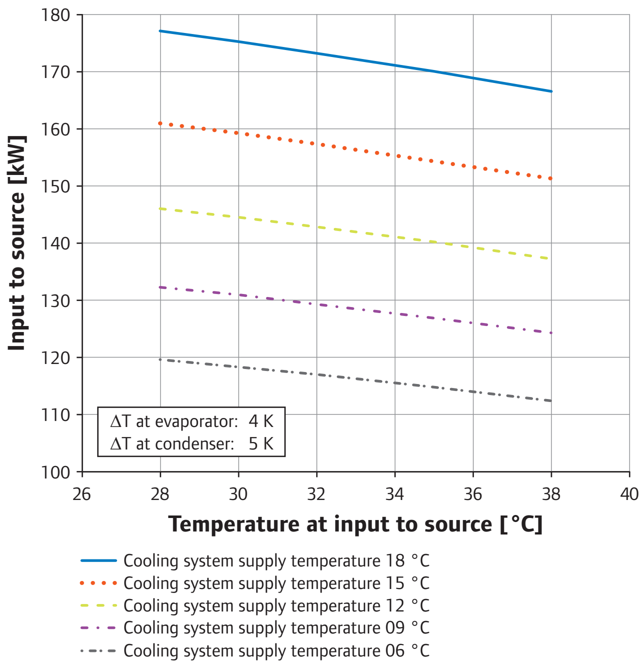


Eco 80 performance curves – cooling mode

Input to source, ΔT = 4 K



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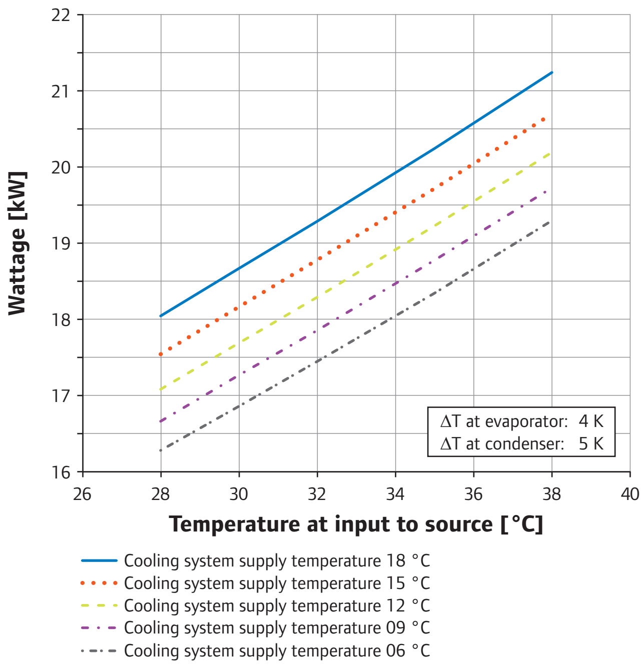
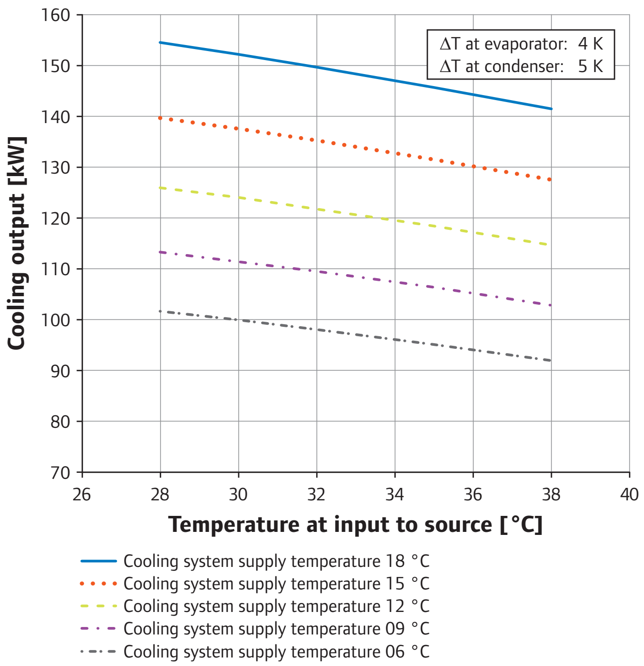


Cooling output



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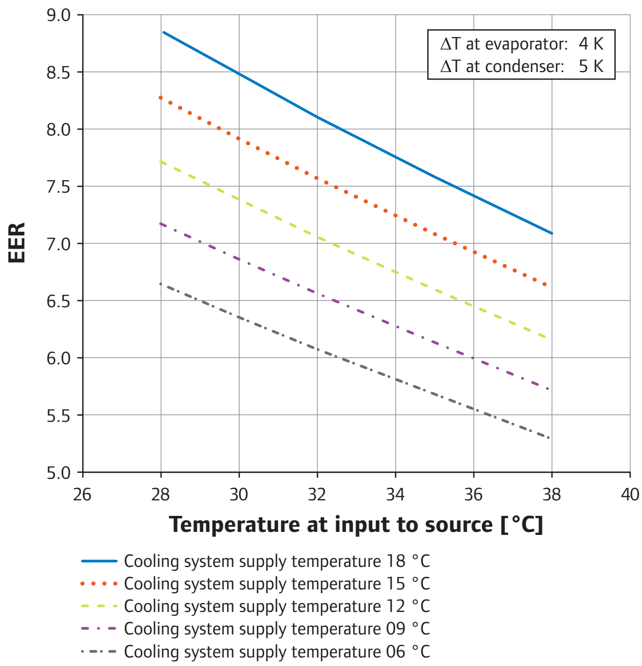
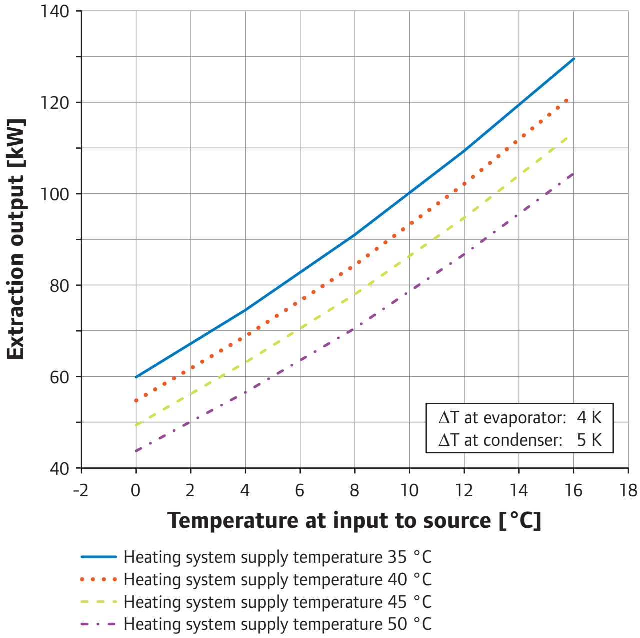


Eco 100 performance curves – heating mode

Extraction output from source, ΔT = 5 K



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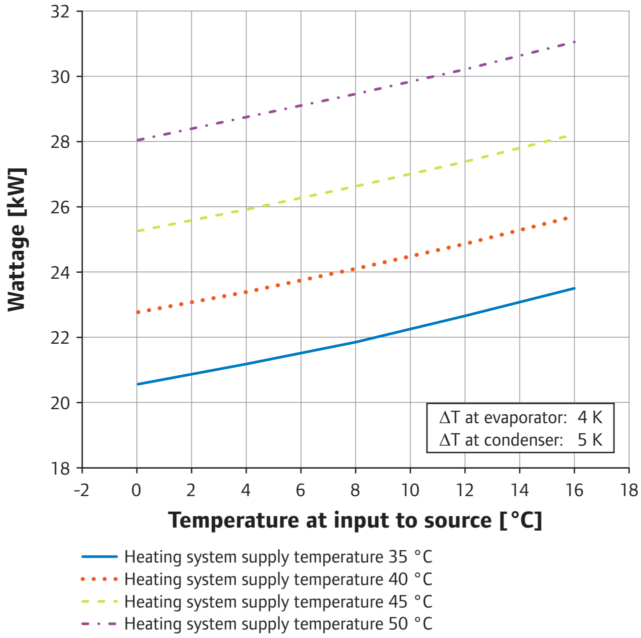
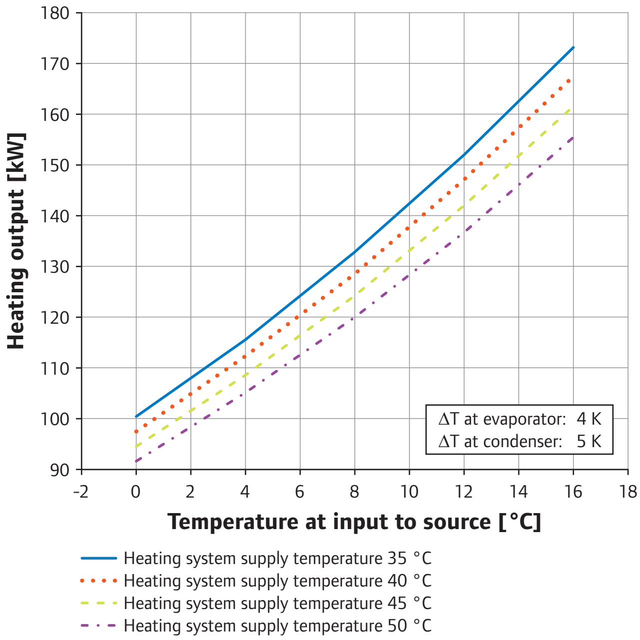


Heating output



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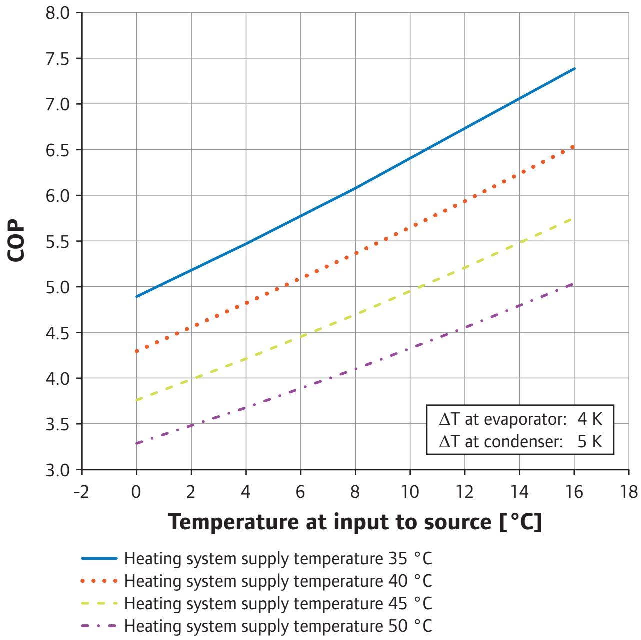
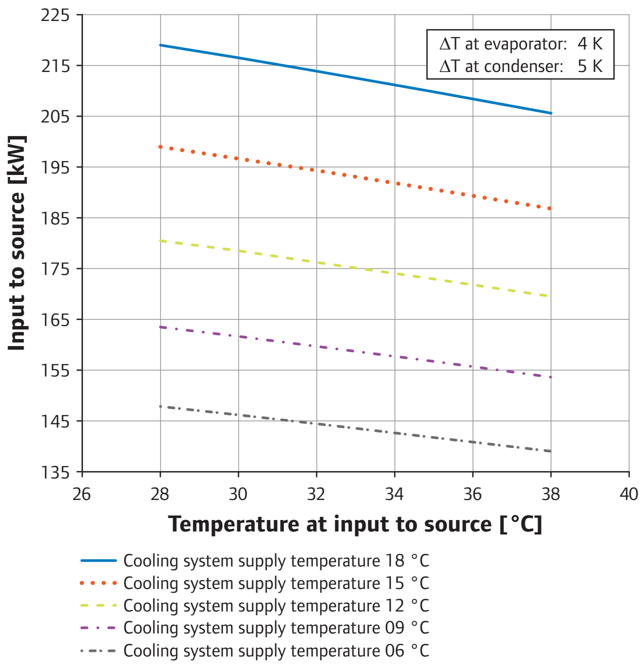


Eco 100 performance curves – cooling mode

Input to source, ΔT = 4 K



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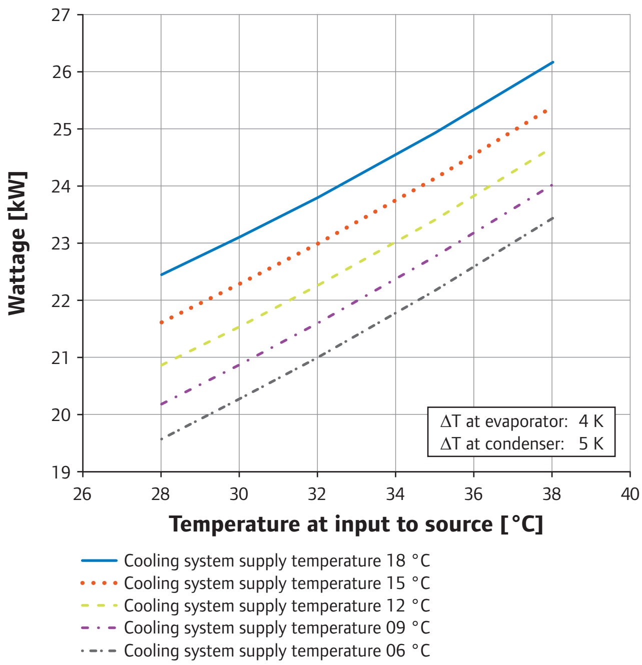
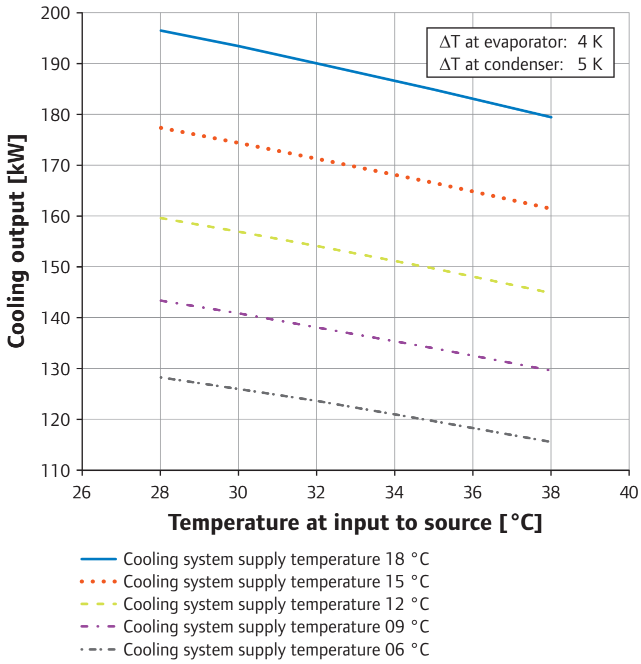


