Efficiency is a matter of the right Planning.

Heat pumps for central heating
Hot water heat pumps

Vaillant Comfort for my home

Introduction

Around three quarters of private energy requirements are expended on generating heat for heating and hot water.

Energy production is thus mainly achieved through the combustion of fossil energy sources. However, frugal use of natural resources and the associated economical and ecological advantages (reduction of CO_2 emissions) are decisive criteria for more and more people when it comes to selecting a suitable heating system. In this respect, the heat pump technology can be seen as a genuine alternative.

The thermal energy that is stored in the earth, in groundwater or in the air is used as a heat source. This heat source is supplied to the heat pump in order to heat a building and supply it with hot water. 75% environmental energy and 25% supplied electrical energy (drive energy) combine to provide 100% heating energy for heat and hot water. In addition, the heat pump, as the only regenerative heating system, is capable of independently generating heating energy and hot water throughout the whole year.

Vaillant system solutions provide a product range that includes various equipment variants in order to offer the optimum heat pump for every application. This means that a heat pump from Vaillant is one of the most economical and most effective options for guaranteeing that heat is supplied to residential and commercial properties in new or existing buildings.

Our contribution to environmental protection and perfect living comfort for all users: With Vaillant heat pumps, this ideal combination succeeds at the highest level.

The following sections describe the basic principles of heat pump technology in detail. The focus is solely on how heat pumps are designed and how they operate. Details on how to determine the output figure and working figure are also provided using relevant examples. The various operating modes and the possible heat sources are listed last.

You can find general planning information for carrying out customised planning from section 3 onwards.

1 Basic principles

1.1 Why use a heat pump?

Using a high number of fossil energy sources to supply us with energy has serious consequences for the environment. Large quantities of pollutants, such as sulphur dioxide and nitrogen oxide, are released during combustion.

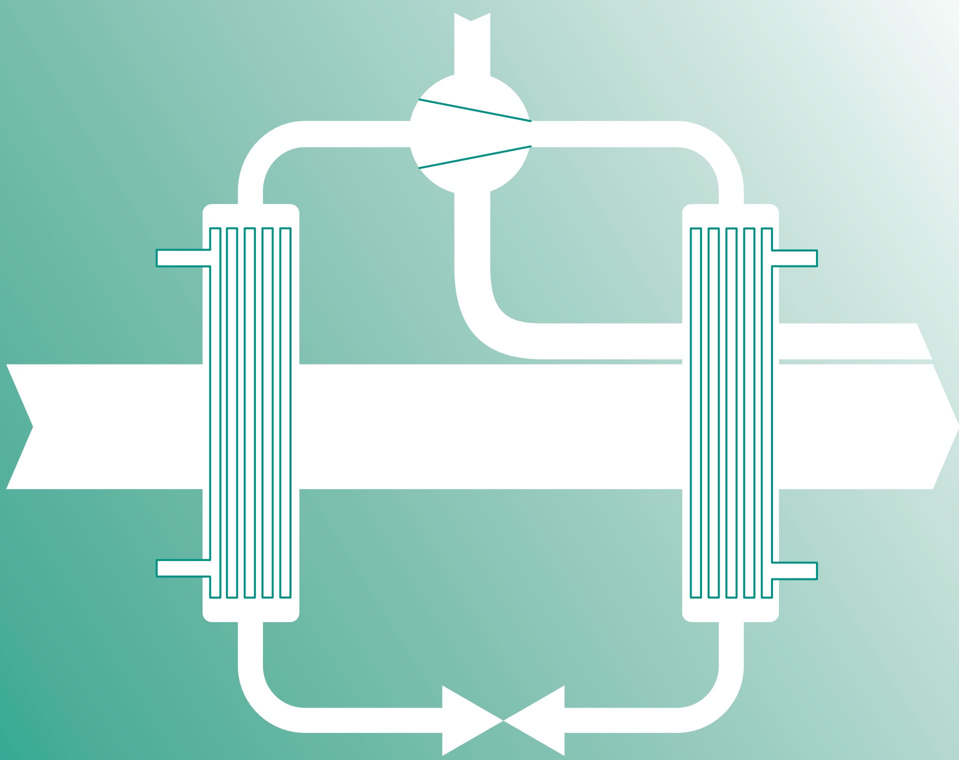
Heating living rooms with fossil energy sources makes a substantial contribution to the emission of pollutants (CO_2).

Using a high number of fossil energy sources to supply us with energy is also problematic on account of limited resources of oil and gas reserves.

The type of power generation continues to transition to renewable or newly developed generation methods in the future. Make sure you are part of this development, as electricity is the energy of the future for driving a heat pump.

A heat pump is a „transport unit“ which brings environmental heat that is available free of charge to a higher temperature level. It extracts stored environmental heat from the environment – ground, water (e.g. groundwater) and air – and, in addition to the drive energy, supplies it to the heating and hot water circuit in the form of heat.

Heat cannot pass from a colder body to a warmer one. It always flows from a higher-temperature body to a lower-temperature body (second law of thermodynamics). The heat pump must therefore use high-quality energy – e.g. electricity for the drive motor – to bring the thermal energy absorbed from the environment to the temperature level required for heating and hot water generation.



1.2 Functions of the heat pump

Renewable energies are free, available everywhere and can be used intelligently. This is particularly true for the environmental heat that is stored in the earth, groundwater and air.

Vaillant compression heat pumps use this environmental heat as a heat source with technology that, in principle, is based on how a refrigerator operates, but with the cooling process reversed (see fig. 1).

A refrigerator cools a small, limited area and, at the same time, heats an air space that is infinite when compared to the refrigerator. In contrast, a heat pump cools an inexhaustible heat source while it heats a small, limited air space via the heating areas.

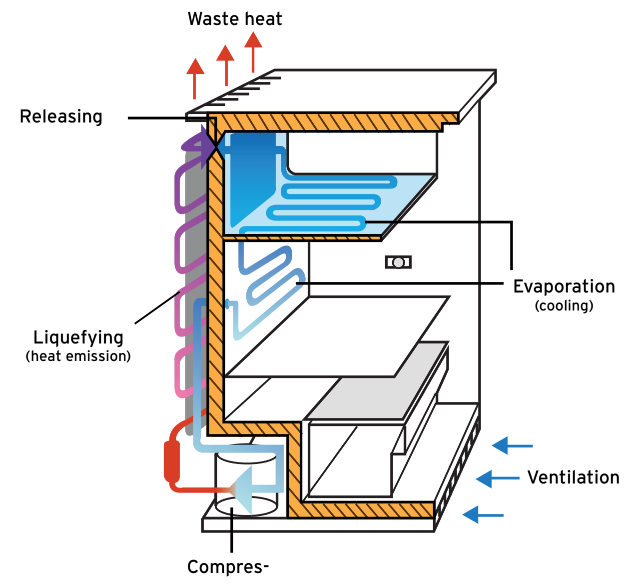


Fig 1: How a refrigerator works

The refrigeration circuit

In a cyclical process, the heat extracted from the environment is brought to a higher temperature level and thus becomes usable for heating purposes.

In a closed circuit, a safety refrigerant (see fig. 2) with an extremely low boiling point circulates and performs the following steps:

- Evaporation **(evaporator)**
- Compression **(compressor)**
- Condensation**(condenser)**
- Expansion**(expansion valve)**

The refrigerant is initially in liquid form in the evaporator, and the temperature of the surrounding heat source is higher than the boiling point of the refrigerant. As a result, heat is transferred from the heat source to the refrigerant. This energy is used to evaporate the coolant.

The **compressor** continuously extracts the refrigerant vapour and heavily compresses it. In doing so, the pressure and the temperature of the refrigerant vapour increase. Electrical energy is required for this process.

The refrigerant vapour delivers the heat in the **condenser** to the heat distribution system (e.g. heating return); the temperature of the heat distribution system is below the condensation temperature of the refrigerant vapour, which subsequently turns back into liquid.

The refrigerant, which is now liquid again, decreases in pressure and temperature through an expansion valve to such an extent that the level falls below the temperature of the heat source again. This process allows the evaporator to absorb heat from the heat source again and repeat the cycle.

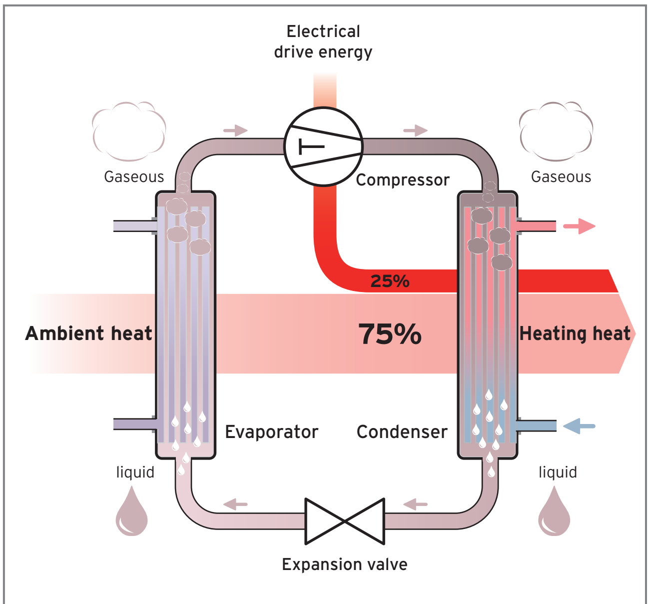


Fig 2: Heat pump cycle – schematic drawing

1.3 Components in a heat pump

Vaillant heat pumps combine modern technology with all the components required to operate a heating installation. There is the option for the cylinder for hot water generation to be integrated into the unit.

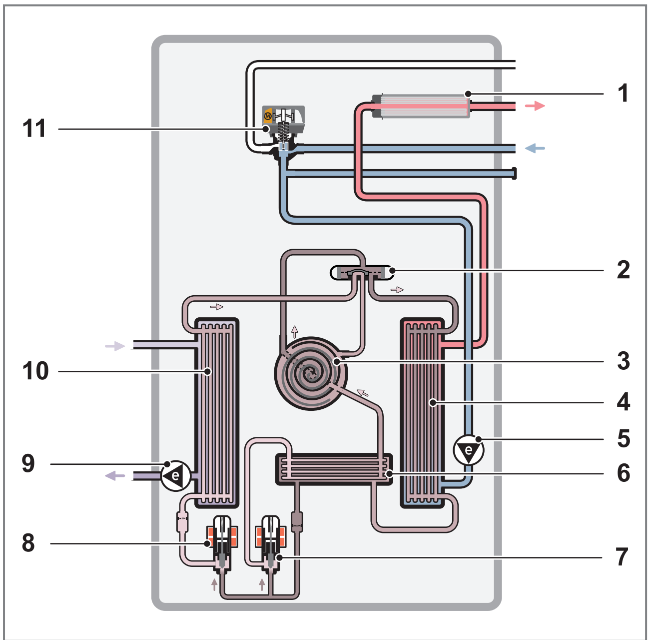


Fig 3: Design of a heat pump

1 Auxiliary electric heater
2 4-way diverter valve
3 Scroll compressor
4 Condenser
5 Heating pump
6 Auxiliary evaporator
7 Expansion valve, auxiliary evaporator
8 Expansion valve
9 Brine circulation pump
10 Evaporator
11 Hot water diverter valve

1.4 Heat sources

The following heat sources can be used for the heat pump:

Heat sources for the heat pump

Heat source	Ground	Water	Air
Collector	Compact collector	Groundwater	Outside air
	Ground collector	Overground bodies of water	Heat recovery
	Ground probe	Cooling water, waste water, process water	
	Trench collector		
	Energy cages		

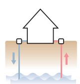
There are relevant options for each heat source to use the stored energy from the environment.

Note
The active cooling with brine/water and water/water heat pump systems depends on the external heat source. The local restrictions, laws and standards must be taken into consideration. The ground water and ground application for W35/W18 or B35/W18 is subject to approval (the ground water or ground is heated up to 40 °C).

Ground heat source

The ground is a heat source with high heat output all year round. The heat stored in the ground can be used by ground collectors, ground sensors or compact collectors.

Compact collector



The compact collector is a space-saving solution that is used to exploit the ground as a heat source. It consists of several collector mats, which are inserted horizontally into the ground.

The individual collector mats are connected in parallel using a combined distributor/collector.

The compact collectors are laid horizontally 20 cm to 30 cm below the frost line. In most regions, the frost protection limit is at a depth of 1.0 to 1.5 m.

The surface above the piping must not be sealed or built over, because the ground absorbs the heat from rainwater and solar radiation.

Ground collector

The ground collector consists of piping, which is routed horizontally over a large area approx. 20 30 cm below the frost line. In most regions, the frost protection limit is at a depth of 1.0 to 1.5 m.

At a depth of 1.3 to 1.8 m, the prevailing average annual temperature is approx. 5 °C. This temperature depends on the time of year. As the depth increases, this temperature also increases.

The surface above the piping must not be sealed or built over, because the ground absorbs the heat from rainwater and solar radiation.

Ground sensor

One or more sensors that are vertically embedded in the ground use geothermal energy, which remains for the most part constantly at a temperature of approx. 10 °C from a depth of approx. 15 metres, irrespective of the season.

Seasonal fluctuations in the ground temperature decrease as the depth increases. The following illustration shows typical temperature values for undisturbed ground.

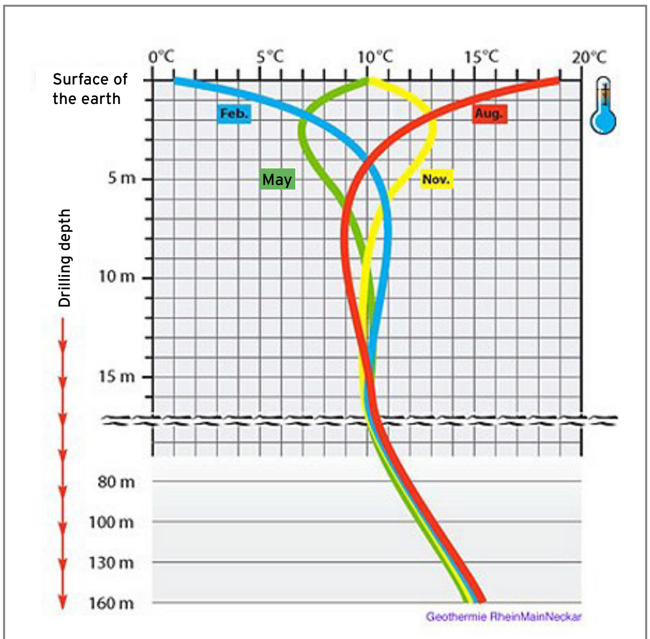


Fig 4: Ground temperature values

A U-shaped sensor (usually a double-U sensor) is inserted into a borehole, and is firmly connected to the surrounding ground.

„Brine“ is pumped through the sensors. This is water that, for frost-protection reasons, is treated with an environmentally friendly glycol solution, for example. The water/glycol mixture has a concentration of approx. 30% glycol.

The brine that comes out of the heat pump is colder than the pipe wall or the ground that surrounds the sensor (e.g. 7 °C), meaning that, when pumping down and coming back up, it extracts heat from the ground. The brine temperature increases, for example, from 7 °C to 9 °C, and reaches the surface at this temperature.

Heat source: Water

Groundwater is the heat source with the highest yield. Thanks to the temperature being constantly at 7 -12 °C throughout the year, it can achieve the highest level of heat extraction performance when compared to all other systems. If groundwater is available at a sufficient volume, temperature and quality, and at as low a depth as possible, this can be used extremely economically with a water/water heat pump.

Groundwater

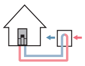
An immersion pump is used to feed the groundwater to the heat pump via a suction well. This extracts heat from the groundwater and then returns the cooled water to the groundwater again via an injection well. In most regions, cooling of groundwater is encouraged (down to approx. 5 °C), since the groundwater temperatures are increased by cultural influences in many places.

Suction and injection wells are installed at a distance of approx. 15 m. A groundwater solution is particularly worthwhile for larger buildings that have a high heat demand.

Air heat source

Outside air requires the least effort to exploit as a heat source and can be used almost anywhere.

Air/water heat pump with outdoor unit



The air/water heat pump uses the outside air warmed by the sun. However, ambient air is subject to high temperature fluctuations depending on the time of the year. The temperature of this heat source is very low in winter (i.e. at times when the heat demand is at its highest) which makes the air/water heat pump less efficient than ground-coupled systems. An air/water heat pump can still generate heating heat at an outside air temperature of down to -20 °C.

1.5 Operating modes of a heat pump

The operating mode of a heat pump can be divided into four groups:

Monovalent mode

The heat pump is the sole heat generator for heating and hot water generation. An additional heat generator is not required. The heat source must be dimensioned for year-round operation of the system.

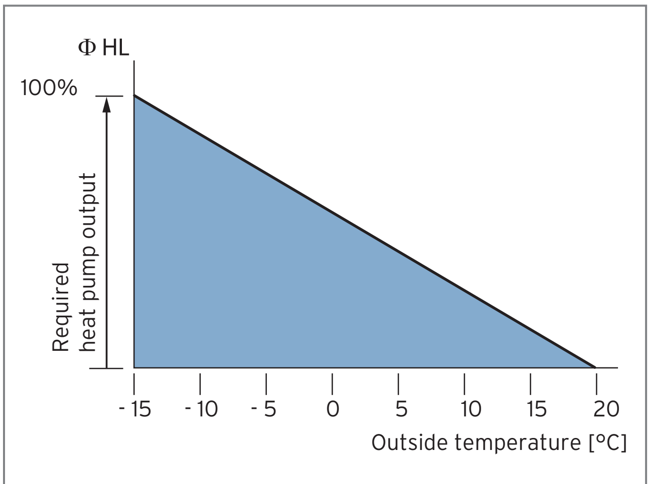


Fig 5: Monovalent mode

Mono-energy mode

The mono-energy operating mode follows the same principle as bivalent operating mode. However, the additional heat generator is not an oil-fired or gas-fired floor-standing boiler, but an auxiliary electric heater.

The heat supply is provided by means of two heat generators that are operated with the same energy source (e.g. electricity).

The heat pump is combined with additional electric heating to cover demand peaks. The auxiliary electric heater is installed in the flow of the utilisation system and is also switched on as required by the controller.

The proportion of the head demand covered by the additional electric heating should be as small as possible.

Bivalent parallel mode

The heat supply is provided by two heat generators that are operated with different energy sources.

In addition to the heat pump, a second heat generator is installed that uses a different energy source (e.g. gas or oil) to cover the heat demand.

Once a specific outside temperature is reached, the second heat generator is switched on to cover the heat demand.

This operating mode requires that the heat pump can continue operating down to the lowest outside temperature.

The heat pump‘s extended running time must be taken into consideration when dimensioning the heat source.

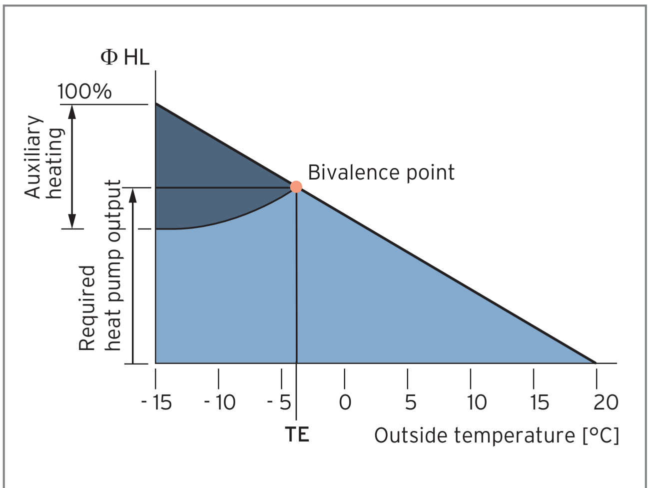


Fig 6: Bivalent parallel mode

TE = Auxiliary heater cut-in temperature

Bivalent alternative mode

The heat supply is provided by two heat generators that are operated with different energy sources.

In addition to the heat pump, a second heat generator is installed that uses a different energy source to cover the heat demand.

With such an arrangement, the heat pump only operates until what is known as the alternative point (bivalence point) is reached (e.g. outside temperature of -4 °C), in order to transfer the task of supplying heat at lower outside temperatures to the second heat generator (e.g. a gas-fired or oil-fired boiler).

This operating mode is used in heat distribution systems with high flow temperatures. The heat pump is able to cover 60 - 70% of the annual heating output in such cases (Central European climatic conditions).

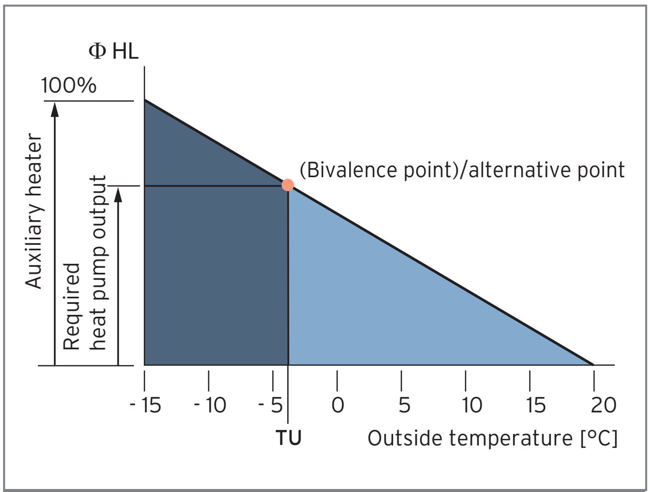


Fig 7: Bivalent alternative mode

TU = Switch-on temperature of the second heat generator and switch off of the first heat generator.

Bivalent semi-parallel mode

Down to a specified outside temperature (bivalence point), the heat pump generates only the necessary heat. If the temperature drops below this value, the second heat generator that uses a different energy source (e.g. gas or oil) steps in. If the flow temperature of the heat pump is no longer sufficient, the heat pump switches off. The second heat generator takes on the task of supplying the full heat demand.

The section „Planning heat sources“ provides an overview of the various dimensioning points for the different operating modes.

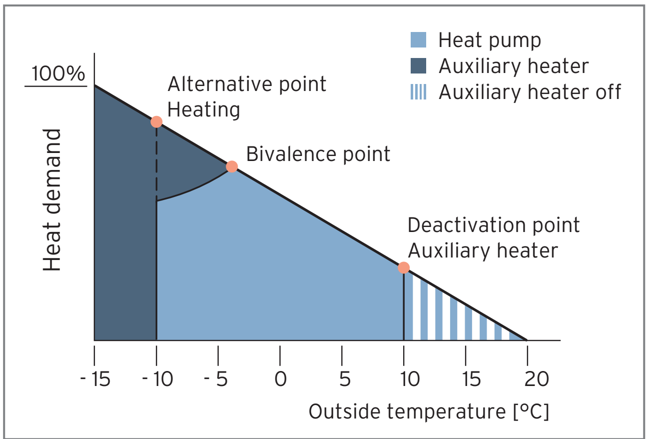


Fig 8: Bivalent semi-parallel mode

1.6 Output figure (COP)

The **output figure ϵ**, which is also referred to as the **COP** (**c**oefficient **o**f **p**erformance), is indicated as the efficiency for heat pumps. It provides information about the efficiency of the heat pump.

The output figure defines the relationship between the usable heat output and the electrical compressor power that is used.

In order to achieve the greatest possible energy efficiency (= high output figure) for a heat pump, the difference between the temperature of the heat source (heat sink) and the temperature of the heat distribution system should be as small as possible.

The following formula is used to calculate the relationship between the heating output and electrical power consumption:

$\epsilon = Q_H / P_{el}$

Formula 1: Calculation of the output figure by means of the electrical power consumption

Q_H = Heating output of the heat pump in kW

P_{el} = Electrical power consumption of the heat pump in kW

The information required for this can be found in the technical data sheet.

Another type of calculation allows the output figure to be determined by means of the temperature difference between the heat source and the heating circuit flow temperature:

$\epsilon = 0.5 * (T/(T - T_0)$

Formula 2: Calculation of the output figure by means of the temperature

T = System temperature (underfloor and radiator heating) in K

T_0 = Temperature of the heat source in K

Sample calculation of the output figure by means of the temperature difference

Comparison of a heat pump in conjunction with 35 °C underfloor heating and radiator heating with a flow temperature of 50 °C. The temperature of the heat source is 0 °C in this sample calculation.

Underfloor heating sample calculation

$T = 35\,°C = (273 + 35)\,K = 308\,K$

$T_0 = 0\,°C = (273 + 0)\,K = 273\,K$

Sample calculation for underfloor heating

$\epsilon = 0.5 * (308\,K/(308\,K - 273\,K))$

$\epsilon = 0.5 * (308\,K/35\,K) = 4.4$

Result: 4.4

Radiator heating sample calculation

$T = 50\,°C = (273 + 50)\,K = 323\,K$

$T_0 = 0\,°C = (273 + 0)\,K = 273\,K$

Sample calculation for radiator heating

$\epsilon = 0.5 * (323\,K/(323\,K - 273\,K))$

$\epsilon = 0.5 * (323\,K/50\,K) = 3.2$

Result: 3.2

The smaller the temperature difference between the heating circuit flow temperature and the heat source temperature, the higher the output figure.

The higher the output figure, the more energy efficiently the system operates.

Output figure (depending on the temperature difference)

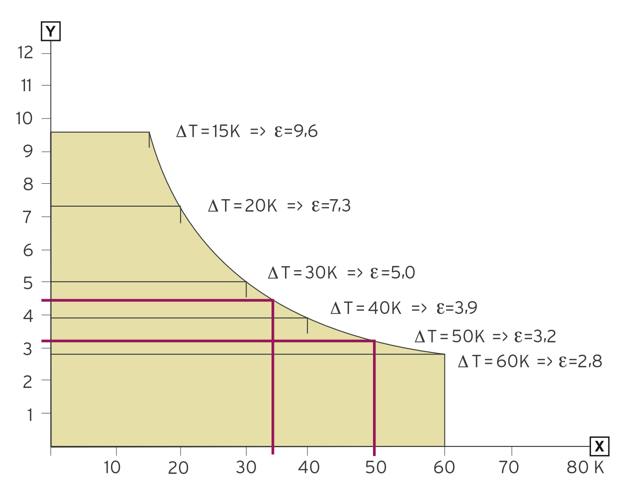


Fig 9: Output figure (depending on the temperature difference)

X Temperature difference ΔT

Y Output figure ϵ

EER (energy efficiency ratio)

The **cooling output figure ϵ**, which is also referred to as the **EER** (**e**nergy **e**fficiency **r**atio), provides information about the efficiency of heat pumps in cooling mode. This value is comparable to the COP (for heating mode).

The EER is the relationship between power consumption (electrical consumption) and power output (cooling capacity) in cooling mode. It is measured under the same measuring conditions as the COP (35 °C outside air temperature and 27 °C inside air temperature).

For example, an EER of four means that 1 kilowatt of electrical power must be used to air-condition a room that requires a cooling capacity of 4 kilowatts (4:1).

Comparison of heat pumps

To enable the output figure for heat pumps to be compared, the temperatures of the heat source and the heat distribution system are standardised (determined in accordance with DIN EN 14511).

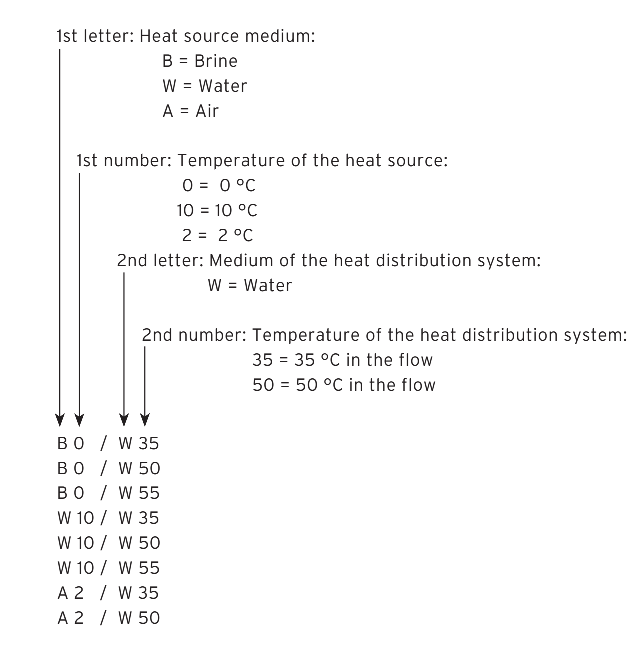


Fig 10: Nomenclature

When stating output figures, always pay attention to the reference point to which this information relates (heat source temperature and heating system flow temperature).

1.7 Seasonal performance factor (SPF)

While the output figure (COP) is a snapshot of the situation in precisely defined conditions, the **seasonal performance factor β(SPF)** reflects the relationship between the delivered thermal energy and the applied electrical energy of the entire heat pump system over the period of a year.

In order to calculate the efficiency over an entire year as early as in the planning phase, it is necessary to calculate the seasonal performance factor in accordance with VDI 4650.

The result can be determined in a simplified manner using the following calculation method:

$\beta = Q_{WP}/P_{el}$

Formula 3: Calculation of the output figure by means of the electrical power consumption

Q_{WP}= Quantity of heat delivered by the heat pump in a year in kWh

P_{el} = Electrical energy supplied to the heat pump in a year in kWh

A seasonal performance factor of 3.0 therefore means that three times the electrical power used is converted into thermal energy.

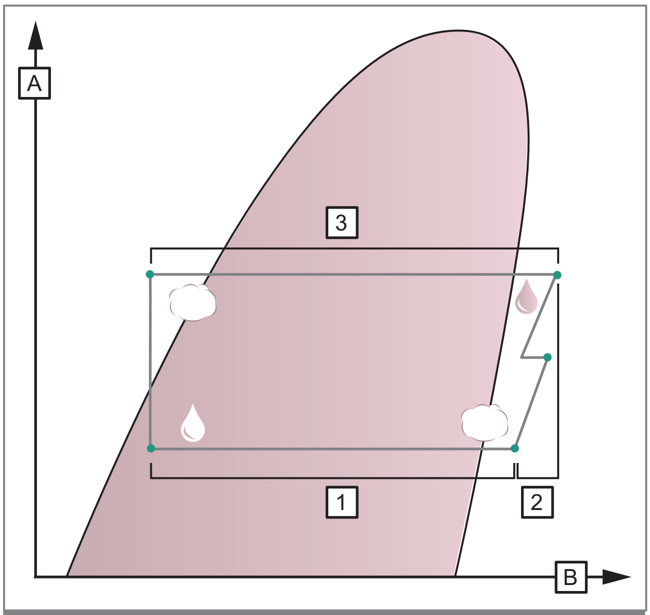


Fig 11: Illustration of cooling and heating output

A log p (pressure) MPa
B h (enthalpy) kj/kg
1 Cooling capacity
2 Electrical drive energy
3 Heating output

Very good heat pump systems have a seasonal performance factor for air/water of greater than 3.5 and for brine/water and water/water of greater than 4.

2 Legal framework

Anyone planning a construction project or an extensive renovation must observe the legal framework. The following Germany-wide energy saving ordinances are particularly important here.

2.1 Energy Saving Act (EnEG)

On 15th May 2013, the fourth amendment to the Energy Saving Act (EnEG) passed into law. This provides the legal framework for the revision of the Energy Saving Ordinance (EnEV).

Among other things, the EnEG regulates the allocation of operating costs and billing information.

In this case, the energy demand for a building relates not only to the energy that is required to provide heat for heating, ventilation and domestic hot water, but also to the energy required for cooling the building.

2.2 Energy Saving Ordinance (EnEV 2014/2016)

The first version of the EnEV has been in force since February 2002. To implement the EC Directive on the energy performance of buildings, a new version was created and this came into force on 1st October 2009.

Since 1st January 2016, even stricter efficiency requirements apply for new builds.

The Energy Saving Ordinance (EnEV) aims to comply with the Kyoto Protocol from 1997 and the German government‘s aim, which resulted from Kyoto, to have a building stock which is almost climate-neutral by 2050.

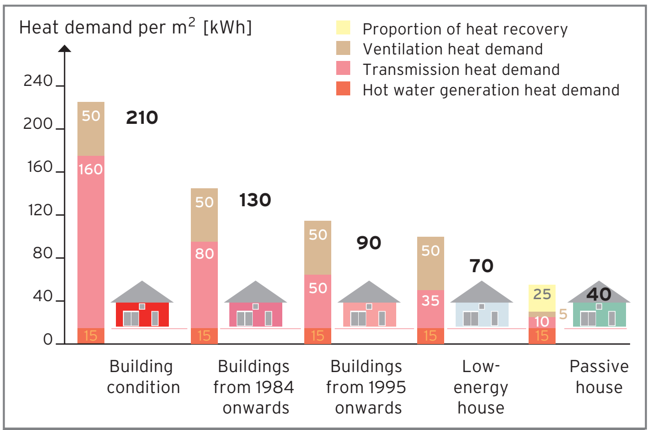
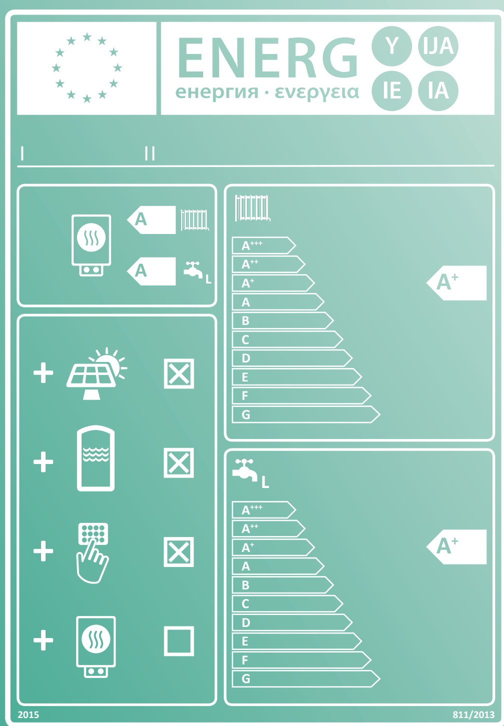


Fig 12: Developing the heat demand



In contrast to the previous energy-saving ordinance, the calculation now includes not only the heat demand but also the energy that is required for room ventilation and for heating potable water. The primary energy requirement for a house is determined from the total number of such parameters.

By taking heat recovery into account as a replacement measure, using controlled domestic ventilation with heat recovery has a positive effect on a building's primary energy requirement and facilitates the Energy Saving Ordinance requirement.

EnEV 2014/2016 regulates the standards for the maximum permissible annual primary energy requirement for buildings at the time of the building application.

The thermal insulation requirements for the building shell have been made stricter.

The amendments to EnEV 2014/2016 mean that the requirements for new builds, existing buildings and the energy performance certificate are more precise, simplified and stricter.

Non-residential buildings with rooms that are more than four metres high do not have to comply with these stricter regulations if they are heated using decentralised fan heating or radiation heating systems.

2.3 Renewable Energies Heat Act (EEWärmeG)

On 6th June 2008, the German Renewable Energies Heat Act (EEWärmeG) for the promotion of renewable energies in the heating sector was passed. Its aim is to increase the proportion of renewable energies in final energy consumption for heat to 14% by the year 2020.

This law came into force on 1st January 2009 and its objective is, in the particular interest of climate protection, to protect fossil resources and reduce dependency on energy imports, to enable the sustained development of the supply of energy and to promote the further development of technologies for generating heat from renewable energies.

As of a usable area of more than 50 square metres (calculated in accordance with EnEV), Section 3 of the EEWärmeG states that builders are obligated to cover a proportion of the heat demand for new buildings with renewable energies.

This obligation applies for all owners of new buildings, regardless of whether they are being/were constructed by commercial or private builders. The owner can decide which type(s) of renewable energies is/are used.

In this case, several minimum requirements must be observed. A fixed minimum proportion of the entire heat and/or cooling requirement must therefore be covered by renewable energies. The proportion required depends on which renewable energies are used.

At present, when using thermal, solar radiation energy, at least 15% of the heat and cooling energy requirement of the building must be covered by a solar thermal installation.

Fig 13: Using solar energy through tube collectors

When using solid or liquid biomass, 50% of the energy requirement must be covered; 50% is also required when using geothermal energy. The differing proportions are due to different investment and fuel costs.

Anyone who does not want to use renewable energies can choose from various alternative measures. For example, this usage obligation is deemed to be met if at least 50% of the heat and cooling energy demand is covered by waste heat or combined heat and power systems (CHP systems).

Financial support is available from the EU, the state, the federal states, municipalities and energy providers for measures that save energy and use renewable energies. Introducing environmentally friendly energy technologies to the market is supported by many different subsidy programmes.

You can find the latest information about the various subsidy programmes online at:

http://www.vaillant.de/heizung/marktinfos/forderung-finanzierung/fordermittelsuche/index.de_de.html

2.4 Connection to the Renewable Energies Heat Act

The law on the promotion of renewable energies in the heating sector (Renewable Energies Heat Act, EEWärmeG), dated 1st January 2009, stipulates that a certain portion of renewable energies must be used to heat new buildings. EEWärmeG must be complied with in addition to EnEV (Energy Saving Ordinance). If you opt for a heat pump, it must supply at least 50% of the heating energy required.

Certain minimum requirements in the Renewable Energies Heat Act (EEWärmeG) for the seasonal performance factor apply to all boilers: The usage obligation is deemed to be met if an electrically driven heat pump reaches a calculated seasonal performance factor (air/water) of at least 3.5. A calculated seasonal performance factor of at least 4 applies for all other types.

If the heat pump is also used to generate domestic hot water in buildings, the required seasonal performance factors are each reduced by 0.2 points.

Heat pump installations must be fitted with a meter for heat quantities and current.