Cooling output



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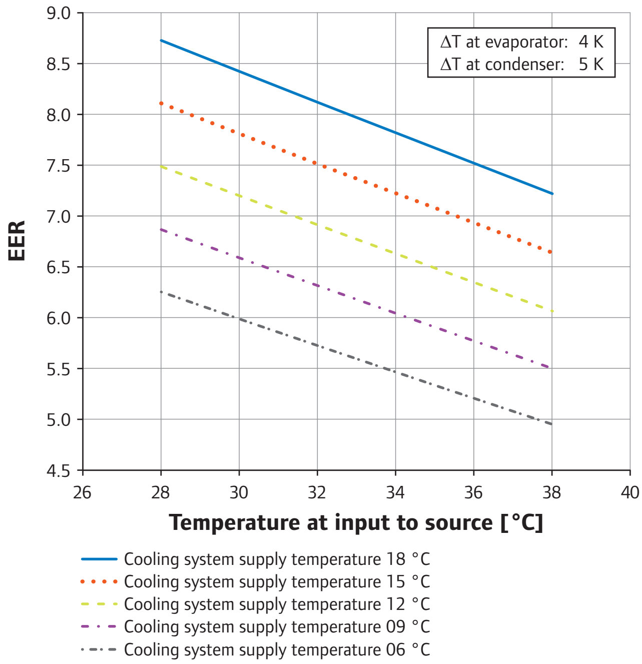
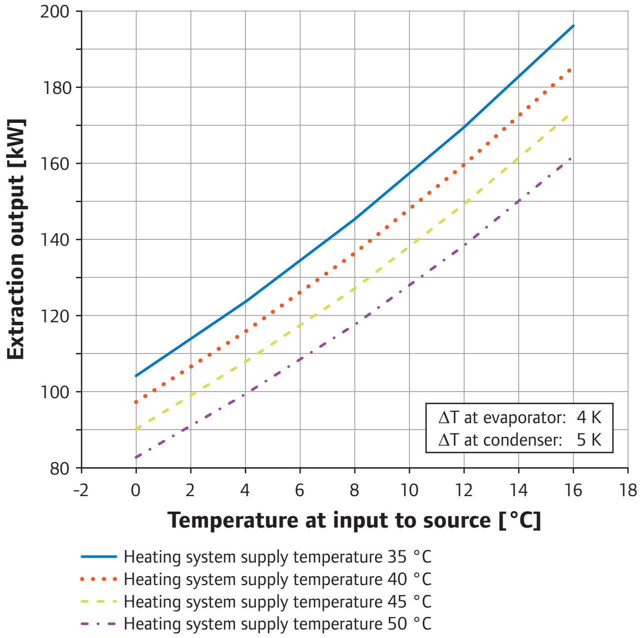


Eco 130 performance curves – heating mode

Extraction output from source, ΔT = 5 K



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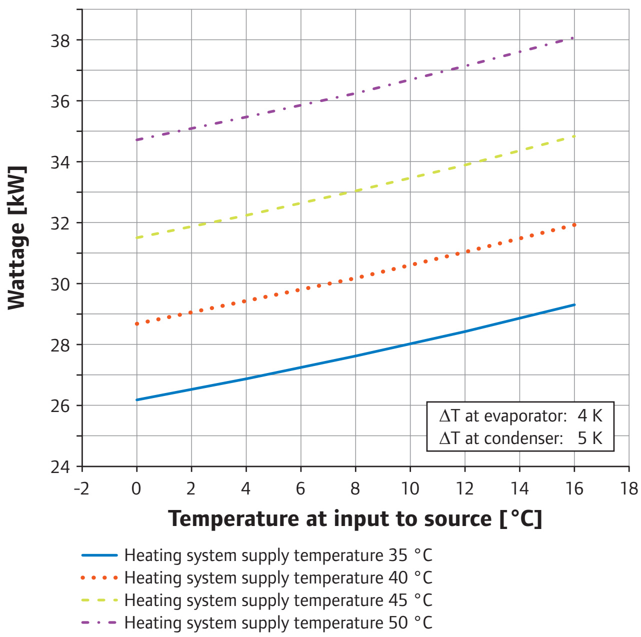
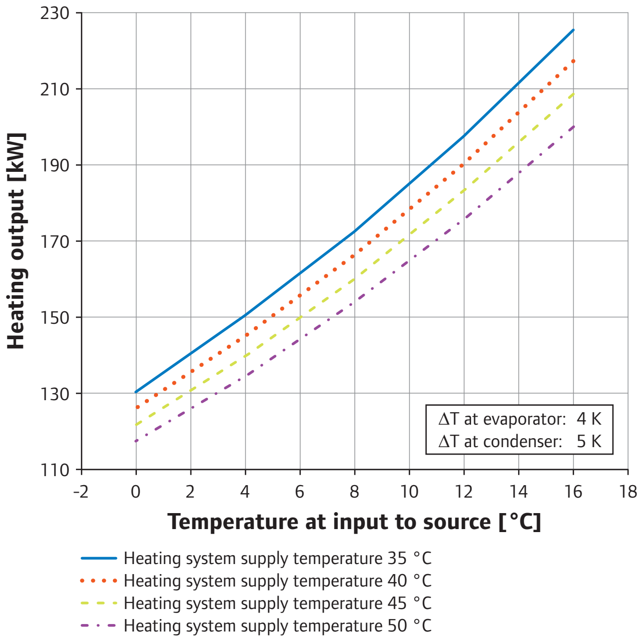


Heating output



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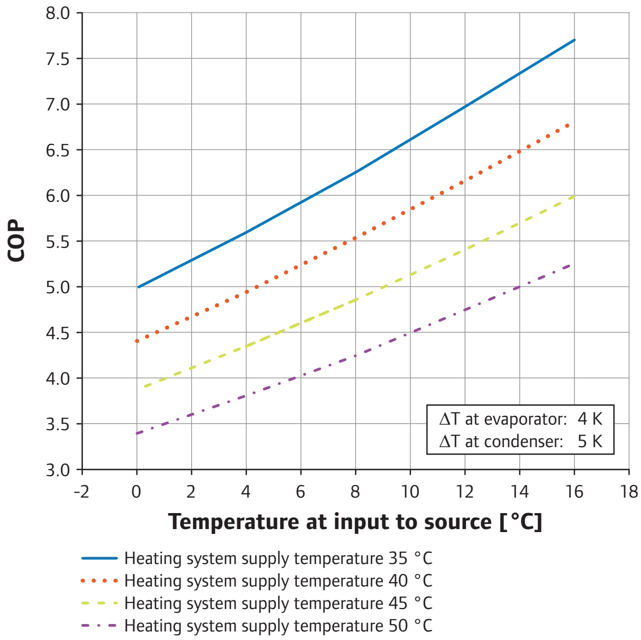
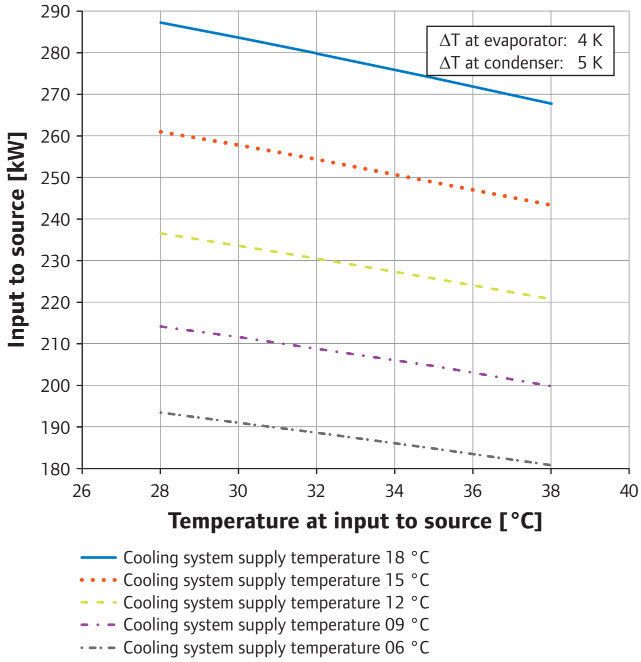


Eco 130 performance curves – cooling mode

Input to source, ΔT = 4 K



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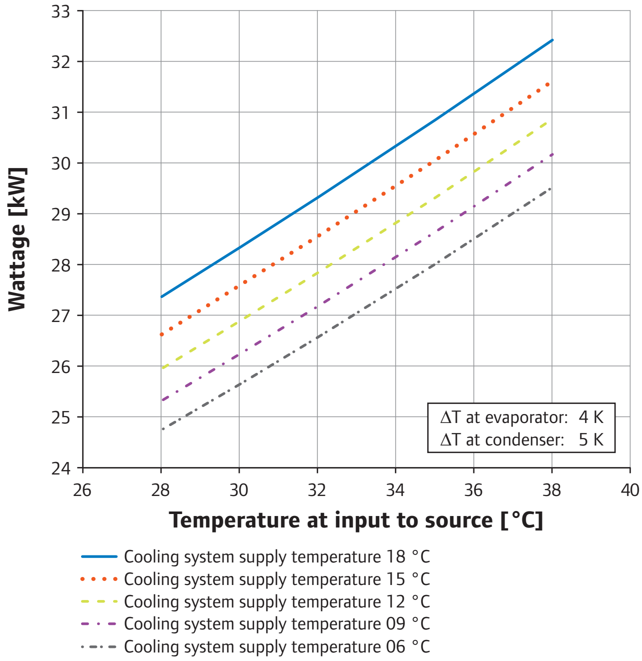
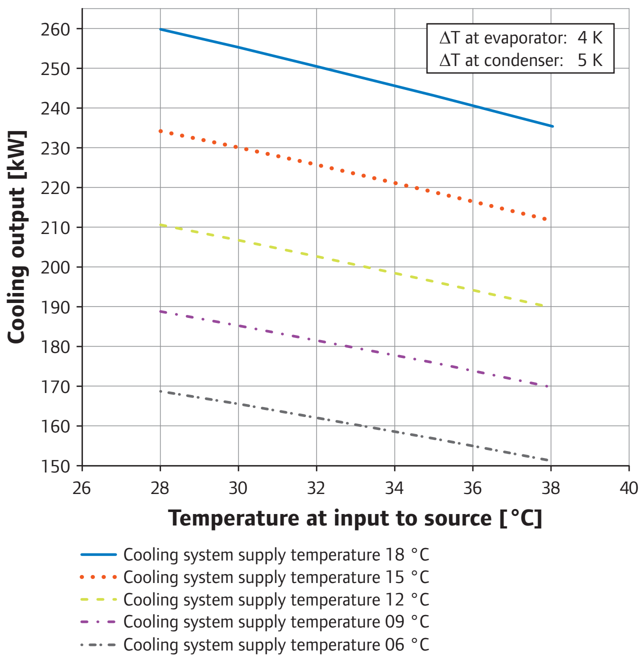


Cooling output



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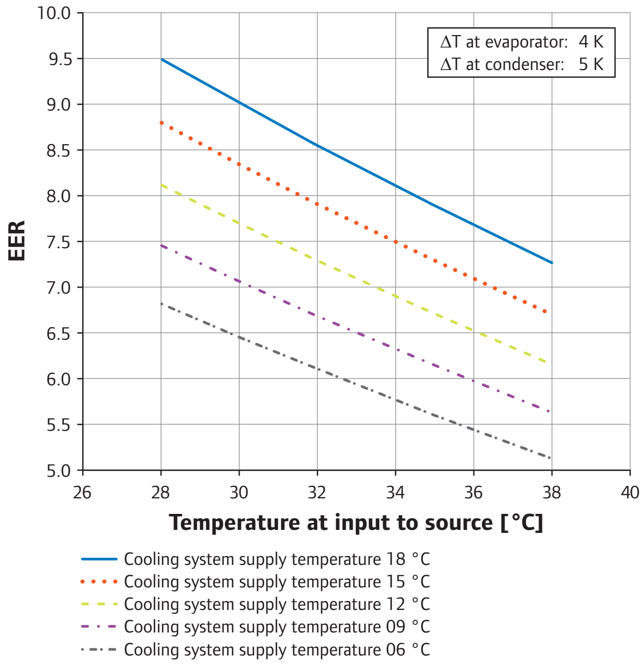
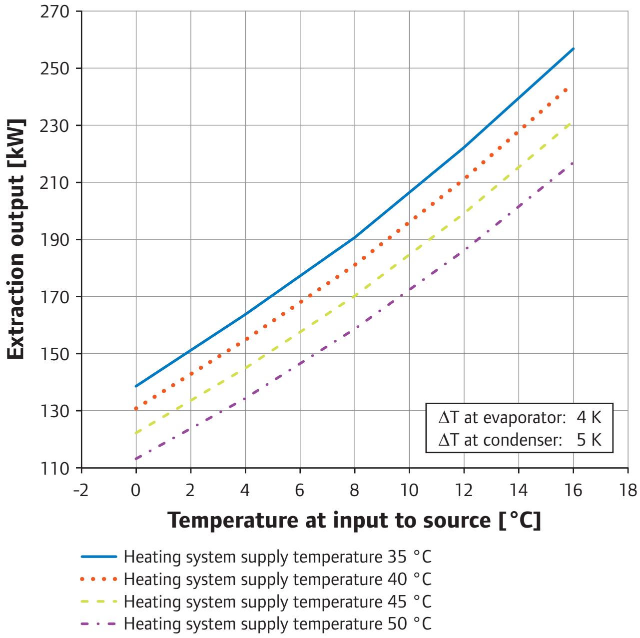


Eco 170 performance curves – heating mode

Extraction output from source, ΔT = 5 K



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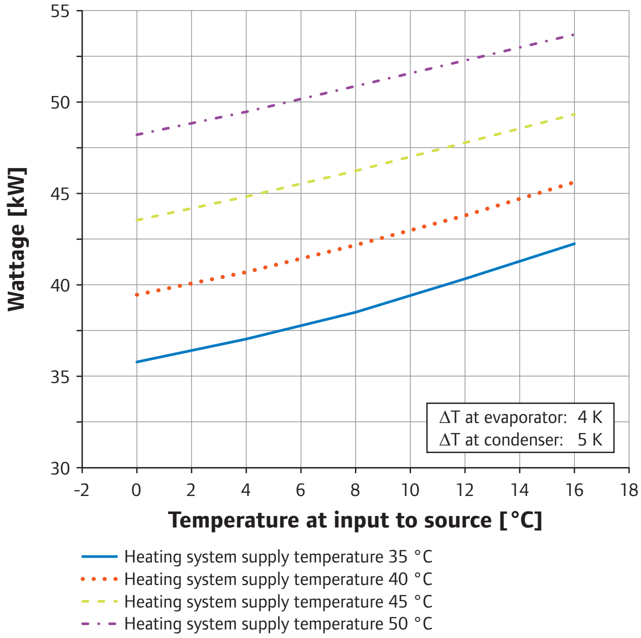
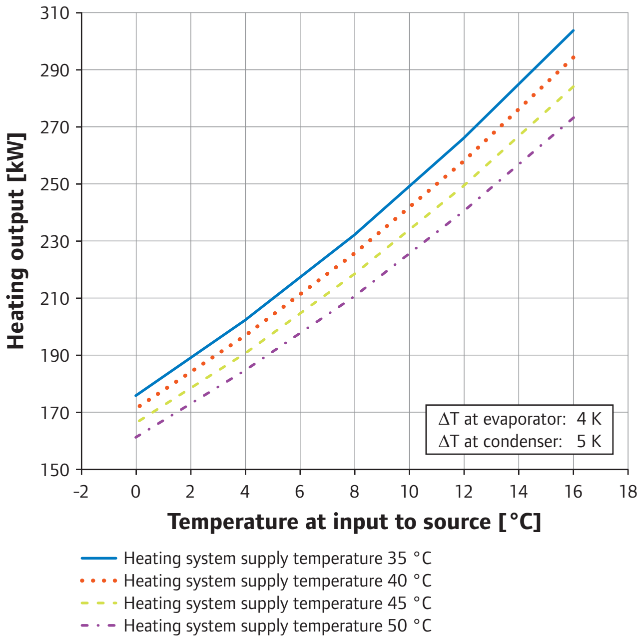