Requirements for heat pumps (extract from EEWärmeG, Appendix III b)

Heat pump current:
- Meter for heat and current
- Requirements for the seasonal performance factor SPF
- If potable water is mainly heated by renewable energies then

Oil-fired/gas-fired heat pumps:
- Meter for heat and fuel
- Requirements for the seasonal performance factor SPF ≥ 1.2

Heat pumps have developed into one of the most efficient and least expensive solutions in terms of the requirements of EEWärmeG.

2.5 Ecodesign Directive

The aim is for building services to become more environmentally friendly and energy-saving throughout Europe.

Based on the 20-20-20 targets of the EU climate and energy package, the EU has passed the Ecodesign Directive) (ErP – **E**nergy-**r** elated **P**roducts) and the Energy Labelling Directive (ELD – **E**nergy **L**abelling **D**irective).

The Ecodesign Directive (ErP) sets the framework for defining the efficiency requirements for designing products that consume energy. This directive is binding.

Based on the Ecodesign Directive, minimum efficiency requirements have been defined for products that consume energy in order to reduce their energy consumption and potential environmental impact. Products that do not comply with these requirements must no longer be placed on the market.

Since 1st January 2016, the Ecodesign Directive has also been obligatory for ventilation units.

2.6 Energy label directive

People are already familiar with the EU's energy-efficiency labelling from washing machines and refrigerators. This is now also obligatory for boilers and domestic hot water cylinders.

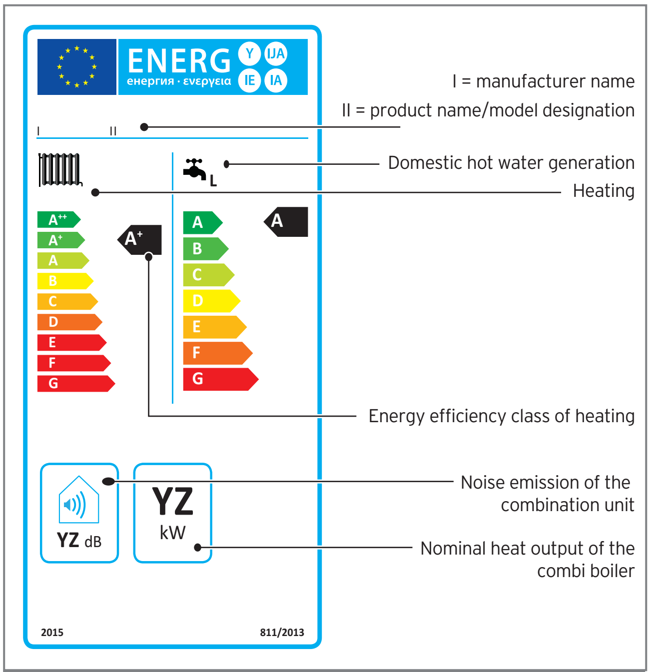


Fig 14: Energy-efficiency label – Information (e.g. combi boiler)

In accordance with EU regulation no. 1254/2014 (LOT 6), energy labelling for domestic ventilation units has also been obligatory since 1st January 2016.

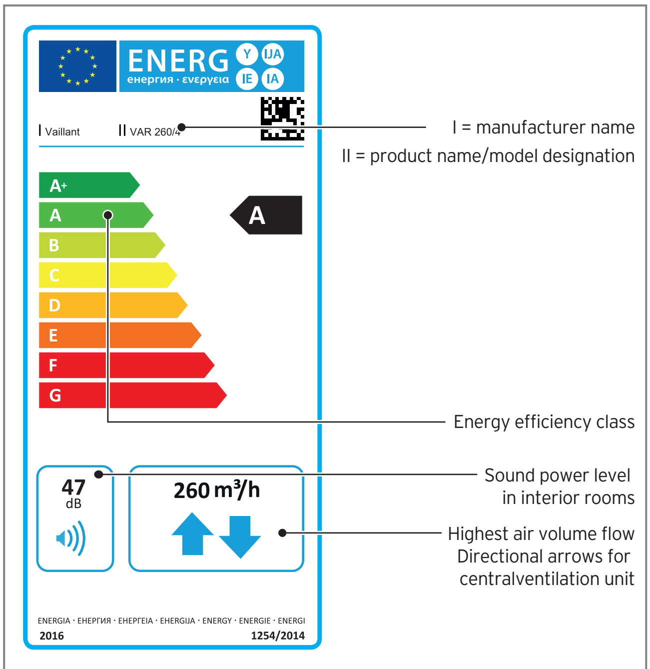


Fig 15: Energy-efficient label for ventilation units

At the same time that the Ecodesign Directive comes into effect, the corresponding Energy Labelling Directive will come into effect across Europe. This prescribes that an energy-efficiency label and a data sheet must be available for each relevant product and system package in order to inform consumers about the efficiency of these products and system packages.

Corresponding labels, along with an additional data sheet, are enclosed with every Vaillant unit.

The specialist companies are responsible for labelling system packages; Vaillant will, of course, provide them with support for this.

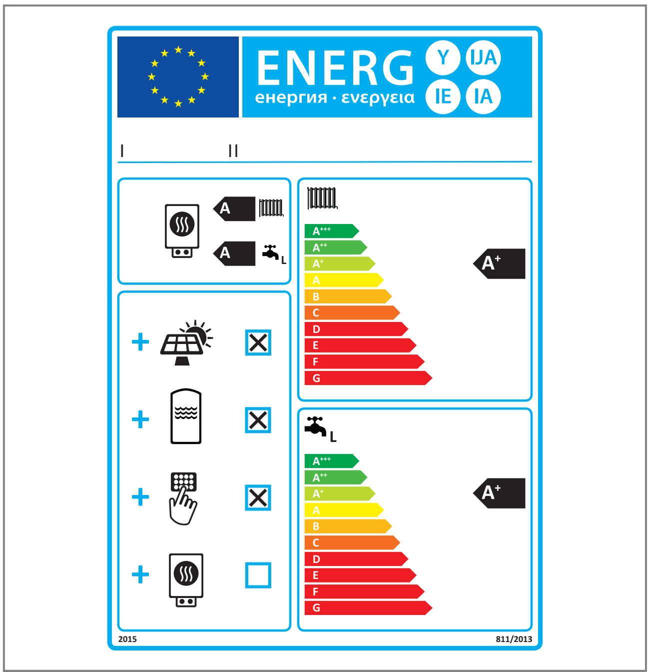


Fig 16: Energy-efficiency label – System package example

Vaillant's planSOFT software solution provides you with all of the information about the relevant product labels (in digital format too), and you do not have to deal with the time-consuming and complex calculation procedure. This makes it easy to calculate a system's energy efficiency and create the system label.

You can find detailed information on the Ecodesign Directive on Vaillant's website (www.vaillant.de) and in our online training course on Ecodesign.

It can be found at the following link:

http://www.vai.vg/erp-eld

2.7 Framework in new buildings

If you are planning a new building, it must be an energy-efficient building in accordance with the EnEV.

With EnEV 2014/2016, the German federal government has laid the foundations for implementing the European directive for energy efficiency in buildings. This states that, as of 2021, only ultra-low-energy new buildings may be constructed within the EU. Public buildings must comply with this standard as of 2019.

EnEV 2014/2016 specifies new, stricter limits for the maximum permissible annual primary energy requirement in new buildings. As always, this is compared with the maximum permissible primary energy requirement of prototype buildings but, as of January 2016, it must be 25 % below the old value for the reference building.

The primary energy factor for power has been 1.8 from 2016.

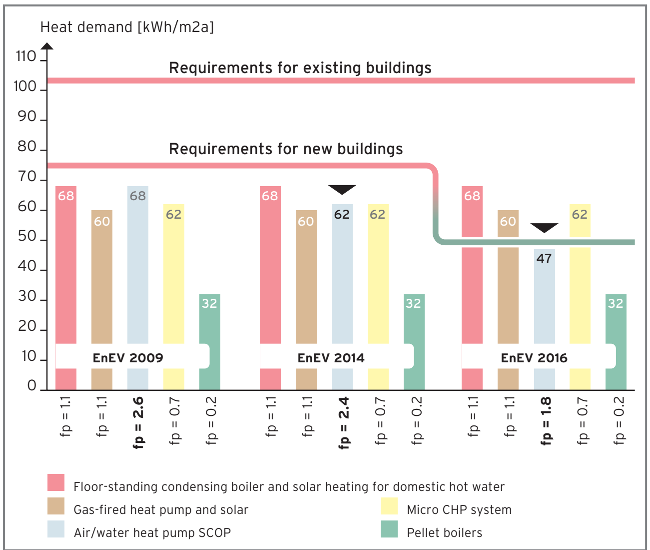


Fig 17: Requirements for new buildings and existing buildings

Thermal insulation requirements

The heat loss through the building envelope of the new residential building must not be higher than what is specified in EnEV 2014/2016. The following table lists these binding maximum values.

Thermal insulation requirements

Building type/residential building		Maximum values for the specific transmission heat loss (H'T) in W/(m²·K)
Free-standing	With A_N* ≤ 350 m²	0.40
	With A_N* > 350 m²	0.50
Semi-detached**		0.45
Other types		0.65
Extensions and expansions in accordance with Section 9 Paragraph 5		0.65

* A_N – usable area of the residential building
** A residential building is semi-detached if a proportion of 80% or more of the vertical surfaces of this building, which are oriented towards a point on the compass, adjoins another residential building or non-residential building that has a target room temperature of at least 19 °C. Source: EnEV 2014, Appendix 1 (requirements for residential buildings), www.bundesgesetzblatt.de

EnEV-easy for non-cooled residential buildings

The revised EnEV also makes a number of simplifications. EnEV certification for new, non-cooled residential buildings is no longer necessary if they comply with certain specifications regarding fixtures and fittings.

These specifications relate to the size, shape, alignment and leak-tightness of the building, to the prevention of thermal bridges, and the proportion of the exterior when compared to the entire heat transfer surface. Holiday and weekend homes are also exempt from EnEV certification if they are mainly used in spring and summer and their energy demand is less than 25 % of the energy demand across an entire year.

Counting power from renewable energies

Counting power from renewable energies is already regulated by EnEV 2009. This power must be deducted from the final energy requirement of the new building if it is generated in or on the building and is used as the main energy source there. The corresponding calculation procedure is now provided by the revised EnEV. Since May 2014, experts have determined the power requirement as a monthly value using DIN V 18599; in the case of power from wind energy, this is determined based on DIN V 18599, Part 10.

2.8 Framework in existing buildings

To achieve the desired increase in the overall efficiency of existing buildings, the German federal government is primarily focusing on developing and increasing incentive measures. The requirements for renovating and modernising have been made stricter, but these changes are rather moderate compared to EnEV 2009.

Replacing older heating systems

In accordance with EnEV 2014/2016 (German Energy Saving Ordinance), as of 1st January 2015, boilers can no longer be used if they are older than 30 years old.

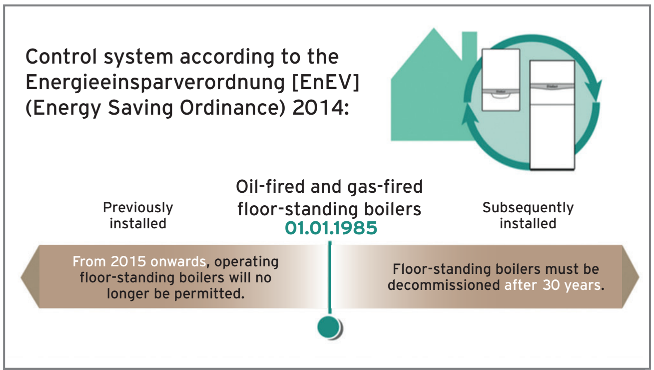


Fig 18: Obligation to replace floor-standing boilers that are 30

This regulation excludes condensing boilers and low-temperature floor-standing boilers that have a high level of efficiency.

Owners who have lived in their detached or semi-detached house since 1st February 2002 are exempt from the obligation to replace these units. After a change of ownership, the purchaser must replace any heating system that is 30 years old or older within two years.

Heating installations with a nominal output of <4 kW or >400 kW and installations that are only used to handle domestic hot water are excluded from this.

You can find the latest information about the various subsidy programmes online at:

http://www.vaillant.de/heizung/marktinfos/forderung-finanzierung/fordermittelsuche/index.de_de.html

Changes to outer surfaces/façades

EnEV 2014/2016 now makes it quite clear that, if buildings are modified, expanded or extended, only those outer surfaces that are actually handled must comply with the stricter version of the EnEV requirements. EnEV 2009 already stated this but this section was frequently misunderstood.

Simplified certification for structural extensions

If the owner extends or expands their existing building, the requirements that must be complied with depend on whether or not they have taken the opportunity to modernise the heating system.

As of 2016, if a heating system is newly installed, the parts of the building that have been modified must comply with the requirements for new builds set out in EnEV 2014/2016. If the parts of the building that have been modified are heated using the existing heating system, they must comply with the requirements for renovating parts of existing buildings.

In the case of a usable area of more than 50 square metres, the requirements for thermal insulation in the summer must also be complied with.

Obligation to provide ceiling insulation

To unambiguously clarify the obligation to provide ceiling insulation in existing buildings, EnEV 2014/2016 establishes the minimum level of thermal insulation in accordance with DIN 4108, Part 2 (issued February 2013).

By the end of 2015, accessible ceilings for heated rooms that are below an unheated roof-space must be insulated to a maximum heat transfer coefficient (U-value) of 0.24 (W/m² x k). Alternatively, the owner can insulate the roof that lies above this.

Ventilation concept

In accordance with DIN 1946-6, when modernising existing buildings, you must always check whether a ventilation measure is necessary if:

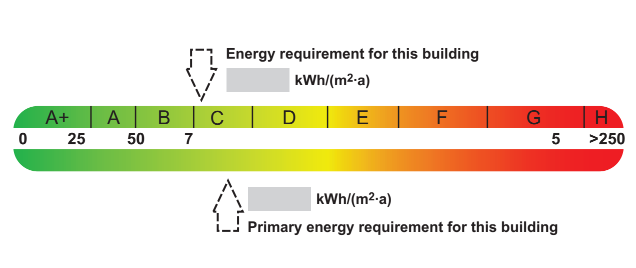
- In the multiple-occupancy house, more than 1/3 of the existing windows are replaced and
- In the single-occupancy house, more than 1/3 of the existing windows are replaced or more than 1/3 of the roof area is sealed.

Observe DIN 18017-3 with regard to ventilating bathrooms and WCs without an outside window.

2.9 Energy performance certificate

The energy performance certificate helps increase the energy efficiency of buildings by making their energy performance clear to owners, purchasers and tenants. In comparison to the EnEV (Energy Saving Ordinance) 2009, legislators have changed EnEV 2014/2016 as follows.

The span of the sliding bar has been significantly reduced – from over 400 kWh/(m^2 a) to a maximum of over 250 kWh/(m^2 a).



Source: EnEV 2014, Appendix 6 (sample energy performance certificate for residential buildings), www.bundesgesetzblatt.de

Fig 19: Sliding bar with energy efficiency classes

Recommendations for modernisation are also integrated into this as part of the energy performance certificate. Appendix 10 of the EnEV now documents the efficiency classes for residential buildings.

Energy performance certificate

Energy efficiency class	Final energy [kWh/(m^2 a)]
A+	< 30
A	< 50
B	<75
C	< 100
D	<130
E	<160
F	<200
G	<250
H	>250

2.10 Subsidy programmes checked?

New heating systems can be subsidised by the government, federal states, municipalities and energy suppliers. The size of the subsidy depends on the location of the building, the type of construction project and the time of the application.

When using solar thermal energy, heat pumps, biomass (pellet boilers) or a CHP system, your customers can take advantage of numerous subsidies from the government, federal states, municipalities and energy suppliers.

Do you require help with the numerous different subsidies?

Vaillant supports their expert partners when seeking subsidies. On Vaillant's website, you can use the subsidy search to look for all subsidy options at a federal and state level, as well as all special regional programmes for your location and your project.

You can find the latest information here:

http://www.vaillant.de/heizung/marktinfos/forderung-finanzierung/fordermittelsuche/index.de_de.html

2.11 Regulations on noise pollution

The legal basis in Germany for noise pollution planning is the Bundes-Immisionsschutzgesetz, BImSchG („Federal Emission Safety Act“ which provides protection against harmful environmental effects by air pollution, noise, vibration and the like). Its regulations apply to, among other things, the set-up and operation of systems (and thus also to heat pump installations).

According to this law, installations are to be set up and operated in such a way that

- harmful environmental effects that are avoidable using the technology currently available are prevented.
- harmful environmental effects that are unavoidable with the technology currently available are limited to the minimum achievable.

The general administrative provision relating to the BImSchG is those set out in TA Lärm (German Noise Abatement Regulations). These are intended to protect the neighbourhood (general public) against any harmful environmental effects of (external) noise. Harmful environmental effects are noise emissions that are capable of causing dangers, considerable adverse effects or considerable nuisance to the general public or the neighbourhood. The definitive pollution point within the area affected by the installation is the point at which the applicable limits are most likely to be exceeded. **In the case of developed areas, the definitive pollution point is 0.5 m outside the centre of the open window of the room that is most affected by the noise and requires protection.** At that point, the noise must be below the assessment level L_r (sound pressure level) specified by item 6 of TA Lärm (German Noise Abatement Regulations). Transient noise peaks may exceed those guideline values by 30 dB(A) in the daytime and 20 dB(A) at night.

DIN 4109 (noise abatement in above-ground construction work) states that the permissible sound pressure level in rooms subject to protection (living rooms, bedrooms, offices, etc.) must not exceed a level of 30 dB(A) (in respect of a building service installation as the noise source). Building services installations include supply and disposal systems and permanently installed plant and equipment. This standard does not apply to the protection of habitable rooms against noise from building services installations within their own living area.

VDI 2714 (sound propagation outdoors) is intended to offer a standardised calculation method for determining noise emission and pollution for planning purposes.

3 Planning the building

Efficient, convenient and uniform heating of the building by effectively using Vaillant heat generators can only be achieved if the entire heating installation is carefully calculated, planned in detail, and installed and commissioned accordingly.

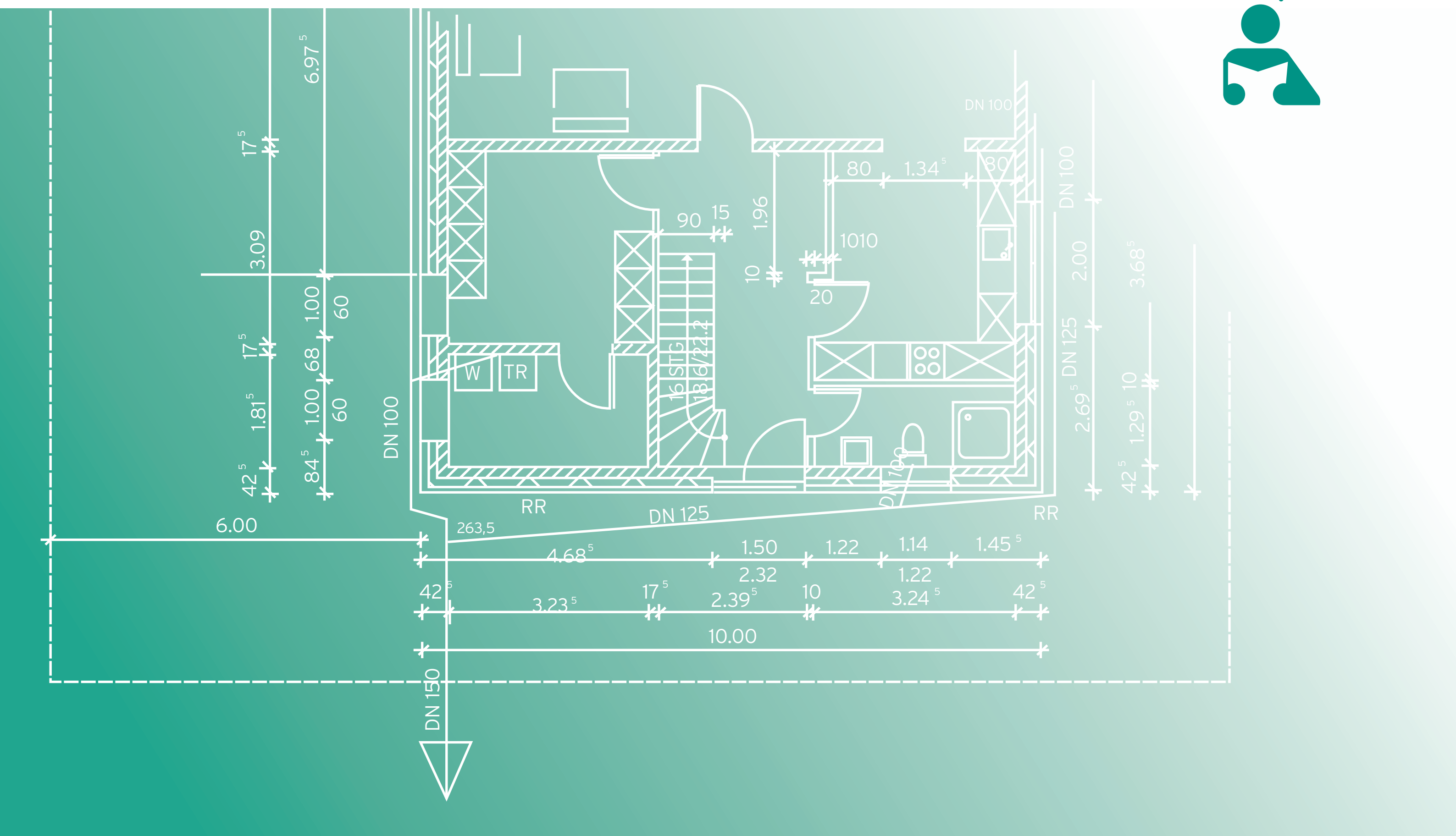
In addition to determining the heat demand for each room, this includes the heating area design, the relevant volume flows, the pipework design calculation for dimensioning the line cross sections and the pressure loss calculation for the system components.

During commissioning, the calculated values are then used to hydraulically balance the heating installation.

3.1 Planning overview

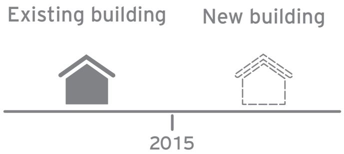
The following overview pages summarise the general planning process.

In addition to the most important steps of the planning process, many important aspects are listed and these must be complied with or checked when planning a heating installation.



Type of building

Planning information:
- New building
- Existing building
- Single-occupancy house
- Multiple-occupancy house
- Residential and commercial building
- Central or non-central heating
- Number of accommodation or service units
- Number of residents/users



Result:
- Type of heating has been planned (central/non-central)
- Statutory requirements for energy saving complied with
- Promotion programmes checked
- Any measures for renovating the building taken into consideration
- Existing heat distribution system checked

Determining the heating load

Planning information:
- Heating load calculation for new buildings
- Estimation for existing buildings
- Estimation on the basis of past consumption data

Planning the heat distribution

Result:
- Number of heating circuits planned
- Type of heating circuits determined
- Material for the heating surfaces (Cu, PE-RT, etc.) selected

System separation

Result:
- System separation planned
- Type of system separation (heat exchanger, buffer cylinder) planned

System temperatures

60/40 — 40/30

Result:
- Flow and return temperatures determined
- Proportion of heating output determined

Other heat generators

Result:
- Additional heat generator planned, if required
- Hydraulic integration planned

Cooling Load Calculation

Planning information:
- Active oder passive Cooling
- Possible cooling areas

Calculation of the cooling load

Result:
- Cooling Load determined
- Cooling- and hydraulic system planned

Fig 20: Planning overview - Part I

Determining the hot water demand

Planning information:
- Requirements for drinking water hygiene
- Type of protection anode

Additional power for hotwater preparation

Result:
- Hot water system and cylinder volume have been designed
- Additional power for hotwater preparation calculated

Planning of the heatsource

Planning information:
- Heating Load building
- Extra heating load hot water
- EVU-supplement
- Permissions
- Operating mode

Dimensioning of the heatsource

Result:
- Heatsource determined
- Heatsource dimensioned
- Operation mode fixed
- Request for permission

Determining the flow temperature

Planning information:
- Heating system temperatures
- Type of hot water generation
- Data on other heat consumers (swimming pool)

Result:
- Required flow temperature of the heat generator determined

Planning the installation of the heat generator

Planning information:
- Access routes to the installation location
- Room sizes/room heights
- Drain present
- Ventilating the installation location

Planning the installation location

Result:
- Installation location determined
- Integration of the heat generator checked
- Actions for reducing noise are taken

Integrating a Photovoltaic installation

Planning information:
- Integrating to the system

Total feeding | Internal consumption | Overrun feeding

Result:
- System version defined

Fig 21: Planning overview - Part II

3.2 Energy source

When planning a heating installation, one of the questions that crops up is that of which energy source should or can be used.

For a new-build project, availability is the decisive criterion for selecting the energy source. When an old building is being renovated, it may be a good idea to change the energy source.

3.3 Building types

A distinction is made between different types of buildings on the basis of the age of a building and the associated construction technique, applicable technical regulations, regulations in terms of building laws and energy at the time of construction and on the basis of the purpose of use.

Fig 22: Building types

As part of planning, a distinction must firstly be made as to whether the property in question is an existing building (old building) or a newly constructed building (new building).

Old buildings and new buildings are differentiated into the following building types according to usage type:

- Residential building
- Single-occupancy house
- Multiple-occupancy house
- Residential and commercial building
- Purpose-built buildings (sports halls, churches, office buildings)

The usage type results in different heat demands that must be taken into account when planning the heating installation.

For example, churches are generally only used at the weekend and therefore do not need to be heated during the week; they therefore cool down considerably. Heating and comfort must therefore be provided in a very short period of time and churches therefore have a higher reheat factor than a residential building that is continuously heated.

Office buildings are generally only heated during office hours, meaning that heating can be reduced outside these hours, but provision must be made for appropriate preheat times when the buildings are in use.

These various aspects have to be taken into consideration alongside customer requirements when planning the heating installation.

The usage type of the building also plays an important role in the provision of hot water. In hospitals or retirement homes, hot water must always be available. In single-occupancy houses, this is more a matter of convenience. In laws governing tenancy there is even a regulation stating that "in multiple-occupancy houses, hot water must constantly be available (24 hours a day)".

3.4 Geological surroundings

Since the heat pump gets the energy required to heat a building and/or to heat drinking water from the environment, information about the external and internal structure of the immediate surroundings is necessary.

This information is important for designing and dimensioning the heat source.

Location

The following aspects must be taken into consideration with regard to precisely designing the source:

- Where is the property located?
  City location?
  Free-standing?
- Is the property unprotected from wind?
  Note that the location may have an effect on the heat demand.
- Adjacent buildings?
  Are the adjacent buildings situated at a distance or nearby?
  This question is significant if we have to use air heat pumps and have to take noise protection into account.
- Layout plan with north arrow?
  Standard document that clearly identifies the property, marks the location of the subsequent source and is used for approval procedures.
  Is also used to design the property so that it is south-facing if heating is to be solar-assisted.
- Water protection zone?
  In a designated water protection zone, separate approval procedures may be required or the use of geothermal heat sources may be restricted or not permitted at all.

Surroundings

- How large is the plot of land?
- This information is very important for designing a ground collector
- Is the plot of land easily accessible (access for the drill, suitability for traffic, stairs)?
- The heat pump and buffer cylinder components are normally delivered to the property in a lorry. It is therefore important to ensure that access routes are well developed.
- What is the extent of tree cover (shadows)?
- The sun should shine on ground collectors to warm them up sufficiently for the winter. Furthermore, tree cover and any shadows this causes are also of essential importance for solar collectors or photovoltaic installations.
- Are there large structures, mountains or hills in the surroundings?
- Depending on the position and size of the sun, areas of a plot of land may be in shadow year-round, even though they may be south-facing.

Geotechnical investigation

- Do the relevant authorities have information about the geology and/or fertility of the soil?
- Has a geotechnical investigation been carried out on the plot of land?
- The more accurate the information, the more accurate and efficient drilling will be. In some circumstances, it is necessary to write to the relevant authorities to obtain information.
- If probe boreholes have already been created near the property, there will normally also be a bore log that provides important information on the source design.

If the potential extraction rates for the ground are not known, it may be necessary to create a test borehole to assess the ground. For installations larger than 30 kW, a test borehole is absolutely necessary (Thermal Response Test).

Visit http://www.erdwaermeliga.de/leitfaeden.html for all the important information about the potential of the heat source.

During drilling, soil samples must be taken in order to determine and document the extraction rate that is actually possible to achieve. These are then compared with the planned extraction rates. If there are differences between the planned extraction rate and the on-site extraction rate, the drilling depth must be adapted to the extraction rates that were actually achieved.

In order to get a valid value for accurately calculating drilling depth, an average value must be calculated from the individual values.

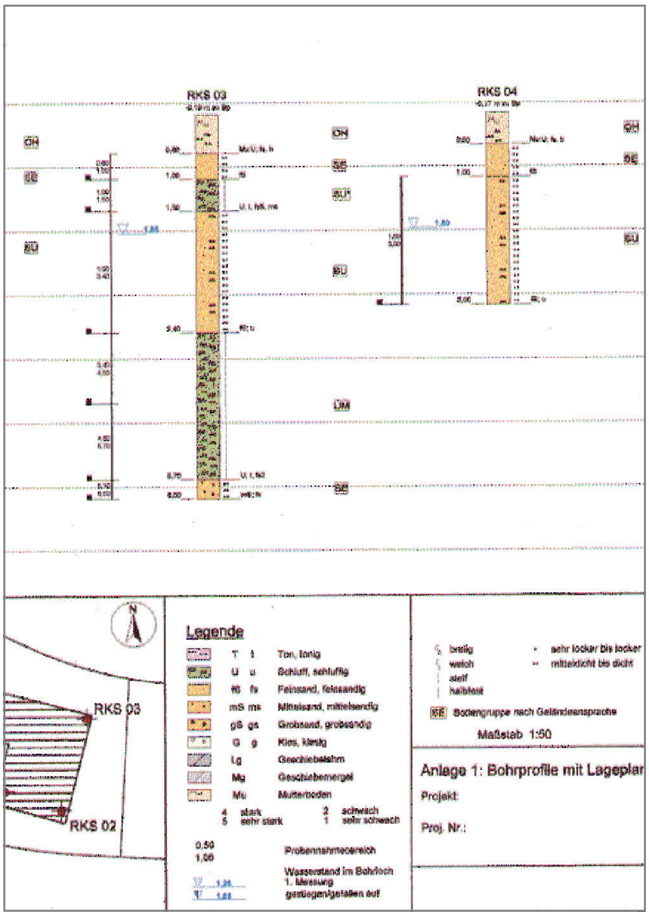


Fig 23: Geotechnical investigation

Groundwater

- Is there information about potential groundwater use for the plot of land?
  The decisive factors for potential groundwater use are the quality of the groundwater and whether it is available in sufficient quantities, and also that the groundwater source is not too deep (not deeper than 15 metres).
- Are there water protection regulations?
  Water protection regulations differ greatly from region to region. Check approval requirements.
- Has the groundwater been analysed?
- Is the groundwater temperature known?
  The groundwater temperature should also be measured when the groundwater is sampled, as this temperature is of subsequent importance for the heat pump's output.
- Is it impossible for meltwater (surface water) with a low temperature to enter the well?
- A well-water system must be designed
- The line in the injection well must be introduced at groundwater level as, otherwise, there is a risk of deposits forming. (Iron in the groundwater oxidising with oxygen from the air; blockage of the injection well)
- Groundwater quality and quantity must be checked and documented.
- The groundwater flow direction must be known.
- The well pump must be dimensioned precisely. Otherwise, this leads to increased operating costs as a result of groundwater pumps that are too powerful.

3.5 Planning in new buildings

When planning a heating installation in a new building, some basic pieces of information are important and have an effect on the possible system variations.

First, the building type must be determined. Is it a single-occupancy house or a multiple-occupancy house? Is the property a residential or commercial building, or is it mixed-use?

Selecting the heat source for new systems

Setting the flow temperatures

In principle, the heat demand should be assigned at the lowest possible flow temperature. The system's heat distribution system is to be designed accordingly. A flow temperature that is lower by 1 degree saves approximately 2.5% energy.

The maximum flow temperature of a heat pump heating installation should not be higher than 55 °C. Particularly large heating areas, for example underfloor heating, are suited to such temperatures.

Selecting the heat source

The heat source used depends on the following parameters:

- Investment costs:
- Heat pump and heat distribution system costs as well as heat source exploitation costs must be taken into account.
- Operating costs:
- The expected seasonal performance factor of the heat pump is an essential factor here.
- This depends on the type of heat pump, the average heat source temperature and the required flow temperature.

The seasonal performance factor for air/water heat pumps is lower than for water/water and brine/water heat pumps. It is therefore simpler and less expensive to exploit the heat source.

Central heating in new builds

Central heating involves a central heat generator supplying heat to several accommodation or service units or an entire building.

This is either a sufficiently large single heat pump or a cascade of several units connected in series or in parallel.

Fig 24: Cascade solution for central heating

Domestic hot water can be generated by a central domestic hot water cylinder with post-heating via a second energy source. As an alternative, provision can be made for (electric) instantaneous water heaters or heat interface units for each accommodation unit/service unit.

Heat interface units can be used to emit heat in a non-centralised manner for heating rooms and generating domestic hot water. Each accommodation unit is connected to the main line at only one point; domestic hot water is generated in the flat itself according to the through-flow principle.

The individual accommodation/service units must be fitted with heat meters to calculate the extra costs.

Remote diagnostics for complex heating systems

By means of modern remote diagnostics software, faults in a central heating system can be remotely diagnosed and the heating can be adjusted. This enables complex systems to be professionally serviced and service costs to be reduced.

Vaillant products and solutions with the „Green iQ label" meet the highest requirements in terms of „connective technologies", as well as providing environmentally aware and sustainable heating comfort.

The „Green iQ" products are fitted at the factory with the VR 920 Internet communication unit, which offers the end customer the following options:

- Remote control of the VRC 700 system control via the free end customer „VRC 700 app"
- Internet connection via LAN or WLAN
- Energy monitoring
- Analysis of usage data and use of reporting apps

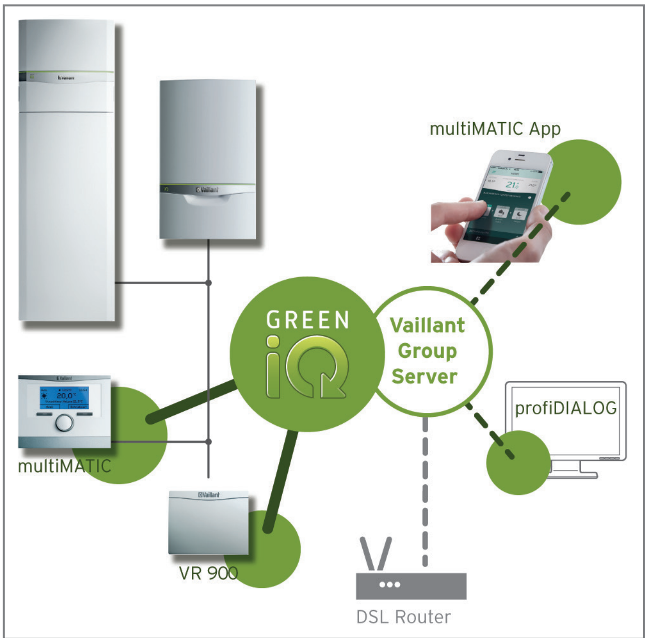


Fig 25: System diagram - VR 920

The competent person can parametrise the heating installation via the profiDIALOG remote diagnosis portal.

Required planning information

The following information forms the basis for further planning and the required calculations:

- Size of the surface area to be heated
- Number of accommodation or service units
- Number of residents/users
- Checking the size of the plot of land, location and tree cover
- Options for the air/flue pipe; whether a hearth is planned and, if so, the hearth height
- Structural analysis for installing a solar thermal system

When planning a new building, it is important that you consult the contractor and the contracted architect before construction begins.

Further consultations with all parties involved in construction (civil engineers and building services) are also necessary.

Building drying

Problem with heat pumps with ground collectors/ earth-tube collector

Ground collectors and/or earth-tube collectors are designed for max. 1800 or 2100 operating hours per year (with and without preparation of domestic hot water) and the corresponding extraction performance.

In accordance with the model energy regulations for the cantons (MuKEn), a heat pump's power must be determined using the SIA documentation D 0208:2005 (calculating the standard heating load in accordance with standard SIA 384.201). Power reserves for drying a building or building temperature control are not defined in this standard and are therefore not permissible.

In general, a heating mode without closed insulation sleeves in cold weather is therefore not permitted (see sections 5.2 and 9 in the SIA documentation that is mentioned).

With normal operation and a limit to the operating hours for heat pumps with ground collectors, the thermal recovery from the ground is guaranteed. With the additional use for drying buildings or building temperature control, the maximum permissible operating hours are significantly exceeded.

As a result, the ground around the ground collector is cooled too much or, in extreme cases, it is even frozen. If different expansion behaviour is observed in the ground and the sensor, this may lead to cavities forming during subsequent thawing. The heat transfer is reduced or even prevented. The ground collector no longer performs to the same level and has to be replaced.

Heat pumps (ground collectors/earth-tube collectors) must not be used to dry buildings or control the temperature of buildings.

Problem with air/water heat pumps

Air-to-water heat pumps can generally be used to dry buildings and/or control the temperature of buildings. Various manufacturers/suppliers also prohibit this application for their Air-to-water heat pumps.

We therefore recommend that you adhere strictly to the instructions and specifications from the manufacturer/ supplier.

When constructing new builds, large volumes of water are processed for mortar, grout, plaster and wall coverings. Rain that enters the shell of the building also increases moisture. This water takes time to evaporate. Moisture increases the building's heat demand in the first heating seasons.

The building drying must therefore always be supported and accelerated using special units. Particularly in the case of building drying in autumn or winter and when a heat pump is used, an additional electrical immersion heater should be installed to cover the heat demand that is increased at the beginning. This immersion heater is activated more often in the first heating season of the heat pump, depending on the flow temperature (approximately 0 °C), or as a result of the limit temperature (0 °C to 5 °C).

The aroTHERM must not be used for screed drying in winter.

Only in exceptional cases and in the short term can the screed-drying function be used with a building surface area smaller than 150 m^2 and an outdoor temperature of 2 °C or higher.

This function can also be used with a surface area of 150–200 m^2 and an outdoor temperature of 4 °C or higher. In doing so, note that the BUH must never be deactivated.

For all buildings with a surface area of more than 200 m^2, it is not possible to dry the buildings without special back-up heaters.

3.6 Planning in existing buildings

When planning a heating installation in an existing building, you should ask questions such as: Should only the heating installation be renewed? Or: Which renovation measures are necessary overall? Is the energy source to be changed? Are systems for using renewable energies also being considered?

When substantially modifying or installing a new heating, domestic hot water or ventilation system in an existing building, you must comply with and implement the requirements of the Energy Saving Ordinance (EnEV).

When renovating or modernising the heating system in an existing building, coming to an agreement with the property owner on the heating concept should be a priority during planning.

This concept must subsequently be reviewed in terms of its efficiency and energy efficiency by the competent person or planner.

The following points should be checked and agreed on during planning:

- Energy source information
- The energy source available (gaseous or liquid or electricity)
- The condition of the oil tank system, liquid gas system or natural gas house connection
- Whether an alternative energy source is to be used
- Checking the size of the plot of land, location and tree cover
- Taking into consideration measures for renovating the building (insulating external walls or the roof, fitting new windows)
- Type of domestic hot water generation and consumers (standard, comfort or luxury)
- Checking the existing heat distribution network
- Checking the use of existing heating areas
- Checking options for the air/flue pipe
- If there is a hearth, checking that it is suitable for use and planning renovation if necessary
- Consultation with the chimney sweep
- Requesting structural analysis (e.g. for the roof if a solar system is planned)

In addition to the geometric and structural data for the property, this information is important for planning potential system variations.

Selecting the heat source (renovation)

It is not always possible to install a geothermal collector, geothermal probe or well-water system when renovating a building. The heat source used is therefore often outdoor air only.

Air is available everywhere. Although the expected seasonal performance factors are less than for water and brine systems, the heat source installation is considerably more simple and less expensive to exploit.

One important point to consider when selecting air as the heat source is noise emission (sound).

Required renovation measures

If there is no underfloor heating and if it is not possible to subsequently install it either, the following alternative measures should be observed to ensure that all rooms are sufficiently heated.

Checking and adapting the heating areas is equally as important as selecting the system-specific output.

- If the required flow temperature is below 55 °C, no additional measures are necessary.
- Any low-temperature heat pump can be used for flow temperatures up to 55 °C.
- If the flow temperature is above 55 °C in some rooms only, measures should be taken to reduce the temperature.
- For this purpose, only the radiators in the affected rooms must be replaced to make it possible to use a low-temperature heat pump.
- If temperatures between 55 °C and 65 °C are required in some of the rooms, the radiators in these rooms must be replaced or you can opt to use a moderate-temperature heat pump.
- If flow temperatures from 65 °C to 75 °C are required, the entire heating system must be converted or adapted.

The building's heat demand can be reduced by:

- Replacing the windows
- Reducing ventilation losses and
- Insulating intermediate ceilings, the roof truss and/or façades

are reduced.

These renovation measures have the following aims:

- A lower heat demand makes it possible to use a smaller and therefore less expensive heat pump.
- The lower heat demand results in a reduction of the annual demand for heating energy that the heat pump has to supply.
- This heat demand can be covered at lower flow temperatures and improves the seasonal performance factor
- The improved heat insulation leads to an increase in the average surface temperatures of the surfaces enclosing the room. The same comfort is thus achieved at lower room air temperatures.

Auxiliary heating using fossil energy sources (hybrid system)

Auxiliary heating using fossil energy sources is often used in existing buildings since there is already an energy source (gas) available here.

It is a combination of renewable energy and fossil fuels.

This system is also referred to as a hybrid system. The hybrid system combines, for example, the free environmental yields of a heat pump with gas heating. In such a system, the heat pump mainly covers the heat demand in the transition periods that have outside temperatures of ≥ 0 °C (basic load). The gas heating in turn covers the heat demand at low outside temperatures. Hot water is generated solely by the gas-fired boiler.

Combining the two technologies results in significant savings on energy and costs in comparison with the sole operation of a heat pump or a gas-fired boiler.

4 Heating load calculation

In general, the heat demand for each building can be calculated irrespective of the usage type of a new or existing building.

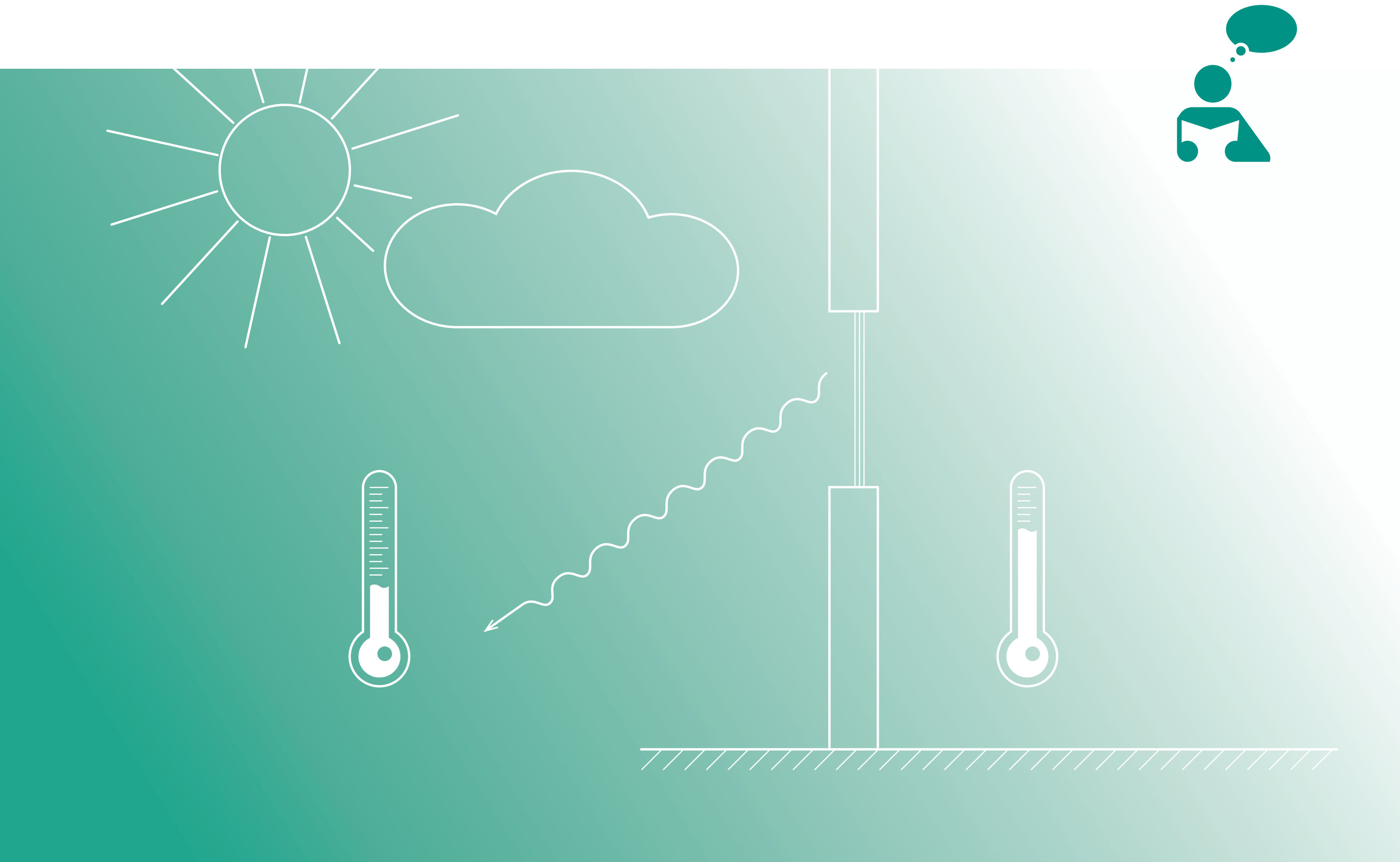
There are appropriate calculation programmes and European or country-specific standards for this purpose, e.g. DIN EN 12831, and possibly other calculation procedures for calculating the heating load.

4.1 Calculation procedure overview

Nowadays, the standard heating load is generally calculated using appropriate computer programmes.

For this purpose, Vaillant offers its expert partners the planSOFT free software solution.

Fig. 26: Vaillant calculation software - planSOFT



The calculation steps according to DIN EN 12831 are outlined below and are required for calculating the heating load.

This is intended to explain what constructional information is required to correctly determine the standard heating load.

To help you record the relevant data in a structured manner, there is a project planning sheet at the end of this section that provides methodical assistance.

Calculation steps

- Determining climate data for the building location (standard outdoor temperature)
- Setting the usage type of the individual rooms and agreeing on inside temperatures with the contractor (unheated, heated, standard inside temperature for each room)
- Requesting building data from the architect/structural engineer (dimensions, thermal heating properties)
- Determining standard heat transfer coefficients (U value, DIN EN ISO 6946)
- Calculating standard transmission heat losses
- Calculating standard ventilation heat losses
- Indicating the reheat factor (optional)
- Adding up all of the standard heat losses to give the standard heating load

Necessary documents for calculating the heating load

When planning a **new building,** the construction planning documents are normally supplied by the architect and heat insulation engineer (structural engineer).

These consist of the following information:

- Layout plan indicating the cardinal points, height of the adjacent building and the geographical location.
- Building plan with floor plans and building cross sections (as a CAD file where appropriate) with a minimum scale of 1:100, floor plans with building dimensions including window and door dimensions, the rooms with an indication of use, and numbering of the rooms.
- Entry of any changed inside room temperatures that differ from the standard inside temperatures in the construction plan (consultation with the contractor).
- Building specification including wall, ceiling and roof structure (density, λ values), type of window glazing, window frame material, window material classes, indication of door material and the portion of the building that is made up of glass.

Purpose of the heating load calculation

The purpose of calculating the heating load in accordance with DIN EN 12831 is therefore to determine the standard heating load of the building depending on building physics and the standard outdoor temperature at the relevant location.

The following planning parameters are determined on the basis of the standard building heating load:

1. The maximum required heating output [kW]
2. Design of the heating areas for the individual rooms

Standard outdoor temperature Θe [°C]

The standard outdoor temperature Θe [i.e. theta e (external)] is the lowest temperature of a cold spell lasting for at least two successive days 10 times in the course of 20 years.

The heat generator output must be configured so that, given a standard outdoor temperature, the building is heated to an agreed standard inside temperature (depending on the usage type of the room) of 20 °C, for example.

DIN EN 12831, supplement 1 documents the standard outdoor temperatures and the relevant classification of areas that experience strong winds for over 500 locations in Germany.

Sample calculation – Single-occupancy house

New building at the Remscheid site

Standard outdoor temperature according to the table: -12 °C

Result: -12 °C

Standard inside temperature Θint,i [°C]

The usage type of the relevant room determines its standard inside temperature Θint,i [i.e. theta $_{int,i}$ (internal)].

Supplement 2 of DIN EN 12831 provides reference values for rooms used for different purposes.

During planning, the desired inside temperatures must always be agreed with the customer (written confirmation, signature).

Standard inside temperature

No.	Room type	Standard inside temperature [°C]
1	Living rooms and bedrooms	+ 20
2	Offices, conference rooms, exhibition rooms, main stairs, counter areas	+ 20
3	Hotel rooms	+ 20
4	Showrooms and shops in general	+ 20
5	Classrooms in general	+ 20
6	Bath and shower rooms, swimming pools, changing rooms, doctor's surgeries	+ 24
8	WCs	+ 20
9	Heated ancillary rooms (halls, etc.)	+ 15
10	Unheated ancillary rooms (cellars, staircases, storage rooms)	+ 10

The standard heating load ΦHL

The standard heating load Φ_{HL} [i.e. phi HL] can be determined for an entire building in order to dimension the heat generator and for individual rooms in order to dimension the individual heating areas.

The standard heating load consists of the following values:

- Standard transmission heat losses Φ_T [i.e. phi T]
- Standard ventilation heat losses Φ_V [i.e. phi V]
- Additional heating output Φ_{RH} [i.e. phi RH]

The heating load is calculated on the basis of rooms or zones $\Phi_{HL,i}$ (for a heated room i) and then added up to give the total heating load of a building.

This enables the number and output of the individual heat consumers to be determined and the heat generator to then be selected.

Formula for calculating the **standard heating load** for individual rooms:

$\Phi_{HL,i} = \Phi_{T,i} + \Phi_{V,i} + \Phi_{RH,i}$ [W]

Standard transmission heat loss ΦT,i [W]

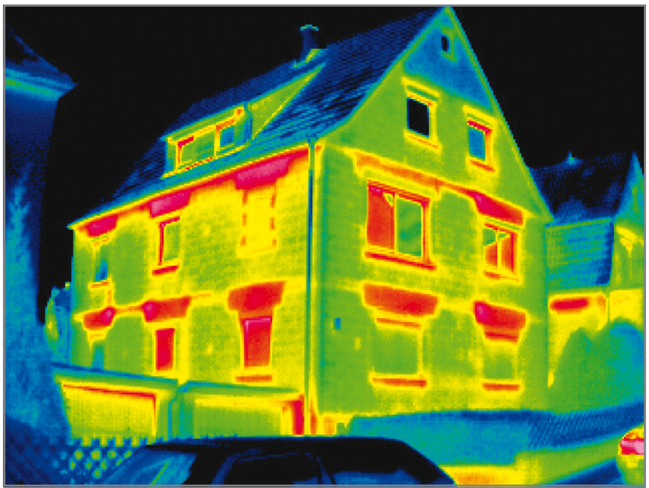


Fig. 27: Transmission heat losses through the building shell

The standard transmission heat loss $\Phi_{T,i}$ for a heated room (i) consists of the following parts in accordance with DIN EN 12831:

H$_{T,ie}$ – Transmission heat loss coefficient between the heated room **(i)** and the external environment **(e)** through the building shell in watt per kelvin [W/K]

H$_{T,iue}$ – transmission heat loss coefficient from the heated room **(i)** to the external environment **(e)** through an unheated room **(u)** in watt per kelvin [W/K]

H$_{T,ig}$ – Stationary transmission heat loss coefficient of the ground from the heated room **(i)** to the ground **(g)** in watt per kelvin [W/K]

H$_{T,ij}$ – Transmission heat loss coefficient of a heated room **(i)** to an adjacent heated room **(j)** which is kept at a significantly different temperature level as a result of heating; this may be an adjacent heated room within a building unit or a heated room in an adjacent building unit, in watt per kelvin [W/K].

Using the determined standard inside/outdoor temperatures, the **standard transmission heat loss** is calculated as follows:

$\Phi_{T,i} = (H_{T,ie} + H_{T,iue} + H_{T,ig} + H_{T,ij}) * (\Theta_{int,i} - \Theta_e)$

Standard ventilation heat loss ΦV,i [W]

The standard ventilation heat losses $\Phi_{V,i}$ for a heated room (i) consist of the following parts in accordance with DIN EN 12831:

$H_{V,i}$ – Standard ventilation transfer loss coefficient in watt per kelvin [W/K]

The difference between the standard inside temperature and the standard outdoor temperature is used to calculate the **standard ventilation heat loss** as follows:

$\Phi_{V,i} = H_{V,i} * (\Theta_{int,i} - \Theta_e)$

Additional heating output ΦRH,i [W]

The simplified method for determining the additional heating output for a heated room consists of the following parts in accordance with DIN EN 12831:

A_i – Floor area of the heated room (i) in square metres [m²]

f_{RH} – Correction factor depending on the heat-up time and the expected reduction in the room temperature during the reduction period in watt per square metre [W/m²]

The **additional heating output ΦRH,i** is calculated using the following formula:

$\Phi_{RH,i} = A_i * f_{RH}$

Explanation of the transmission heat loss calculation

The transmission heat loss Φ consists of the **area A**, the **heat transfer coefficient U** of the component and the temperature difference $\Delta\Theta$ (inside temperature to outdoor temperature/inside temperature to inside temperature):

$\Phi = A * U * (\Theta_{int,i} - \Theta_e)$ where $(\Theta_{int,i} \geq \Theta_e)$ in [W]

The losses of all components (walls, ceilings, floors) are added together to give the entire transmission heat loss of a room. This total results in the transmission heat demand:

$\Phi = \Sigma A_k * U_k * (\Theta_{int,i} - \Theta_e) = \Sigma H_{t,k} * (\Theta_{int,i} - \Theta_e)$ in [W]

Where:

$H_T = A * U$ of the transmission heat loss coefficient of the relevant component in [W/K].

In accordance with the regulations in DIN EN 12831, the area A of the building is to be dimensioned according to the following illustration.

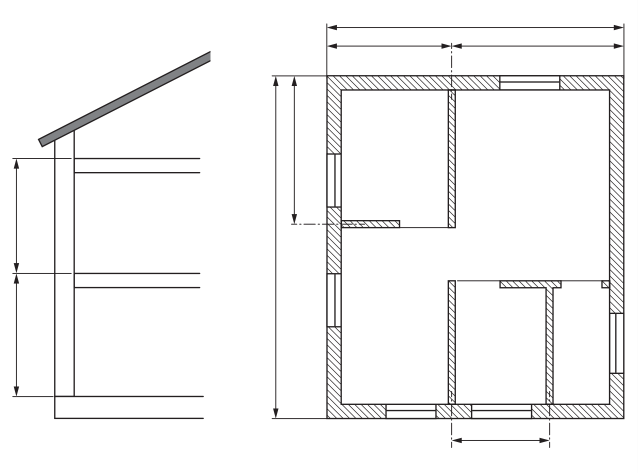


Fig. 28: Dimensioning example in accordance with DIN EN 12831

When determining the wall areas, ensure that they are calculated on the basis of external walls in their entirety and half the area of interior walls.

The height of the floor is always given from finished floor level (FFL) to finished floor level (FFL).

In the following calculations, the transmission heat loss coefficient H_T contains various correction factors, some of which show complex physics processes.

The calculations for the total transmission heat loss $\Phi_{T,i}$ of a room in accordance with DIN EN 12831 are designed so that the total of all transmission heat loss coefficients H_T is multiplied by the difference between the inside air temperature and the outside air temperature.

Corresponding temperature correction factors are therefore used when calculating the transmission heat losses Φ that relate to other temperature differences .

4.2 Heating load calculation – Summary

The following example illustrates the calculation and documentation of a heating load calculation in accordance with DIN EN 12831. The individual points are explained in more detail below.

	Form G 1, detailed procedure			DIN EN 12831
	Project no./name			**Standard heating load as per DIN EN 12831**
	BUILDING COMPOSITION			Page G 3
1	**HEAT LOSS COEFFICIENTS**			**W/ K**
	Transmission heat loss coefficient	$\Sigma H_{T,e}$		129
	Ventilation heat loss coefficient	ΣH_{V}		60
	Building heat loss coefficient	$H_{building}$		**189**
2	**HEAT LOSSES**			**W**
2.1	**Transmission heat losses** (to the outside)	$\Phi_{T,building}$		**4347**
	Minimum air exchange	$\Phi_{V,min,building}$	$= 0.5 \Sigma\Phi V,min$	969
	Natural infiltration	$\Phi_{V,inf,building}$	$= \zeta \cdot \Sigma\Phi_{V,inf}$	
	Mechanical supply air volume flow	$\Phi_{V,su,building}$	$= (1 - \eta) \cdot \Sigma\Phi_{V,su}$	
	Excess volume of exhaust air	$\Phi_{V,mech,inf,building}$		
2.2	**Ventilation heat losses**	$\Phi_{V,building}$		**969**
	BUILDING HEATING LOAD			**W**
3	**Net heating load**	$\Phi_{N,building}$		**5316**
4	**Additional heating output**	$\Phi_{RH, building}$		**2101**
5	**Standard building heating load**	$\Phi_{HL,building}$		**7417**
6	**SPECIFIC VALUES**			
	Heating load/heated building surface	$\Phi_{HL,building}/A_{N,building}$	131,3 m²	56,5 W/m²
	Heating load/heated building volume	$\Phi_{HL,building}/V_{N,building}$	326,9 m³	16,3 W/m³
	heat-transferring surrounding area	A	772.0 m²	
	Specific transmission heat loss	H_T'		**0.17 W/m²K**

Fig. 29: Standard heating load in accordance with DIN EN 12831 – Summary

Heat loss coefficients (1)

The calculated building heat loss coefficient can be found here. This consists of the loss coefficients of heat transfer through the enclosing surfaces (transmission heat loss coefficient) and the heat loss caused by the required exchange of air in the building (ventilation heat loss coefficient). The total of the two values gives the building heat loss coefficient.

This coefficient is a relative value and relates to the temperature difference between the standard inside temperature and the standard outside temperature.

Heat losses (2)

Transmission heat losses (2.1)

The transmission heat loss is the heat that a building loses through its enclosing surfaces. This value is an absolute value for the calculated property.

Ventilation heat losses (2.2)

For reasons of hygiene, a minimum exchange of air is required for each room. The value for the **minimum air volume flow** of the building is calculated from the room volumes.

On account of leaks in doors and windows, the natural exchange of air in a building results in a heat loss which is referred to as **natural infiltration**.

If a building contains internal toilets or bathrooms without windows, these rooms must be mechanically ventilated. These rooms generally have an exhaust air fan that extracts the air from the room and conveys it outside. The extracted volume of air flows from outside into the building through leaks in windows and doors and must be heated. The power required for this is referred to as **„natural infiltration with HVAC“** (HVAC system = heating, ventilation and air-conditioning system).

In more complex ventilation systems, e.g. for a commercial kitchen, the supply air volume flow and the exhaust air volume flow have different settings. The room (kitchen) is kept at negative pressure, i.e. more air is extracted than is supplied, so that no smells pass into the adjacent rooms. The deficit between extracted air and supplied air is covered by the adjacent rooms. The difference must be heated as it generally enters the rooms through the leaks in windows and doors. The calculated values can be found in the **„mechanical supply air volume flow“** and **„mechanically infiltrated volume flow“**.

The **larger value** of minimum air volume flow and the volume flow from natural infiltration is always used in the calculation. The ventilation heat losses listed below are added to this. The total of all of the individual losses can be considered the ventilation heat loss and is an absolute value for a building.

Net heating load (3)

The total of all transmission and ventilation heat losses of the individual rooms is the net heating load.

Additional heating output (4)

If an additional heating load is required for one or more rooms, this value is displayed in total as an additional heating output.

These may be rooms with a restricted heating mode that must be heated for a short period of time (e.g. churches).

Standard building heating load (5)

The total of the standard building heating load and the additional heating output results in the design heating load. A heat generator must provide at least the design heating load.

Specific values (6)

In the „Heating load/heated building area“ row, the quotient of design heating load divided by the area to be heated is calculated. This is a building-specific value. It is synonymous with the specific heat demand.

In the „Heating load/heated building volume“ row, the quotient of design heating load divided by the building volume to be heated is calculated and this is a building-specific value.

The „Heat transfer area“ row displays the total of all of the enclosing surfaces of a building.

In the „Specific transmission heat loss coefficient“ row, the quotient of „heating load divided by building area“ and the temperature difference between the inside and outside are used to calculate a calculation coefficient.

4.3 Determining the estimated heating load in existing buildings

When planning a heating installation in an existing building, the heating load can be estimated.

The older a building, the rarer it is for old calculations or heat transfer coefficients (U values in (Km²)/W) to be available. For this reason, consumption data for the property is available and this can be used to determine the heat demand.

On account of the age alone, basic data is available that makes it possible to estimate the heat demand of a building. These specific demands are generally based on 1 m² of area to be heated, i.e. W/m², or on the volume of the room to be heated, i.e. W/m³.

The following illustration shows an overview of typical specific heat demands for different years of construction:

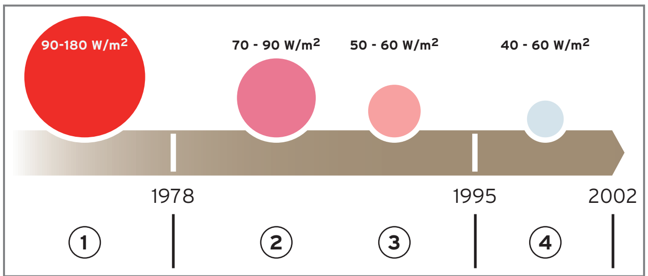


Fig. 30: Heat demands per m² of area to be heated

1 Old building, without special heat insulation
2 Building constructed before 1995, normal heat insulation
3 New build, constructed after the 1995 Thermal Insulation Ordinance
4 New build, constructed after the 2002 Energy Saving Ordinance

The stated values apply to Germany and may differ from country to country.

Example for estimating the heating demand Q on based on the specific heat demand

- Old building, year of construction 1990
- Heat insulation (70 W/m²)
- Heated area 150 m²

Sample calculation

$Q = 70\ W/m^2 * 150\ m^2 = 10{,}500\ W$

Result: Q = 10.5 kW

An estimated heat demand does not replace a detailed calculation of a heat demand.

This rough calculation procedure is used to determine an approximate value and check the plausibility of existing calculations.

Determining a heat demand via the aforementioned specific heat demands results in a good reference value, but is not enough to design the heat generator.

Determining the heat demand of a property via the volume of fuel consumed, e.g. oil or gas, on the basis of the average fuel consumption over the last five years provides us with a more accurate value.

Determining the heat demand using consumption data

Due to the oil crisis in the 1970s and the fact that energy has become increasingly expensive over time, the necessity to constantly improve heat insulation in buildings has grown in order to therefore reduce primary energy demand. This is also associated with refined and adapted calculation procedures as well as recording the demand, energy consumption and duration of the heating seasons.

Using this statistical data, it is possible to quantify the heat demand for a building on the basis of the consumption data.

Example for estimating the heat demand Q on the basis of consumption data

- Old building, year of construction 1990
- Heat insulation (70 W/m²)
- Heated area 150 m²
- Installed boiler 34 kW
- Average oil consumption 1900 l/a
- Hours of full operation b_v 1800 h/a

Sample calculation

$Q = (V\ [l] * H_i\ [kWh/l] * [a])/([a] * b_v\ [h/a] * [l])$

$Q = (1900 * 10)/1800$

Result: Q = 10.6 kW

Values for heating oil

Values for heating oil		
Net calorific value H_i	[kWh/l]	10
Density	[kg/l]	0,845

The example shows that the installed output of the old boiler is three times greater than required. When replacing heat generators, it is therefore always necessary to check what boiler output is actually necessary.

Some characteristic values, which are explained below, are required for the calculations performed in the example.

The **net calorific value** H_i indicates the net calorific value of a fuel and is a measure of the energy content thereof. The following table shows the net calorific values of various fuels.

Net calorific values of various fuels

Fuel	Unit	Net calorific value H_i [kWh/unit]
Heating oil EL	l	10.00
Heavy fuel oil	kg	11.40
Natural gas H	m³	10.40
Brown coal, briquettes	kg	5.34
Hard coal, coke	kg	8.60

The number of hours per year that a boiler must be operated with nominal heat output to cover the annual heat demand is calculated to give the **hours of full operation**.

This statistical value must not be confused with the operating hours. The number of operating hours may be considerably higher than the theoretical hours of full operation in the case of modulating heat generators.

The hours of full operation per year were determined statistically. This results in different values, depending on the building type and use. You can find some examples of hours of full operation in Germany in the following table.

Hours of full operation in Germany

Building type/use	Hours of full operation [h/a]
Single-occupancy house (heating only)	1500-1800
Single-occupancy house (with HW generation)	1800-2100
Multiple-occupancy house	1600-2000
Office block	1400-1900
School	1100-1400

The hours of full operation can be estimated by dividing the heat content of the fuels consumed by the heating load of the building (when the boiler output approximately corresponds to the heating load) or dividing the quantity of fuel consumed (in kWh) by the nominal output of the floor-standing boiler.

Weather normalisation

In order for the calculation to take into account weather fluctuations, the consumption data must be weather-normalised. Heating seasons that are warmer than average or colder than average are therefore calculated in terms of the values throughout the year and the weather at the location of the property is taken into consideration.

In order to be able to evaluate these climatic differences, the **amount of degree days** was introduced. This statistical value is determined daily by Germany's National Meteorological Service (dwd) for many locations in Germany, for example, and added up for the whole year.

The calculation is based on the assumption that heating is required when the outdoor temperature falls below 15 °C. For days when this is the case, the average outdoor temperature is determined and the difference between this temperature and 20 °C is made up.

Accordingly, the degree days for a year are the total of the temperature differences (20 °C minus the average outdoor temperature) of all degree days for this period. The greater the degree days value, the colder it was in the period under consideration and the greater the demand for heating energy.

Determining the portion of consumption that is weather-dependent

For weather normalisation, the portion of consumption that is not weather-dependent and the portion of consumption that is weather-dependent must firstly be determined for each year.

If domestic hot water is generated (independently of the climate) using the same energy source as is used for heating, the portion of hot water consumption must be subtracted from the total consumption.

If the domestic hot water consumption is measured by a water meter, the measured volume can be multiplied by the specific heat capacity of water (1.163 Wh/kg K) and a standardised temperature spread of $\Delta\Theta = 45$ K.

The losses as a result of water distribution and storage must also be added to the measured consumption. By default, 15 kWh/m² per year may be used to cover this.

If the domestic hot water consumption is not measured, a guideline value of 18% of the total consumption can be used.

The following example illustrates the weather normalisation procedure.

Sample calculation

$$Q_{VH} = (G_M/G) * Q_T$$

Values for heating oil		
Normalised heating energy consumption	[kWh/a]	Q_{VH}
Temperature-dependent heating energy consumption	[kWh/a]	Q_T
Number of degree days for the year measured	[K * d]	G
Average value for degree days over X years	[K * d]/x	G_M

For a single-occupancy house in Remscheid with a usable building area A_N of 132 m², the following consumption values are determined. They each relate to the entire year.

2011: **17,440 kWh**

2012: **17,860 kWh**

2013: **17,520 kWh**

2014: **17,390 kWh**

First, the weather-normalised portion for domestic hot water is deducted. Since the domestic hot water consumption was not measured, the guideline value of 18% of the total consumption is deducted.

The weather-normalised portion for the relevant years is therefore calculated as follows:

2011: 17,440 kWh * (100 % - 18 %) = **14,301 kWh**

2012: 17,860 kWh * 0.82 = **14,645 kWh**

2013: 17,520 kWh * 0.82 = **14,366 kWh**

2014: 17,390 kWh * 0.82 = **14,260 kWh**

In order to convert the consumption values so that they represent an average year at the Remscheid location, the amount of degree days in the relevant years and an average year at this location are firstly used to determine a conversion factor for each year and this factor is multiplied by the measured consumption:

2011

Q_T = 14,301 kWh

G_M/G = 3262/2867 = 1.14

Q_{VH} = 1.14 x 14,301 kWh = 16,303 kWh

2012

Q_T = 14,645 kWh

G_M/G = 3262/3201 = 1.02

Q_{VH} = 1.02 x 14,645 kWh = 14,938 kWh

2013

Q_T = 14,366 kWh

G_M/G = 3262/3425 = 0.95

Q_{VH} = 0.95 x 14,366 kWh = 13,648 kWh

2014

Q_T = 14,260 kWh

G_M/G = 3262/2711 = 1.20

Q_{VH} = 1.20 x 14,260 kWh = 17,112 kWh

The portion of domestic hot water is then added to these weather-normalised consumption values:

2011: 16,303 kWh + 17,440 x 0.18 = **19,442 kWh**

2012: 14,938 kWh + 17,860 x 0.18 = **18,153 kWh**

2013: 13,648 kWh + 17,520 x 0.18 = **16,802 kWh**

2014: 17,112 kWh + 17,390 x 0.18 = **20,242 kWh**

The average value of the normalised consumption values is then formed. This can be displayed as a consumption characteristic value based on the usable building area A_N:

Consumption characteristic value:

18,660 (kWh/a)/132 m² = **141 kWh/m²**

If past heating seasons are taken as a basis for calculating consumption data, checks must be performed as to whether other renovation measures carried out on the building have an effect on the heat demand. For example, subsequent heat insulation or fitting new windows. Completed renovation measures can reduce the heat demand by 50 %.

5 Cooling with heat pumps

5.1 Active cooling

The cooling output of the heat pump (primary circuit) is transferred to the heating system.

The heat pump compressor is in operation during the cooling function; the heat pump cools actively.

All **flexoTHERM** and **flexoCOMPACT** heat pumps can cool actively and passively, depending on the heat source.

Vaillant **aroTHERM** and **flexoTHERM/COMPACT** heat pumps with **aroCOLLECT** use the outdoor air as their heat source and can provide an active cooling function in the summer.

The system switches between heating mode and cooling mode via a diverter valve in the refrigeration circuit.

During active cooling, the air indoor unit is used both to absorb energy from and emit energy to the environment.

Vaillant **aroTHERM** heat pumps use underfloor circuits or fan coils for cooling.

Suitable individual room thermostats must be used for cooling mode. The VWZ MEH 61 hydraulic station offers a switch output. The individual room control can be switched to cooling mode via the X 141 connection on the **flexoTHERM**.

5.2 Passive cooling

The **flexoTHERM** and **flexoCOMPACT** heat pumps with ground or ground water as their heat source, and the **geoTHERM** VWS 36/4 and VWS heat pumps from 22 kW are suitable for passive cooling.

The VWZ NC natural cooling modules are required for the **flexoTHERM/flexoCOMPACT**.

The low temperature of the ground water or the ground is transferred to the heating system via a heat exchanger.

The heat pump compressor is not in operation during the cooling function; the heat pump cools only passively.

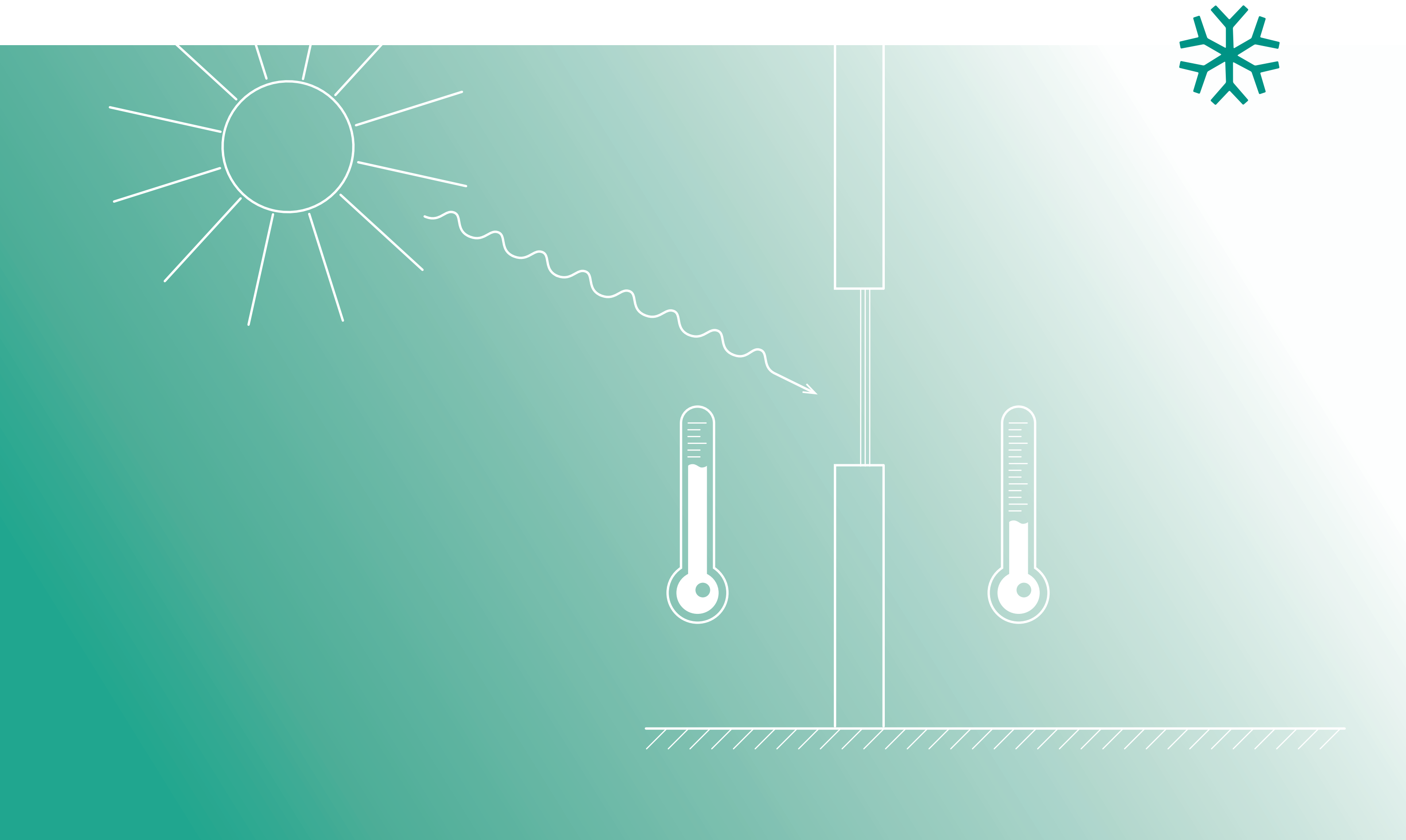
Passive cooling uses natural heat sinks such as cool ground.

The use of storage effects is also possible.

In order to use the cooling function, the system must be hydraulically suitable.