Heating output



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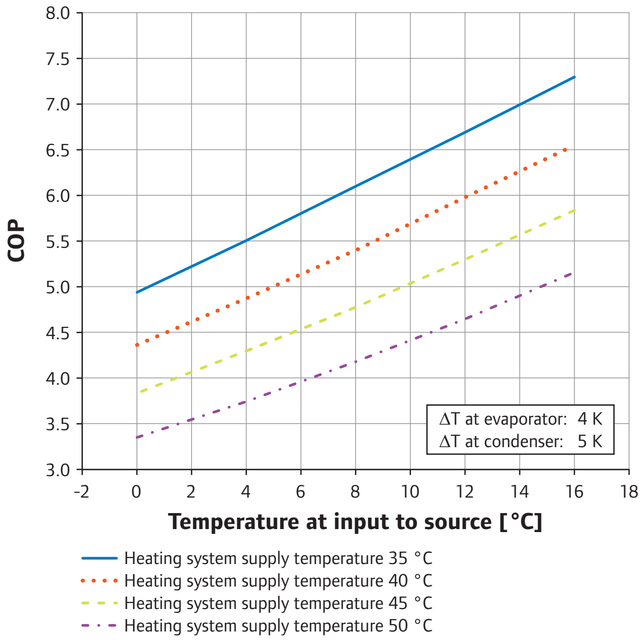
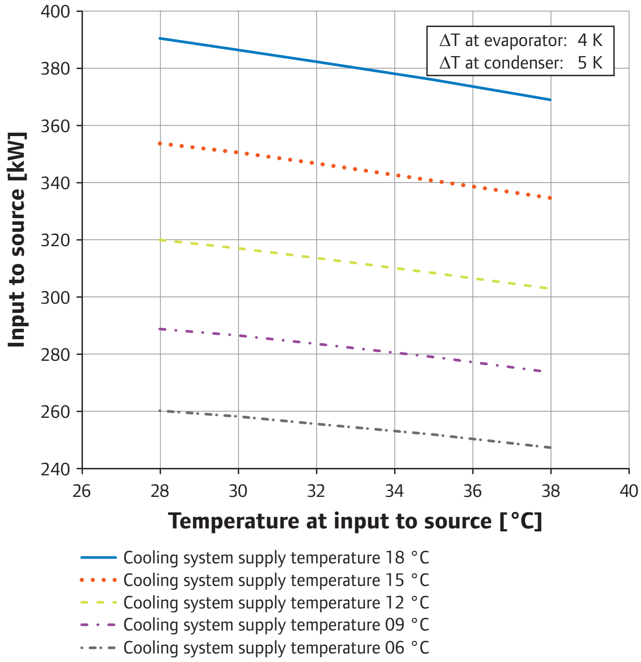
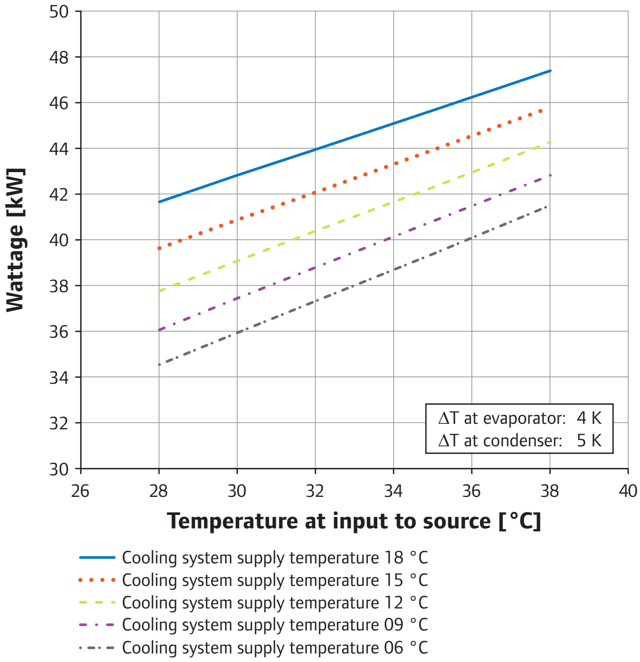