For active cooling with brine and water as the heat source, due to the heating of the ground water, approval must be sought from the lower-level water authority.

You must agree on the use with the drilling company due to the thermal load of the source and the material that is used.



Dew point

As a general rule, the room air temperature drops, the absolute water content of the air remains constant and the relative air humidity increases during the cooling process.

If the air temperature is reduced further, the saturation line is reached. This means the relative air humidity is at a level of 100%. If the temperature is cooled further, condensation occurs and this reduces the absolute water content in the air.

Dew point and air temperatures

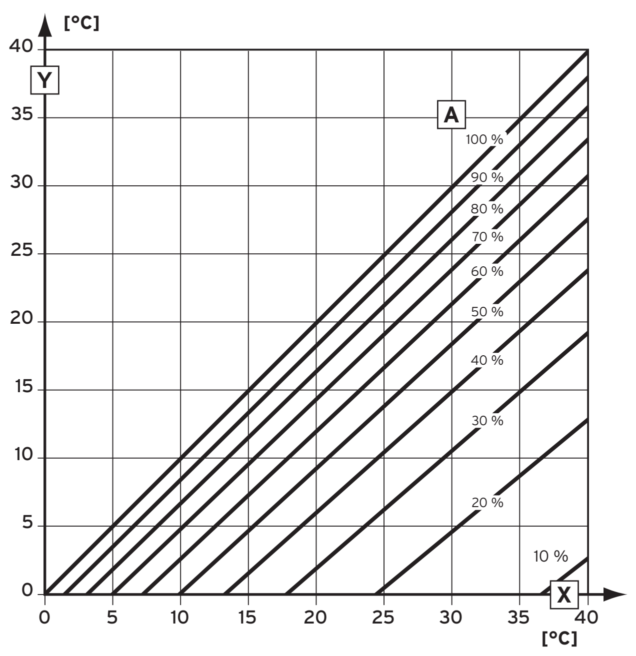


Fig. 31: Dew point and air temperatures

X Air temperature
Y Dew point temperature
A Relative humidity

Minimum flow temperature, dew point temperature

Due to the natural limitation of the cooling output, an underfloor heating system is not always able to maintain the room temperature at a fixed value. However, the flow temperature must always be maintained at a level that prevents the risk of condensate formation. The graphic shows that, in the summer, the amount of humidity reaches slightly more than 9 g/kg of air. With this water vapour content, the dew point occurs at roughly 13 °C (at a relative air humidity of approx. 55%).

Minimum flow temperature, dew point temperature

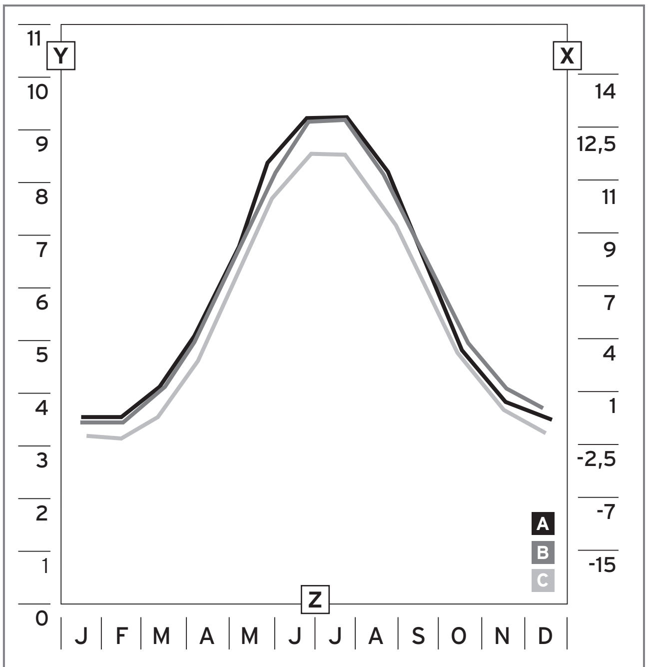


Fig. 32: Minimum flow temperature, dew point temperature

X Dew point in °C
Y Humidity x in g/kg
Z Months
A Mannheim
B Bremerhaven
C Berlin

Vaillant recommends a flow temperature of approx. 20 °C (default setting) for the cooling function.

At an air temperature of 25 °C and with relative air humidity of 70%, the dew point is not reached until a temperature of 19 °C. On average, the relative air humidity in a house is 50-55%, meaning that the air does not fall below the dew point.

The upper air humidity limit of 65% should not be exceeded according to EN 814 T1 - T3 and DIN 1946.

Cooling using radiant systems

Cooling using radiant systems is part of a gentle temperature control system, the use of which is made possible by the excellent thermal insulation generally used nowadays. The optimum quality heat insulation and underfloor heating adapted to the additional cooling function ensure perfect operation.

When using radiant systems for cooling, it is important to limit the surface temperatures or water temperatures in order to prevent condensation. One option is to make provision for a minimum temperature for the flow temperature.

In underfloor heating systems, a minimum flow temperature of 18 °C should be selected. In practice, residential buildings are assumed to have a flow temperature of 18 - 20 °C and a return temperature of 21 - 23 °C in cooling mode.

For tiled floors, a specific cooling output of approx. 30 - 35 W/m² can be expected.

The humidity in the building depends on the outdoor air humidity and the internal loads. The outdoor air humidity exceeds 13 g/kg (18 °C dew point) for a very low number of hours per year only.

For pipes laid in screed, it is possible to select a flow temperature that is approx. 1 - 2 °C lower by heating the water between the mixer and manifold to a certain extent. As a general rule, the flow temperature should not be lower than the dew point temperature in dry-laid systems.

Actuators and manifolds in radiant systems for cooling

For the cooling function, particular demands are placed on the actuators for the underfloor heating. The actuators must be reversible; in other words, in cooling mode the actuators are functionally inverted for cooling mode by means of a signal.

In heating mode, the actuator closes when the relevant room temperature has been exceeded. In cooling mode, the actuator must close when the temperature drops below the relevant room temperature.

In addition, cooling mode is completely blocked in the bathroom underfloor circuit. An electrically actuated isolation valve is required to do this. In wet rooms, such as bathrooms, it is generally recommend not to cool the floor, but rather to close this circuit in cooling mode.

Vaillant recommends insulating the underfloor heating rising pipes, including the heating circuit distributors, so that they are vapour diffusion-tight in order to prevent them from falling below the dew point in cooling mode.

Radiators in cooling systems

In cooling mode, condensate would form on radiators and their supply lines, and this can cause mould to form and structural damage. Radiator circuits must therefore not be cooled.

Since the absolute humidity in a house is approximately identical in all rooms due to the movement of air, the same flow temperature can be selected for all rooms.

A heat-recovery ventilation system allows the air humidity limit in accordance with EN 814 and DIN 1946 to be observed.

5.3 Components of the cooling load

The purpose of air-conditioning systems is to provide rooms with a sufficient supply of fresh air and to maintain them at a certain temperature and humidity level. Heat can be removed, for example, by supplying cool (dry) air.

The VDI 2078 directive contains two calculation methods: A short method and an electronic data processing method. Only the short method is described here.

Calculation of the cooling load in accordance with VDI 2078 is similar to the heating load calculation in accordance with DIN 12831 in certain respects.

Cooling loads are created by various types of heat supply. The cooling load of a room Q_{CR} is divided into internal and external cooling load components:

$Q_{CR} = Q_I + Q_E$

The internal **cooling load Q_I** consists of the following heat sources.

Q_P = Heat from people

Q_B = Heat entering through windows

Q_M = Heat from machines

Q_G = Heat from goods passing through the room

Q_C = Other heat, e.g. from chemical reactions

Q_R = Heat from adjacent rooms

The external **cooling load QE** consists of the following:

Q_W = Heat entering through walls

Q_F = Heat entering through windows

Q_T = Transmission heat through windows

Q_S = Radiation heat through windows

Q_{FL} = Heat entering as a result of infiltration

5.4 Basis of calculation (in accordance with VDI 2078 [Verein Deutscher Ingenieure – Association of German Engineers])

The essential difference from the heating load calculation is that the cooling load is time-dependent, i.e.

$Q_{CR} = Q_{CR}\ (t)$

The heating load calculation is based on a stationary process (a cold spell that lasts for a long time) with a constant outside and inside temperature. This is not possible for the cooling load. The sun only shines throughout the day, meaning that the building is not heated up permanently. These are only two external cooling loads.

The short method from VDI 2078 therefore proceeds on the basis of a 24-hour curve and requires this curve to be in a thermally steady state.

The maximum is found from this cooling load curve and termed the nominal cooling load:

$Q_{CR,\ nom} = \max\ (Q_{CR}\ (t))$

For this method, the (estimated) moment (day and time) of the maximum cooling load must be known for the year, as the solar radiation depends on this.

Local apparent time

The sun reaches its highest level at 12:00 local apparent time at the location of the building. However, Germany observes Central European Summer Time (CEST). With CEST, the sun is at its highest level at 12:00 at the meridian 15°E. In this case, the local apparent time is the same as CEST.

For locations at different degrees of longitude, the **local apparent time** τ_l must be calculated as follows:

$\tau_l = \tau_{CEST} - 1\ h + ((M - 15°)/15°) * h$

The external cooling load Q_E consists of the following:

Calculation parameter:

τ_l = Local apparent time

τ_{CEST} = Central European Summer Time in h

M = Meridian at the location of the building

Germany is between 6° (Aachen) and 15° (Frankfurt (Oder)).

The smallest deviation is therefore in Frankfurt (Oder), i.e. 1 h; this means that at 12:00 (CEST), it is 11:00 (local apparent time).

The follow deviation applies to Aachen:

$-1\ h + (6 - 15)/15\ h = -1.6\ h$

i.e. at 12:00 (CEST), it is 10:04 = 10:24 (local apparent time).

Room air temperature

The room air temperature can either be set (e.g. 22 °C) or controlled depending on the outside temperature. The warmer it is outside, the warmer the room air temperature can also be without people feeling uncomfortable.

A formula for this is as follows:

$\upsilon_{AR} = 13.2\ °C + 0.4 \times \upsilon_{AR}$

Thermal volumetric loading

All cooling load components contain amounts of radiation and/or convection.

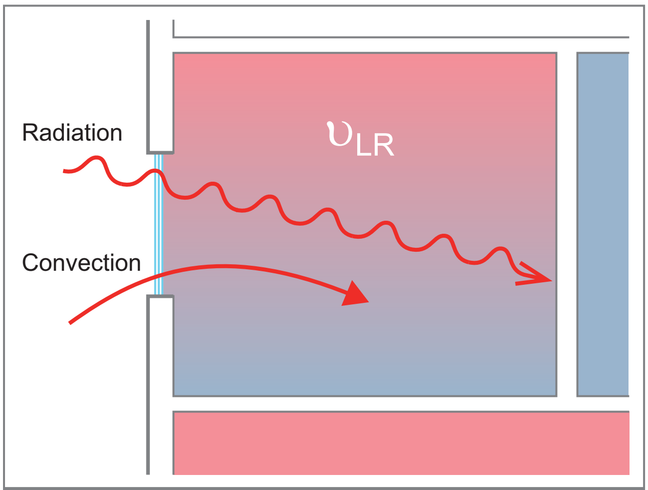


Fig. 33: Radiation and convection

Convective loading (1) is the quantity of heat that is absorbed immediately from the air; this instantly increases the room temperature u_{AR} and therefore is a cooling load without delay.

→ No time delay

Radiation loading (2) is the quantity of heat that is initially absorbed somewhere (floor, wall, furnishings, internal shading, etc.) and then transferred to the room air.

Some time therefore passes before the room temperature Θ_{AR} increases, i.e. until the heat supply becomes the cooling load.

Furthermore, the maximum loading is reduced, depending on the storage capacity of the room.

→ Damping ΔQ and time difference Δ_{TD} (this forms the basis of the cooling load factor S_i or S_e, see below).

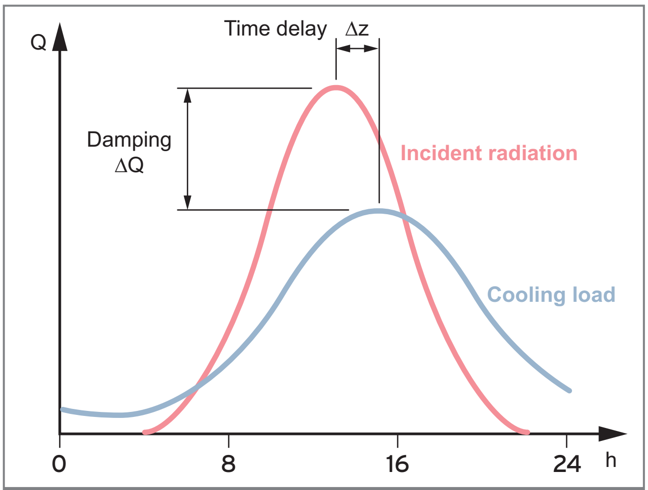


Fig. 34: Damping and time difference for incident radiation

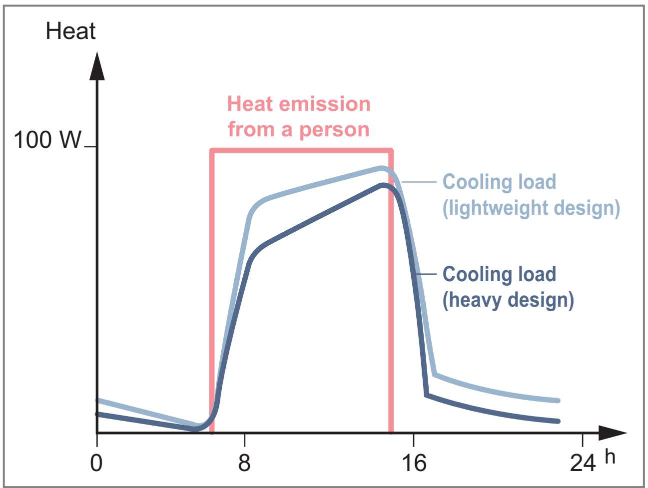


Fig. 35: Various cooling load curves

5.5 Internal cooling loads (according to VDI 2078)

The following sections show the formulae and parameters required to calculate the **internal cooling load Q_I**.

Cooling load as a result of heat from people

$Q_P = n * q_{P, dr} * S_i + n * q_{P, m}$

n = Number of persons

$q_{P, dr}$ = Emission of dry heat per person in W (table A1)

$q_{P, m}$ = Emission of moist heat per person in W

S_i = Cooling load factor for internal cooling loads (table A5)

The heat emission from people is divided into a dry ($q_{P,dr}$) and a moist part $q_{P,m}$.

Both are multiplied by the number of persons (n).

S_i is the cooling load factor for internal cooling loads with amounts of radiation and takes into account the storage capacity of the room. It is dependent on the room type, loading period, time of day and extent of the amount of convection, and can be found in table A5 of VDI 2078.

An amount of convection of 50% is assumed for the emission of dry heat by people. The cooling load factor is dispensed with for the emission of moist heat as radiation does not occur here (100% convection).

Cooling load as a result of heat from lighting

$Q_B = P_{el} * I * \mu_B * S_i$

P_{el} = Electrical power of the lamps in W

I = Diversity factor

μ_L = Room loading degree (table A4)

S_i = Cooling load factor for internal cooling loads (table A5)

The total electrical power of the lamps is eventually supplied to the room in the form of heat.

Either the connection power of the lamps that is actually installed is calculated (number of lamps * individual power), or the illumination intensity that is required for a particular purpose in the room is used to determine the required connection power.

The following applies for the second case:

$P_{el} = E_N * p * A$

P_{el} = Electrical power of the lamps in W

E_N = Nominal illumination intensity in lx (table A2)

P = Drawn connection power in W/(m² * klx) (table A3)

A = Area of the room in m²

The **diversity factor I** is the relationship between the artificially illuminated area and total area of the room at the time of calculation.

Values less than one may be caused by areas illuminated by windows or assumptions about the amount of simultaneous use of workplace lights.

The **room loading degree μ_L** takes into account combined lighting and exhaust air devices that remove part of the heat generated from the room in the exhaust air and are therefore not effective as the cooling load in the room. This distinguishes between three types of air extraction:

Options for extracting air

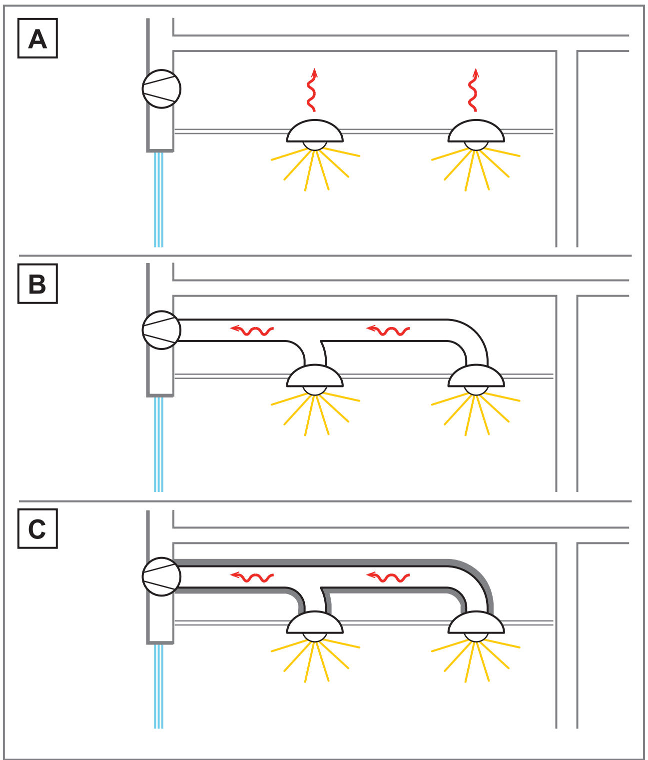


Fig. 36: Options for extracting air

A Air extraction in the ceiling cavity
B Air extraction via uninsulated air lines
C Air extraction via insulated air lines

The **cooling load factor S_i** also takes into account the damping and time delay as a result of the amounts of radiation.

The cooling load factor is determined depending on the amount of convection, which depends on the installation situation.

Cooling load factor installation situation

Installation situation	Amount of convection	Amount of radiation
Freely hanging lights	50 %	50 %
Built into the ceiling	30 %	70 %
Combined lighting and exhaust air device	0 %	100 %

Cooling load as a result of heat from machines and units

$Q_M = ((P_{N1}/\eta 1 * \mu 1) + (P_{N2}/\eta 2 * \mu 2) + ...) * I * S_i$

P_N = Nominal output of the machines in W (identification plate)

η_r = Average motor efficiency (table A6.1)

μ = Degree of loading of the machine

I = Diversity factor

S_i = Cooling load factor for internal cooling loads (table A5)

The heat from machines corresponds to the electrical energy supplied.

Since the nominal output P_N (useful energy) is stated on the identification plate, it must be divided by the efficiency η. The efficiency depends on the nominal output and can be found in table A6.1, as can the incident heat from machines Q_M.

The above formula $Q_M = P_N/\eta$ applies for instances where machine and motor are installed in the same room. The following applies for other configurations (motor outside, machine inside) (the motor losses are not considered):

$Q_M = P_N/\eta - P_N = P_N * \eta/(1 - \eta)$

All three configurations are considered in table A6.1.

The **degree of loading μ** indicates which proportion of the full load is represented by the standard load.

The **diversity factor I** takes into consideration how many machines are running simultaneously when there are several of them.

Reference values for both sizes can be found for individual branches of industry in the following table.

Cooling load as a result of heat from machines and units

Branch of industry	Machine output/ area [W/m²]	Degree of loading μ	Diversity factor I
Paper industry	700	0.6 ... 0.8	0.8 ... 0.9
Electroplating	400 ... 800	0.8 ... 0.9	0.7 ... 0.8
Plastics processing	< 500	0.7 ... 0.8	0.6 ... 0.8
Electronics	< 400	0.2 ... 0.8	0.2 ... 0.7
Precision engineering	< 500	0.3 ... 0.5	0.6 ... 0.9
Metal processing	< 300	0.6 ... 0.9	0.2 ... 0.8
Textile industry	< 300	0.7 ... 0.8	0.8 ... 0.95

There is often uncertainty regarding the extent of the amount of convection and radiation. If the amount of convection is assumed to be 100%, the cooling load factor S_i then becomes one.

Table A6.2 provides reference values for the heat emission of PC workstations. The power to be applied corresponds to the incident heat from machines Q_M.

The power indicated on the identification plate is to be used as a guide. The not inconsiderable difference in the end comes from the efficiency η and the degree of loading μ, see above.

Cooling load as a result of heat from adjacent rooms

$Q_R = k * A * \Delta\Theta$

k (U) = Heat transfer coefficient according to ISO 6946 in W/m²K

A = Area of the wall in m² (height of the floor and internal dimensions)

$\Delta\Theta$ = Temperature difference between the adjacent rooms in K

This is calculated in a similar manner to the heating load, with the sole difference that the component dimensions are calculated on the basis of internal dimensions.

If no other information is known, the temperature of the adjacent rooms can be taken from table A7.

5.6 External cooling loads

The **external cooling load Q_E** is calculated using the formulae listed in the following sections.

Cooling load as a result of transmission heat through external walls and roofs

$Q_W = k * A * \Delta\Theta_{eq}$

k (U) = Heat transfer coefficient in accordance with ISO 6946 in W/m²K or table (A17 or A20 from VDI 2078)

A = Area of the wall in m² (height of the floor and internal dimensions)

$\Delta\Theta_{eq}$ = Equivalent temperature difference (A18 or A21)

First of all, the **construction class** (1 to 6) of the wall or roof must be determined. To do so, the wall is assigned to a design in table A17 (walls) or a roof is assigned to a design in table A20 (roofs).

In addition to the construction class, the **heat transfer coefficient k** and also a **time difference Δtd** in hours (see below) can be found in table A17.

The equivalent temperature difference $\Delta\Theta_{eq}$ is the temperature difference between inside and outside corrected by the absorption and emission properties of the outside wall area as well as by the storage properties of the wall.

For the following general parameters

- Air temperature in the room Θ_{AR} = 22 °C,
- average outside air temperature
- $\Theta_{Ae,av}$ = 24.5 °C (July)
- $\Theta_{Ae,av}$ = 18.5 °C (September)
- pale façade or dark roof

$\Delta\Theta_{eq}$ can be found in table A18 (walls) or A21 (roofs), depending on the construction class, the point of the compass and the time (local apparent time + time difference Δtd, see above).

The average outside air temperature $\Theta_{Ae,av}$ depends on the location of the building.

Table 1 assigns cities to a cooling load zone.

If the average outside air temperature $\Theta_{Ae,av}$ or the room temperature Θ_{AR} deviates from the above values, $\Delta\Theta_{eq}$ must be corrected to $\Delta\Theta_{eq1}$.

For **July** (and September if not south-facing), the following applies:

$\Delta\Theta_{eq1} = \Delta\Theta_{eq} + (\Theta_{Ae,av} - 24.5\,°C) + (22\,°C - \Theta_{AR})$

For **September**, table A18 contains values for south-facing walls only. The following correction applies for these walls:

$\Delta\Theta_{eq1,Sept,S} = \Delta\Theta_{eq} + (\Theta_{Ae,av} - 18.5\,°C) + (22\,°C - \Theta_{AR})$

For other points of the compass, the July values are adjusted according to the first correction formula.

If the wall is not pale or the roof is not dark, different absorption and emission degrees apply than those considered in table A18 or A21. $\Delta\Theta_{eq}$ (or now $\Delta\Theta_{eq1}$) must then be corrected to $\Delta\Theta_{eq2}$.

A correction value $\Delta\Theta_{es}$ can be found in table A19 or A22 (VDI 2078), depending on the **construction class**, the **point of the compass** and the **time** (local apparent time + time difference Δz), and it must be processed as follows:

Dark wall = $\Delta\Theta_{eq2} = \Delta\Theta_{eq} + \Delta\Theta_{eq,es}$

White wall = $\Delta\Theta_{eq2} = \Delta\Theta_{eq} - \Delta\Theta_{eq,es}$

Blank metallic wall = $\Delta\Theta_{eq2} = \Delta\Theta_{eq} - \Delta\Theta_{eq,es} + 2.0$

Pale roof = $\Delta\Theta_{eq2} = \Delta\Theta_{eq} - \Delta\Theta_{eq,es}$

Blank metallic wall= $\Delta\Theta_{eq2} = \Delta\Theta_{eq} - 2\,\Delta\Theta_{eq,es}$

Cooling load as a result of transmission heat through windows

$Q_T = k_F * A * (\Theta_{AO} - \Theta_{AR})$

k_F = Heat transfer coefficient of the window in W/m²K

A = Wall opening dimensions in m²

Θ_{AO} = Current outside temperature (table A8 or A25 from VDI 2078)

Θ_{AR} = Air temperature of the room

The transmission heat flow through the windows is assumed to be stationary, i.e. no storage effects are taken into consideration. Amounts of radiation are discussed separately in the next section.

The current outside air temperature can be found in table A8 (July and September) or table A25 (from VDI 2078).

Cooling load as a result of solar radiation through windows

$Q_S = (A_1 * I_{max} + (A - A_1) * I_{diff, max}) * b * S_e)$

A_1 = Sunlit glass area in m²

$A = g_V * A_M$ = Total glass area in m²

g_V = Amount of glass area (table A12)

A_M = Wall opening dimensions

I_{max} = Total radiation behind a double-glazed windowpane in W/m² (table A11 from VDI 2078)

$I_{diff, max}$ = Diffused radiation behind a double-glazed windowpane in W/m² (table A11 from VDI 2078)

b = Permeability factor (table A13 from VDI 2078)

S_e = Cooling load factor for external cooling loads (table A16 from VDI 2078)

The solar radiation through the windows is often the component to determine when establishing the maximum external cooling load.

Approx. 1368 kW/m² of the total solar radiation reaches the Earth. Sometimes significantly less radiation actually reaches the building façade and it comprises the components shown.

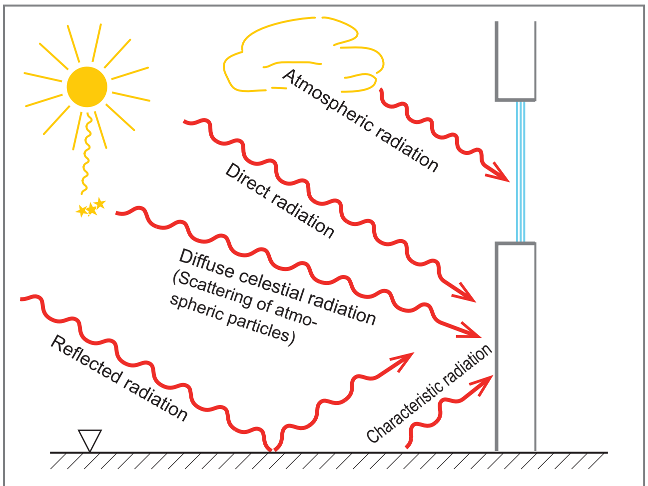


Fig. 37: Components of solar radiation

The cooling load calculation distinguishes between total radiation (all components) and diffuse radiation (all parts that reach the façade indirectly, i.e. also reach parts in the shade).

The total glass area must be determined first; this comprises wall opening dimensions A_M and amount of glass area g_V (A_M - A is the frame area).

The sunlit glass area A_1 must then be determined. The difference A - A_1 indicates the shaded glass area which only the diffuse radiation reaches.

Shade is sometimes very difficult to calculate and is not described in any more detail here.

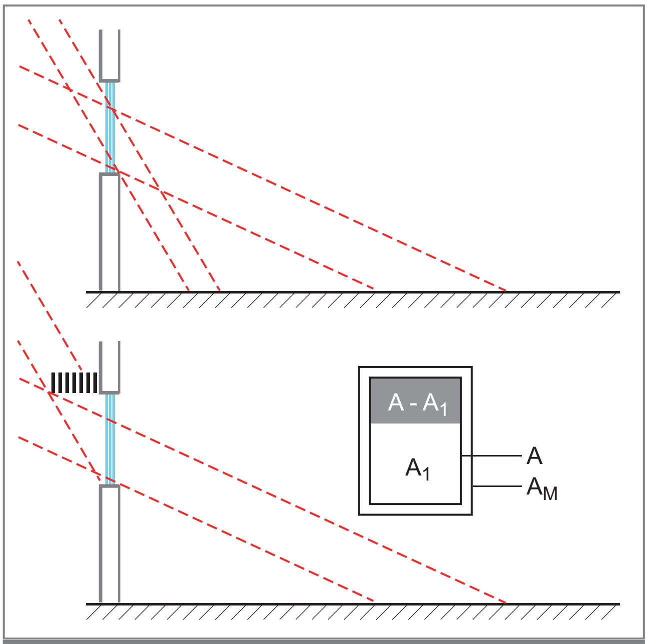


Fig. 38: Solar radiation through window openings

Values for the total radiation and the diffuse radiation are listed in table A11. These indicate the radiation through double-glazed surfaces depending on the point of the compass.

For the diffuse radiation $I_{diff,max}$, the value of the total radiation I_{max} northwards can be selected.

The permeability factor „b“ takes into consideration different types of glass and/or sun-protection devices (table A13). Several permeability factors are multiplied by each other.

Cooling load factors S_e for external cooling loads are determined from table A16, depending on the type of room, direction of shading (outside or inside), point of the compass and time of day.

Cooling load as a result of infiltration

Modern-day window construction methods mean that outside air infiltrating air-conditioned rooms can usually be disregarded.

On hot summer days, wind power and lift are normally low. This amount of cooling load does not apply anyway if there is excess pressure in the room.

5.7 Estimating the cooling load for individual rooms

Item	System:										
0	Room	Kitchen	Length [m]	3.45	Width [m]	4.07	Height [m]	2.49	surface m²	14.04	Volume m³	34.96

External cooling load

1	Solar radiation through windows/outside doors				Unprotected			Reduction factors for sun protection			Cooling load for windows/ outside doors in watts	Total cooling load in watts
		Building shell dimensions										
	Orientation	Width m	Height m	Surface m²	Single-glazed W/m²	Double-glazed W/m²	Thermal insulation glazing W/m²	Inside blind with protective glass	Sunblind	Outside blind		
	N				65	60	35					
	NO				80	70	40					
	O				310	280	155					
	SO				270	240	135					
	S	0.76	1.26	0.96	350	300	165	x 0.7	x 0.3	x 0.15	202	
	SW				310	280	155					
	W	0.88	1.26	1.11	320	290	160				225	
	W	0.88	2.19	1.93	320	290	160				392	
	NW				250	240	135					
	Sky light				500	380	220					
	TOTAL for windows/outside doors [1]											819

2	Walls (minus window and door openings)							
		Width m	Height of the floor m	Extraction m²	m²	W/m²	Watts	
	Outside	4.59	2.77	3.0	9.7	10	97	
	Outside	3,96	2,77	1,0	10,0	10	100	
	Inside	3,96	2,77		10,9	10	109	
	Inside	4,59	2,77	1,8	10,09	10	109	
	TOTAL for walls							415

3	Floor in non-air-conditioned rooms					
		Length	Width	m²	W/m²	Watts
		3,45	4,07	14,04	10	140
	TOTAL for floor					140

4	Ceiling				Flat roof		Pitched roof/ceiling				
		Length	Width	m²	Not insulated W/m²	Insulated W/m²	Not insulated W/m²	Insulated W/m²	Non-air-conditioned room W/m²	Watts	
		3.45	4.07	14.04	60	30	50	25	10	140	
	TOTAL for ceiling										140

Internal cooling load

5	Lighting	Total connection power [watts]	
		100	
	TOTAL for lighting		100

6	Electrical units				
		Quantity	Watts/unit	Watts	
	Electric cooker	1	1450	1450	
	Refrigerator	1	500	500	
	Hotplate	1	250	250	
	Toaster	1	200	200	
	TOTAL for electrical units				2400

7	Total persons				
		Quantity	Watts/pers.	Watts	
		4	115	460	
	TOTAL for persons				460

8	Outside air				
		m³/h	W/m³	Watts	
	Manufacturer's specifications	/	10	/	
	TOTAL for outside air				/

1) For different points of the compass, use only the maximum value; for adjacent points of the compass, add both values

TOTAL COOLING LOAD: 4474

Fig. 39: Form for estimating the cooling load

Basis and explanations for estimating the cooling load

The estimation of the cooling load also takes into consideration the storage capacity of the room as well as the specified influences.

The basis for this is the numerical values on which the „VDI cooling load rules" (VDI 2078) are based.

The calculation is based on a room air temperature of 27 °C at an outside air temperature of 32 °C and continuous operation of the cooling unit.

Position 0

Type of room, internal clearance dimensions, floor area and capacity.

Position 1

The window areas must be divided according to the various points of the compass and multiplied by the relevant values.

The wall opening dimensions (building shell dimensions) are considered to be the window area. The point of the compass that results in the maximum value is to be used in the sum for calculating the cooling load. When there are different window designs at one point of the compass, it may also be necessary to add several values.

If windows are located at two immediately adjacent points of the compass, e.g. SW and W, the total of both these values must be used.

For undivided windowpanes over 2 m², the factors must be increased by 10%.

Horizontal sky lights must also be taken into consideration (see „Sky light" row).

For internal shading devices, the reduction factors stated must be taken into account.

Position 2

Heat flow through walls (cooling load through walls).

To simplify the calculation method, flat-rate values that correspond to the current thermal standard were taken as a basis based on VDI 2078. Since the walls do not have a significant influence on the cooling load, these values can also be used for old buildings.

Position 3

If the room below or adjacent is not air-conditioned or cooled, the relevant value must be used.

Position 4

The ceiling area (roof), minus any sky lights, must be multiplied by the applicable values.

Position 5

Since only part of the connection power of the lamps is converted into light, the total connection power is to be considered as heat.

If the in-line units of discharge lamps are located in the room that is to be cooled, allowances also have to be made for them with their corresponding power.

Position 6

In addition to the specified values, heat-emitting units that are in operation at the moment of maximum solar radiation must also be used, e.g. television sets, lights and other electric units with their connection power.

Position 7

The number of persons must be multiplied by the specified value. Pursuant to VDI 2078, the following conditions are assumed for the heat emission from people (heat emitted by people):

Activity: No physical activity to gentle activity standing up, activity level I to II in accordance with DIN 1946 part 2, room air temperature 26 °C.

Position 8

The amount of outside air in accordance with the manufacturer's specifications must be used here. The only basis of the calculation is that the outside air volume flow is cooled by 5 K.

Total cooling load

Total of the individual cooling loads from positions 1 to 8.

Selected cooling unit:

To reach an inside temperature of approx. 5 K below the specified outside air temperature, the sensible cooling output Q_c must be identical to or larger than the calculated cooling load.

The supply air volume flow of the unit in m³/h divided by the room volume from row 0 gives the air exchange rate. Air exchange rates over 10 are only acceptable for air pipes that were planned very carefully by experts, as tensile disruptions must otherwise be expected.

Terms:

Cooling load is the total of all (convective) heat flows that have an effect and must be discharged in order to maintain the required air temperature in a room.

Sensible cooling load is the heat flow that must be discharged out of the room given a constant humidity content in order to maintain the target air temperature; it therefore corresponds to the convective heat flows determined.

Latent cooling load is the heat flow required to condense a vapour mass flow at air temperature so that, at a constant air temperature, a target humidity content is maintained in the room.

Cooling output of the unit is the total sensible and latent cooling output or cooling capacity provided by the cooling unit. Sensible cooling output of the unit is the cooling output provided by the unit for cooling the air without removing humidity.

Latent cooling output is the cooling output provided by the unit due to the humid air falling below the dew point in order to remove some of the water vapour contained in the humid air by means of condensation. The evaporation heat contained in the water vapour is supplied by the unit in the form of cooling energy for condensation.

6 Determining the hot water demand

In practice, there are various approaches to determining drinking water demand:

For residential buildings, the design process is often carried out in accordance with DIN 4708, part 2. The demand index N is determined taking into account the sanitary fittings of the individual dwellings or accommodation units, the number of occupants/users and the diversity factors. This demand index, together with the boiler output and the cylinder output characteristic figure (NL figure), are incorporated when planning hot water generation.

This design and dimensioning method, which only applies to floor-standing boilers, is not used on heat pump systems as hardly any cylinder NL figures for the flow temperatures used in heat pump mode are available.

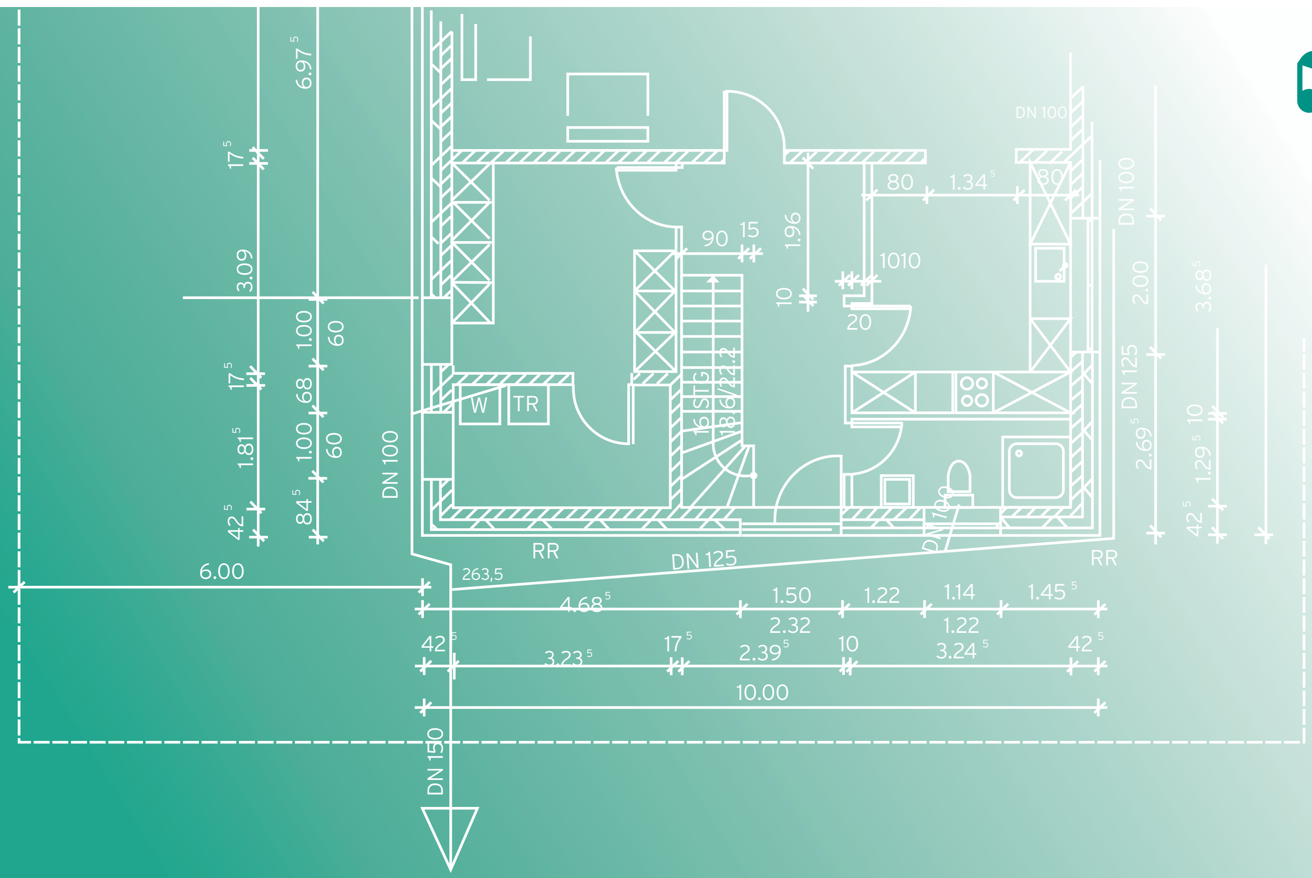
It is therefore practical to ensure that the design takes into account the quantities of heat required in the system.

In doing so, several factors which influence each other must be noted:

- The daily demand
- The peak demand
- Expected losses
- The heating output available for reheating the domestic hot water cylinder

The required hot water output must be available in the reference period in the form of stored hot water or as heating output.

For design purposes, it is firstly necessary to determine the maximum daily hot water demand and the corresponding consumption behaviour. Average draw-off profiles can be used in addition to real consumption values in order to determine this.



6.1 Draw-off profiles

Average draw-off profiles for three user groups are specified in DIN EN 15450. Details are provided regarding the time when domestic hot water is drawn off and the energy quantity required for this, and these details are useful for planning domestic hot water generation with a heat pump.

The user groups according to DIN EN 15450 are defined as follows.

Each draw-off type stated is based on the table „**Assumptions about volume**„.

1. Average draw-off profile for an individual (36 litres per day at 60 °C).
2. Average draw-off profile for a three-person family with a shower and without a bath (100 litres per day at 60 °C).
3. Average draw-off profile for a three-person family with a shower and a bath (200 litres per day at 60 °C).

The following pages present these draw-off profiles.

Assumptions about volume

The following assumptions on the energy consumption, the volume and the draw-off duration for different draw-off types are used as the basis for the following calculations.

Assumptions about volume

Draw-off type	Energy	Volume	Required value for $\Delta\Theta$	Draw-off duration at the stated mass flow			
	[kWh]	[l]	[K]	[min]			
				at 3.5 l/min	at 5.5 l/min	at 7.5 l/min	at 9 l/min
Low	0,105	3	30	0.9	0.5	0.4	0.3
Floor	0,105	3	30	0.9	0.5	0.4	0.3
Clean	0,105	2	45	0.6	0.4	0.3	0.2
Washing dishes Low	0,315	6	45	1.7	1.1	0,8	0.7
Washing dishes Medium	0,420	8	45	2.3	1.5	1.1	0.9
Washing dishes More	0,735	14	45	4	2.5	1.9	1.6
"A lot"	0,525	15	30	4.3	2.7	2	1.7
Showering	1,400	40	30	11.4	7.3	5,3	4.4
Using the bath	3,605	103	30	29,4	18.7	13.7	11.4

A cold water temperature of 10 °C is applied.

Specific heat capacity

Heat quantity (in joules or Wh) required to heat 1 kg of material by 1 kelvin. This value is important for storing and transporting heat.

Specific heat capacity of water: c = 1.163 Wh/kg * K

Draw-off profile for an individual Draw-off profile for an individual

No.	Time of day	Energy for draw-off procedure	Reference periods for dynamic heating systems		Draw-off type	Required value for ΔΘ (to be achieved during draw-off)	Minimum value of Θ for when the meter starts recording energy use
			Energy requirement during a reference period	Energy requirement for a service unit during a reference period			
	hh:mm	Q_{EZ} in kWh	Q_{DPB} in kWh	Q_{DPNE} in kWh		[K]	[°C]
1	07:00	**0,105**			Low		25
2	07:30	**0,105**			Low		25
3	08:30	**0,105**			Low		25
4	09:30	**0,105**			Low		25
5	11:30	**0,105**	Selected		Low		25
6	11:45	**0,105**	Selected		Low		25
7	12:45	**0,315**	Selected		Washing dishes	50	0
8	18:00	**0,105**	Selected		Low		25
9	18:15	**0,105**	Selected		Clean		45
10	20:30	**0,420**	Selected	Selected	Washing dishes	50	0
11	21:30	**0,525**	Selected	Selected	A lot		45
Q_{EZ} (kWh)		**✣ 2.1**					
Q_{DPB} (kWh)			✣ 1.68				
Q_{DPNE} (kWh)				✣ 0.945			

The average domestic hot water volume V is calculated as follows from the total energy for the draw-off processes:

Sample calculation

V = ✣ Q_{EZ} [Wh]/(c [Wh/kg * K] * (ΔΘ [K]))

V = 2100 Wh / (1.163 Wh/(kg * K) * (60 - 10 K))

Result: V = 36 kg

Sample calculation values

Values	
Total energy for draw-off procedure Q_{EZ}	[kWh]
Specific heat capacity of water c	1.163 Wh/(kg * K)

This results in a domestic hot water demand of 36 litres per day at 60 °C.

Draw-off profile for a three-person family with a shower

No.	Time of day	Energy for draw-off procedure	Reference periods for dynamic heating systems		Draw-off type	Required value for ΔΘ (to be achieved during draw-off)	Minimum value of Θ for when the meter starts recording energy use
			Energy requirement during a reference period	Energy requirement for a service unit during a reference period			
	hh:mm	Q_{EZ} in kWh	Q_{DPB} in kWh	Q_{DPNE} in kWh		[K]	[°C]
1	07:00	**0,105**		Selected	Low		25
2	07:15	**1,400**	Selected	Selected	Showering		40
3	07:30	**0,105**	Selected	Selected	Low		25
4	08:01	**0,105**	Selected		Low		25
5	08:15	**0,105**	Selected		Low		25
6	08:30	**0,105**	Selected		Low		25
7	08:45	**0,105**	Selected		Low		25
8	09:00	**0,105**	Selected		Low		25
9	09:30	**0,105**	Selected		Low		25
10	10:30	**0,105**	Selected		Floor	30	10
11	11:30	**0,105**	Selected		Low		25
12	11:45	**0,105**	Selected		Low		25
13	12:45	**0,105**	Selected		Washing dishes	45	10
14	14:30	**0,105**	Selected		Low		25
15	15:30	**0,105**	Selected		Low		25
16	16:30	**0,105**	Selected		Low		25
17	18:00	**0,105**	Selected		Low		25
18	18:15	**0,105**	Selected		Clean		40
19	18:30	**0,105**	Selected		Clean		40
20	19:00	**0,105**	Selected		Low		25
21	20:30	**0,105**	Selected	Selected	Washing dishes	45	10
22	21:15	**0,735**	Selected	Selected	Low		25
23	21:30	**1,400**	Selected	Selected	Showering		40
Q_{EZ} (kWh)		**✢ 5.845**					
Q_{DPB} (kWh)			✢ 5.740				
Q_{DPNE} (kWh)				✢ 2.24			

Calculating the domestic hot water volume V:

Sample calculation

V = ✢ Q_{EZ} [Wh]/(c [Wh/kg * K] * (ΔΘ [K]))

V = 5845 Wh / (1.163 Wh/(kg * K) * (60 - 10 K))

Result: V = 100 kg

Values	
Total energy for draw-off procedure Q_{EZ}	[kWh]
Specific heat capacity of water c	1.163 Wh/(kg * K)

This results in a domestic hot water demand of 100 litres per day at 60 °C.

Draw-off profile for a three-person family with a shower and a bath

No.	Time of day	Energy for draw-off procedure	Reference periods for dynamic heating systems		Draw-off type	Required value for ΔΘ (to be achieved during draw-off)	Minimum value of Θ for when the meter starts recording energy use
			Energy requirement during a reference period	Energy requirement for a service unit during a reference period			
	hh:mm	Q_{EZ} in kWh	Q_{DPB} in kWh	Q_{DPNE} in kWh		[K]	[°C]
1	07:00	**0,105**			Low		25
2	07:05	**1,400**	Selected		Showering		40
3	07:30	**0,105**	Selected		Low		25
4	07:45	**0,105**	Selected	Selected	Low		25
5	08:05	**3,605**	Selected	Selected	Bathroom	30	10
6	08:25	**0,105**	Selected	Selected	Low		25
7	08:30	**0,105**	Selected	Selected	Low		25
8	08:45	**0,105**	Selected	Selected	Low		25
9	09:00	**0,105**	Selected		Low		25
10	09:30	**0,105**	Selected		Low		25
11	10:30	**0,105**	Selected		Floor	30	10
12	11:30	**0,105**	Selected		Low		25
13	11:45	**0,105**	Selected		Low		25
14	12:45	**0,315**	Selected		Washing dishes	45	10
15	14:30	**0,105**	Selected		Low		25
16	15:30	**0,105**	Selected		Low		25
17	16:30	**0,105**	Selected		Low		25
18	18:00	**0,105**	Selected		Low		25
19	18:15	**0,105**	Selected		Clean		40
20	18:30	**0,105**	Selected		Clean		40
21	19:00	**0,105**	Selected		Low		25
22	20:30	**0,735**	Selected	Selected	Washing dishes	45	10
23	21:00	**3,605**	Selected	Selected	Bathroom	30	10
24	21:30	**0,105**		Selected	Low		25
Q_{EZ} (kWh)		**✢ 11.655**					
Q_{DPB} (kWh)			✢ 11.445				
Q_{DPNE} (kWh)				✢ 4.45			

Calculating the domestic hot water volume V:

Sample calculation

$V = ✢ Q_{EZ}$ [Wh]/(c [Wh/kg * K] * (ΔΘ [K]))

V = 11655 Wh / (1.163 Wh/(kg * K) * (60 - 10 K))

Result: V = 200 kg

Values	
Total energy for draw-off procedure Q_{EZ}	[kWh]
Specific heat capacity of water c	1.163 Wh/(kg * K)

This results in a domestic hot water demand of 200 litres per day at 60 °C.

6.2 Design example: Multiple-occupancy house

Six service units, each with three people.

Table 3, which features an average family draw-off profile (corresponds to three people) with a shower and a bath (200 litres per day at 60 °C) is used in accordance with DIN EN 15450 to design hot water generation.

The reference period with the greatest energy requirement is read from table 3 to design hot water generation.

Extract from the table „Draw-off profile for a three-person family with a shower and a bath“

21	19:00	0,105	Selected	
22	20:30	0,735	Selected	**Selected**
23	21:00	3,605	Selected	**Selected**
24	21:30	0,105		**Selected**
Q_{EZ} (kWh)		✣ 11.655		
Q_{DPB} (kWh)			✣ 11.445	
Q_{DPNE} (kWh)				**✣ 4.45**

Design according to reference period

The reference period with the greatest energy requirement is the time from 20:30 to 21:30. 4.445 kWh per dwelling is required for hot water during this time.

This data can be used to carry out the individual planning steps.

The total energy requirement for the six service units is determined as follows during a reference period:

$Q_{DPB} = N_{NE} * Q_{DPNE}$

Design values according to reference period

Values		
Q_{DPB}	Energy requirement during a reference period	[kWh]
Q_{DPNE}	Energy requirement for a service unit during a reference period	[kWh]
N_{NE}	Number of service units with the same profile	[-]

Sample calculation

$Q_{DPB} = N_{NE} * Q_{DPNE}$

$Q_{DPB} = 6 * 4.445$ kWh

Result: Q_{DPB} = 26.67 kWh = 26,670 Wh

The required hot water volume can be calculated from the total energy requirement during a reference period.

$V_{DP} = Q_{DPB}/c_W * (t_{target} - t_{cw}) *$ kg/litre

Design values according to reference period

Values		
V_{DP}	Hot water volume required during a reference period	[l]
Q_{DPB}	Energy requirement for a service unit during a reference period	[Wh]
C_W	Specific heat capacity of water	1.163 Wh/(kg * K)
t_{target}	Target cylinder temperature	[°C]
t_{cw}	Cold water temperature	[°C]

The following calculation results for designing a multiple-occupancy house.

Sample calculation

$V_{DP} = Q_{DPB}/c_W * (t_{target} - t_{cw}) *$ kg/litre

V_{DP} = 26,670 Wh * kg * K/1.163 Wh * (60-10)K

Result: V_{DP} = 459 kg

Sample calculation values

Values		
Q_{DPB}	Energy requirement for a service unit during a reference period	26,670 Wh
t_{target}	Target cylinder temperature	60 °C
t_{cw}	Cold water temperature	10 °C

The required hot drinking water volume during the reference period is 459 kg, which corresponds to **459 litres**.

Selecting the cylinder

The following losses must also be considered when selecting the cylinder.

- Cylinder loss as a result of heat emitted via the surface. The manufacturer's technical data sheets state the cylinder loss in x kWh/24 h.
- Loss due to mixing the inflowing cold water. This is taken into account by applying a supplement for unusable cylinder volume owing to mixing. For this purpose, 15-20% of the cylinder volume can generally be applied.

Supplement for unusable cylinder volume

$V_{cyl.\ min} = V_{DP} * 1.15$

Cylinder selection values

Values		
$V_{cyl.\ min}$	Minimum cylinder volume	[l]
V_{DP}	Hot water volume required during a reference period	[l]
1.15	15% mixing loss	[-]

This results in the required minimum cylinder volume for the design example.

Sample calculation

$V_{cyl.\ min} = V_{DP} * 1.15$

$V_{cyl.\ min} = 459\ l * 1.15$

Result: 528 l

The minimum required cylinder volume for the specimen property is 528 litres. This means that thermal energy of 30,703 Wh is required during the reference period. This thermal energy must be stored in the domestic hot water cylinder.

Whether the heat quantity is sufficient is tested in the next step for two cylinder variants.

Variant 1 (VIH RW 300)

2 * 285 litres with cylinder losses per cylinder of 1.8 kWh/24 h.

Calculation:

2 * 285 kg * 1.163 Wh * 50 K/kg * k = **33,146 Wh**

The cylinder losses for each cylinder must also be subtracted from this value.

33,146 Wh – 1800 Wh – 1800 Wh = **29,546 Wh**

Variant 2 (VIH RW 400 B)

2 * 390 litres with cylinder losses per cylinder of 2.1 kWh/24 h.

Calculation:

2 * 390 kg * 1.163 Wh * 50 K/kg * k = **45,357 Wh**

The relevant heat losses are also subtracted in this case.

45,357 Wh – 2100 Wh – 2100 Wh = **41,157 Wh**

Comparing the results from variants 1 and 2 with the required thermal energy of 30,703 Wh shows that the 390 l cylinders from variant 2 provide sufficient thermal energy throughout the entire reference period, even when cylinder losses are taken into consideration.

The cylinders from variant 1 are insufficient because the cylinder losses prevented them from achieving the required 30,703 Wh.

6.3 Determining the heating output required for hot water generation

In the next step, the necessary heat pump heating output for hot water generation must then be determined.

This value is the supplement on the heat pump heating output that is required for hot water generation and depends on the time available between the individual reference periods.

$Q_{WP} = V_{cyl.} * c_w * (t_{target} - t_{cw})/T_{heat.} * kg/litres$

Values for determining the heating output required for hot water generation

Values		
Q_{WP}	Heat pump heating output required for hot water	[kW]
$V_{cyl.}$	Cylinder volume (total)	[kg]
C_W	Specific heat capacity of water	1.163 Wh/(kg * K)
t_{target}	Target cylinder temperature	[°C]
t_{cw}	Cold water temperature	[°C]
$T_{heat.}$	Time between the reference periods	[h]

The following period between two reference periods is determined for the specimen system from the average draw-off profile of the relevant user group:

Extract from a draw-off profile

7	08:30	0,105	Selected	Selected
8	08:45	0,105	Selected	Selected
9	**09:00**	0,105	Selected	
10	**09:30**	0,105	Selected	
11	**10:30**	0,105	Selected	
12	**11:30**	0,105	Selected	
13	**11:45**	0,105	Selected	
14	**12:45**	0,315	Selected	
15	**14:30**	0,105	Selected	
16	**15:30**	0,105	Selected	
17	**16:30**	0,105	Selected	
18	**18:00**	0,105	Selected	
19	**18:15**	0,105	Selected	
20	**18:30**	0,105	Selected	
21	**19:00**	0,105	Selected	
22	**20:30**	0,735	Selected	Selected
23	21:00	3,605	Selected	Selected
24	21:30	0,105		Selected

A period of 11.5 hours elapses between the first reference period before 09:00 and the second after 20:30.

In these 11.5 hours, the 2 * 390 litres, i.e. a total of 780 litres, must be heated from 10 °C to 60 °C.

In the following example, we determine how large the heating output required for hot water generation must be.

Sample calculation

$Q_{WP} = V_{cyl.} * c_w * (t_{target} - t_{cw})/T_{heat.} * kg/litre$

$Q_{WP} = 780\ kg * 1.163\ Wh/(kg * K) * 50\ K/11.5\ h * kg/l$

Result: Q_{WP} = 3944 W

Values for determining the heating output required for hot water generation

Values		
$V_{cyl.}$	Cylinder volume (total)	780 kg
t_{target}	Target cylinder temperature	60 °C
t_{cw}	Cold water temperature	10 °C
$T_{heat.}$	Time between the reference periods	11.5 h

The heat pump requires an **additional output of 3.94 kW** to heat the 780 litres of hot water from 10 °C to 60 °C in 11.5 hours.

If the interval between two reference periods is very short and the output required by the heat pump for hot water generation is therefore very high, two alternatives come into consideration:

4. The cylinder volume is increased by the value that applies to the second reference period.
5. A second heat generator for hot water generation is planned.

The latter option may be the best one in terms of costs, as it results in lower investment costs for exploiting the primary source of the heat pump. This is relatively frequently the case in larger multiple-occupancy houses.

6.4 Plausibility check

If the design takes into account reference periods, performing a plausibility check at the end is recommended.

The heating output calculated for the heat-up time must be greater than the calculated output required for constant draw-off throughout the whole day.

$Q_{WP} > Q_{DPB} * N_{NE}$

Values		
Q_{WP}	Heat pump heating output required for hot water	[kWh]
N_{NE}	Number of service units with the same profile	[-]
Q_{DPB}	Output requirement for daily consumption	[kWh]

For the specimen system, this means:

No.	**Time of day**	**Energy for draw-off procedure**	**Reference periods for dynamic heating systems**	
			Energy requirement during a reference period	**Energy requirement for a service unit during a reference period**
	hh:mm	**Q_{EZ} in kWh**	**Q_{DPB} in kWh**	**Q_{DPNE} in kWh**
1	07:00	0,105		
2	07:05	1.4	**Selected**	
3	07:30	0,105	**Selected**	
4	07:45	0,105	**Selected**	Selected
5	08:05	3,605	**Selected**	Selected
6	08:25	0,105	**Selected**	Selected
7	08:30	0,105	**Selected**	Selected
8	08:45	0,105	**Selected**	Selected
9	09:00	0,105	**Selected**	
10	09:30	0,105	**Selected**	
11	10:30	0,105	**Selected**	
12	11:30	0,105	**Selected**	
13	11:45	0,105	**Selected**	
14	12:45	0,315	**Selected**	
15	14:30	0,105	**Selected**	
16	15:30	0,105	**Selected**	
17	16:30	0,105	**Selected**	
18	18:00	0,105	**Selected**	
19	18:15	0,105	**Selected**	
20	18:30	0,105	**Selected**	
21	19:00	0,105	**Selected**	
22	20:30	0,735	**Selected**	Selected
23	21:00	3,605	**Selected**	Selected
24	21:30	0,105		Selected
			+ 11.445	

The heating output required for constant draw-off throughout the whole day is calculated as follows:

Sample calculation

$Q_{WP} > Q_{DPB} * N_{NE}$

3.94 kW > 11.445 kWh/24 h * 6

Result: 3.94 kW > 2.86 kW

Result

A multiple-occupancy house requires a domestic hot water cylinder with a capacity of 780 litres and an additional heat pump output of 3944 W.

6.5 Simplified method

When constructing a standard residential building, it is assumed that the maximum hot water demand is approximately 25 litres per person and per day at a temperature of approximately 60 °C. This corresponds to an additional heating load of approximately 0.20 kW per person given a heat-up time of eight hours for the domestic hot water cylinder.

This value is doubled if a cylinder is being designed for up to approximately 10 people. This provides the minimum required cylinder volume.

- Cylinder volume **for up to 10** people:
- 2 * 25 litres/person
- Cylinder volume **as of 10** people:
- 25 litres/person

Supplement for water heating

The following table provides reference values for the hot water supplement (hot drinking water, HDW).

Hot water demand	Hot water demand at a hot water temperature of 60 °C	Specific useful heat	Recommended heating load supplement for hot water generation
	[litres/day and person]	[Wh/day and person]	[kW/person] in 8 h
Low demand	15 - 30	880 - 1750	0,11 - 0,22
Normal demand	30 - 60	1750 - 3500	0,22 - 0,44

If the actual hot water demand exceeds the given values – for example, when there are particularly high demands on comfort – the required higher output supplement must be calculated separately.

Example: Multiple-occupancy house

Six service units, each with three people.

6 service units * 3 people * 25 l = 450 l hot water with a cylinder temperature of 60 °C.

This result approximately corresponds to the result calculated using the detailed method.

To find out the total energy requirement calculated using the simplified method, proceed as follows.

Sample calculation

$$Q_{DPB} = V_{DP} * c_w * (t_{target} - t_{cw})$$

$$Q_{DPB} = 450\,kg * 1.163\,Wh/(kg * K) * 50\,K$$

Result: Q_{DPB} = 26,168 Wh

Values from the simplified method

Values		
V_{DP}	Hot water volume required during a reference period	[kg]
C_W	Specific heat capacity of water	1.163 Wh/(kg * K)
t_{target}	Target cylinder temperature	60 °C
t_{cw}	Cold water temperature	10 °C

The thermal energy required during the reference period is 26,168 Wh

The simplified variant is a good alternative for calculating the required hot water volume without creating your own draw-off profiles or using DIN EN 15450.

Determining the additional heating output using a simplified method

A simpler variant for determining the heating output for hot water generation consists of multiplying the number of people by 200 W.

In our case, the following additional heating output for hot water generation for a multiple-occupancy house applies for six user units each with three people:

6 * 3 * 200 W = **3600 W**

6.6 Planning the secondary circulation line

Central hot water generation with a circulation system is a very advantageous solution for drinking water installations and is therefore used frequently.

A secondary circulation line is mandatory in accordance with DVGW W 551 (German Technical and Scientific Association for Gas and Water) and DIN 1988-200 when the flow paths between the cylinder and withdrawal point contain more than three litres in pipe content. It is not relevant here whether the system is large or small.

According to EnEV (Energy Saving Ordinance), the hot water in the central drinking water cylinder must have an outlet temperature of at least 60 °C and may cool by a maximum of 5 K in the secondary circulation line. This provision must be complied with by providing appropriate heat insulation for the lines and correctly setting the circulation pump.

6.7 Drinking water hygiene

Drinking water hygiene has a great influence on people's health. Drinking water installations must therefore be planned, constructed and operated in such a way that they do not cause any illnesses.

We take high-quality drinking water for granted, often meaning that not enough consideration is given to hygiene in respect of our most important nutrient.

Faults during installation, a lack of maintenance and also low-quality materials in the drinking water installation lead to consumers not always being protected.

The water company is responsible for the quality of drinking water as far as the water meter. The operator of a water supply system is responsible for the stretch between the water meter and the water tap. The operator is, for example, the owner or landlord of a multiple-occupancy house.

Disinfection using UV radiation

Since drinking water hygiene plays an important role in heat pump systems with central hot water generation, there is the option to carry out disinfection using ultraviolet radiation (UV radiation) in addition to the standard method (thermal disinfection).

Most heat pumps require an auxiliary heater for thermal disinfection – disinfection by means of UV radiation is therefore an alternative.

If heating for hot water generation is compared to a required flow temperature of 70 °C for heating water, the use of UV radiation therefore results in a considerably lower energy consumption. The hot water volume that is disinfected is also the actual hot water volume that is drawn.

6.8 Project planning sheet

The most important planning parameters can be logged in a structured manner in the following project logging sheet.

Project logging

for Vaillant heat pump (basic planning)

Vaillant

Request based on information provided by the competent person

Please complete the form as accurately as possible to enable the heat pump system to be planned correctly. In order to operate the heat pump efficiently, it is necessary to calculate the heating load in accordance with DIN 12831.

Installation location/customer data		**Vaillant employee**	
Name:		Name:	
Street:		Street:	
Postcode/town or city:		Postcode/town or city:	
Telephone:		Telephone/fax:	
Construction project:		E-mail:	
Project:		Customer no.:	

Appendix: ☐ pages ◯ Attached ◯ To be provided Date ☐

Planning steps

Energy supplier information

Total anti-cycling time in hours ◯ 0 h ◯ 2 h ◯ 2x2 h ◯ 3x2 h ◯ Other: ☐ h

Heat operating mode

Type of operating mode ◯ Monovalent ◯ Monoenergetic ◯ Bivalent parallel

Heat pump output ☐ kW

Auxiliary heater output ☐ kW

Heating load values

Heating load of the building ☐ kW

Building

Type of building ◯ New building ◯ Existing building, year of construction ☐
◯ Single-occ. house ◯ Multiple-occ. house with ☐ AU per ☐ person(s)
◯ Other ☐

If there is no heating load

Size of the living room to be heated ☐ m room height ☐ m² area

Estimated heating load of surface heating ☐ kW Liquid screed ◯ Yes ◯ No

System temperature of surface heating ☐ °C flow ☐ °C return

Estimated heating load of static heating ☐ kW

System temperature of static heating ☐ °C flow ☐ °C return

Annual consumption (average for the last three to five years) 1. ☐ kWh ☐ l oil ☐ m³ gas ☐ t pellets ☐ m³ wood
2. ☐ kWh ☐ l oil ☐ m³ gas ☐ t pellets ☐ m³ wood

Other heat generators, e.g. hearth, solid fuel boiler ☐ ☐ kW

Page 1 of 3

Fig. 40: Project logging sheet for the heat pump

Project logging

for Vaillant heat pump (basic planning)

Vaillant

Request based on information provided by the competent person

Hot water generation

System for heating hot water? — ◯ Yes, provided by [ ] ◯ No

Hot water via heat pump — ◯ Yes ☐ Circulation [ ] m secondary circulation line; provided by [ ] ◯ No

Hot water with cylinder or drinking water station — ◯ VPS/2 + VPM W 20/30 ◯ VIH RW ◯ VDH ◯ VPA ◯ No

Hot water demand/persons — [ ] persons [ ] l per person/day [ ] °C cylinder set target temp.

Bath fittings — ◯ Standard ◯ Comfort Luxury: ◯ 45 ◯ 50 ◯ 60 l per person/day

Controlled ventilation and purging

Ventilation system — ◯ Yes ◯ No [ ] % degree of recovery

Ventilation heat demand — [ ] watts

Swimming pool heating

Swimming pool heating planned — ◯ Indoor pool ◯ Outdoor pool ◯ No

[ ] m x [ ] m x [ ] m pool size

[ ] Bathers per day

Cover? — ◯ Yes ◯ No

Outdoor pool location — ◯ Exposed ◯ Protected from wind

[ ] °C pool temperature

Solar thermal energy

Use of solar thermal energy — ◯ Yes ◯ No

If solar thermal energy is used, please complete "Project logging for solar thermal energy" and attach it.

Heating circuits

Quantity and type — [ ] Direct [ ] Mixed [ ] Fixed value

Heating surfaces

Type and percentage of heating output

Underfloor heating	[ ] %	[ ] °C flow	[ ] °C return
Radiators	[ ] %	[ ] °C flow	[ ] °C return
Fan coils	[ ] %	[ ] °C flow	[ ] °C return

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Fig. 41: Project logging sheet for the heat pump

Project logging

for Vaillant heat pump (basic planning)

Request based on information provided by the competent person

Boiler room/positioning information

Confined spaces (e.g. staircases and doorways) ☐ m height ☐ m width

Boiler room ☐ m height ☐ m width ☐ m length

Building height from roof to basement/ground floor ☐ m height

Passive cooling

Cooling function ◯ Yes ◯ No

☐ kW output ☐ °C flow ☐ °C return

Type of cooling ◯ Underfloor circuit ◯ Fan coil

Heat source

Type of heat source

Soil characteristics	Extraction performance
Cohesive soil with residual moisture	30 W/m²
Dry, non-cohesive soil	10 W/m²
Cohesive soil, moist	20-30 W/m²
Waterlogged sand, gravel	40 W/m²
Dry sediment	25 W/m²
Normal sediment, waterlogged	60 W/m²
Normal sediment, average value	60 W/m²
Gravel, dry sand	< 25 W/m²
Gravel, water-bearing sand	65-80 W/m²
Clay, moist loam	35-50 W/m²

Extraction performance guideline values for ground collectors/deep boreholes

◯ Brine borehole ☐ W/m extraction performance

◯ Brine area ☐ W/m² extraction performance

◯ Groundwater ☐ m³/h volume flow

☐ °C groundwater temperature

◯ Air ☐ °C outside temperature

◯ Other, type/description: ☐

Section for information, e.g. hydraulic diagram, heat pump/cylinder arrangement, duct layout for air/water heat pump, etc.

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Fig. 42: Project logging sheet for the heat pump

7 Buffer cylinder

As a basic principle, buffer cylinders fulfil three functions in a heat pump installation:

- Bridging energy supply company anti-cycling times to ensure a continuous supply of heat
- Increasing heat pump minimum running times in installations with low water circulation
- Ensuring the minimum water circulation rate when the buffer cylinder is connected as a separating cylinder.

The most important buffer cylinder connection forms are explained below.

Buffer cylinder integrated into the heating installation as a separating cylinder

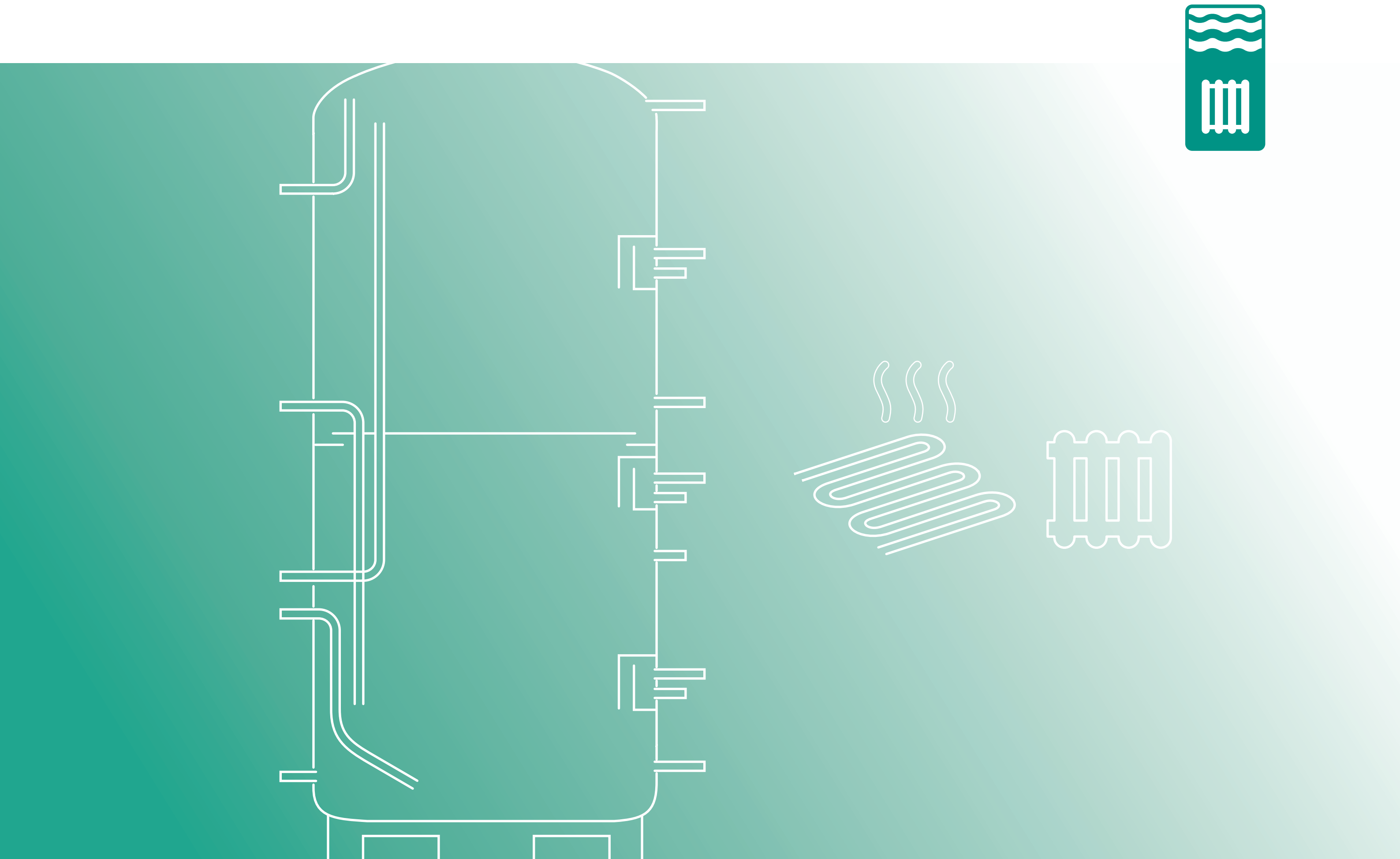
The separating cylinder is used to hydraulically separate heat generation (heat pump in this case) from heat recovery (underfloor heating). The pressure in the separating cylinder is zero. This achieves the heat pump's minimum circulation water volume and reduces the heat pump switching cycles. The single-room temperature control system can be used by the user.

Buffer cylinder as a return flow series cylinder

The return flow series cylinder is used to increase the circulation water volume to such an extent that the minimum compressor running time of three to four minutes can be bridged. The single-room temperature control can therefore be used by the user.

In contrast to the separating cylinder, a second heating circulation pump is not required. The minimum circulation water rate must be ensured by a suitable bypass valve.

It is even possible to incorporate multiple heat generators or solar thermal energy into the buffer cylinder. This means that, in some cases, a combination of a heat pump with a heating output of 6 kW and a VPS 2000 multi storage tank may even be of use, if additional yields resulting from solar thermal energy or from further heat generators are to be fed into the buffer cylinder from time to time.



7.1 Dimensioning buffer cylinders

For heat pump operation, electricity is mostly supplied under special conditions (dual-tariff meter). The separate supply of electricity enables the power supply network operator (energy supply company) to remove a heat pump from the network up to three times for a duration of two hours each. The number of times a heat pump can be started is also limited to three starts per hour. From this point of view, some applications (e.g. radiator heating) require buffer cylinders to provision thermal energy.

In the past, buffer cylinders with very large dimensions were frequently recommended. Since many houses are now constructed without cellars and utility rooms frequently also have to contain sufficient space for a washing machine and tumble dryer, dimensions have to be precisely calculated here.

To minimise compressor wear, the buffer cylinder must also be able to ensure what is known as the minimum compressor running time. This is three to four minutes for Vaillant heat pumps. The buffer cylinder must be able to absorb the heat volume produced in this time without the pressure in the refrigeration circuit exceeding the permitted level.

It must also cover the building energy loss that occurs in a potential anti-cycling time. In this case, only the actual losses that occur are used as a basis and not the building heating load according to DIN EN 12831. The heating load according to DIN EN 12831 is defined as the heat generator output that is required to heat the building with a standard outside temperature of, for example, -10 °C to ti = 20 °C. The energy losses that occur in an anti-cycling time are much lower, however, and the buffer cylinder can be dimensioned with smaller dimensions.

To be able to determine the heat volume that is to be stored, the heat pump output must be known. The heat source temperature also plays a role here. For brine-to-water heat pumps, 5 °C should be taken as a basis (particularly at the beginning of the heating season, the brine temperature is higher than 0 °C), for water-to-water heat pumps, 10 °C can be assumed to be the heat source temperature and for air-to-water heat pumps, the respective heating limit temperature of 10 °C/12 °C/15 °C must be observed.

The buffer cylinder volume can be calculated in two ways:

1. Calculation to the minimum compressor running time
2. Calculation using the values from the EnEV (Energy Saving Ordinance) certificate if the system data has still not been determined. The result provides a first, sufficiently accurate estimation of the cylinder volume.

Calculation to the minimum compressor running time

The minimum compressor running time for Vaillant heat pumps is three minutes.

The transition period is seen as particularly important for this type of design, so the heat pump output used for the calculation is taken at transition period temperatures.