Eco 170 performance curves – cooling mode

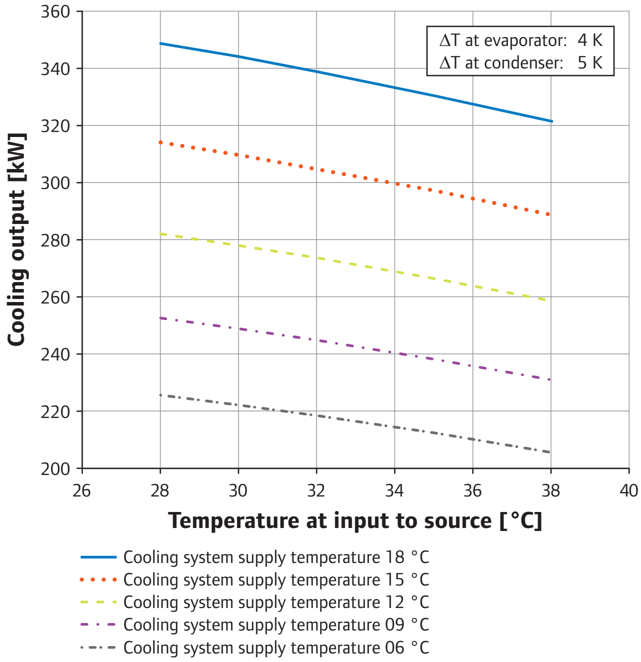
Input to source, ΔT = 4 K



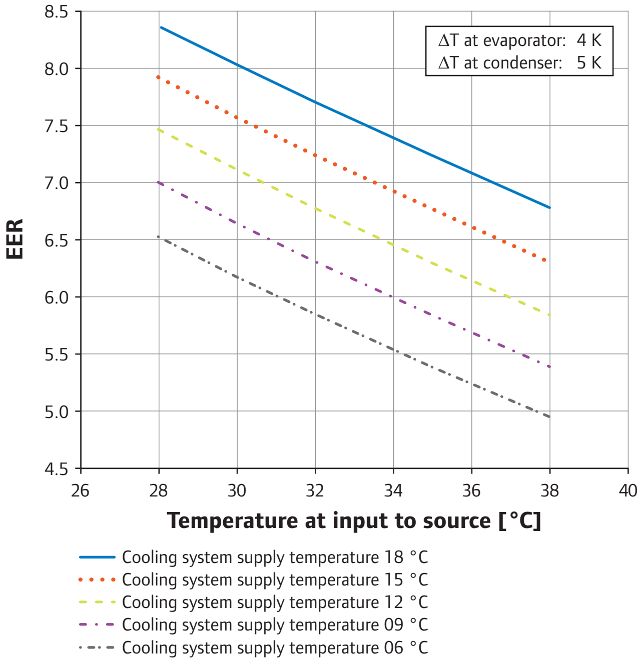
Wattage



Cooling output

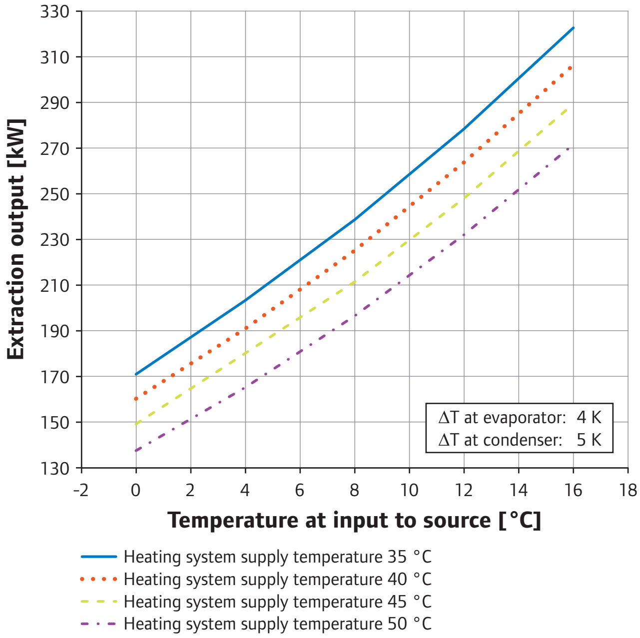


EER

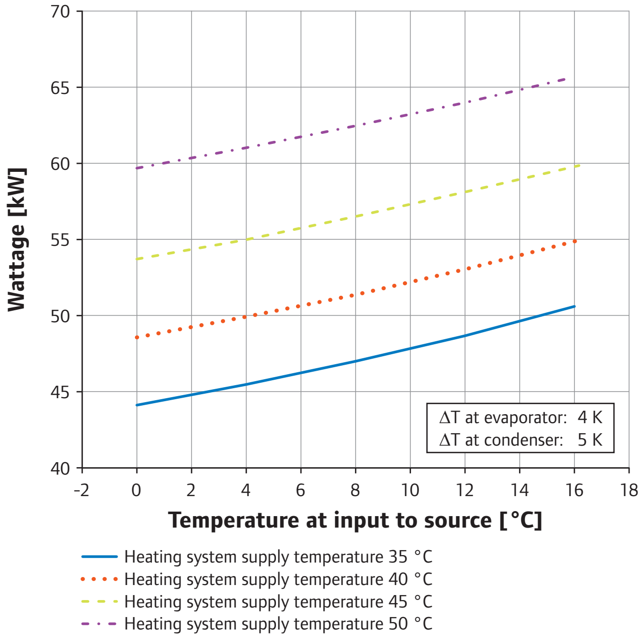


Eco 210 performance curves – heating mode

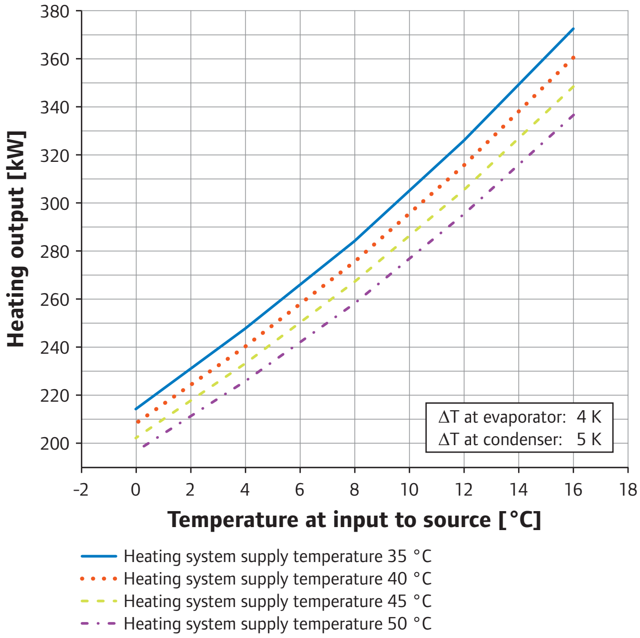
Extraction output from source, ΔT = 5 K



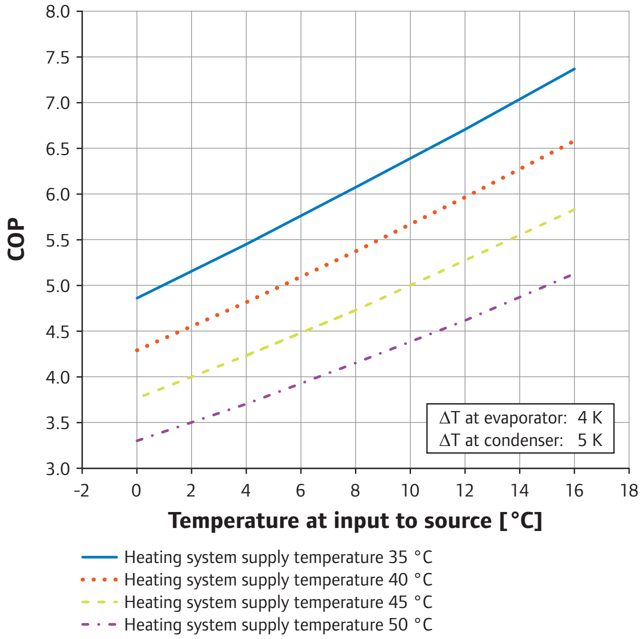
Wattage



Heating output

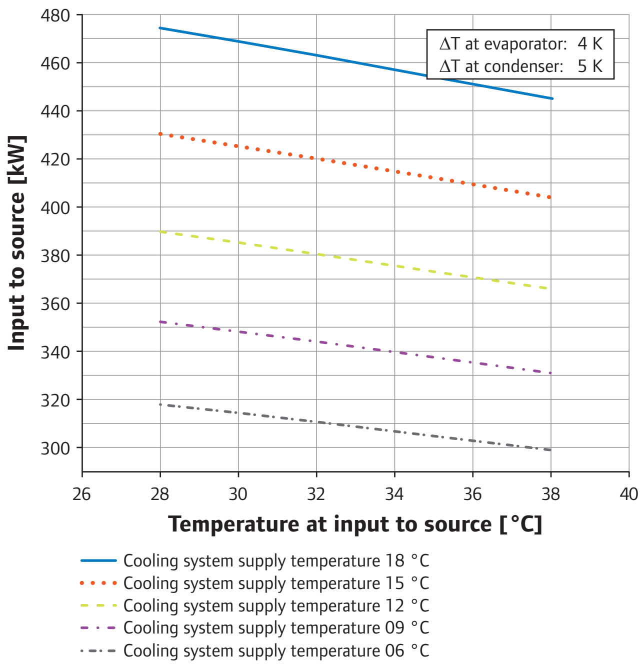


COP

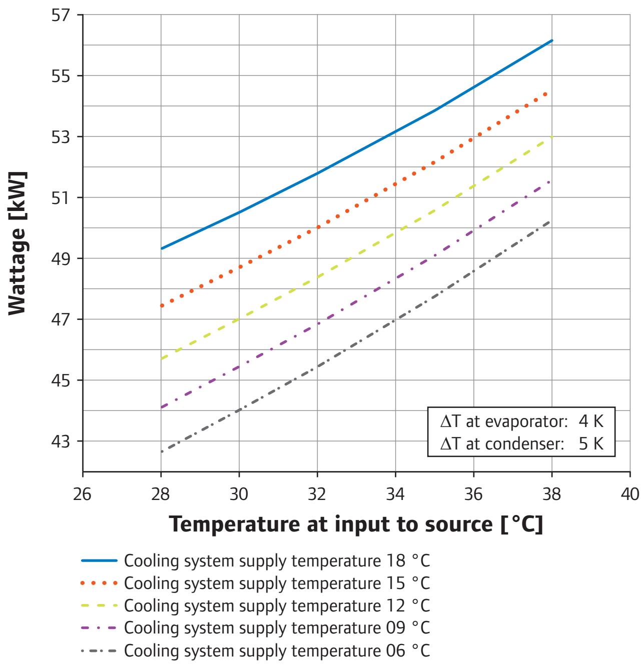


Eco 210 performance curves – cooling mode

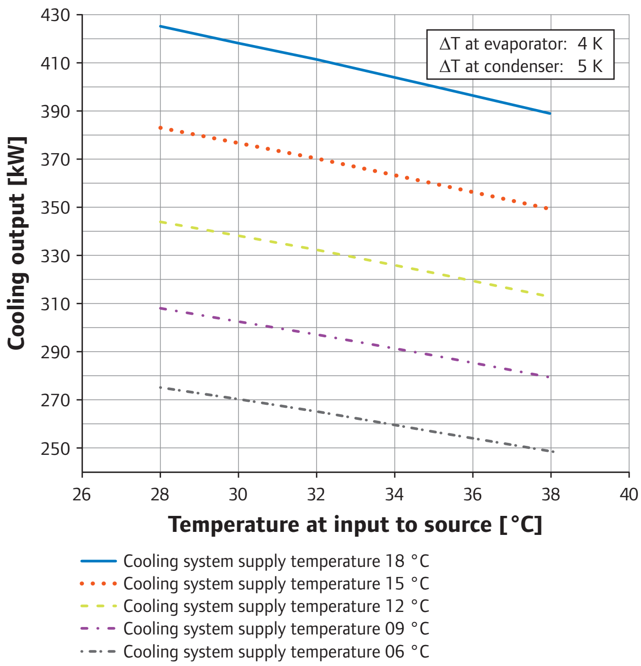
Input to source, ΔT = 4 K



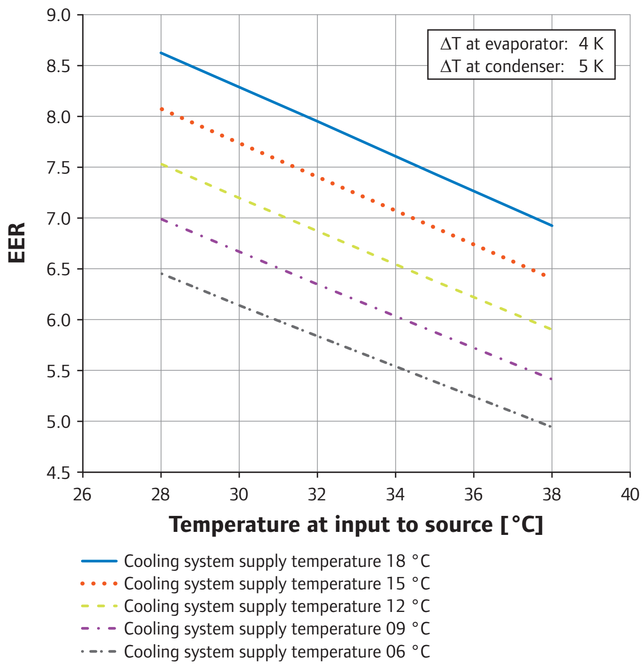
Wattage



Cooling output

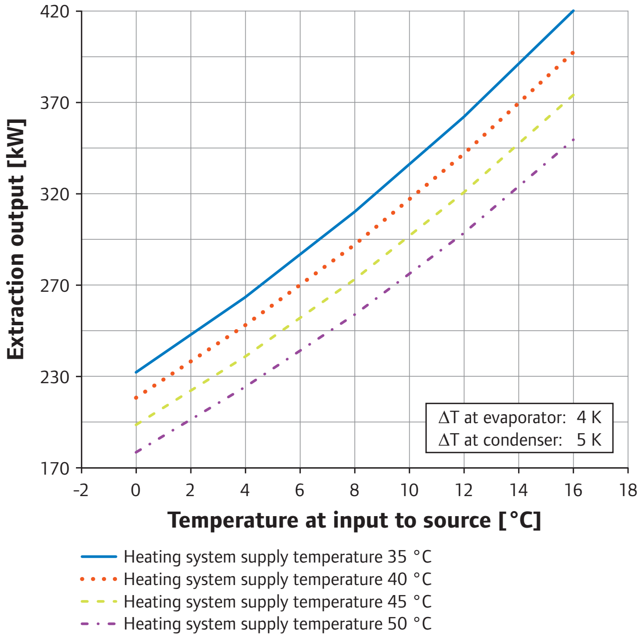


EER

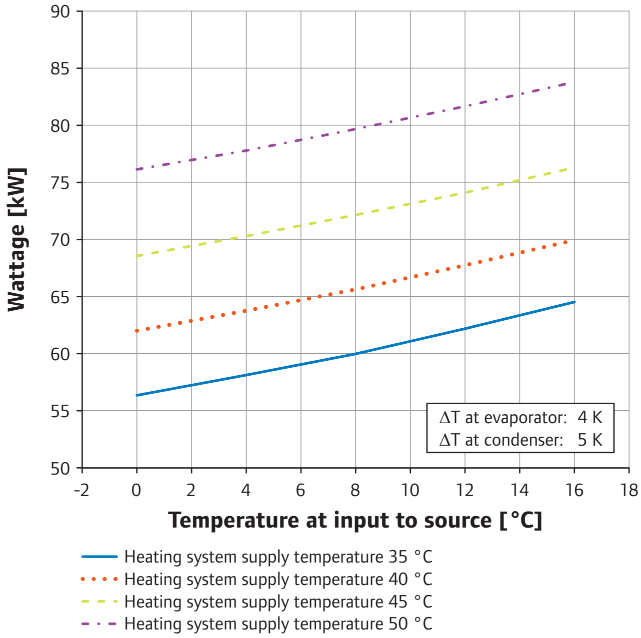


Eco 280 performance curves – heating mode

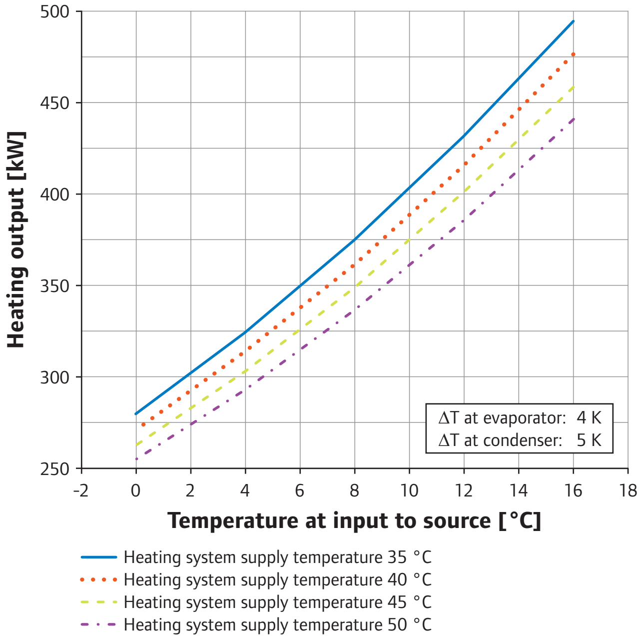
Extraction output from source, ΔT = 5 K



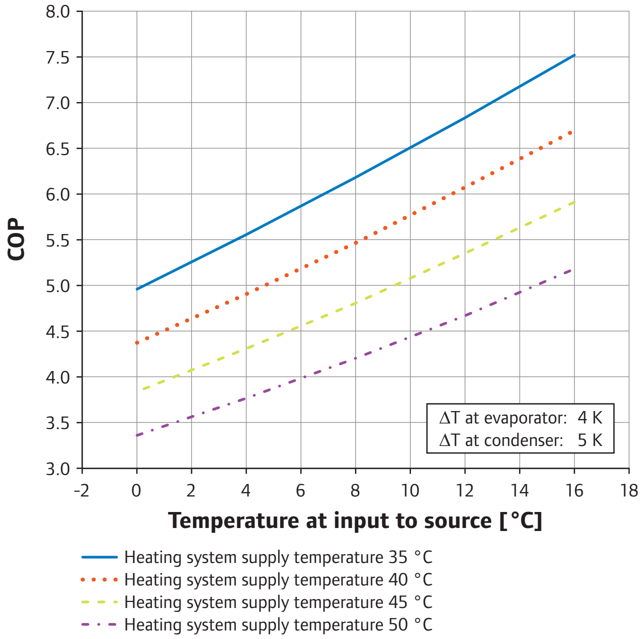
Wattage



Heating output

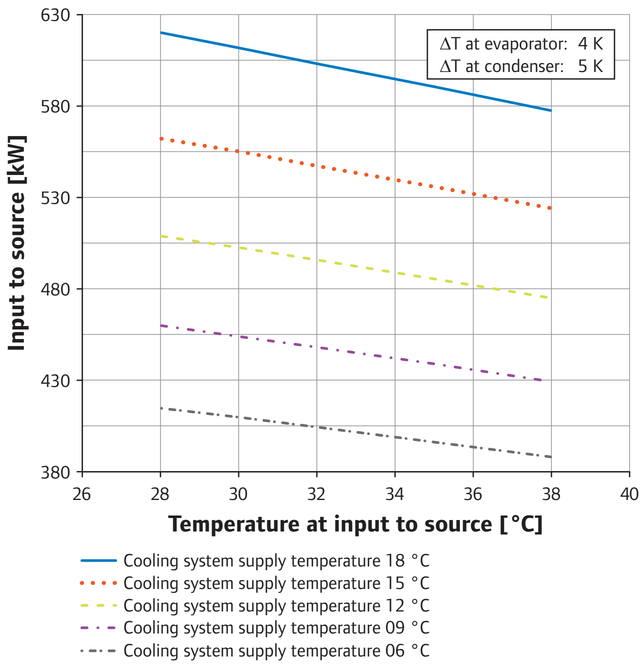


COP

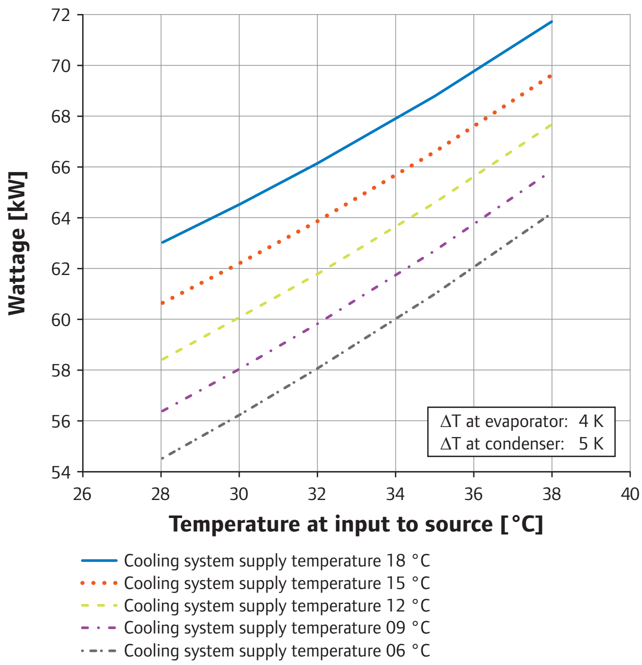


Eco 280 performance curves – cooling mode

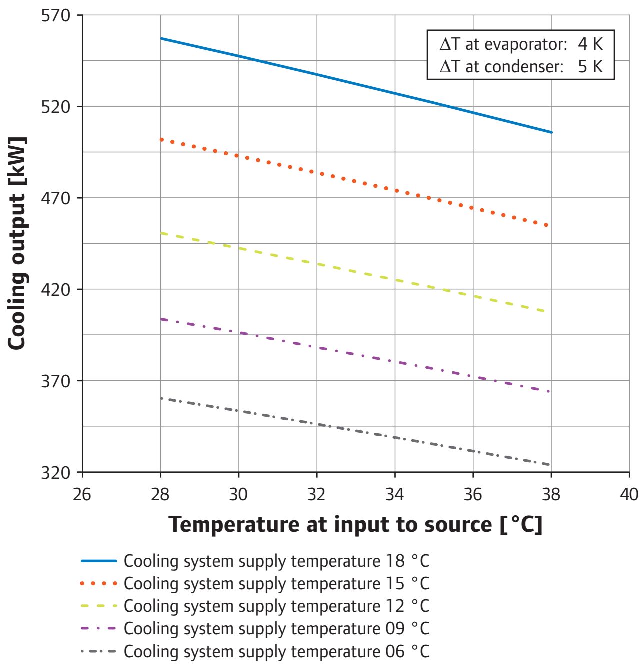
Input to source, ΔT = 4 K



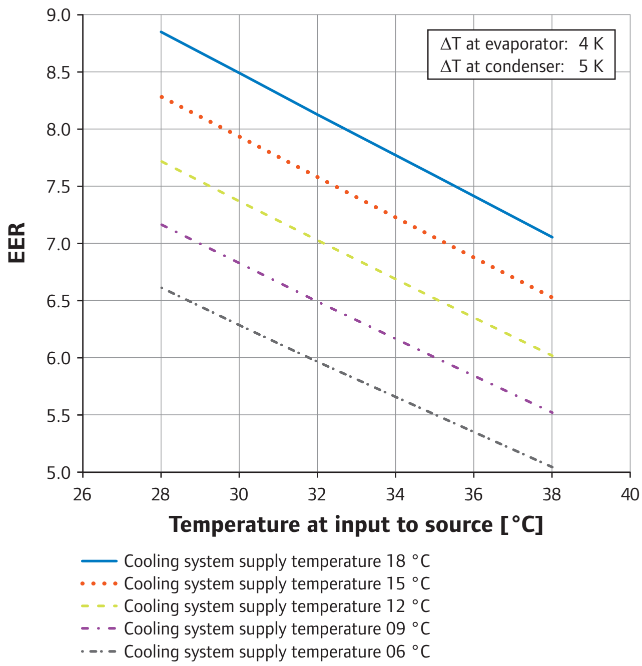
Wattage



Cooling output

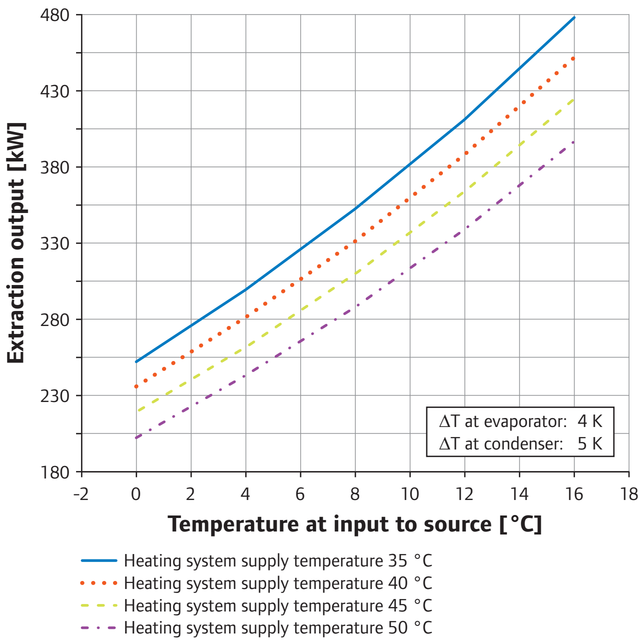


EER

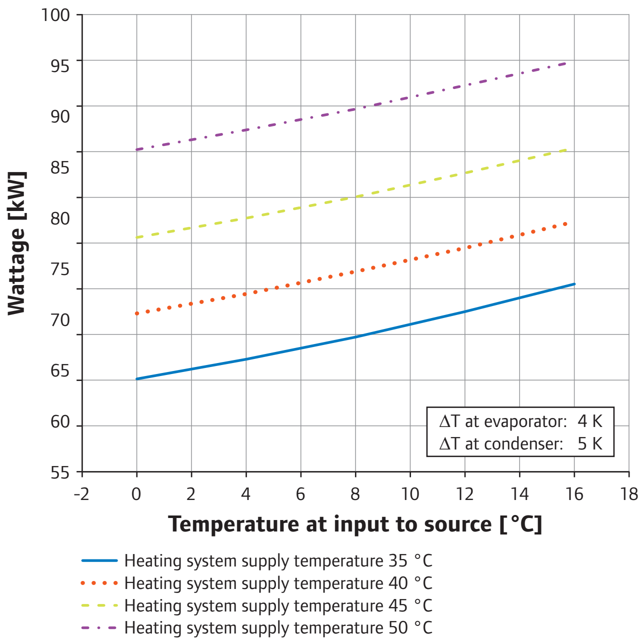