For a sample calculation, the following values are specified for dimensioning:

- Min. compressor running time 3 mins
- For design flow temperatures of 7 °C, a permitted temperature withdrawal of 5 K (direct or mixed heating circuit)
- For design flow temperatures of 18 °C, a permitted temperature withdrawal of 15 K (direct or mixed heating circuit)
- For design flow temperatures of 35 °C, a permitted temperature boost of 20 K (direct or mixed heating circuit)
- For design flow temperatures of 45 °C, a permitted temperature boost of 10 K (direct or mixed heating circuit)
- For design flow temperatures of 55 °C, a permitted temperature boost of 5 K (mixed heating circuit)
- Otherwise: Conventional dimensioning for 10-20 min. and ΔT = 10 K

Air heat source

VWF 88/4	Outside temperature	Heating output	Cooling output	Power consumption	Heat demand
A12W55	12	10,0	7,0	3.0	55

Cylinder volume required:

m = (10 [kW] / (4.186 [kJ / (kg * K)] * 5 K)) * 180 [s/3 min] = 86.0 kg (-> 86.0 l)

m = 10000 [W] * 1 [h] * 3 [min] / 1.163 [Wh / (kg * K)] * 5 [K] * 60 [min] = 86.0 kg

Based on the minimum compressor running time for the air heat source, the required buffer cylinder volume is 86.0 l.

Brine heat source

VWF 88/4	Outside temperature	Heating output	Cooling output	Power consumption	Heat demand
B15W55	15	11,8	8,8	3.0	55

Cylinder volume required:

m = (11.8 [kW] / (4.186 [kJ / (kg * K)] * 5 K)) * 180 [s/3 min] = 101.48 kg (-> 101.5 l)

m = 11800 [W] * 1 [h] * 3 [min] / 1.163 [Wh / (kg * K)] * 5 [K] * 60 [min] = 101.48 kg

Based on the minimum compressor running time for the brine heat source, the required buffer cylinder volume is 101.5 l.

Heat source: Water

VWF 88/4	Outside tempe-rature	Heating output	Cooling output	Power con-sump-tion	Heat demand
W15W55	15	11,3	8,2	3,1	55

Cylinder volume required:

m = (11.3 [kW] / (4.186 [kJ / (kg * K)] * 5 K)) * 180 [s/3 min] = 97.18 kg (-> 97.2 l)

m = 11300 [W] * 1 [h] * 3 [min] / 1.163 [Wh / (kg * K)] * 5 [K] * 60 [min] = 97.18 kg

Based on the minimum compressor running time for the water heat source, the required buffer cylinder volume is 97.2 l.

Calculation according to EnEV data

If only an EnEV certificate but no system data is available, the values shown can be used to estimate the required buffer cylinder volume.

The following information is necessary:

- Specific transmission heat loss H'T: 0.4 W/ m^2K
- Surrounding heat transfer surface: 440.34 m^2
- Standard indoor temperature: 21 °C
- Standard outdoor temperature: -10 °C
- Specific heat capacity (c) for air: 0.34 Wh/m^3K
- Heated building volume: 592.70 m^3
- Minimum air change: 0.5 h^{-1}
- Correction factor for the heated building volume (V_e): Up to three full floors 0.76; more than three full floors 0.8
- Number of full floors: 3
- Anti-cycling time (2, 4 or 6 hrs).

This allows the energy extracted from the buffer cylinder during the anti-cycling time to be calculated. This is 3.92 kWh in the selected example, which leads to a required cylinder volume of 337 litres for bridging the anti-cycling time of two hours.

This includes the following calculation:

Consumed energy = Specific heat loss H'_T * surrounding heat transfer surface * (average standard inside temp. – standard outside temperature) + 0.34 * heated building volume * minimum exchange of air * 0.76 * (average standard inside temp. – standard outside temperature) * longest anti-cycling time / 1000 / 4

Sample calculation:

Consumed energy = ((0.4 W/m^2K * 440.34 m^2 * (21 °C - -10 °C)) + (0.34 Wh/m^3K * 592.70 m^3 * 0.5 h^{-1} * 0.76 * (21 °C - -10 °C)) * 2 h / 1000 / 4

Result: 3.917 kWh

Buffer volume calculation

The consumed energy in the example is 3.92 kWh.

Δt is the flow temperature of the heating system minus the min. buffer cylinder temperature.

Flow temperature

- Underfloor heating: 35 °C
- Panel radiator: 50 °C
- Sectional radiator: 55 °C
- Cast iron radiator: 55 °C

Min. buffer cylinder temperature

- Underfloor heating: 25 °C
- Panel radiator: 30 °C
- Sectional radiator: 35 °C
- Cast iron radiator: 30 °C

Buffer volume = (consumed energy/spec. heat capacity/(delta theta)) * 1000

- Consumed energy: 3.92 kWh
- Specific heat capacity (c) for water: 1.163 Wh/kg * K
- Flow temperature for underfloor heating: 35 °C
- Min. buffer cylinder temperature for underfloor heating: 25 °C

Buffer volume
= (3.92 kWh / 1.163 Wh/kg*k / (35 °C - 25 °C)) * 1000

= 337 litres

7.2 Additional heat pump output requirement

Energy supply company anti-cycling times

Heat pumps are generally operated on a discounted heating tariff that is linked to „anti-cycling times“, in which the heat pump is not supplied with power and can therefore also not produce any heat. The power supply can only be interrupted for a maximum of 3 x 2 hours within a 24-hour period, however, and the time between two anti-cycling times must be at least as long as the previous anti-cycling time. The heat pumps cannot be operated during this interruption, which means that the heat volume that is required during the energy supply company's anti-cycling times for heating the building is produced in advance and usually temporarily stored in a buffer cylinder.

In order to have sufficient power after a heat pump anti-cycling time, an anti-cycling time factor for the heat pump output must be taken into consideration when designing the system. The required increase in power corresponds to the number of anti-cycling times here. These interruption periods are taken into consideration using a factor to determine the power requirement. The required anti-cycling time factor is determined using the following formula:

Anti-cycling time factor = 24 hrs/(24 hrs - anti-cycling time)

Practice has shown that the required increase in output is lower as not all the rooms are heated and the lowest outdoor temperatures are only reached on rare occasions.

The following dimensioning has proven to work in practice:

Energy supply company anti-cycling times

Anti-cycling period (total)	Heat pump dimensioning factor
2 h	1.08
4 h	1.10
6 h	1.12

For solidly built houses with underfloor heating, the heat cylinder capacity is usually sufficient to bridge the anti-cycling times with no significant loss of comfort. It is therefore not necessary to connect a second heat generator (e.g. condensing boiler).

However, the increase in heat pump output, which is caused by increasing the heat source, is necessary to subsequently reheat the buffer cylinder.

General planning parameters for swimming pools

The following planning parameters must be determined for planning swimming pool heating.

General planning parameters for swimming pools

Parameter	Planning parameters
Swimming pool location	Weather data Wind protection
Type of swimming pool	Open-air swimming pool Indoor swimming pool
Pool parameters	Size, surface Depth Pool colour Type of cover
User habits	Number of visitors and their activity Operating times Times when the cover is removed Fresh water supply Set target temperature and maximum permitted temperature
Solar system data (if available)	System concept Collector design Orientation and incline Required heat transfer output

Swimming pool heat exchanger

Screw-fastened plate heat exchangers or tube bundle heat exchangers are used as a swimming pool heat exchangers. The average logarithmic temperature difference between the heat generator circuit and the filter circuit should not exceed 5-7 K. Appropriate volume flows must be ensured so that as much energy as possible can be transferred with a small temperature difference.

Open-air swimming pools

In Central Europe, open-air swimming pools are usually operated in the period from May to September. The pool temperature is a decisive factor and will usually fluctuate in the range from 23-25 °C. On account of the very large water volumes in the pool, each degree is decisive for the energy demand. Due to the very high surface losses for open-air swimming pools, provision of a pool cover is recommended. A pool cover significantly reduces heat losses and causes the heat demand to decrease.

The energy demand of an open-air swimming pool fluctuates between 150 kWh/m² and 700 kWh/m² per day according to the water temperature, the effects of wind, the weather situation, the fresh water supply and the number of visitors.

The majority of the losses are caused by evaporation. The effects of evaporation are intensified by large differences in temperature and humidity between the pool and its surroundings. Wind, the number of users and their actions also increase the evaporation losses because these factors cause the water to move.

The following rule of thumb is used to approximately design the heating of an open-air pool with a solar system:

Size of absorber surface for open-air pool **with** cover: (0.5-0.6) x pool surface

Size of absorber surface for open-air pool **without** cover: (0.8-1) x pool surface

Indoor swimming pools

When designing installations for indoor swimming pools, the room temperature and the relative humidity are also important for correctly calculating the heat demand.

When heating an indoor pool with a solar system, an absorber surface of (0.4-0.6) x pool surface is regarded as the empirical value. In both cases, for open-air pools and indoor pools, the rule of thumb only provides the basis for calculating the exact quantity of energy and the degree of solar cover using simulation software.

7.3 Vaillant buffer cylinder - Overview

Vaillant heating buffer cylinder - Overview

			uniTOWER incl. buffer module 18 l		Decoupler module			Buffer cylinder					
			VIH QW 190/1	VWL 58/5 IS	VWZ MPS 40 at VL 35 °C	VWZ MPS 40 at VL 45 °C	VWZ MPS 40 at VL 55 °C	VPS R 100/1 M at VL 35 °C	VPS R 100/1 M at VL 45 °C	VPS R 100/1 M at VL 55 °C	VPS R 200/1 M at VL 35 °C	VPS R 200/1 M at VL 45 °C	VPS R 200/1 M at VL 55 °C
Flexible heat pumps	**flexoCOMPACT** Brine/water 5.2-11.3 kW	VWF 58/4	–	–	●	●	–	–	●	●	–	–	●
		VWF 88/4	–	–	●	–	–	–	●	–	–	●	●
		VWF 118/4	–	–	●	–	–	●	●	–	–	●	●
	flexoCOMPACT Air/water 5.4-9.6 kW	VWF 58/4	–	–	●	●	–	–	●	●	–	–	●
		VWF 88/4	–	–	●	–	–	–	●	●	–	●	●
		VWF 118/4	–	–	●	–	–	●	●	–	–	●	●
	flexoCOMPACT Water/water 6.3-13.5 kW	VWF 58/4	–	–	●	●	–	–	●	●	–	–	●
		VWF 88/4	–	–	●	–	–	–	●	●	–	●	●
		VWF 118/4	–	–	●	–	–	●	●	–	–	●	●
	flexoTHERM Brine/water 5.2-19.3 kW	VWF 57/4	–	–	●	●	–	–	●	●	–	–	●
		VWF 87/4	–	–	●	–	–	–	●	–	–	–	●
		VWF 117/4	–	–	●	–	–	●	●	–	–	●	●
		VWF 157/4	–	–	–	–	–	●	●	–	–	●	●
		VWF 197/4	–	–	–	–	–	●	–	–	–	●	–
	flexoTHERM Air/water 5.4-17.9 kW	VWF 57/4	–	–	●	●	–	–	●	●	–	–	●
		VWF 87/4	–	–	●	–	–	–	●	●	–	–	●
		VWF 117/4	–	–	●	–	–	–	●	–	–	–	●
		VWF 157/4	–	–	–	–	–	●	●	–	–	●	●
		VWF 197/4	–	–	–	–	–	●	●	–	–	●	●
	flexoTHERM Water/water 6.3-23.4 kW	VWF 57/4	–	–	●	●	–	–	●	●	–	–	●
		VWF 87/4	–	–	●	–	–	–	●	●	–	–	●
		VWF 117/4	–	–	●	–	–	●	●	–	–	●	●
		VWF 157/4	–	–	–	–	–	●	●	–	–	●	●
		VWF 197/4	–	–	–	–	–	●	–	–	–	●	–
Large heat pumps	**geoTHERM** Brine/water 22.0-45.7 kW	VWS 220/3	–	–	–	–	–	●	–	–	●	●	–
		VWS 300/3	–	–	–	–	–	●	–	–	●	●	–
		VWS 380/3	–	–	–	–	–	–	–	–	●	–	–
		VWS 460/3	–	–	–	–	–	–	–	–	●	–	–
Air heat pump	**aroTHERM** Air-to-water 5.0-15.0 kW	VWL 55/3	●	–	●	●	●	●	●	●	●	●	●
		VWL 85/3	–	–	●	●	●	●	●	●	●	●	●
		VWL 115/2	–	–	●	●	●	●	●	●	●	●	●
		VWL 155/2	–	–	–	–	–	●	●	●	●	●	●
Air HP split	**aroTHERM** Air-to-water 3.0 kW-15.0 kW	VWL AS 35/5	–	●	●	●	●	●	●	●	●	●	●
		VWL AS 55/5	–	●	●	●	●	●	●	●	●	●	●
		VWL AS 75/5	–	–	●	●	●	●	●	●	●	●	●
		VWL AS 105/5	–	–	●	●	●	●	●	●	●	●	●
		VWL AS 125/5	–	–	–	–	–	●	●	●	●	●	●
3 kW	**geoTHERM** Brine/water 2.5 kW	VWS 36/4.1	●	–	–	–	–	–	–	–	–	–	–

● Recommended / ○ Recommended under certain circumstances / – Not recommended

			allSTOR exclusiv						allSTOR plus					
			VPS 300 / 3-7	VPS 500 / 3-7	VPS 800 / 3-7	VPS 1000 / 3-7	VPS 1500 / 3-7	VPS 2000 / 3-7	VPS 300 / 3-5	VPS 500 / 3-5	VPS 800 / 3-5	VPS 1000 / 3-5	VPS 1500 / 3-5	VPS 2000 / 3-5
Flexible heat pumps	**flexoCOMPACT** Brine/water 5.2-11.3 kW	VWF 58/4	–	–	–	–	–	–	●	●	●	–	–	–
		VWF 88/4	–	–	–	–	–	–	○	●	●	–	–	–
		VWF 118/4	–	–	–	–	–	–	–	●	●	–	–	–
	flexoCOMPACT Air/water 5.4-9.6 kW	VWF 58/4	–	–	–	–	–	–	●	●	●	–	–	–
		VWF 88/4	–	–	–	–	–	–	●	●	●	–	–	–
		VWF 118/4	–	–	–	–	–	–	○	●	●	–	–	–
	flexoCOMPACT Water/water 6.3-13.5 kW	VWF 58/4	–	–	–	–	–	–	●	●	●	–	–	–
		VWF 88/4	–	–	–	–	–	–	○	●	●	–	–	–
		VWF 118/4	–	–	–	–	–	–	–	●	●	–	–	–
	flexoTHERM Brine/water 5.2-19.3 kW	VWF 57/4	●	○	○	○	○	○	●	○	○	○	○	○
		VWF 87/4	○	●	○	○	○	○	●	○	○	○	○	○
		VWF 117/4	–	○	●	○	○	○	●	○	○	○	○	○
		VWF 157/4	–	○	●	●	○	○	○	●	○	○	○	○
		VWF 197/4	–	–	○	●	●	○	○	●	●	○	○	○
	flexoTHERM Air/water 5.4-17.9 kW	VWF 57/4	●	○	○	○	○	○	●	○	○	○	○	○
		VWF 87/4	○	●	○	○	○	○	●	○	○	○	○	○
		VWF 117/4	–	○	●	○	○	○	●	○	○	○	○	○
		VWF 157/4	–	○	●	●	○	○	○	●	○	○	○	○
		VWF 197/4	–	–	○	●	●	○	○	●	●	○	○	○
	flexoTHERM Water/water 6.3-23.4 kW	VWF 57/4	●	○	○	○	○	○	●	○	○	○	○	○
		VWF 87/4	○	●	○	○	○	○	●	○	○	○	○	○
		VWF 117/4	–	○	●	○	○	○	●	○	○	○	○	○
		VWF 157/4	–	○	●	●	○	○	○	●	○	○	○	○
		VWF 197/4	–	–	○	●	●	○	○	●	●	○	○	○
Large heat pumps	**geoTHERM** Brine/water 22.0-45.7 kW	VWS 220/3	–	–	○	○	○	○	–	–	○	○	○	○
		VWS 300/3	–	–	–	–	○	○	–	–	–	–	○	○
		VWS 380/3	–	–	–	–	○	○	–	–	–	–	○	○
		VWS 460/3	–	–	–	–	○	○	–	–	–	–	○	○
Air heat pump	**aroTHERM** Air-to-water 5.0-15.0 kW	VWL 55/3	●	○	○	○	○	○	○	○	○	○	○	○
		VWL 85/3	○	●	○	○	○	○	●	○	○	○	○	○
		VWL 115/2	○	●	●	○	○	○	●	○	○	○	○	○
		VWL 155/2	○	○	●	●	○	○	●	●	○	○	○	○
Air HP split	**aroTHERM** Air-to-water 3.0 kW–15.0 kW	VWL AS 35/5	●	○	○	○	○	○	○	○	○	○	○	○
		VWL AS 55/5	●	○	○	○	○	○	○	○	○	○	○	○
		VWL AS 75/5	○	●	○	○	○	○	●	○	○	○	○	○
		VWL AS 105/5	○	●	●	○	○	○	●	○	○	○	○	○
		VWL AS 125/5	○	○	●	●	○	○	●	●	○	○	○	○
3 kW	**geoTHERM** Brine/water 2.5 kW	VWS 36/4.1	–	–	–	–	–	–	–	–	–	–	–	–

● Recommended / ○ Recommended under certain circumstances / – Not recommended

Vaillant cooling buffer cylinder - Overview

			Decoupler module	Buffer cylinder			
			VWZ MPS 40 at VL 18 °C	VPS R 100/1 M at 7 °C	VPS R 100/1 M at 18 °C	VPS R 200/1 M at 7 °C	VPS R 200/1 M at 18 °C
Flexible heat pumps	**flexoCOMPACT** Brine/water 5.2-11.3 kW	VWF 58/4	●	●	●	●	●
		VWF 88/4	●	●	●	●	●
		VWF 118/4	–	●	●	●	●
	flexoCOMPACT Air/water 5.4-9.6 kW	VWF 58/4	●	●	●	●	●
		VWF 88/4	●	●	●	●	●
		VWF 118/4	●	●	●	●	●
	flexoCOMPACT Water/water 6.3-13.5 kW	VWF 58/4	●	●	●	●	●
		VWF 88/4	●	●	●	●	●
		VWF 118/4	–	●	●	●	●
	flexoTHERM Brine/water 5.2-19.3 kW	VWF 57/4	●	●	●	●	●
		VWF 87/4	●	●	●	●	●
		VWF 117/4	–	●	●	●	●
		VWF 157/4	–	–	●	●	●
		VWF 197/4	–	–	●	●	●
	flexoTHERM Air/water 5.4-17.9 kW	VWF 57/4	●	●	●	●	●
		VWF 87/4	●	●	●	●	●
		VWF 117/4	●	●	●	●	●
		VWF 157/4	–	–	●	●	●
		VWF 197/4	–	–	●	●	●
	flexoTHERM Water/water 6.3-23.4 kW	VWF 57/4	●	●	●	●	●
		VWF 87/4	●	●	●	●	●
		VWF 117/4	–	●	●	●	●
		VWF 157/4	–	–	●	●	●
		VWF 197/4	–	–	●	●	●
Large heat pumps	**geoTHERM** Brine/water 22.0-45.7 kW	VWS 220/3	–	–	–	–	–
		VWS 300/3	–	–	–	–	–
		VWS 380/3	–	–	–	–	–
		VWS 460/3	–	–	–	–	–
Air heat pumps	**aroTHERM** Air/water 5.0-15.0 kW	VWL 55/3	●	●	●	●	●
		VWL 85/3	●	●	●	●	●
		VWL 115/2	●	●	●	●	●
		VWL 155/2	–	●	●	●	●
Air HP split	**aroTHERM** Air-to-water 3.0 kW-15.0 kW	VWL AS 35/5	●	●	●	●	●
		VWL AS 55/5	●	●	●	●	●
		VWL AS 75/5	●	●	●	●	●
		VWL AS 105/5	●	●	●	●	●
		VWL AS 125/5	–	●	●	●	●
3 kW	**geoTHERM** Brine/water 2.2-2.4 kW	VWS 36/4.1	–	–	–	–	–

● Recommended / ○ Recommended under certain circumstances / – Not recommended

7.4 VWZ MPS 40 decoupler module – product description

Order no. 0020145020

Fig. 43: VWZ MPS 40 decoupler module

Equipment

The decoupler module is provided with several connection options for the heat generator circuit flow and return. On the secondary side, there are flow and return connectors for the heating circuits. In the upper and lower areas of the decoupler module, guide plates ensure optimum heat transfer within the module. This prevents intermixing of the different volume flows and/or temperature zones. A temperature sensor can be fitted in the decoupler module.

The cylinder volume is 35 litres.

Potential applications

The decoupler module can be used to hydraulically separate the heat pump and heating installation. This ensures that a minimum circulation rate is always maintained even with sealed underfloor circuits.

In a heating system that operates in bivalent mode, the auxiliary boiler can be hydraulically connected to the decoupler module. It can also be used as a return flow sequence cylinder. As such, it serves to increase the water volume in the heating installation and thus extend the running time of the heat pump.

Technical data

	Decoupler module
Nominal cylinder capacity	35 l
Weight	18 kg
Maximum operating pressure	3.0 bar
Minimum operating pressure	0.5 bar
Height	720 mm
Width	360 mm
Depth	350 mm

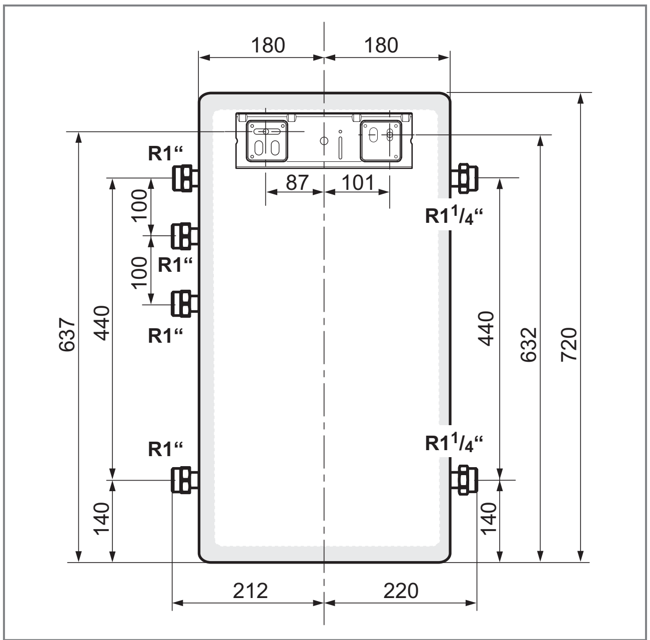


Fig. 44: Dimension drawing

Connection options

The decoupler module can also be used to hydraulically decouple the heat pump and the heat source installation, or to hydraulically incorporate back-up boilers into the heat pump installation.

Hydraulic disconnection

The following illustration shows the possible connections to the decoupler module if the heat source installation is to be hydraulically decoupled in order to guarantee the minimum circulation water volume. Take account of the different pressure losses, depending on the installation site requirements.

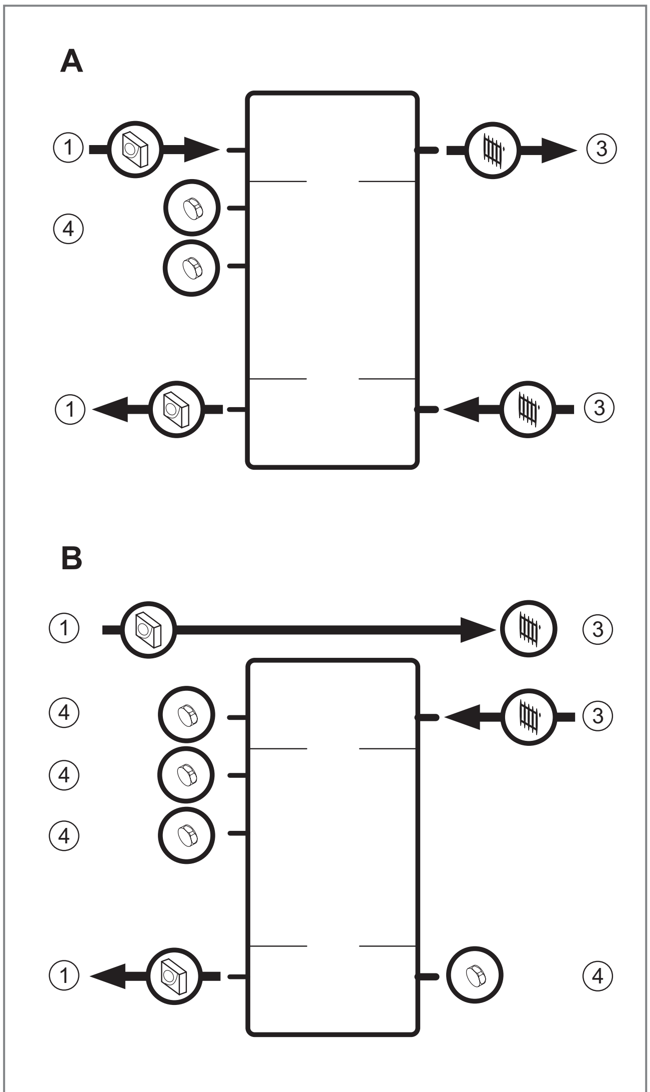


Fig. 45: Hydraulic connection for hydraulic disconnection

1 Heat pump flow/return
3 Heat recovery plant flow/return
4 Plug (connection not used)

Integration of a back-up heater

A back-up heater can be incorporated into the heat pump installation according to the following illustration.

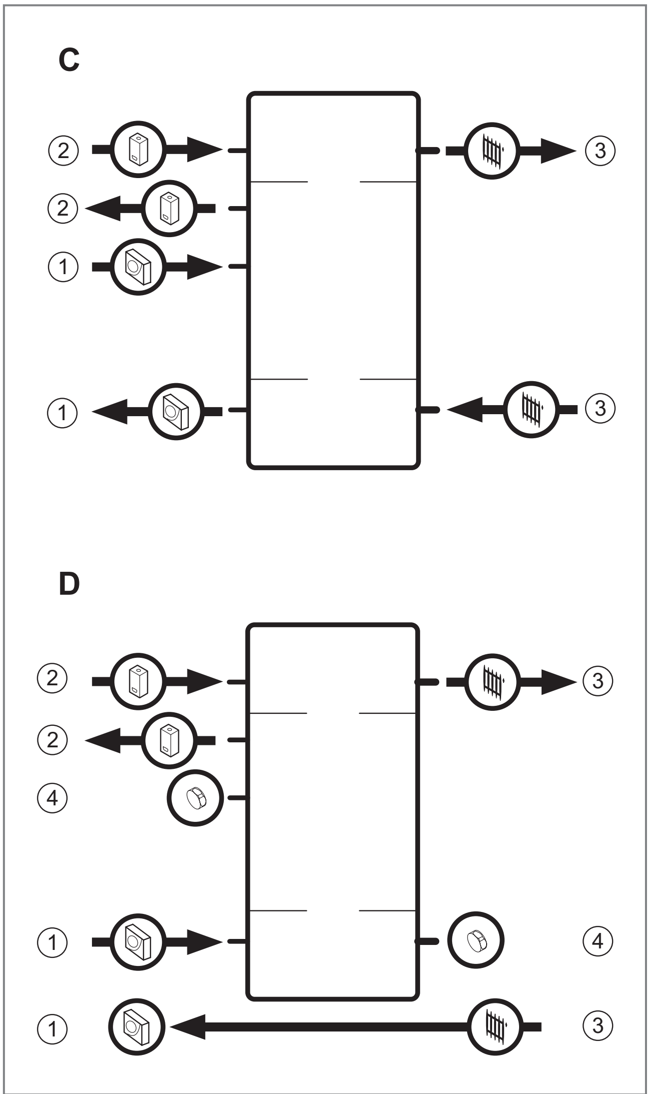


Fig. 46: Hydraulic connection for integrating an auxiliary boiler

1 Heat pump flow/return
2 Auxiliary boiler flow/return
3 Heat recovery plant flow/return
4 Plug (connection not used)

Pressure losses for different installation site requirements

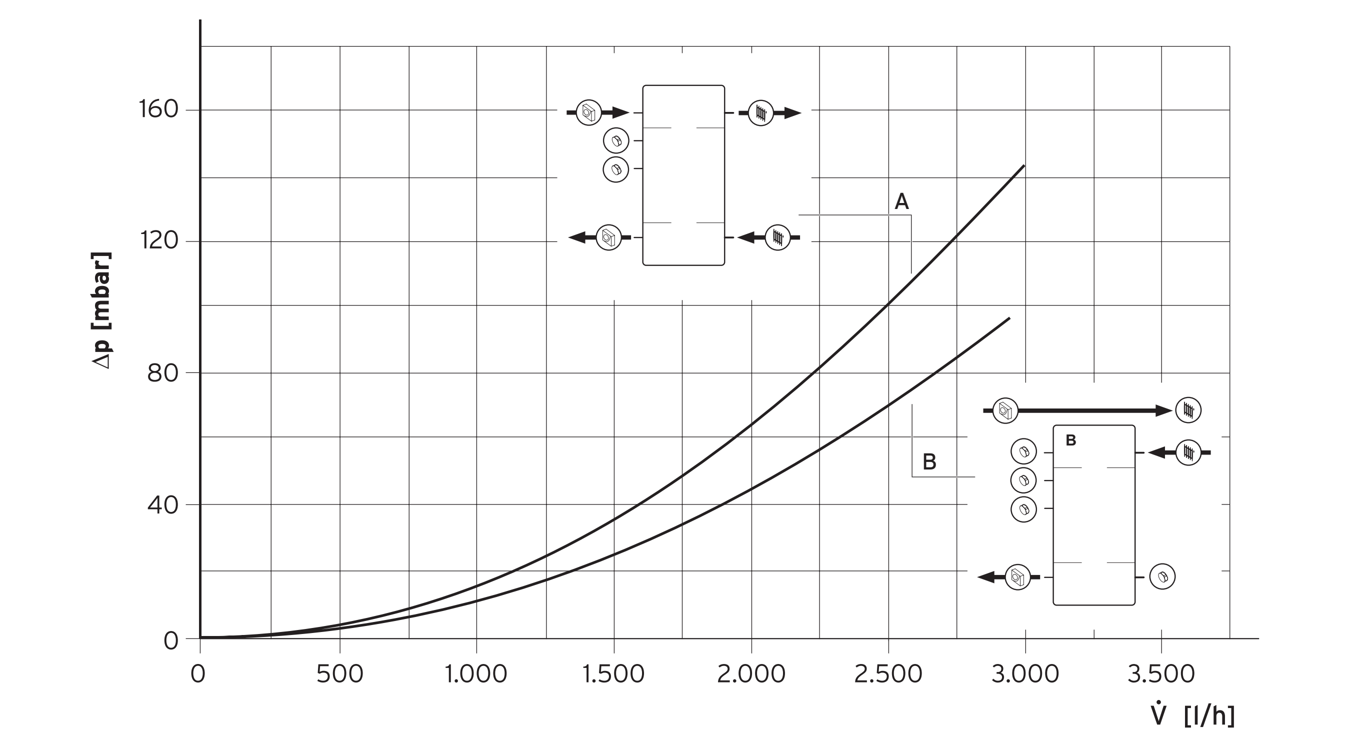


Fig. 47: Pressure losses for different installation site requirements

7.5 Product description for the VPS R 100/1 M and VPS R 200/1 B buffer cylinders

Fig. 48: VPS R 100/1 M buffer cylinder

Fig. 49: VPS R 200/1 B buffer cylinder

Type overview

Product	Art. no.
VPS R 100/1 M	0010021456
VPS R 200/1 B	0010021457

Potential applications

The VPS R 100/1 M and VPS R 200/1 B buffer cylinders can be used to hydraulically separate from the heat pump and heating installation. This ensures that a minimum circulation rate is always maintained even with sealed underfloor circuits.

In a heating system that operates in bivalent mode, the additional boiler can be hydraulically connected to the buffer cylinder. It can also be used as a return flow sequence cylinder. As such, it serves to increase the water volume in the heating installation and thus extend the running time of the heat pump.

The buffer cylinder is used as a cylinder for heating water or cooling water, depending on the requirement. Vapour-diffusion insulation makes it possible to buffer cooling water.

Equipment

The VPS R 100/1 M and VPS R 200/1 B buffer cylinders come with several connection options for the heat generator circuit flow and return. On the secondary side, there are flow and return connectors for the heating circuits. Inlet panels in the buffer cylinder ensure optimum distribution in the cylinder; the heat transfer takes place in the module. This prevents intermixing of the different volume flows and/or temperature zones. A temperature sensor can be installed in the buffer cylinder.

The cylinder volume is 101 and 202 litres.

Technical data

	VPS R 100/1M	VPS R 200/1B
Nominal capacity	101 l	202 l
Outer diameter of the cylinder	550 mm	600 mm
Height of the cylinder	932 mm	1,202 mm
Net weight	34 kg	44 kg
Weight when filled with water	135 kg	246 kg
Material of the cylinder and the connections	Steel	Steel
Water pressure range	0.1 ... 0.3 MPa	0.1 ... 0.3 MPa
Maximum operating temperature	95 °C	95 °C
Diameter of the hydraulic connections	G1" 1/2	G1" 1/2
Diameter of the sensor pocket	G1/2	G1/2

Cylinder with 100-litre capacity

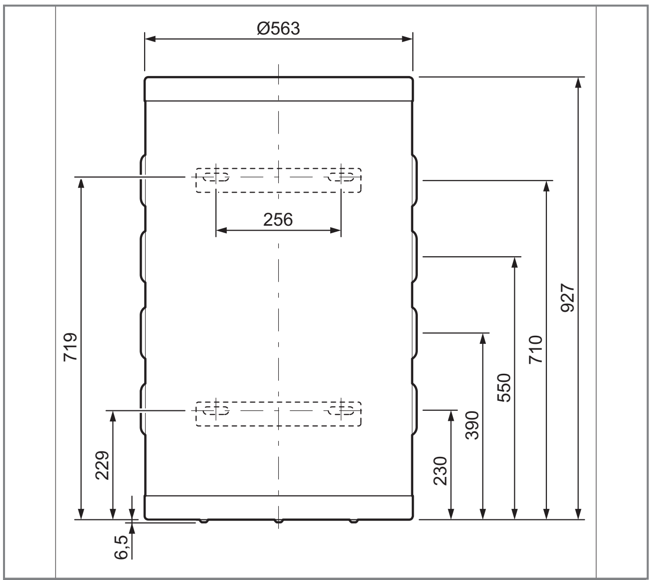


Fig. 50: Product dimensions

Cylinder with 200-litre capacity

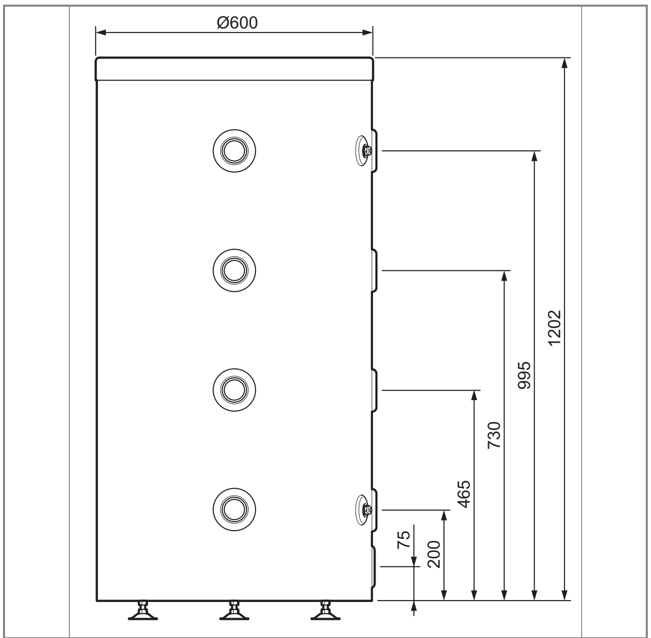


Fig. 51: Product dimensions

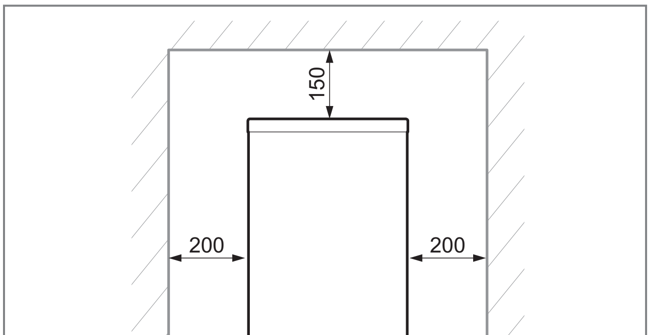


Fig. 52: Minimum clearances

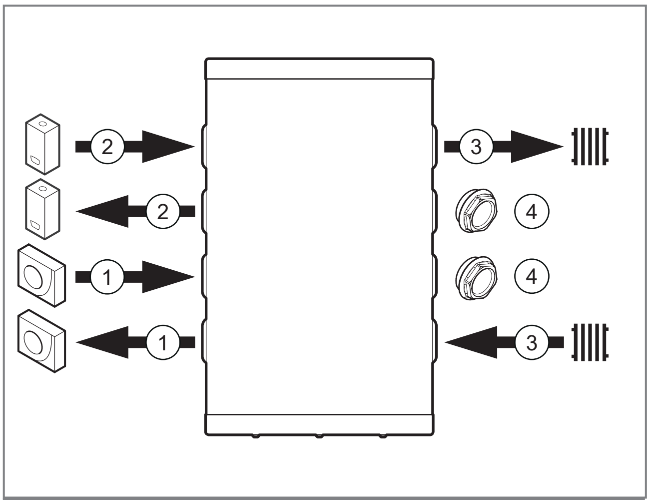


Fig. 53: Case no. 1

Case no. 1

1 Heat pump
2 Boiler
3 Heating circuit
4 Plug

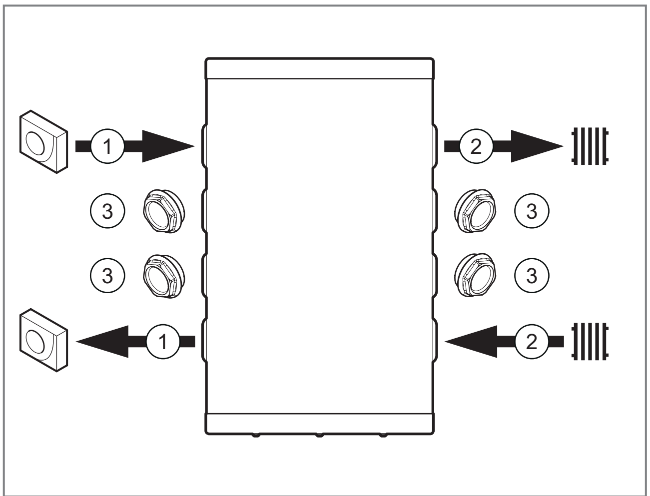


Fig. 54: Case no. 2

Case no. 2

1 Heat pump
2 Heating circuit
3 Plug

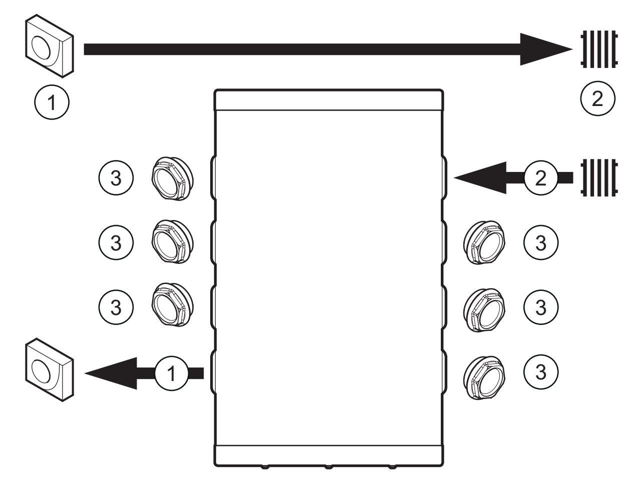


Fig. 55: Case no. 3

Case no. 3

1 Heat pump
2 Heating circuit
3 Plug

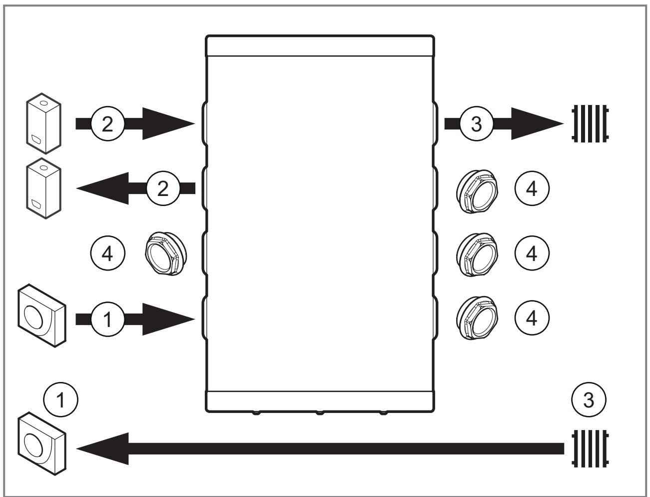


Fig. 56: Case no. 4

Case no. 4

1 Heat pump
2 Boiler
3 Heating circuit
4 Plug

Purging

A purging valve must be provided for purging the buffer cylinder. Open the purging valve (1) when filling the heating circuit with water.

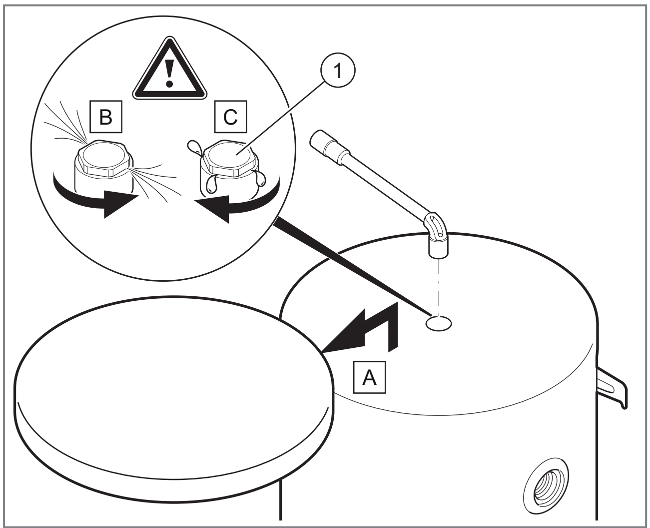


Fig. 57: VPS R 100/1 M purging

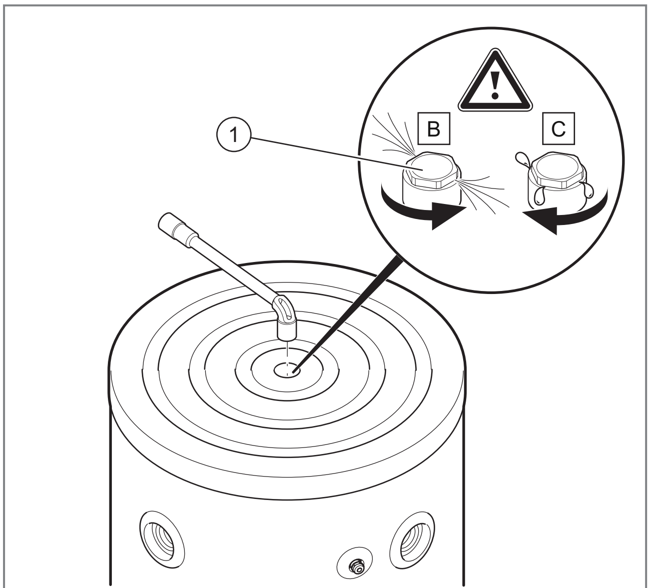


Fig. 58: VPS R 200/1 B purging

7.6 Product description for the allSTOR exclusive VPS 300/3-7 to 2000/3-7

Fig. 59: allSTOR VPS 300/3-7 to VPS 2000/3-7

Unit designation	ErP label	Cylinder capacity in l	Order no.
VPS 300/3-7	B	303	0010015112
VPS 500/3-7	B	491	0010015113
VPS 800/3-7	B	778	0010015114
VPS 1000/3-7	B	962	0010015115
VPS 1500/3-7	B	1505	0010015116
VPS 2000/3-7	B	1917	0010015117

Special features

- Compact buffer shift-load cylinder for combining various energy sources, such as solar, heat pump, wood, oil, gas or CHP
- Hygienic potable water preparation via the domestic hot water station that is suitable for flange mounting
- Additional solar pump station that is suitable for flange mounting for solar domestic hot water generation and heating support
- Easy to carry to the installation site; the heat insulation has not been prefit
- Split heat insulation (two-part up to 1000 l, three-part 1500 l and 2000 l)
- Optional thermal insulation caps for unused connections
- Tail lift from 500 l with pallet truck

Possible application

The multi-functional cylinder is supplied via various heat generators and/or a solar charging system. It is used as a buffer cylinder for heating water and provides heat energy to various consumers, such as domestic hot water stations, heating circuits, swimming pools, etc.

Equipment

- Steel buffer shift-load cylinder
- Baffle plates and control units for optimum stratification
- Highly efficient thermal insulation (140 mm for 300 l-1000 l, 200 mm for 1500 l and 2000 l) made from polyester fibre fleece
- Circulation pump as an accessory
- 8 surface mount sensor straps
- 15 charging and discharging connections for individual cylinder zones
- One sleeve for purging

Note
To prevent corrosion and depositions (scale) in the cylinder, you must observe VDI 2035 T1 and T2. This VDI contains, among other things, information about the water hardness level that must be maintained.

Technical data

Description	Unit	Tolerance	VPS 300/3	VPS 500/3	VPS 800/3	VPS 1000/3	VPS 1500/3	VPS 2000/3
Cylinder tank capacity	l	± 2	303	491	778	962	1505	1917
Perm. system overpressure (heating side)	MPa (bar)	–	0.3 (3)					
Heating water temperature	°C	–	95					
Cylinder tank outer diameter (without heat insulation)	mm	± 2	500	650	790	790	1000	1100
Cylinder tank outer diameter (with heat insulation)	mm	± 10	780	930	1070	1070	1400	1500
Cylinder tank depth (incl. heat insulation and connections)	mm	± 10	828	978	1118	1118	1448	1548
Cylinder tank height (incl. purging valve and positioning ring)	mm	± 10	1735	1715	1846	2226	2205	2330
Buffer cylinder height (incl. heat insulation)	mm	± 10	1833	1813	1944	2324	2362	2485
Cylinder tank weight (empty)	kg	± 10	70	90	130	145	210	240
Cylinder tank weight (full)	kg	± 10	373	581	908	1107	1715	2157
Tilt measurement	mm	± 20	1734	1730	1870	2243	2253	2394
Standby energy consumption	KWh/24 hrs	–	< 1.7	< 2.0	< 2.4	< 2.5	< 2.9	< 3.3

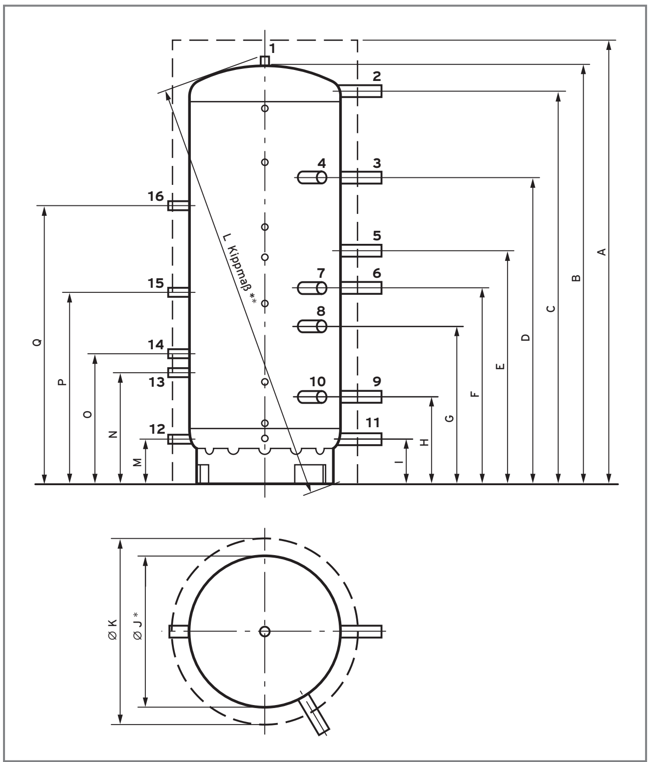


Fig. 60: Dimension drawing

01 Opening for purging valve
02 Heating water flow for domestic hot water station in the case of wall-mounting/flow or return for cascade
03 Boiler flow for hot water demand
04 Boiler flow for hot water demand
05 Boiler return for hot water demand
06 Boiler flow for heating water demand/heating circuit flow
07 Boiler flow for heating water demand/heating circuit flow
08 Boiler return for hot water demand
09 Boiler return for domestic hot water demand/heating circuit return
10 Boiler return for heating water demand/heating circuit return
11 Heating water return for domestic hot water station in the case of wall-mounting/flow or return for cascade
12 Heating water return for the solar charging system (VPS/3-E only)
13 Heating water flow for the solar charging system for low temperatures (VPS/3-E only)
14 Heating water flow for the solar charging system for high temperatures (VPS/3-E only)
15 Heating water return for the domestic hot water station (VPS/3-E only)
16 Heating water flow for the domestic hot water station (VPS/3-E only)

Connection dimensions

Unit type	A	B	C	D	E	F	G	H	I	J diameter	K diameter	L	M	N	O	P	Q
VPS 300/3	1833	1720	1617	1210	920	744	574	365	130	500	780	1734	130	480	580	900	1350
VPS 500/3	1813	1700	1570	1230	930	750	579	394	190	650	930	1730	190	540	640	960	1410
VPS 800/3	1944	1832	1670	1330	1020	820	636	421	231	790	1070	1870	231	581	681	1001	1451
VPS 1000/3	2324	2215	2051	1598	1220	1020	822	451	231	790	1070	2243	231	581	681	1001	1451
VPS 1500/3	2362	2190	1973	1573	1227	1000	797	521	291	1000	1400	2253	291	641	741	1061	1511
VPS 2000/3	2485	2313	2080	1656	1201	1008	803	551	298	1100	1500	2394	298	648	748	1068	1518
Dimensions in mm, all dimensions ± 10 mm, * ± 2 mm, ** ± 20 mm																	

7.7 Product description for the allSTOR plus VPS 300/3-5 to 2000/3-5

Fig. 61: allSTOR VPS 300/3-5 to VPS 2000/3-5

Unit designation	ErP label	Cylinder capacity in l	Order no.
VPS 300/3-5	B	303	0010015118
VPS 500/3-5	B	491	0010015119
VPS 800/3-5	B	778	0010015120
VPS 1000/3-5	B	962	0010015121
VPS 1500/3-5	B	1505	0010015122
VPS 2000/3-5	B	1917	0010015123

Special features

- Compact buffer shift-load cylinder for combining various energy sources, such as solar, heat pump, wood, oil, gas or CHP
- Cascading up to 6000 l is possible
- Easy to carry to the installation site; the heat insulation has not been prefit
- Split heat insulation (two-part up to 1000 l, three-part 1500 l and 2000 l)
- Optional thermal insulation caps for unused connections

Possible application

The multi-functional cylinder is supplied via various heat generators and/or a solar charging system. It is used as a buffer cylinder for heating water and provides heat energy to various consumers, such as drinking water stations, heating circuits, swimming pools, etc.

Equipment

- Steel buffer shift-load cylinder
- Flow damper for optimum stratification
- Highly efficient thermal insulation (140 mm for 300 l-1000 l, 200 mm for 1500 l and 2000 l) made from polyester fibre fleece
- Circulation pump as an accessory
- 8 surface mount sensor straps
- 10 charging and discharging connections for individual cylinder zones
- One sleeve for purging

Note
To prevent corrosion and depositions (scale) in the cylinder, you must observe VDI 2035 T1 and T2. This VDI contains, among other things, information about the water hardness level that must be maintained.

Description	Unit	Tolerance	VPS 300/3	VPS 500/3	VPS 800/3	VPS 1000/3	VPS 1500/3	VPS 2000/3
Cylinder tank capacity	l	± 2	303	491	778	962	1505	1917
Perm. system overpressure (heating side)	MPa (bar)	–	0.3 (3)					
Heating water temperature	°C	–	95					
Cylinder tank outer diameter (without heat insulation)	mm	± 2	500	650	790	790	1000	1100
Cylinder tank outer diameter (with heat insulation)	mm	± 10	780	930	1070	1070	1400	1500
Cylinder tank depth (incl. heat insulation and connections)	mm	± 10	828	978	1118	1118	1448	1548
Cylinder tank height (incl. purging valve and positioning ring)	mm	± 10	1735	1715	1846	2226	2205	2330
Buffer cylinder height (incl. heat insulation)	mm	± 10	1833	1813	1944	2324	2362	2485
Cylinder tank weight (empty)	kg	± 10	70	90	130	145	210	240
Cylinder tank weight (full)	kg	± 10	373	581	908	1107	1715	2157
Tilt measurement	mm	± 20	1734	1730	1870	2243	2253	2394
Standby energy consumption	KWh/24 hrs	–	‹ 1.7	‹ 2.0	‹ 2.4	‹ 2.5	‹ 2.9	‹ 3.3

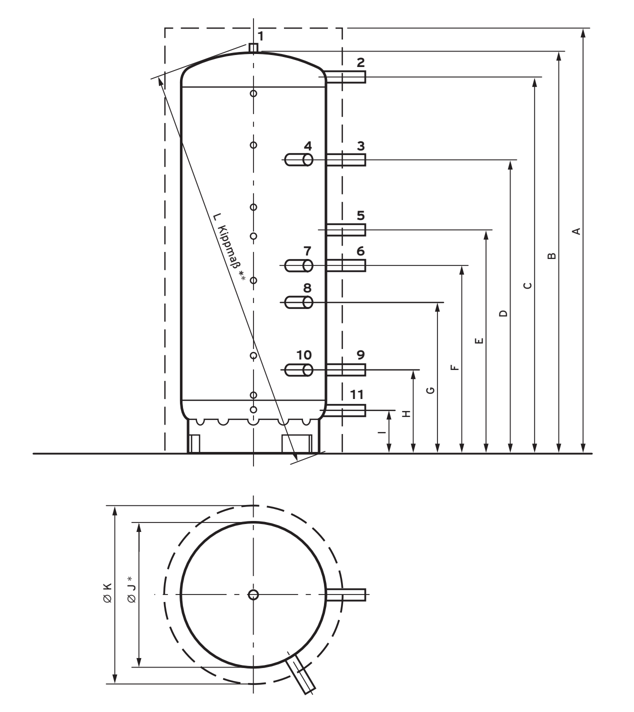


Fig. 62: Dimension drawing

01 Opening for purging valve
02 Heating water flow for domestic hot water station in the case of wall-mounting/flow or return for cascade
03 Boiler flow for hot water demand
04 Boiler flow for hot water demand
05 Boiler return for hot water demand
06 Boiler flow for heating water demand/heating circuit flow
07 Boiler flow for heating water demand/heating circuit flow
08 Boiler return for hot water demand
09 Boiler return for domestic hot water demand/heating circuit return
10 Boiler return for heating water demand/heating circuit return
11 Heating water return for domestic hot water station in the case of wall-mounting/flow or return for cascade

Unit type	A	B	C	D	E	F	G	H	I	J diameter	K diameter	L
VPS 300/3	1833	1720	1617	1210	920	744	574	365	130	500	780	1734
VPS 500/3	1813	1700	1570	1230	930	750	579	394	190	650	930	1730
VPS 800/3	1944	1832	1670	1330	1020	820	636	421	231	790	1070	1870
VPS 1000/3	2324	2215	2051	1598	1220	1020	822	451	231	790	1070	2243
VPS 1500/3	2362	2190	1973	1573	1227	1000	797	521	291	1000	1400	2253
VPS 2000/3	2485	2313	2080	1656	1201	1008	803	551	298	1100	1500	2394

Dimensions in mm, all dimensions ± 10 mm, * ± 2 mm, ** ± 20 mm

7.8 Cylinder connections overview

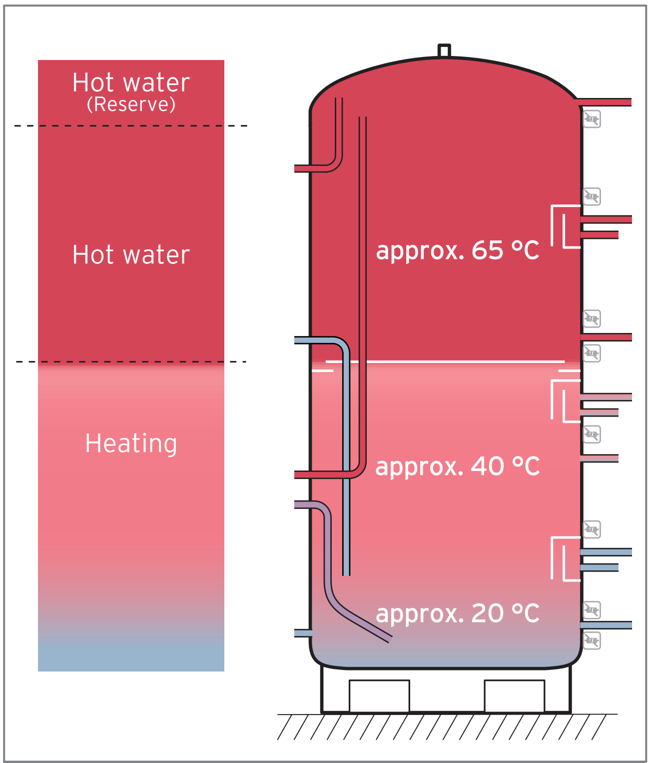


Fig. 63: Controlling cylinder charging

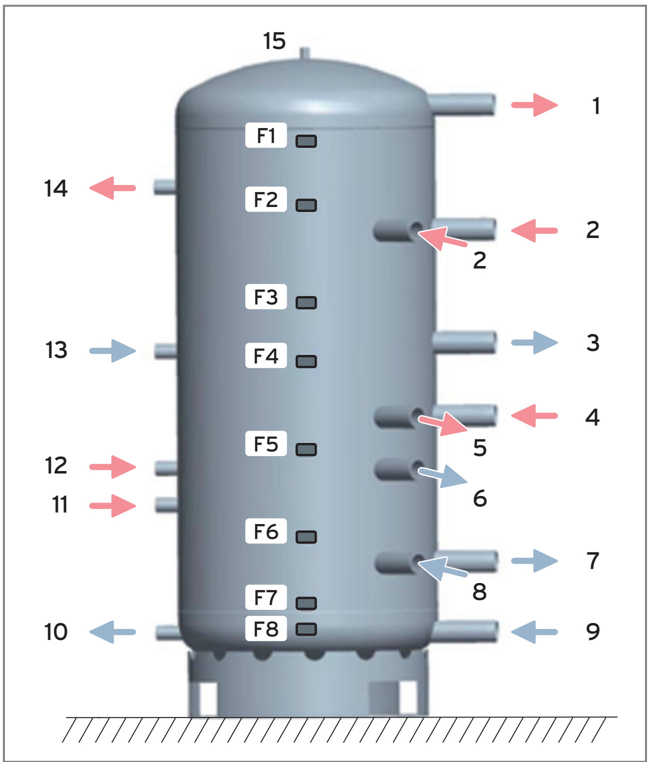


Fig. 64: Cylinder connections - Overview

One after the other, starting from the top, three cylinder temperature sensors each trigger a heat requirement if a target value is not reached. The cylinder is divided into three temperature zones by the way in which the sensors are arranged according to the product and the system. If a solar charging system is used, first the **auroFLOW** and then the post-heating installations are triggered, depending on the current solar energy input.

Sensor 1 (hot water, reserve): For the upper 10% of the cylinder volume (hot water).

Sensor 2 (hot water, comfort zone): For the approx. 40% of the cylinder volume that lies below.

Sensor 3 (heating): For the approx. 50% of the cylinder volume that lies below.

The heat generator and the heating circuits are connected as follows:

1 Heating water flow to VPM-W for wall-mounted installations or cylinder cascades
2 Two boiler flow connections for the process water part of the cylinder
3 Boiler return
4 Boiler flow connection for the heating part of the cylinder
5 Heating circuits flow
6 Boiler return
7 Boiler return
8 Heating circuits return
9 Heating water return to VPM-W for wall-mounted installations or cylinder cascades
10 Heating water return to VPM-S
11 VPM-S heating water flow at low temperatures
12 VPM-S heating water flow at high temperatures
13 Heating water return to VPM-W
14 VPM-W heating water flow
15 Connectors for purging valve
F 1-8 Sensor straps for the temperature sensor

There are eight sensor positions in addition to the three-level connection geometry. Positions F1 to F8 indicate the position of the sensor brackets.

7.9 Planning cascade systems

The allSTOR buffer cylinder system can be used in almost any heating system. The individual system components (VPS, VPM W and VPM S) can be cascaded to create larger systems.

This means that a buffer cylinder system can consist of up to three allSTOR VPS /3 units, four aguaFLOW exclusive VPM /2 W units and a maximum of two auroFLOW exclusive VPM /2 S units.

Vaillant offers a wide range of accessories for all these units to set up cascade systems.

The customised range of accessories makes it possible to set up a cascade system that has the following advantages:

- Simple installation of the system
- High level of operational reliability in the event of faults or maintenance work
- Compact, space-saving solutions

Fig. 65: Installation example: Four-unit VPM W cascade

Advantages of a cascade system

The use of several buffer cylinders basically means that a cascade solution offers increased flexibility when supplying heat to a building according to requirements.

- The system has a modular design and, as the heat demand in the building increases, it can be extended. This means that partial refurbishments of existing heating installations are also possible.
- Simple transport and installation of units and cascade accessories – even in the case of renovations – thanks to these being delivered in individual packaging units. It is easier to install parts of the system in narrow stairways or by doors, for example, which in turn minimises personnel costs.
- High level of maintenance flexibility because maintenance work can be carried out on individual units without having to switch off the entire system.

7.10 Calculating the pressure loss in cylinder cascades

The planSOFT software tool is available on our Expert Partner network to help you calculate the system pressure loss.

The pressure losses in the pipe sections and cylinder tanks can also be determined using the corresponding diagrams.

To calculate the pressure loss in the cylinder cascade, proceed as follows:

- Determine the required pipe length and the number of 90° pipe elbows
- For each 90° elbow, add 0.45 m to the pipe length determined
- Select the pipe diameter
- Determine the pressure loss in the connection pipes (dependent on the volume flow). See diagram.
- Add the pressure losses in the cylinder tanks (dependent on the volume flow). See diagram.

Pressure loss per metre of pipeline

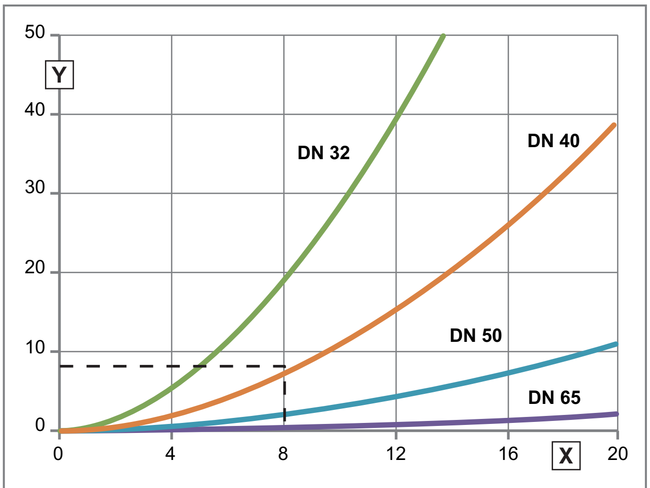


Fig. 66: Pressure loss per metre of pipeline

X Flow rate in m³/h
Y Pressure loss in mbar

For each elbow, an additional equivalent pipe length of 0.45 m must be added.

Pressure loss in the cylinder tanks within a cascade

Pressure loss per metre of pipeline

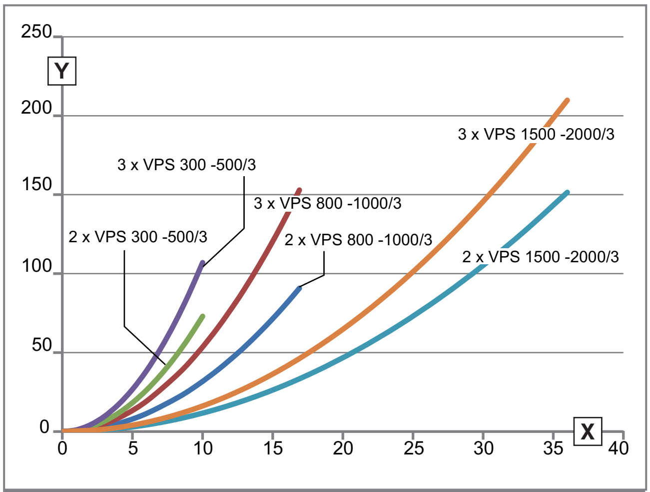


Fig. 67: Pressure loss in the cylinder tanks within the cascade

X Flow rate in m³/h
Y Pressure loss in mbar

A three-unit cascade that consists of allSTOR VPS 500/3 is calculated below:

Sample calculation:

Required pipe length per cylinder connection: 3.4 m

Number of 90° elbows per cylinder connection: 4

Chosen pipe diameter: DN 40

Maximum flow rate for VPS 500/3: 8 m³/h

Calculation of the pipe length:
2 x 3.4 m + 8 x 0.45 m = **10.4 m**

Pressure loss per metre of pipeline: Approx. **8 mbar** (taken from the diagram)

Pressure loss in the three cylinder tanks: Approx. **75 mbar** (taken from the diagram)

Total pressure loss in the cylinder cascade:

10.4 m x 10 mbar/m + 75 mbar = 179 mbar

8 Planning the heat source

8.1 Overview of usable heat sources

Thermal energy from the sun is stored all around us in the ground, water and air.

This energy is absorbed by special heat exchange systems, known as collectors, or directly from the ambient air and supplied to the heat pump cycle.

The heat source must be designed in such a way that it can continuously provide the renewable portion of the useful heat.

The total output that is required for the heat pump is determined from the following portions:

- Building heating load
- Supplement for domestic hot water generation
- Energy supply company supplement

As is evident from the following graphics, the portion of environmental heat depends on the seasonal performance factor (SPF) of the heat pump.

An SPF of four therefore means that 3/4 of the heating output must be provided by the heat source. This must be taken into consideration when planning the heat source.

A seasonal performance factor of four is taken as the basis in the design tables in the following section.

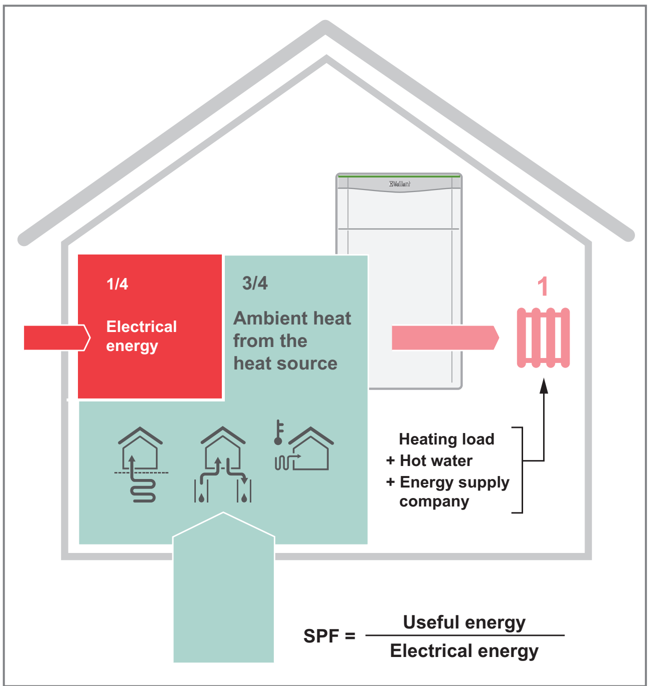


Fig. 68: Seasonal performance factor and heat source design

Each heat source has a different yield, which results in correspondingly different heat extraction performances.

Ground water and ground enable the heat pump to be operated as the sole heating system (monovalent operation). Economical operation (mono-energy or bivalent) is also possible using ambient air as the heat source.

In order to create a coordinated system, consisting of heat source, heat pump and heat source installation, it is important to define requirements and important parameters as accurately as possible in advance.

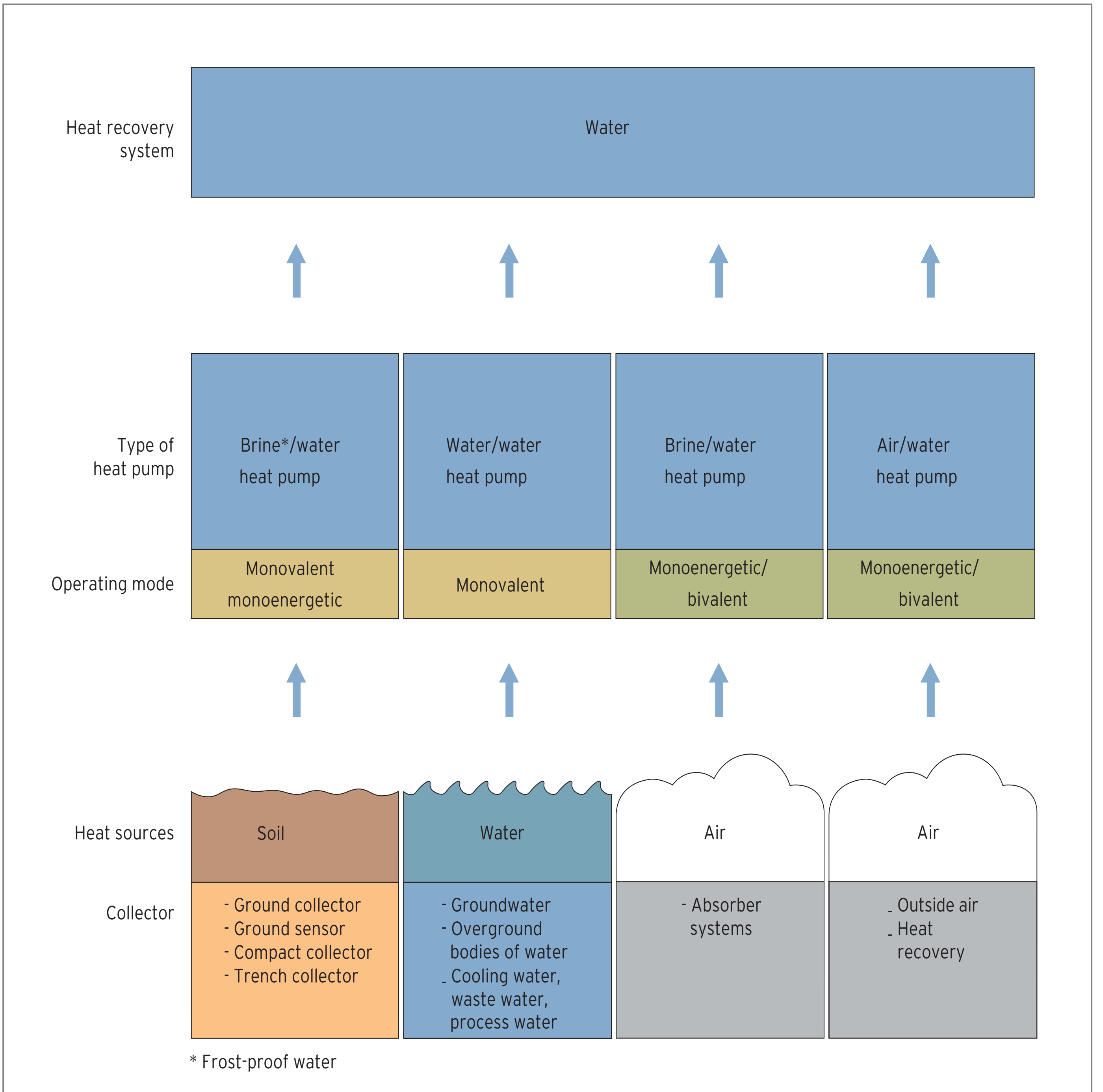


Fig. 69: Heat generation with the heat pump

flexoTHERM exclusive and **flexoCOMPACT exclusive** heat pumps can use all heat sources – ground, water and air.

aroTHERM heat pumps use outdoor air as their heat source.

The **aroSTOR** domestic hot water heat pumps use both outdoor air and extract air from other rooms as their heat source.

geoTHERM heat pumps (greater than 22 kW) use ground as their heat source.

geoTHERM VWS 36/4.1 heat pumps use the ground as a heat source.

The following table provides reference values for selecting the correct heat source.

In addition to information on availability and the temperature level of the different heat sources, initial information on exploitation costs and required permits is given.

The overview can be used to perform an initial estimation for constructing a heat pump installation in your property.

Heat source selection overview

	Brine Earth		**Air Outdoor air**	**Water Ground water**
	Collector	**Sensor**		
Availability	●	+	++	●
Cylinder capacity	+	++	–	++
Temperature level	+	+	●	++
Design temperature *	0 °C	0 °C	-20 °C/+20 °C	10 °C
Regeneration	+	+	++	++
Exploitation costs	+	++	––	+/++ 1)
Subject to approval *	Display	Yes	no	Yes
Passive cooling	no	Yes	no	Yes
Active cooling	no	Yes	Yes	Yes
Noise emissions	––	––	++	–

* Depending on the region
++ very high, + high, ● medium, – low, –– very low
1) Depending on the groundwater depth (max. 15 m)

8.2 Heat sources for brine-to-water heat pumps

Designing geothermal sensors (deep borehole)

A ground sensor is ideal in particular for small property spaces in which there is insufficient space for installing a ground collector. The ground collector pipe system (double U-pipe sensor with fill pipe) is inserted vertically into the ground via deep boreholes generally down to a depth of 99 m (permit granted by water authorities, see also section 3.4: „Geotechnical investigation") and the diameter is approximately 115 to 220 mm depending on the drill used.

Deep boreholes more than 100 m in depth may be of use for larger installations (permit required according to the German Mining Act). If necessary, the sensor length can be distributed between several boreholes.

Note
You can find certified drilling companies at: www.waermepumpe.de

When designing ground collectors, the brine pump's remaining feed head in the relevant heat pump must be taken into account.

Ground collectors are inserted vertically into the drilled hole. Several sensors can be combined. In this case, what is referred to as the „neutral zone" must be taken into consideration, whereby it is not assumed that the sensor length remains the same.

The brine flows into the borehole and back out again twice, i.e. each borehole has two circuits. During this, the brine heats up and supplies the energy for the heat pump or for any potential passive cooling in summer.

To improve heat transfer between the ground and the pipe, a heat conducting material, such as betonite, is forced from the bottom of the borehole in an upwards direction via the fill pipe. In addition to the improved conduction of heat or cold, the filling material also has the task of supporting the pipe in the borehole so that it does not buckle under its own weight, as the weight is considerable at a depth of 100 m. Betonite is a hydric material, meaning that it sets in the presence of moisture. Grouting also prevents the various ground water layers from becoming connected to one another.

The temperature of the brine fluid guided to the heat pump should not change by more than +/- 11 K in temperature compared to the temperature of the undisturbed ground. The influence of the ground collectors on the surrounding ground is then slight.