Eco 320 performance curves – heating mode

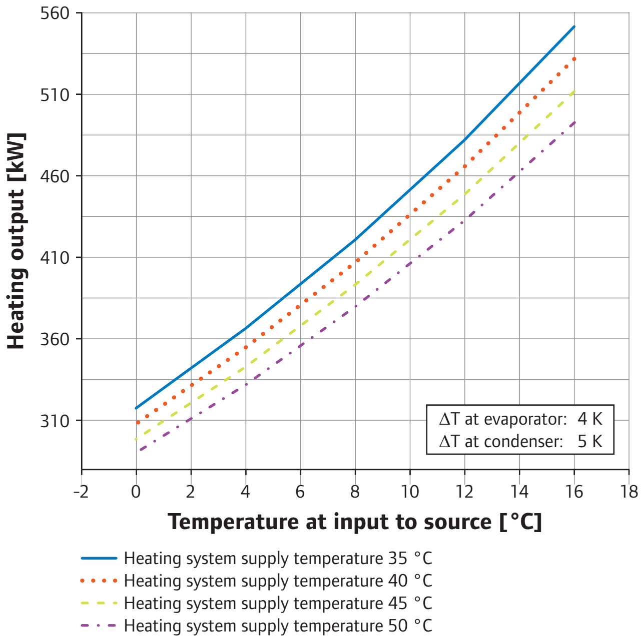
Extraction output from source, ΔT = 5 K



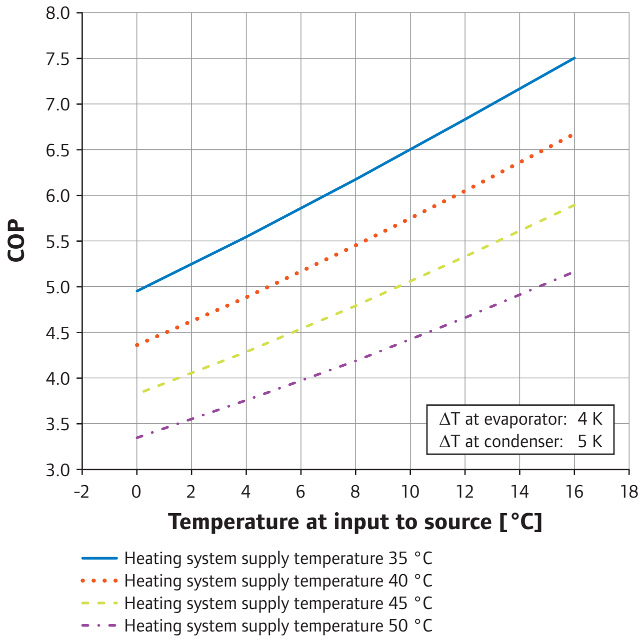
Wattage



Heating output

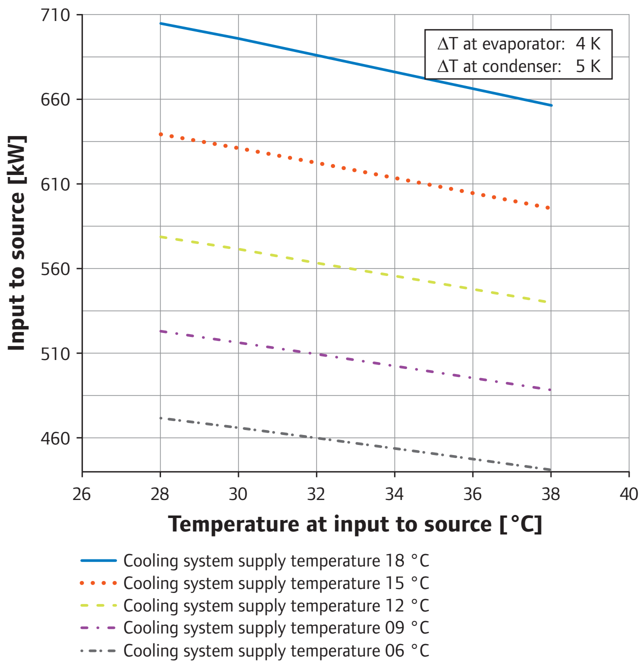


COP

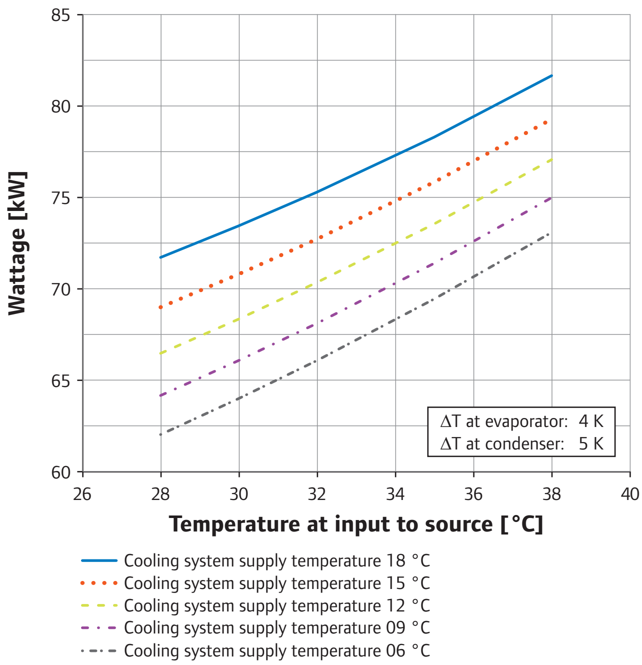


Eco 320 performance curves – cooling mode

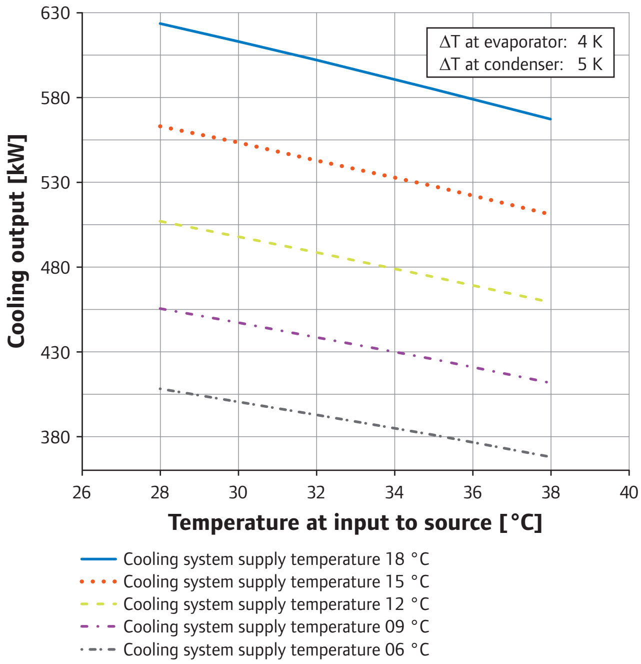
Input to source, ΔT = 4 K



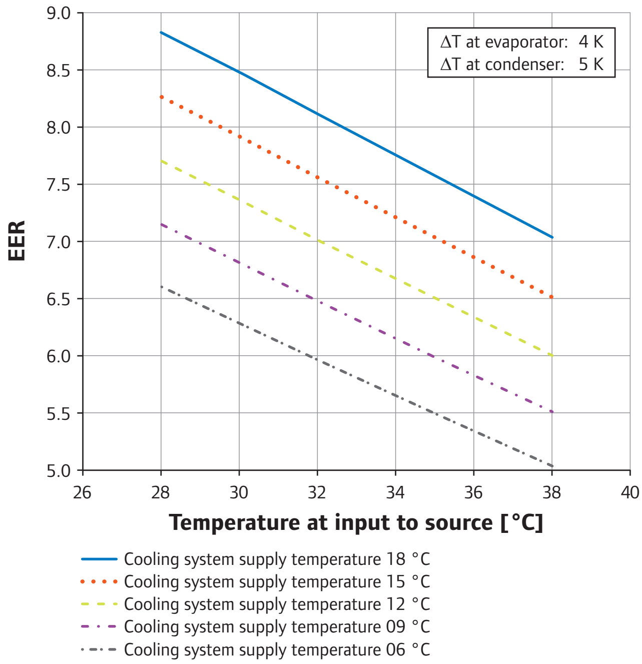
Wattage



Cooling output



EER

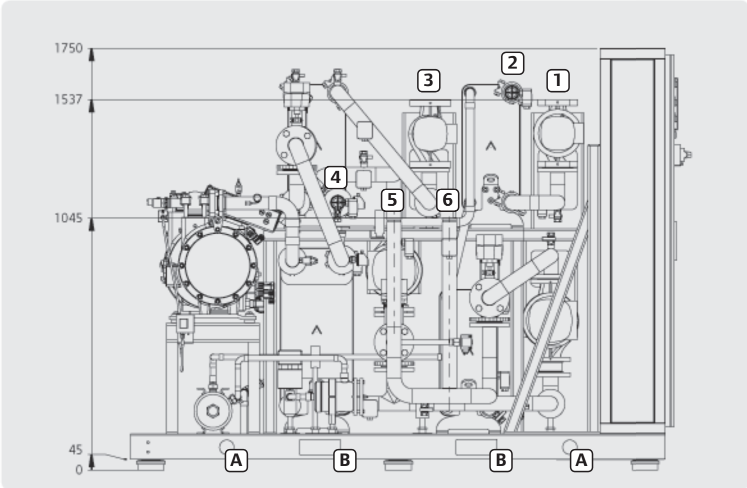


Notes

Dimensions and safety clearances

GEOZENT Eco 80 basic version

Front view



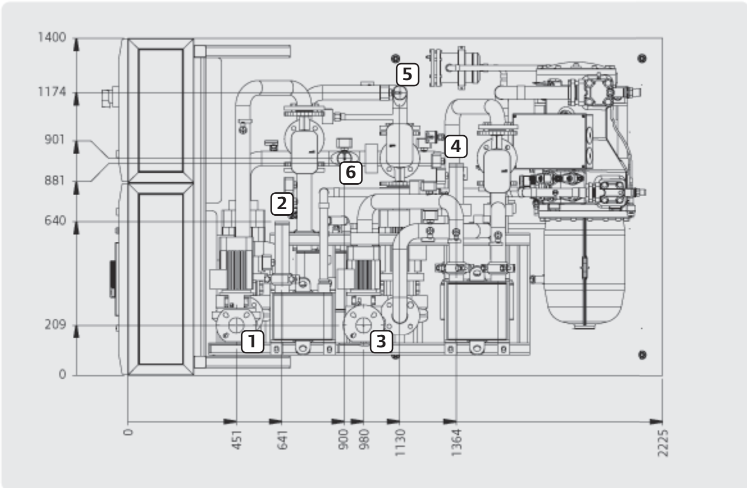
Side view

Connection labeling (DN50 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert

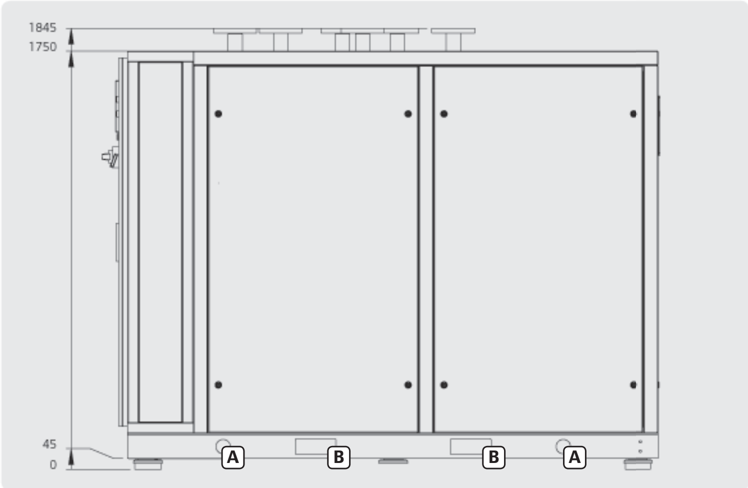


Top view

Dimensions in mm
Subject to change

GEOZENT Eco 80 enclosure version

Front view



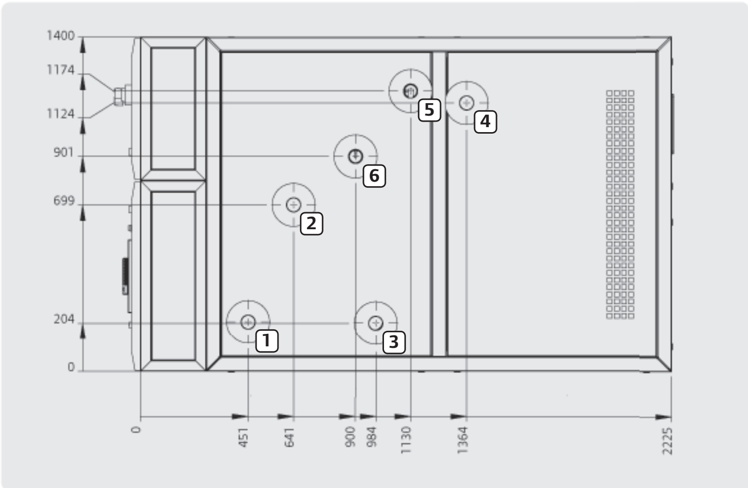
Side view

Connection labeling (DN50 PN10)

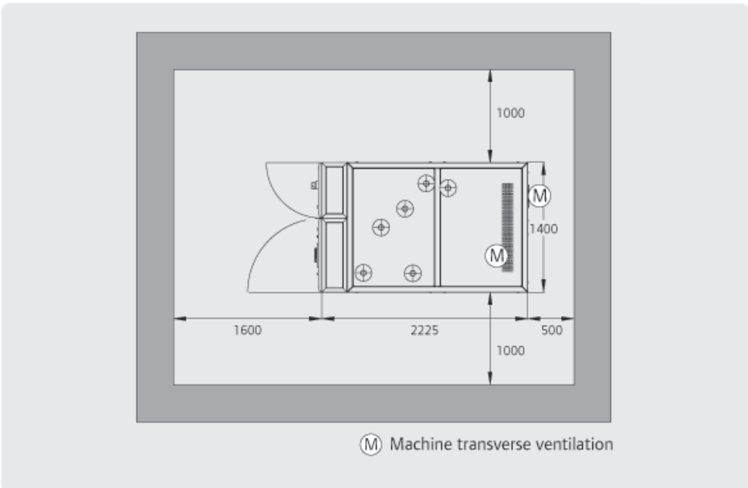
1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert



Top view

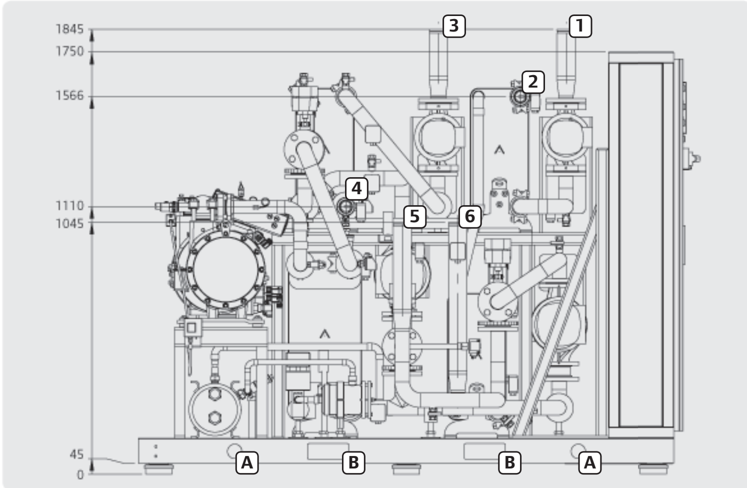


Safety clearances (also apply to basic version)

Dimensions in mm
Subject to change

GEOZENT Eco 100 basic version

Front view



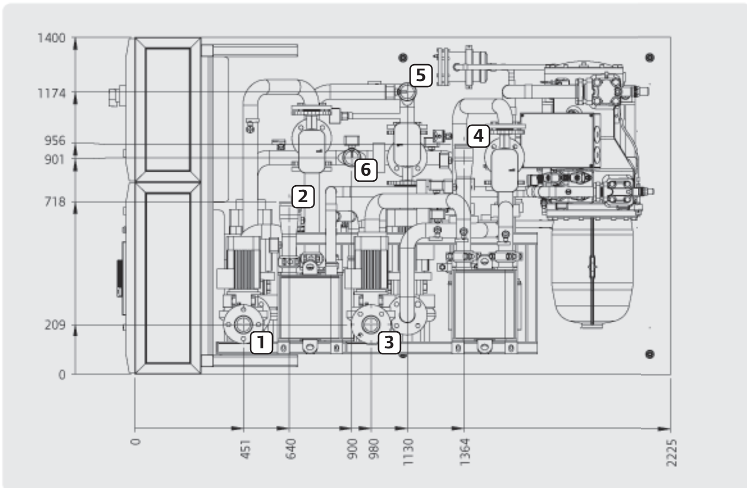
Side view

Connection labeling (DN65 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert

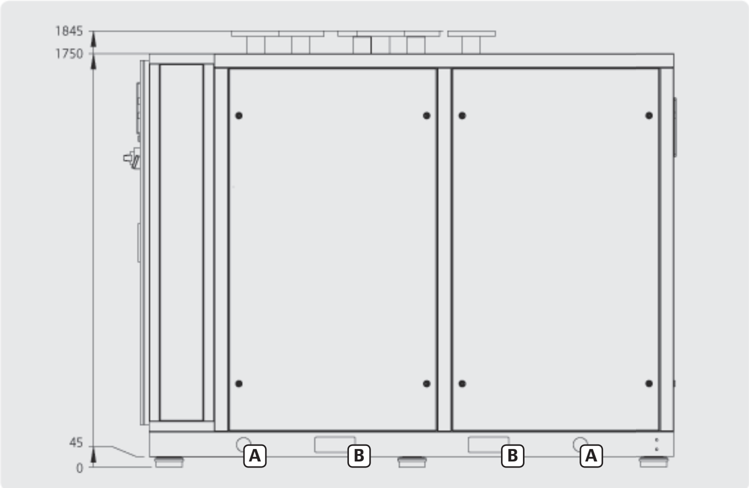


Top view

Dimensions in mm
Subject to change

GEOZENT Eco 100 enclosure version

Front view



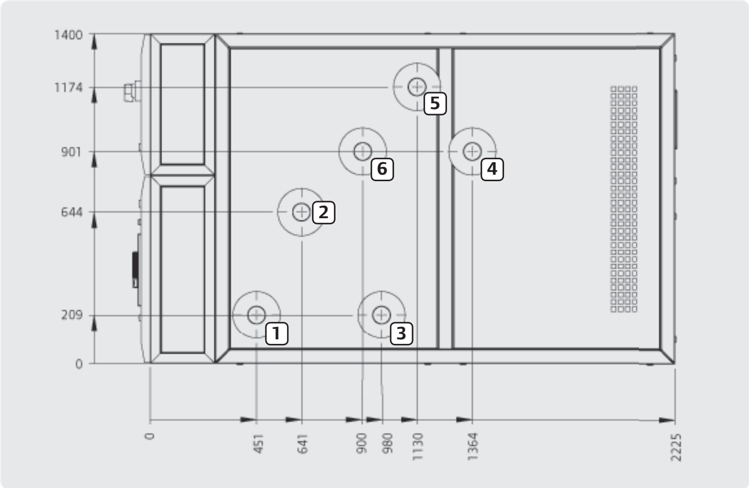
Side view

Connection labeling (DN65 PN10)

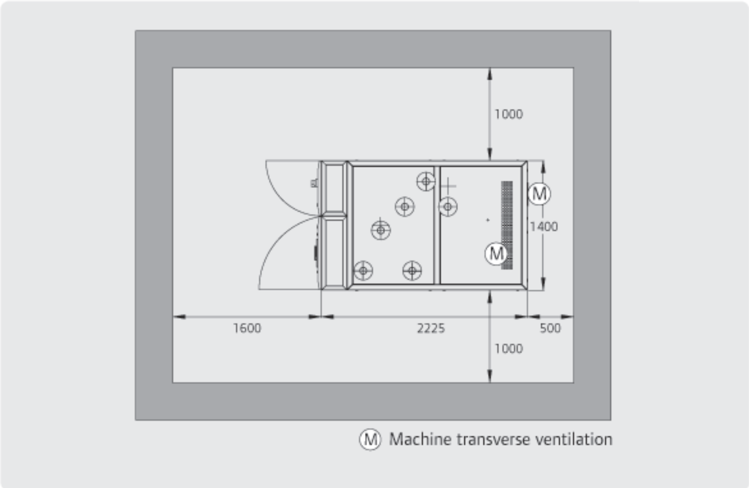
1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert



Top view

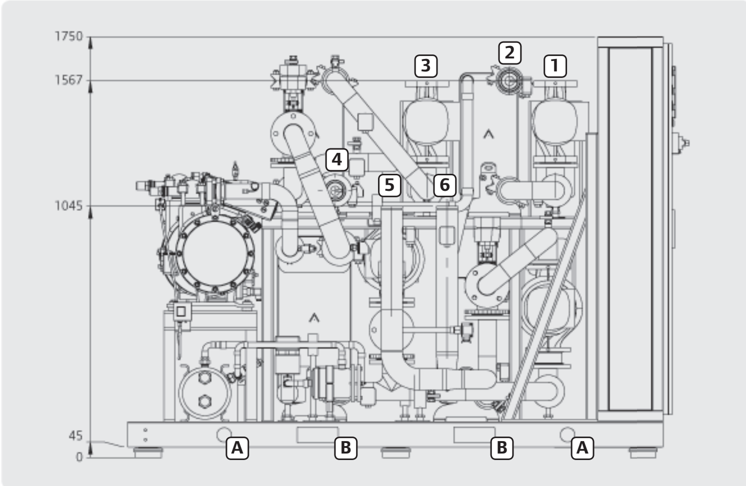


Safety clearances (also apply to basic version)

Dimensions in mm
Subject to change

GEOZENT Eco 130 basic version

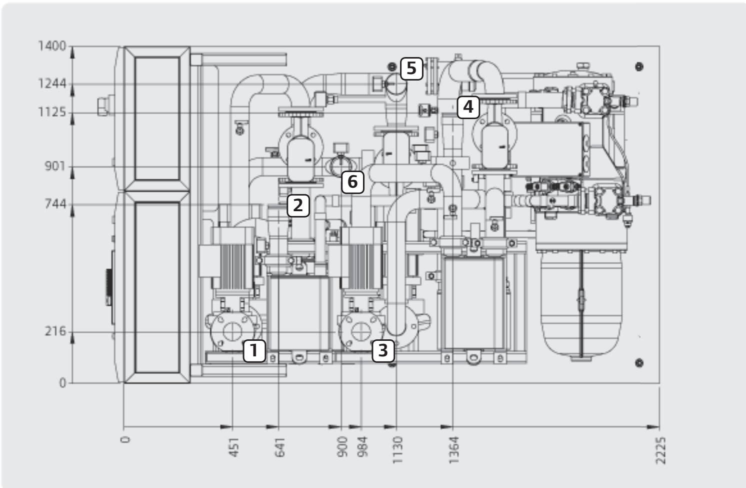
Front view



Side view

Connection labeling (DN80 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system



Top view

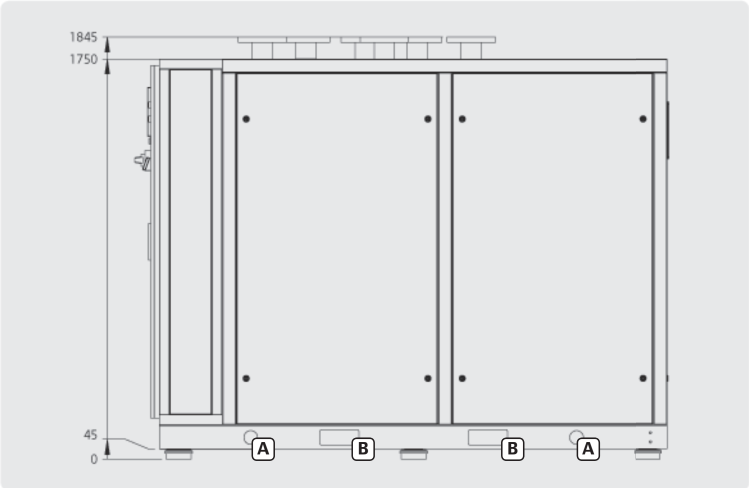
Attachment points

A Crane lug
B Stacker insert

Dimensions in mm
Subject to change

GEOZENT Eco 130 enclosure version

Front view



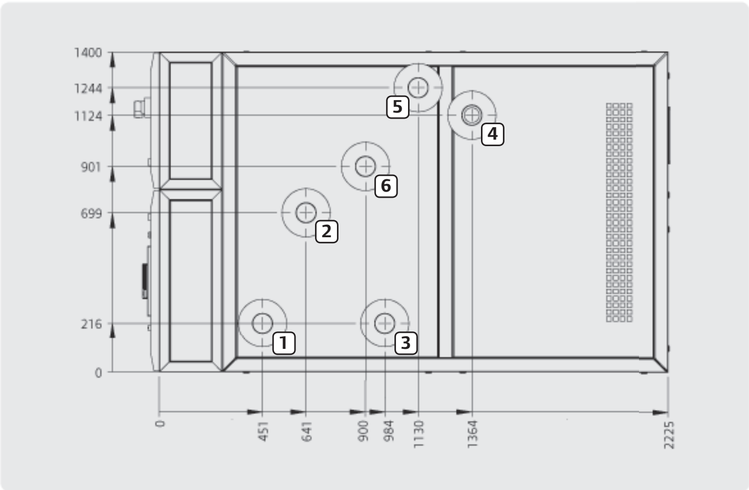
Side view

Connection labeling (DN80 PN10)

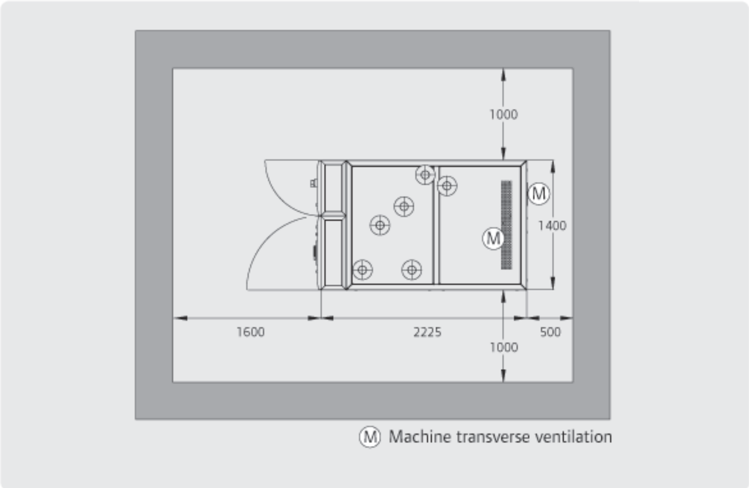
1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert



Top view

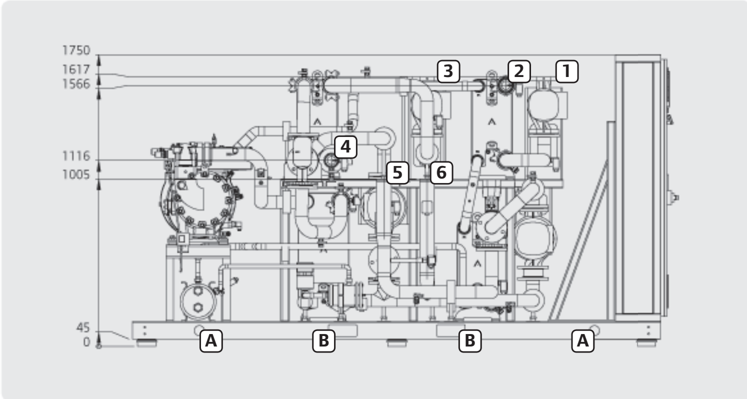


Safety clearances (also apply to basic version)

Dimensions in mm
Subject to change

GEOZENT Eco 170 basic version

Front view



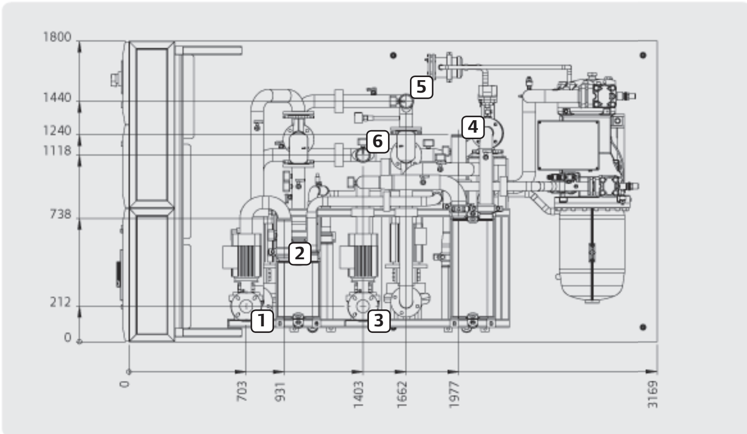
Side view

Connection labeling (DN80 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

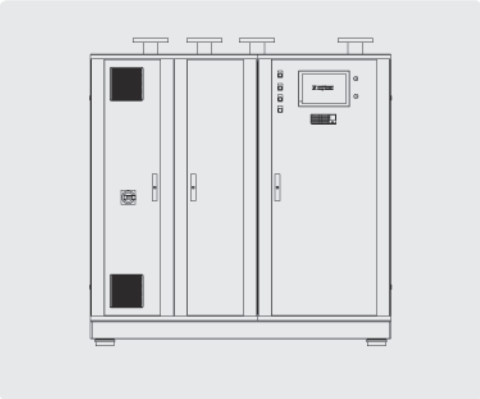
A Crane lug
B Stacker insert



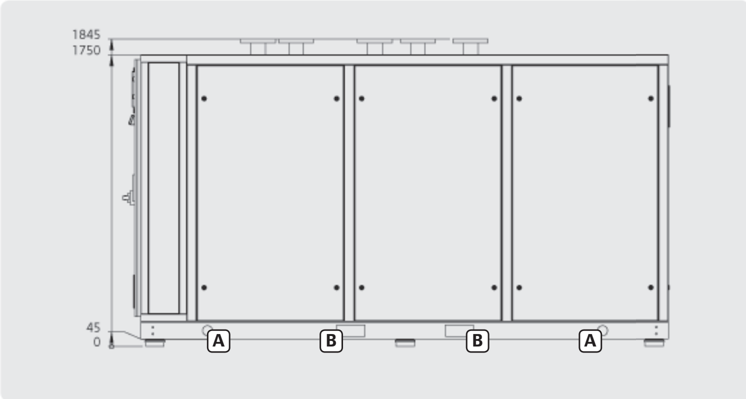
Top view

Dimensions in mm
Subject to change

GEOZENT Eco 170 enclosure version



Front view



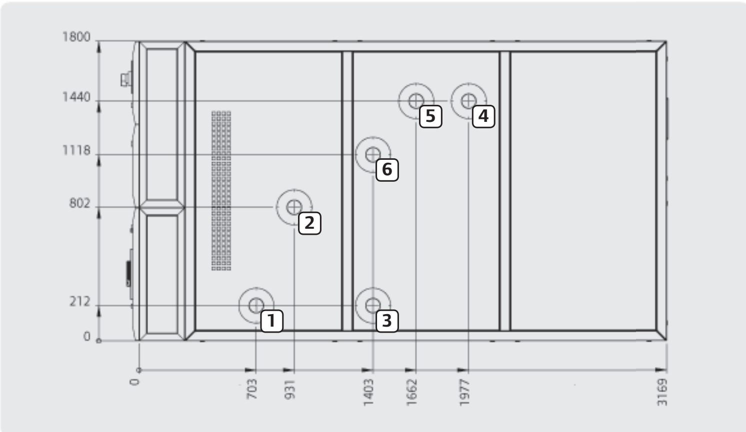
Side view

Connection labeling (DN80 PN10)

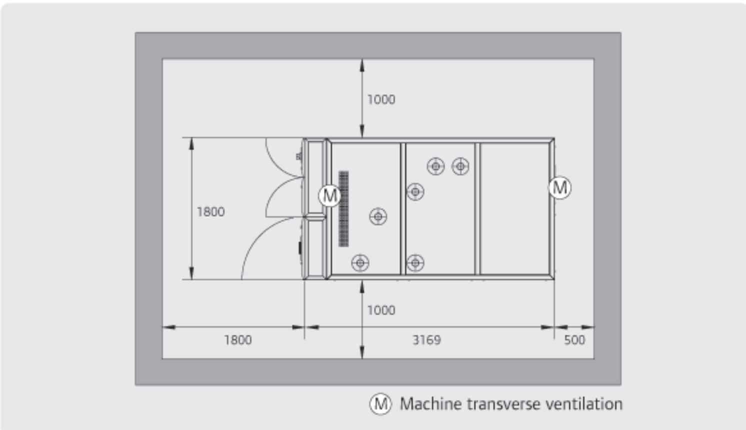
1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert



Top view

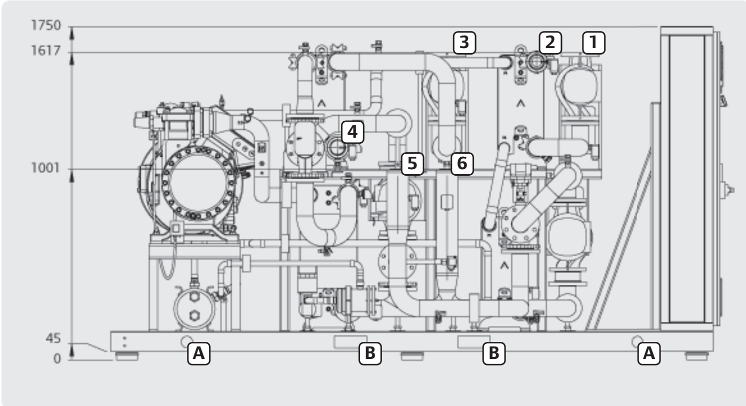


Safety clearances (also apply to basic version)

Dimensions in mm
Subject to change

GEOZENT Eco 210 basic version

Front view



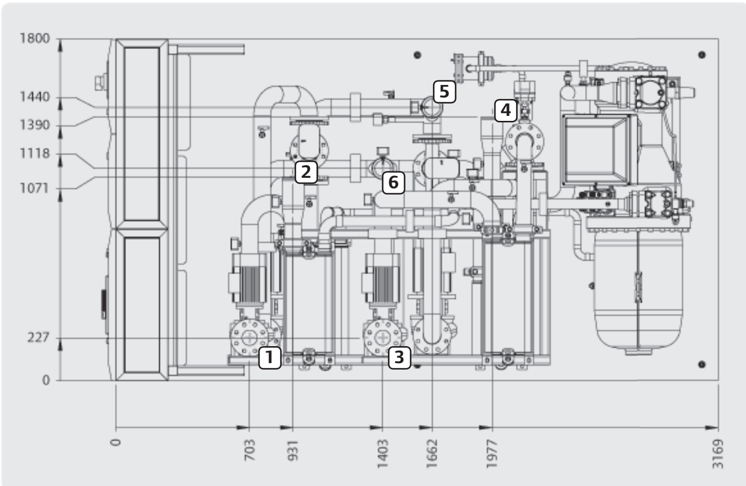
Side view

Connection labeling (DN100 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert

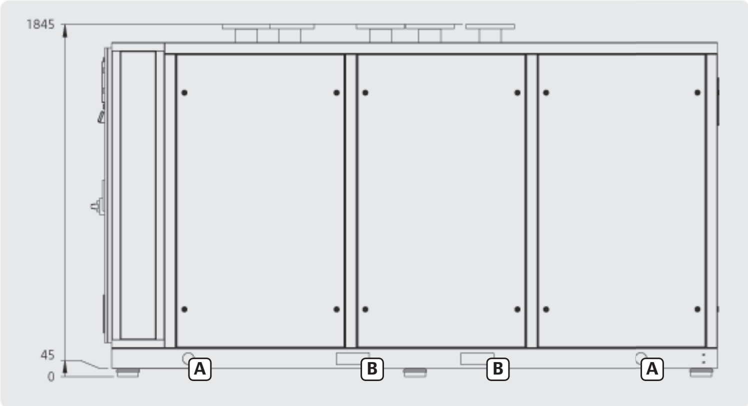


Top view

Dimensions in mm
Subject to change

GEOZENT Eco 210 enclosure version

Front view



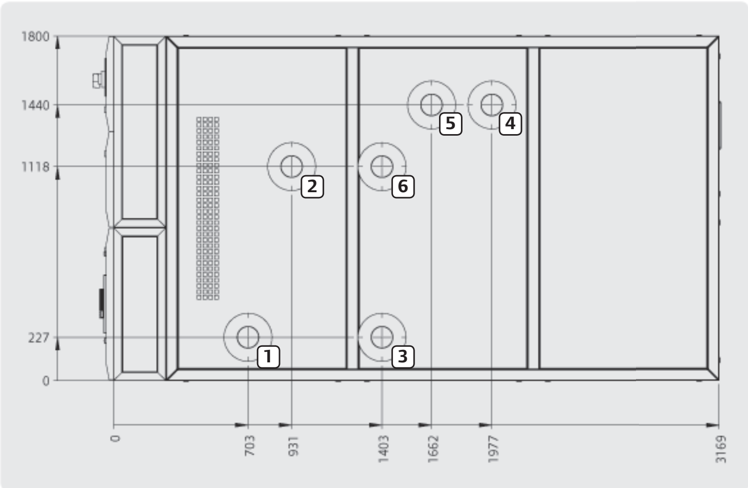
Side view

Connection labeling (DN100 PN10)

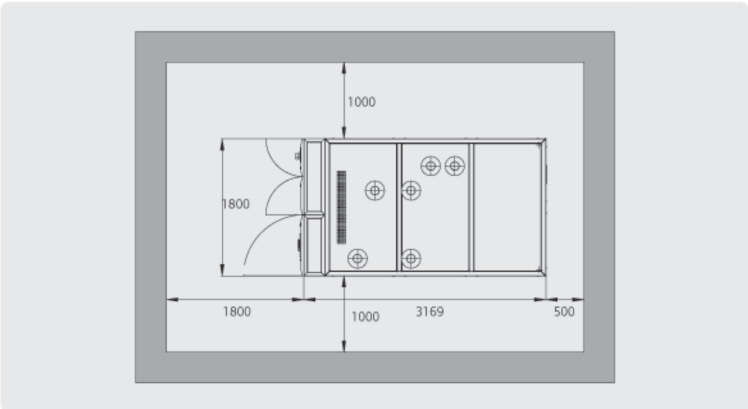
1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

A Crane lug
B Stacker insert



Top view

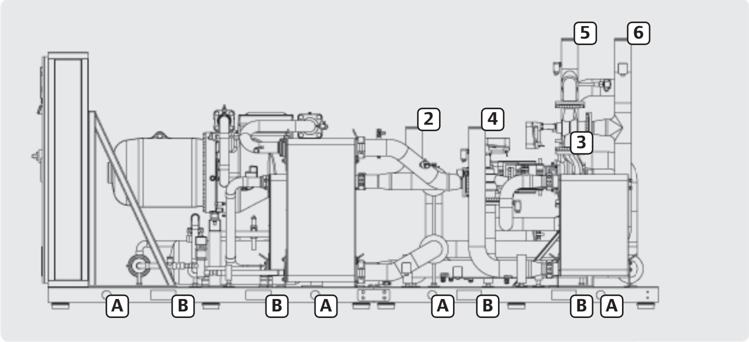


Safety clearances (also apply to basic version)

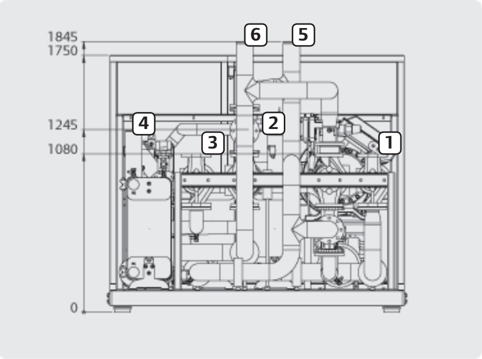
Dimensions in mm
Subject to change

GEOZENT Eco 280 basic version

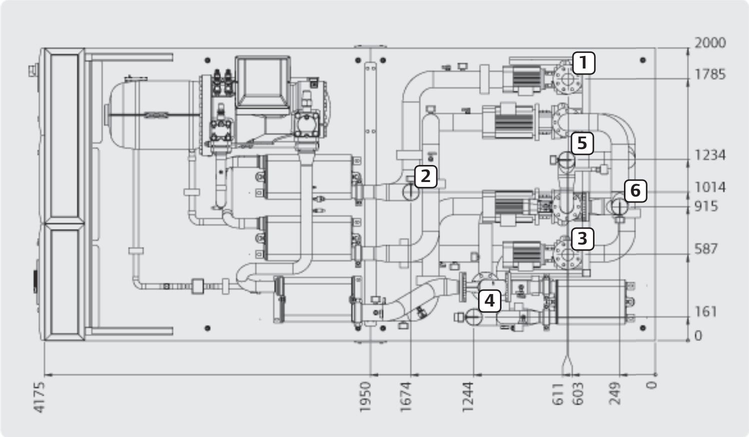
Front view



Side view



Back view



Top view

Connection labeling
(DN100 PN10)

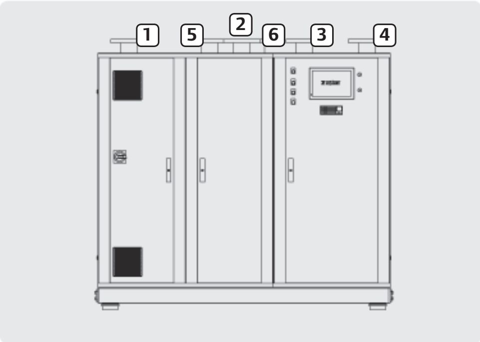
1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

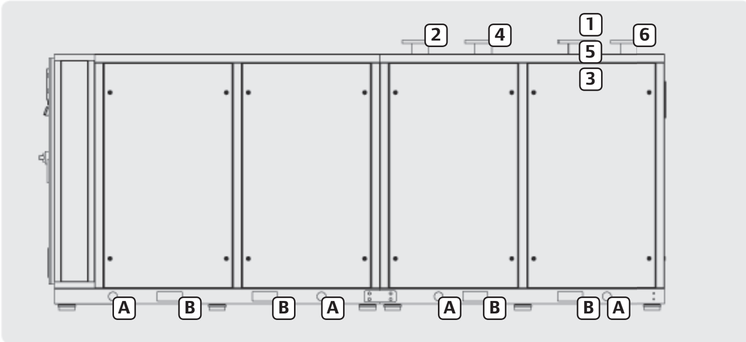
A Crane lug
B Stacker insert

Dimensions in mm
Subject to change

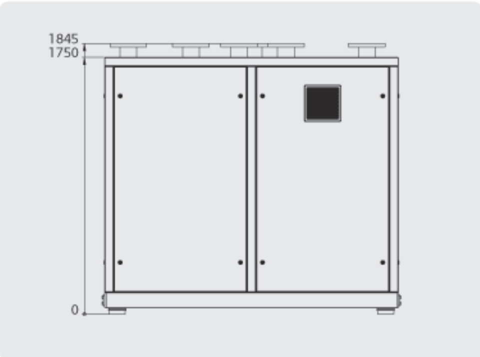
GEOZENT Eco 280 enclosure version



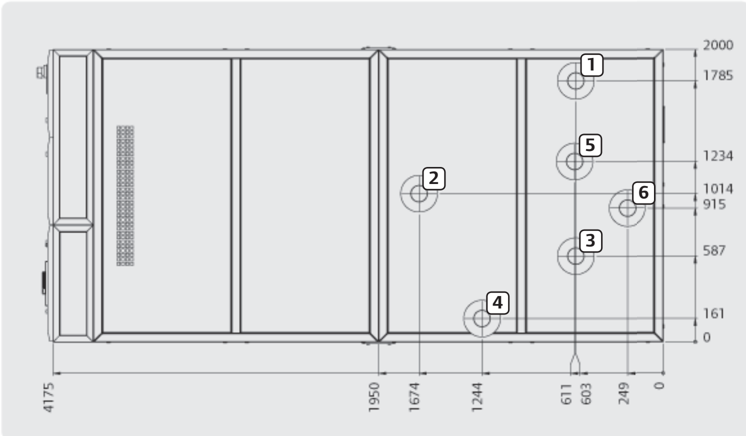
Front view



Side view



Back view



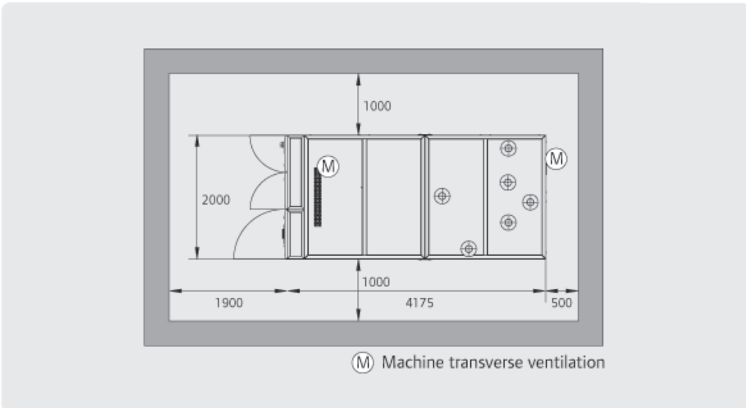
Top view

Connection labeling (DN100 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

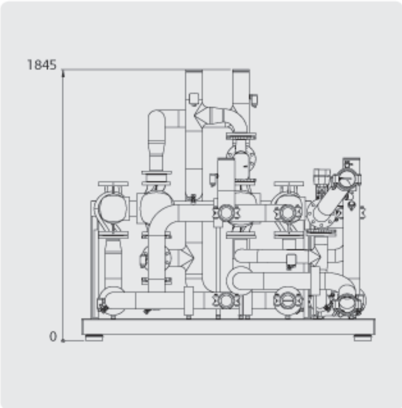
A Crane lug
B Stacker insert



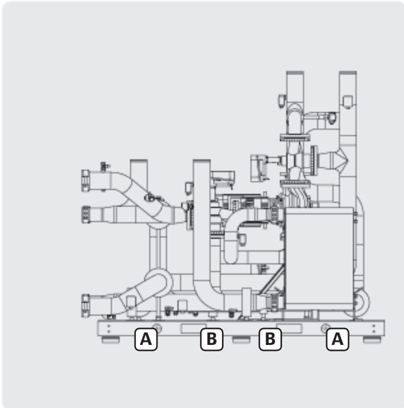
Safety clearances (also apply to basic version)

Dimensions in mm
Subject to change

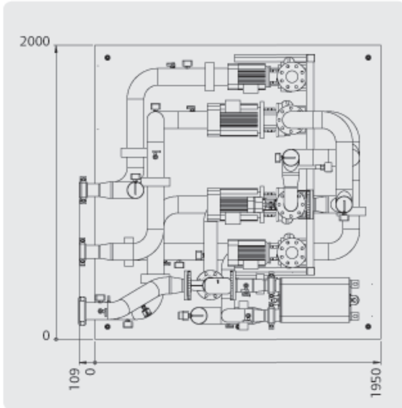
GEOZENT Eco 280 hydraulic module, basic version



Front view



Side view

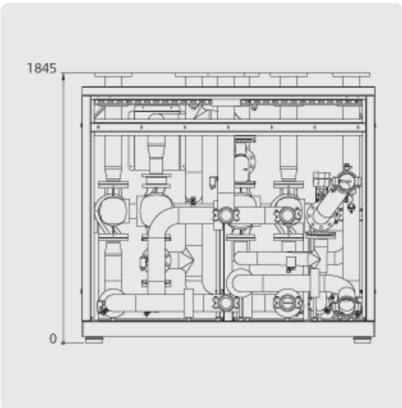


Top view

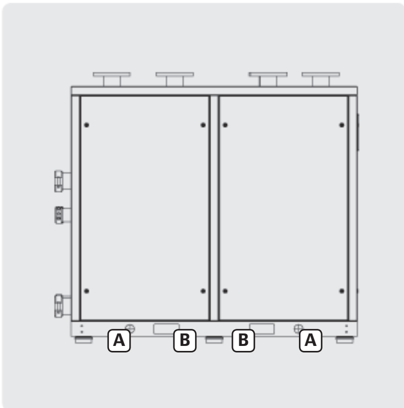
Attachment points

A Crane lug B Stacker insert

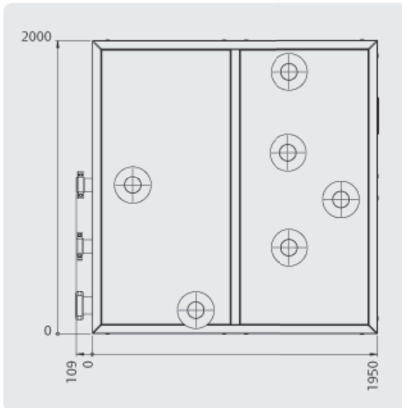
GEOZENT Eco 280 hydraulic module, enclosure version



Front view



Side view



Top view

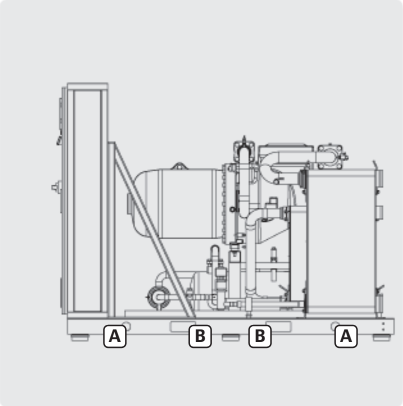
Attachment points

A Crane lug B Stacker insert

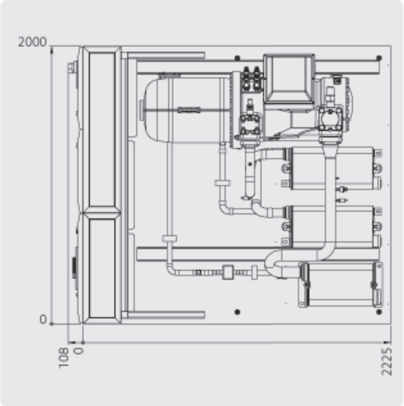
Dimensions in mm
Subject to change

GEOZENT Eco 280 cooling module, basic version

Front view



Side view



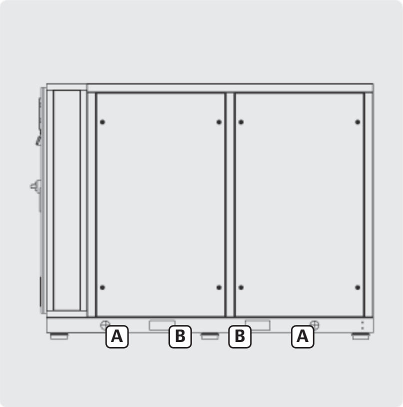
Top view

Attachment points

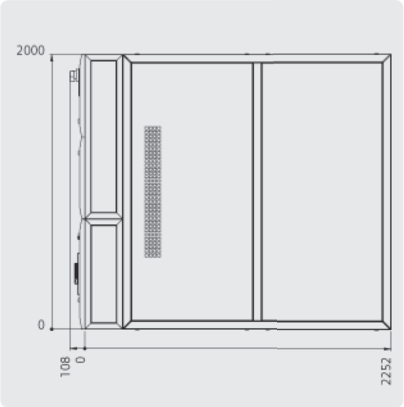
A Crane lug B Stacker insert

GEOZENT Eco 280 cooling module, enclosure version

Front view



Side view



Top view

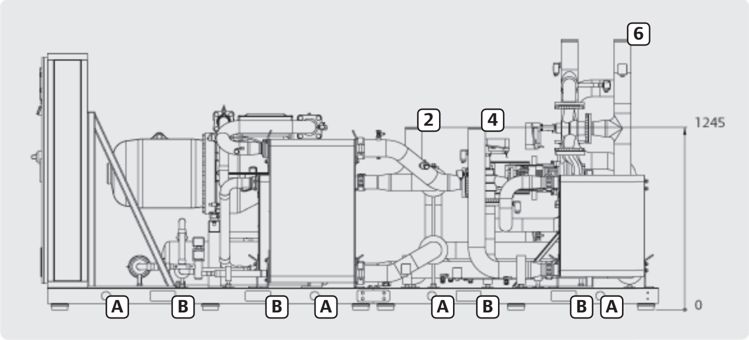
Attachment points

A Crane lug B Stacker insert

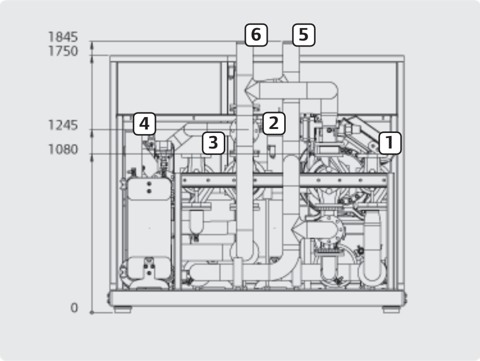
Dimensions in mm
Subject to change

GEOZENT Eco 320 basic version

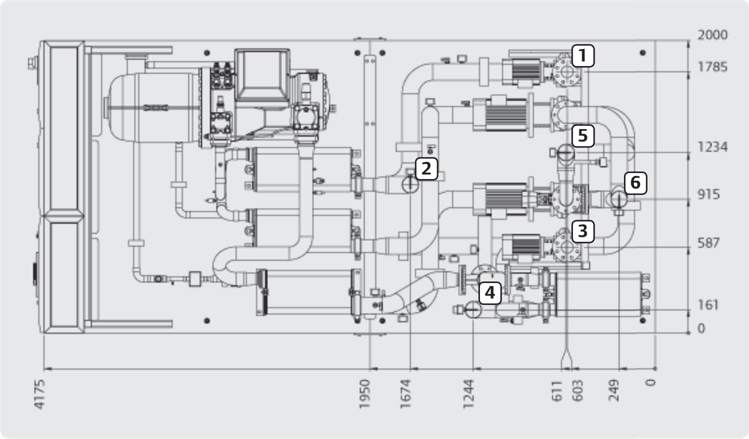
Front view



Side view



Back view



Top view

Connection labeling
(DN100 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

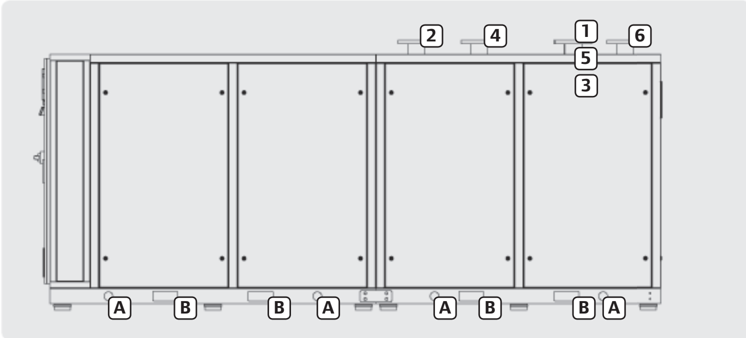
Attachment points

A Crane lug
B Stacker insert

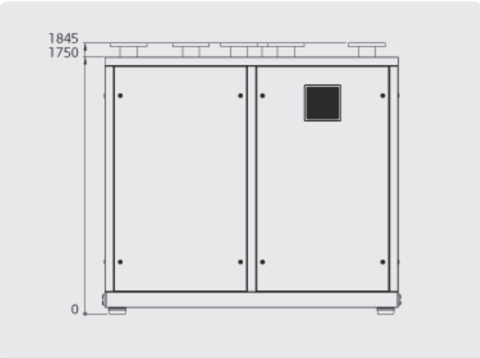
Dimensions in mm
Subject to change

GEOZENT Eco 320 enclosure version

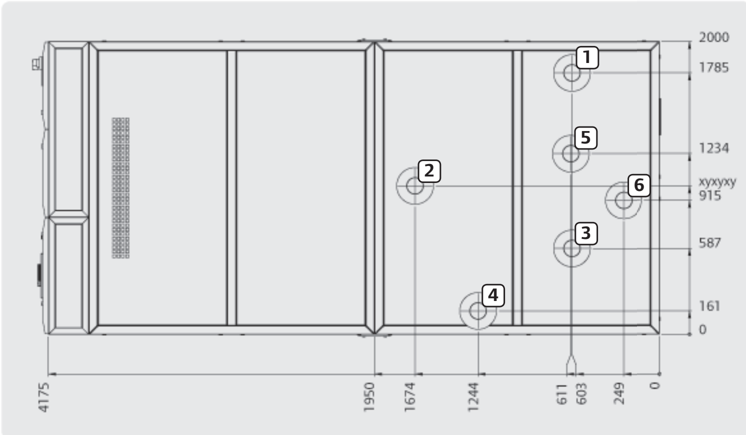
Front view



Side view



Back view



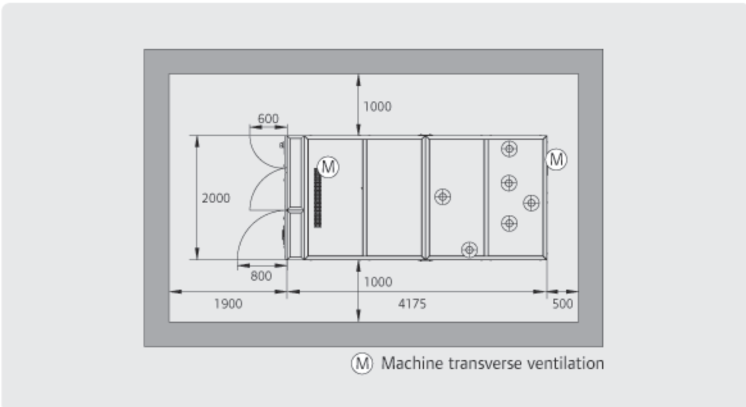
Top view

Connection labeling (DN100 PN10)

1 Return line, heating system
2 Supply line, heating system
3 Return line, cooling system
4 Supply line, cooling system
5 Return line, geothermal system
6 Supply line to geothermal system

Attachment points

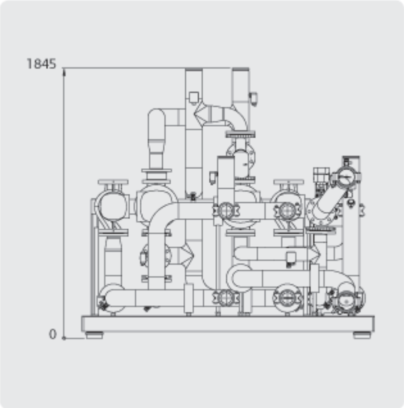
A Crane lug
B Stacker insert



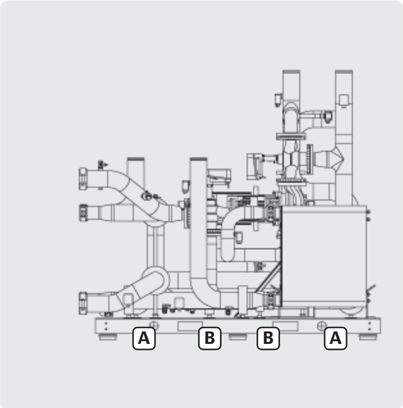
Safety clearances (also apply to basic version)

Dimensions in mm
Subject to change

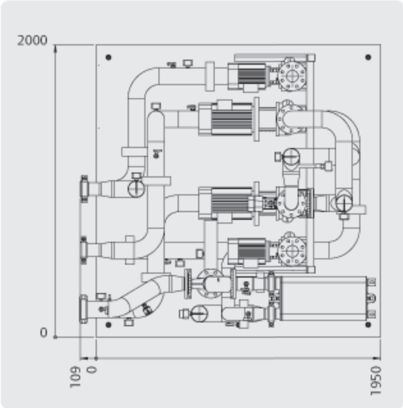
GEOZENT Eco 320 hydraulic module, basic version



Front view



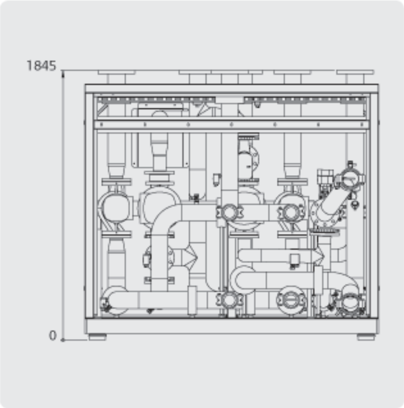
Side view



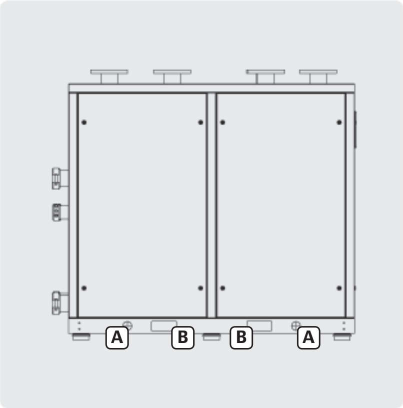
Top view

Attachment points
A Crane lug B Stacker insert

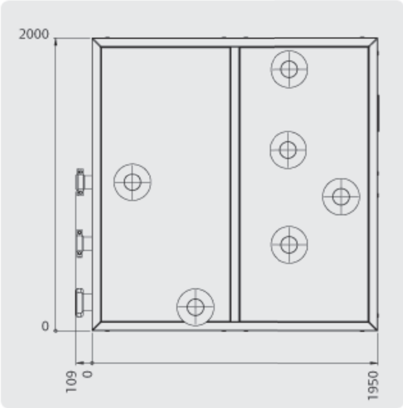
GEOZENT Eco 320 hydraulic module, enclosure version



Front view



Side view



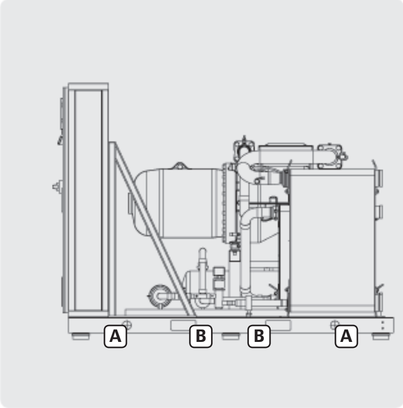
Top view

Attachment points
A Crane lug B Stacker insert

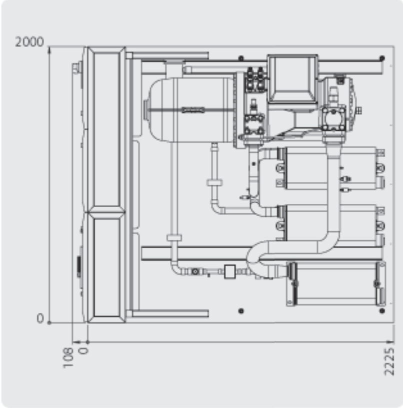
Dimensions in mm
Subject to change

GEOZENT Eco 320 cooling module, basic version

Front view



Side view



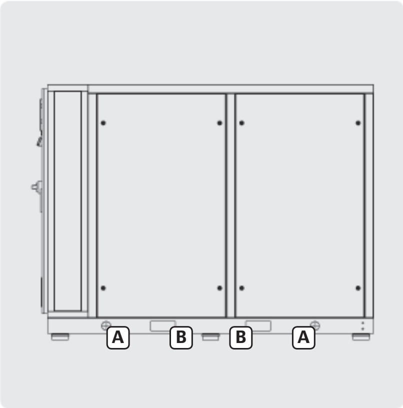
Top view

Attachment points

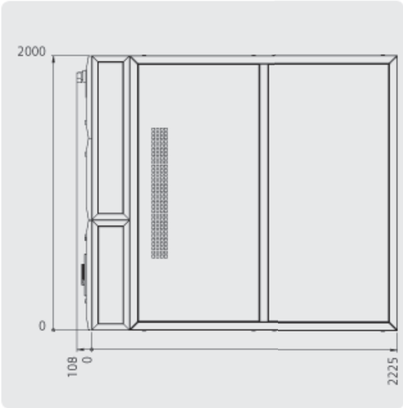
A Crane lug B Stacker insert

GEOZENT Eco 320 cooling module, enclosure version

Front view



Side view



Top view

Attachment points

A Crane lug B Stacker insert

Dimensions in mm
Subject to change

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