If you want to carry out active cooling using ground as the heat source, ensure that the borehole/ground collector is suitable for this purpose.

When using the ground/brine as the heat source, active cooling is limited to a brine output temperature of 40 °C. If this temperature is exceeded (> 40 °C), active cooling mode is switched off.

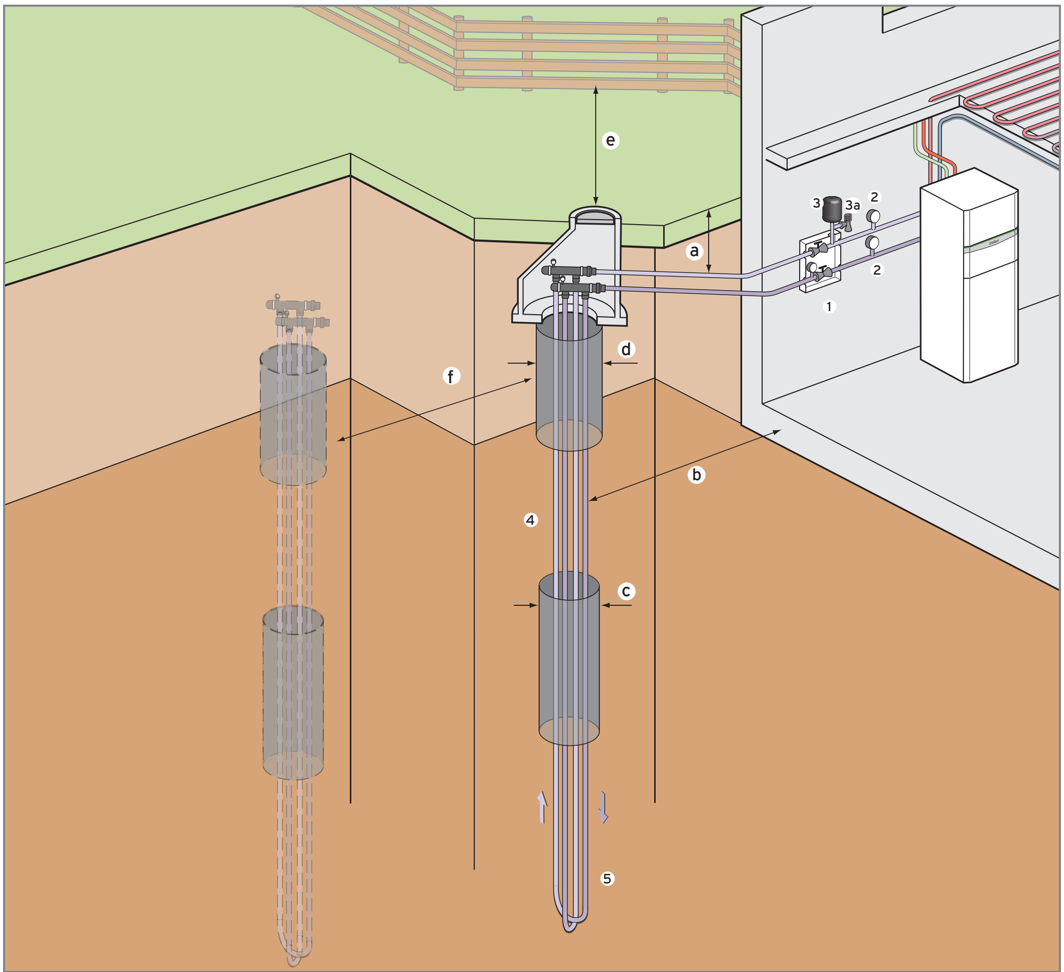


Fig. 70: Geothermal sensor schematic drawing

1 Brine filling unit with pressure gauge and stop valves
2 Temperature display
3 Brine diaphragm expansion vessel
3a Expansion relief valve
4 Double U-pipe sensor (two circuits per borehole), drilling depth depending on the soil characteristics as per the dimensioning
5 Deflection piece with collector lines welded at the factory, length: approx. 150 cm, diameter approx. 10 cm
a Flow/return with downward gradient from the heat pump to the ground sensor in the sand bed at a depth of approximately 1.0 m, purging of the collector near the heat pump
b The minimum distance from the building foundation should be 2.0 m
c Drilled hole diameter of approximately 115-220 mm (filling of the cavity with quartz sand, Dämmer® or betonite)
d Pipe sleeve for loose material, length approx. 6-20 m, diameter approx. 170 mm
e At least 3.0 m clearance from the boundary of the plot of land
f At least 5.0 m clearance between two ground sensors

Filters and filling/draining cocks are not shown.

Design principles

A geothermal sensor system must be designed and constructed in accordance with VDI directive 4640 (Utilization of the Subsurface for Thermal Purposes) and using state-of-the-art technology while observing the applicable statutory regulations.

For ground-coupled heat pumps, high thermal conductivity of the subsoil is desired to therefore allow the heat from the ground to easily reach the collector.

The stationary heat transport capacity can be described by the thermal conductivity (unit = W/(m*K)).

Ground sensors acquire their thermal energy from the geothermal heat flow (from the Earth's interior to the surface) and the groundwater flow. Solar radiation and seepage water or rainwater only have a significant influence down to a depth of 15 m.

Ground sensors can normally reach depths from 10 to more than 200 m.

Designing ground sensors with excessively small dimensions can lead to low brine temperatures. In the long term, this may result in the brine temperature dropping from heating period to heating period.

Permits

German Water Management Act (WHG)

When constructing underground thermal systems, the provisions of the German Water Management Act (WHG) and the administrative regulations passed by the German states in relation to this must be observed.

Constructing and operating a ground sensor system may constitute use under the law, which requires authorisation, under Section 3, Art. 2 of the WHG (irrespective of whether groundwater is struck or not).

The slight temperature change when operating a heat pump in conjunction with a ground sensor in single-occupancy houses and dual-occupancy houses generally does not constitute use under the law. Whether a notification of drilling needs to be issued or whether a permit is necessary depends on the local conditions and administrative regulations.

The following water management objectives must also be observed:
- The brine fluid must comply with the requirements in VDI 4640, part 1.
- Drilling fluids must not contain any materials that are harmful to water.
- The short circuit of two or more groundwater body horizons should be prevented (by grouting the area).
- Approval for installing a geothermal sensor in high-yield groundwater body horizons for exploiting drinking water is generally refused.

German Mining Act (BBergG)

The German Mining Act does not apply when searching for and exploiting geothermal energy in the range of 0-99 m. The WHG may apply here (see paragraph above).

As of a depth of 100 m, the regulations of the BBergG for searching for and exploiting geothermal energy must be applied.

Individual German federal states, such as Bavaria, Baden-Württemberg, North Rhine-Westphalia, Hesse and Rhineland-Palatinate, have published guidelines on the use of geothermal energy with heat pumps in order to make it easier for projects to be granted a permit.

Sensor material

For underground ground sensors and pipelines, hydrocarbon polymers such as

- polyethylene (PE)
- polypropylene (PP)
- or polybutylene

should be selected as the material in accordance with DIN 8074/8075.

Heat transfer medium

Heat transfer media must not cause the ground water or soil to become polluted in the event of a leakage. Non-toxic and biodegradable substances should be chosen. Only materials included in water hazard class 1, footnote 14 (which were therefore in water hazard class 0 before 17th May 1999) may be used. The safety data sheet for the material in question lists the group to which it belongs.

The brine fluid must comply with the requirements in VDI 4640, part 1.

- Propylene glycol (alternatively: ethylene glycol) with corrosion-inhibiting additives is permitted according to the current installation instructions.

Operation is permitted with the following brine fluids:

- Aqueous solution with 30% ± 5% vol. ethylene glycol
- Aqueous solution with 33% ± 5% vol. propylene glycol.

The heat source installation must not be filled with a potassium carbonate/water mixture. Only the brine fluids that are permitted for the relevant type of heat pump must be used.

The antifreeze used by Vaillant in Germany, Austria and Switzerland is a ready-mixed fluid (30 vol.% ethylene/glycol/water mixture) for brine-to-water heat pumps.

In water protection zones, using brine fluid in the ground collector or in the horizontal collector is not permitted. If you want to use water as the medium, a significantly greater drilling depth must be applied for the ground collector. Using a suitable simulation programme (the drilling company that is certified in accordance with DVGW 120 should work with appropriate programmes), it can be proved that the ground collector will operate over a simulated operating period of 25 years in the frost-free temperature range. The drilling depth may increase here by 30% to 50%. Horizontal collectors are unsuitable because of the large installation area that is required.

Vaillant only permits the heat pumps to be operated with suitable brine fluids. If the evaporator is damaged by frost during operation (despite the simulated calculation that was previously carried out), this is not covered by the manufacturer's guarantee. The competent person bears the risk for this.

Planning sequence

Drilling work

The specialist company performing the drilling should be qualified in accordance with DVGW (German Association of Gas and Water Technology) worksheet W 120. Planning should be carried out in cooperation with the customer. The drilling company produces an implementation plan recording all permits and restrictions.

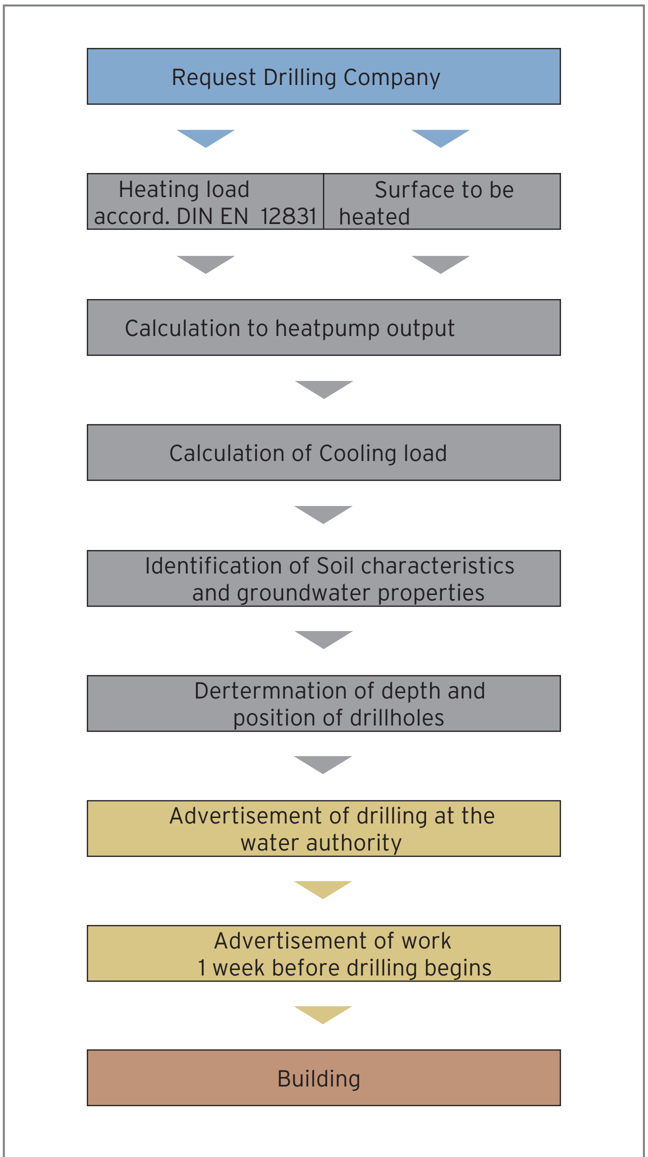


Fig. 71: Procedure for planning a ground sensor

Determining the drilling depth

In contrast to ground collectors, a deep borehole is an entirely geothermal source because, in Germany, temperatures underground are generally 8-10 °C and these are available to use as geothermal energy, and this is not influenced by the sun or rainwater.

The deep borehole can also be used for passive cooling. A different yield is produced depending on the soil class.

The heat extraction performances for the various soil classes are summarised in the following table:

Heat extraction performances for the various soil classes

Soil characteristics	Subsoil yield, heating output [m/kW]	Specific extraction performance [W/m] 1800 h/a	Specific extraction performance [W/m] 2400 h/a
Dry sediment	30	25	20
Normal waterlogged sediment	12.5	60	50
Average value, normal sediment	15	50	
Gravel, dry sand	< 30	<25	<20
Gravel, water-bearing sand	Approx. 10	65-80	55-65
Clay, moist loam	Approx. 18	35-50	30-40
In the case of a strong inflow of groundwater in gravel and sand, for individual systems		80-100	80-100
Limestone	Approx. 12	55-70	
Sandstone	Approx. 10.5	65-80	
Granite	Approx. 10	65-85	
Basalt	Approx. 16	40-65	
Gneiss	Approx. 10	70-85	

This information is based on the following requirements:
- **Clearance between two ground sensors of at least 5 m**
- Collector constructed as a double U-pipe sensor
- Maximum ground sensor depth is 100 m
- The values may fluctuate due to jointing, weathering, etc.
- Values are based on an output figure of four

Installing the sensor

The ground sensor and its flow and return must be laid in such a way that there is a clearance of at least 100 cm from water supply lines, waste-water piping and other supply lines. If supply lines cross, the collector pipe must be insulated at the point where these cross. Geothermal sensors are delivered to the construction site prefabricated and must be handled with the utmost care to avoid damaging them.

The following measures should be taken to set up the construction site:

- Access for the drilling equipment should be secured and the pivot radius should be taken into consideration. Estimated required access width for the drilling equipment: At least 1.5 m for small caterpillar vehicles. At least 2.5 m for HGV drilling equipment.
- Space required for drilling equipment, settling pond or settling basin and remaining material: At least 6 m x 5 m for small caterpillar vehicles. At least 8 m x 5 m for HGV drilling equipment.
- 400 V electrical connection
- Cold water connection
- Layout plan listing electrical lines, water pipes and waste-water piping, or other underground obstructions.

The following points must be observed during installation:

- The sensor must be inserted into the drilled hole by means of suitable devices (winch, etc.) and without the use of force.
- To tightly close the annular gap, a fill pipe must be first inserted into the drilled hole with the sensor.
- After inserting the sensor, a pressure and flow rate check must be performed.
- Before filling the drilled hole, the ends of the sensor must be sealed off with caps.

The details are subject to major variations depending on the drilling company and the drilling method and should only be used as a rough estimate.

The drilling work is ideally performed while the building shell is being constructed. For finished houses, the house may need to be protected from dirt.

Fig. 72: Tip of the sensor with 2 x flow/return

- In order to ensure that heat flows smoothly, the annular space in the drilled hole (clearance between sensor and borehole wall) must be grouted. The fill pipe can be used here to grout the drilled hole from the bottom to the top.
- A mixture of Calidatherm (cement material), blast furnace cement, sand and water has proven to be an effective filling suspension due to its good thermal conductivity. Depending on the subsoil characteristics, quartz powder, quartz sand but also fine gravel on its own or the drilling fluid can be used as additives.
- If the filling material escapes from the mouth of the drilled hole, this means that the hole has been completely filled.
- The operating pressure must be tested with a test pressure of 6 bar (test duration: 60 min, pre-loading: 30 min, maximum pressure drop: 0.2 bar).
- All circuits should be connected in parallel.

Designing near-surface ground collectors

The near-surface ground collector consists of a pipework system, which is routed in coils or in a meandering pattern over a large area 20 to 30 cm below the frost line. The pipe system is laid at a depth of around 1.3 to 1.8 m. At this depth, the prevailing average annual temperature is approx. 5 °C. This temperature depends on the time of year. As the depth increases, this temperature also increases.

The collector is ideal in particular for houses with a sufficiently large property space. The heat extraction performance depends on the soil characteristics. The damper the soil, the smaller the property space required owing to the soil having a greater energy content per m². For a single-occupancy house with a living space of 150 m² and a heating output demand of 7.5 kW, a property space of around 250 m² is required. A system with two circuits is shown here. Several circuits become necessary if the maximum brine pipe length is exceeded with only one circuit.

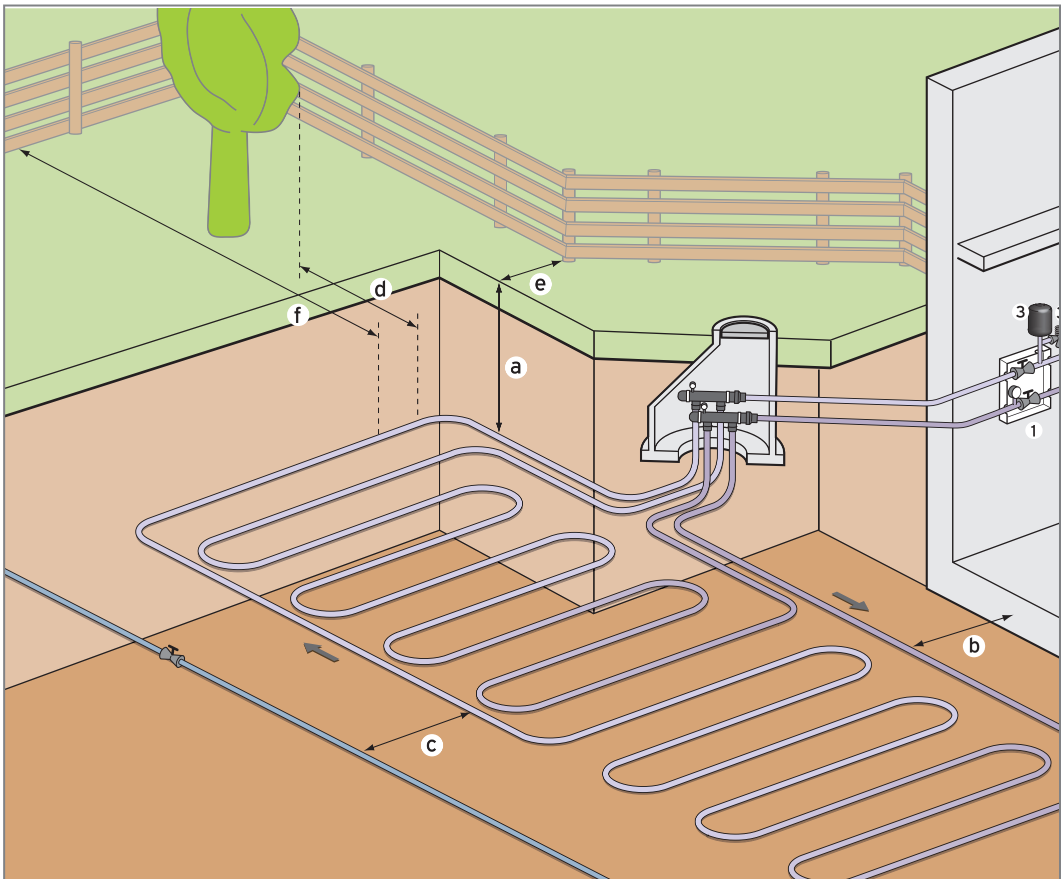


Fig. 73: Basic diagram for the near-surface ground collector

1 Brine filling unit with manometer and isolation valves
2 Temperature display
3 Brine diaphragm expansion vessel
3a Expansion relief valve
4 Air separator
a 1.3 m-1.8 m installation depth*
b 1.5 m clearance from building foundations*
c 1.5 m clearance from drinking water, wastewater and rainwater lines*
d 0.5 m clearance from the outer edge of the treetop*
e 1.0 m clearance from fence foundations and the like*
f 3.0 m clearance from the boundary of the plot of land*

* Installation depth and minimum clearances according to VDI 4640 (note regional differences). Filters and filling/draining cocks are not shown.

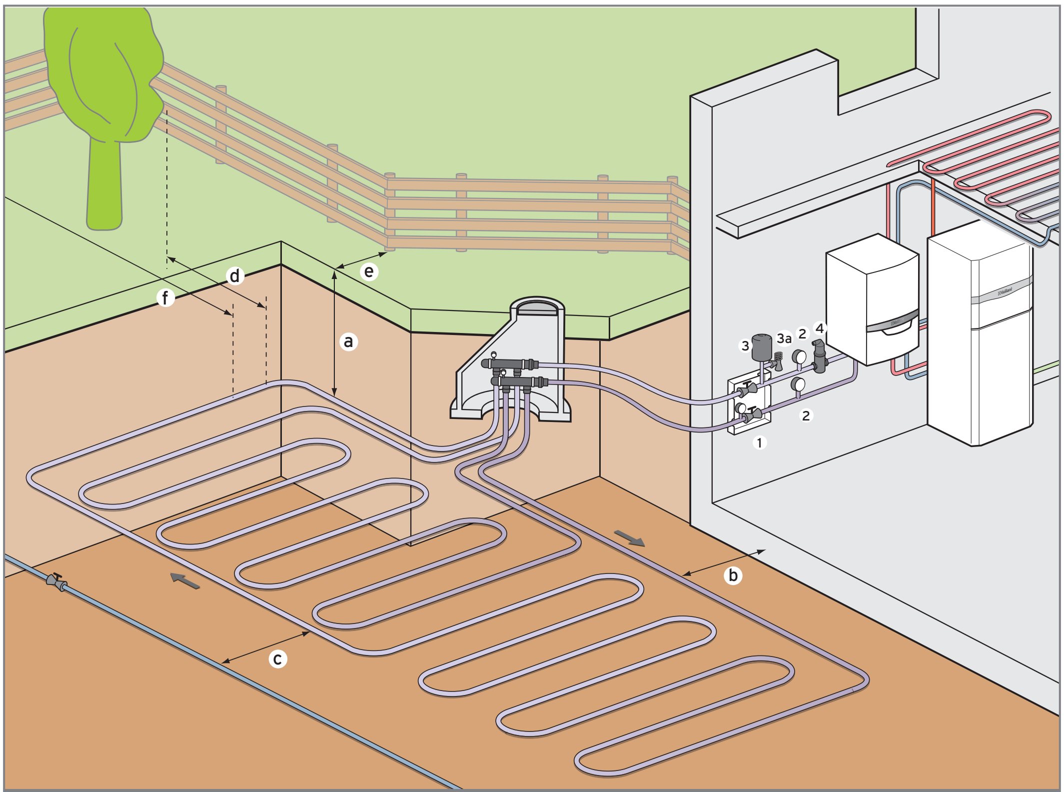


Fig. 74: geoTHERM with uniTOWER

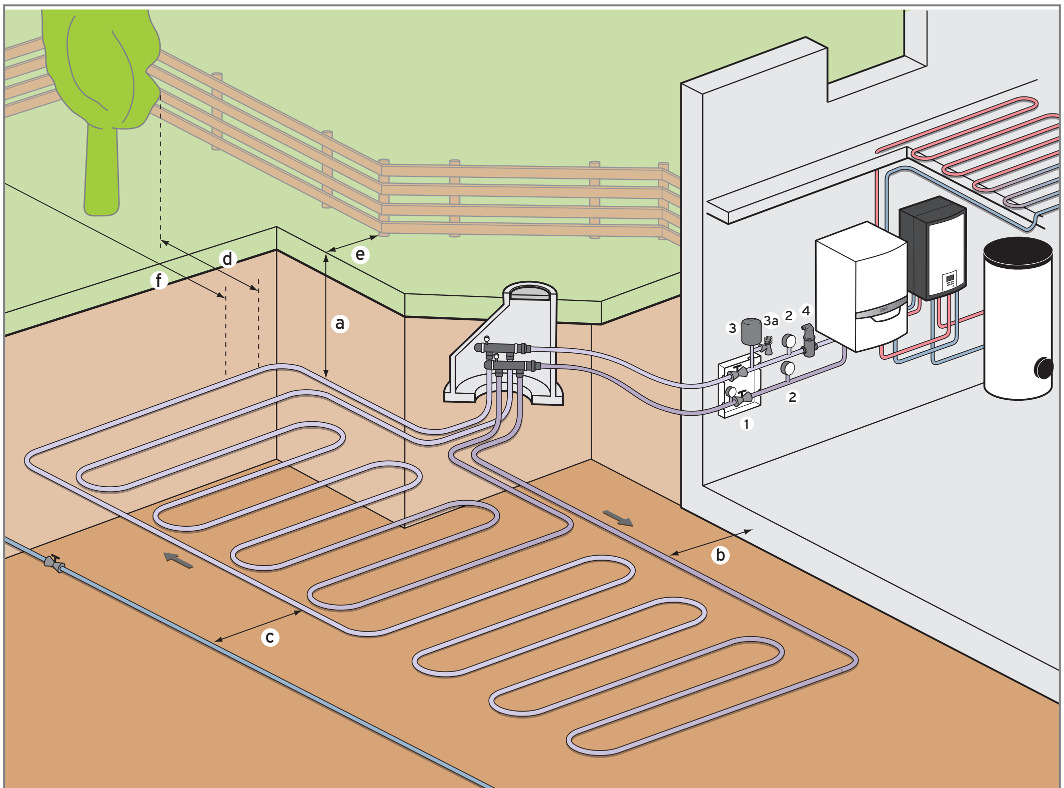


Fig. 75: geoTHERM with MEH 61

Design principles

If near-surface ground collectors are correctly dimensioned, their influence on the surrounding ground is very minor. The surrounding earth is cooled only temporarily as a result of heat pump operation. In summer, the temperatures are identical to those of the undisturbed ground (predominant influence of solar radiation and seepage water).

Excessively small dimensions for ground-coupled heat pumps with near-surface ground collector may lead to negative effects on the vegetation, which are limited to the local area. This results in a smaller seasonal performance factor β. In extreme cases, the lower heat pump application limit may be reached. A correctly dimensioned ground collector is therefore of the utmost importance for ensuring fault-free operation. When designing ground collectors, the brine pump's remaining feed head in the relevant heat pump must be taken into account.

The construction costs for the near-surface ground collector are generally cheaper than the exploitation costs for a ground sensor.
Using the near-surface ground collector when using active cooling is prohibited.

Permits
In exceptional cases, constructing and operating a heat pump with near-surface ground collector can constitute use under the law, which requires authorisation. It would then be necessary to issue a notification in accordance with the WHG (German Water Management Act) in conjunction with federal state law regulations. Work that exceeds a certain depth may be monitored by the German states. However, a notification is not generally required for constructing a ground collector.

The following water management objectives must also be observed:
- The brine fluid must comply with the requirements in VDI 4640, part 1.
- Propylene glycol (alternatively ethylene glycol) with corrosion-inhibiting additives is permitted according to the current installation instructions.
- Operation with the following brine fluids is permitted: Aqueous solution with 30% ± 5% vol. ethylene glycol, aqueous solution with 33% ± 5% vol. propylene glycol.
- Even installation of the ground collector at groundwater level may be granted approval.

Installation factor and extraction performances

Soil characteristics	Installation factor	Extraction performance
Average value: Cohesive soil with residual moisture content	25 m²/kW	30 W/m²
Dry, non-cohesive soil	75 m²/kW	10 W/m²
Cohesive soil, moist	25 m²/kW	20-30 W/m²
Waterlogged sand, gravel	20 m²/kW	40 W/m²

The information is based on the following requirements:
- 1800 annual operating hours
- Heat pump system working figure of four
- The ground collector must not be built over
- The surface above the ground collector must not be sealed
- Installed at a depth in the range of 1.3-1.8 m

Routing
- The required installation area is determined from the calculated heating output and supplements for the property, and not according to the heat pump heating output.
- If stony ground is being excavated, the collector should be placed in a sand bed to prevent it from being damaged.
- Select all circuits so that they are of equal length, or use flow limiters if they are of different lengths.
- All circuits should be connected in parallel.
- The circuit must be purged at its highest point if it is located on a slope.
- The installation clearance between the heat pump flow/return line and the distributor/collecting unit shaft should be at least 70 cm.
- Vegetation can be planted as normal, with the exception of trees that grow deep roots.
- All components must be designed to be corrosion-resistant owing to the formation of condensate and, if possible, must be installed outside the building envelope.
- The collector system must only be filled with the ready-mixed heat transfer medium.
- The circuits must be individually rinsed via an open vessel until they are completely free from bubbles (see also heat pump filling device).

Fig. 76: Near-surface ground collector before being filled in with sand

Designing compact collectors

The compact collector is a space-saving solution that is used to exploit the ground as a heat source. It consists of several collector mats, which are inserted horizontally into the ground. The individual collector mats are connected in parallel using a combined distributor/collector.

The system is laid 20 to 30 cm below the frost line at a depth of 1.3-1.8 m.

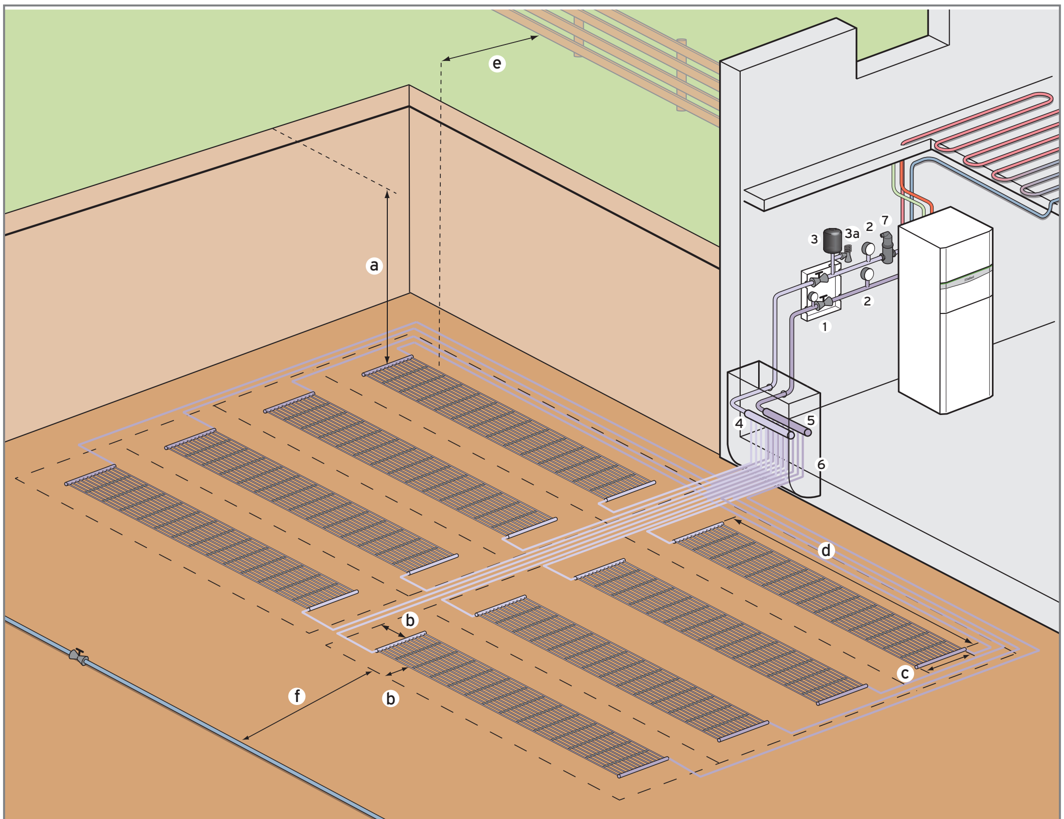


Fig. 77: Compact collector basic diagram

1 Brine filling unit with manometer and isolation valves
2 Temperature display
3 Brine diaphragm expansion vessel
3a Expansion relief valve
4 Manifold
5 Collector
6 Light well
7 Air separator
a Installation depth 20 to 30 cm below the frost line at a depth of 1.3-1.8 m*
b 0.5 m safety clearance
c Collector mat width of 1.0 m
d Collector mat length of 6.0 m
e 3.0 m clearance from the boundary of the plot of land*
f 1.5 m clearance from drinking water, wastewater and rainwater lines*

* Installation depth and minimum clearances according to VDI 4640 (note regional differences). Filters and filling and drainage taps are not shown.

Design principles

For heat pump systems with small plots of land, it is possible to use a compact collector to provide a space-saving solution. In order to enable monovalent/mono-energy mode for the heat pump here, it is necessary to install all of the system components designed by Vaillant and to do so correctly.

A compact collector has the following advantages compared to a ground collector:

- Lower space requirement (area)
- Less soil needs to be moved
- Lower costs (compared to ground sensor or ground collector)
- The user can have the installation carried out by a heating specialist company
- This technology is ideal in particular for low-energy houses (LEH) or passive houses with surface heating systems

A compact collector is unsuitable for the following applications:

- Heating the screed flooring or building to a high temperature and dry-heating the screed flooring or building (an alternative heat generator must be used for building-drying processes)
- Use in dry and/or sandy ground
- Radiator systems with a flow temperature >50 °C
- Swimming pool heating
- All high-temperature processes
- For cooling mode for the heat pumps:
- The additional heat in the collector may cause the ground to dry out.

Permits

The same statements apply to the compact collector as to the construction and operation of a ground collector.

Collector material

The material used is polypropylene random copolymer, type 3, DIN 8078:

- Length (L): 6000 mm
- Width (W): 1000 mm
- Exchange surface: 8.142 m^2
- Content: 3.84 l per mat
- Max. operating pressure: 20 bar

The compact collector is connected to the flow/return by means of socket welding.

The maximum length of the connection lines between collectors and distributors/collecting units must not exceed **200 m** for the VWZ KK 8 and **400 m** for the VWZ KK 10.

Heat transfer medium

30 l ready-mixed fluid with frost protection is required for temperatures down to -16 °C. You can find more detailed explanations in the section on the ground sensor heat transfer medium.

Selection and installation

Selecting the collector mats

The VWZ KK 8/KK 10 compact collector can be used for the VWF 57/4, VWF 87/4, VWF 58/4 and VWF 88/4 heat pumps. In the case of greater heat pump heating output, the pressure losses in the collector mats become too large.

Heat pump selection table with assigned collector sets

Heat pump type	VWF 57/4, 58/4	VWF 87/4, 88/4
Heating output (B0/W35) [kW]	5,3	8.9
Collector set	VWZ KK 8	VWZ KK 10
Distributor/collecting unit Number of outflows	1/8	1/12
Number of mats (pc)	8	12
Space requirement [m²]	115	170

Routing

A thin layer of sand must be provided beneath and above the collectors.

Information on clearances, ground conditions, connection, etc. can be found in the installation instructions.

Fig. 78: Installing the compact collector

Hydraulics

Each individual mat is connected to the distributor and must be hydraulically balanced using flow rate limiters. The supply lines from the distributor to the heat pump can be laid in PE and must have generous dimensions depending on their length. The distributor size is DA 40 at the eighth collector mat field and DA 50 at the twelfth collector mat field. The use of brine pumps with a bronze or long-lasting coating is recommended because the collector mats are not diffusion-tight.

After completing the installation work on the construction site, it is mandatory to test the pressure at 10 bar over four hours.

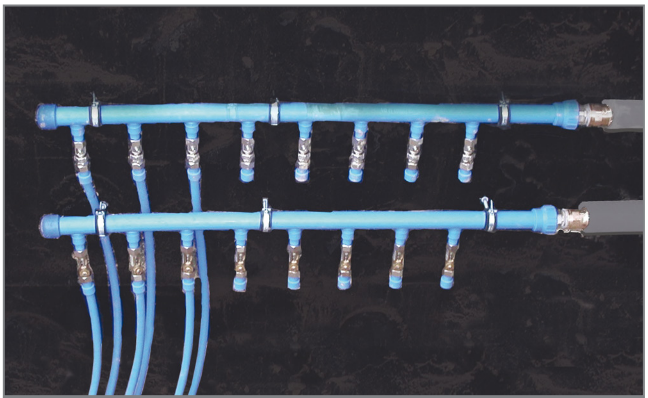


Fig. 79: Detailed view: Distributor and collecting unit

Trench collectors

A trench with a depth of 1.3-3.0 m is excavated for the trench collector. The pipelines are attached to the trench walls on top of each other. The trench is backfilled afterwards.

There are two methods for this: Excavating soil using a digger or a trencher.

The method used by the trencher is based on that for laying underground earth cables in open land. This method involves a small machine digging a small trench approximately 10 cm wide and with an appropriate depth. The pipe is laid in the trench by the machine itself. This is therefore a relatively fast method for laying pipes.

The type of collector that is used in the end depends on some parameters. If the plot of land is too small, it is clear that no ground collector can be constructed.

The trench or the deep borehole is recommended for small plots of land. The special method of laying pipes using a trencher is recommended for large plots of land. Expenses incurred by wages and the machine costs are lower.

Note
This is designed by the manufacturer.

Fig. 80: Trench collector

Fig. 81: Trencher

Geothermal pile cage

The spiral-shaped energy pile cages are inserted into the ground in a vertical borehole or in trenches at a depth of around 2 to 4 m. As is the case for a geothermal sensor or for ground collectors, the environmental heat stored in the soil is extracted from the ground.

Energy pile cages are ideal in particular for single-occupancy houses with a low output requirement (low-energy houses). They also have the advantage of being able to be installed even on small plots of land and in a time-saving manner.

Particularly for plots of land on which drilling equipment cannot be used and a ground collector cannot be used due to a lack of space, energy pile cages provide a real alternative. The risk of ground frost is also significantly lower when geothermal pile cages are installed than when alternative methods are used.

Design principles

An unsealed area of 10 m^2 per cage is required for installing geothermal pile cages. It must also be possible for diggers to access the site.

Clearance from surrounding trees, buildings and various lines must be taken into consideration. Trees with a deep root system should be avoided and the cages should not be built over. A minimum clearance of 1.5-2 m from any type of building or line generally applies.

During heating mode, a 30% glycol/water mixture circulates through the wound pipe, which is between 75 and 200 m in length and has an extraction performance of 0.7-2 kW. The heat pump brings the heat extracted from the ground during this process to heating water temperature.

Note
This is designed by the manufacturer.

Routing

The geothermal pile cages are either connected in parallel or in series. A clearance of between 5 m and 7 m must be ensured between the cages, depending on the diameter.

After being inserted, they are refilled with sand from German soil classes SC 1 to 4, without sharp-edged stones, and water. This also requires the excavated ground to be regenerated.

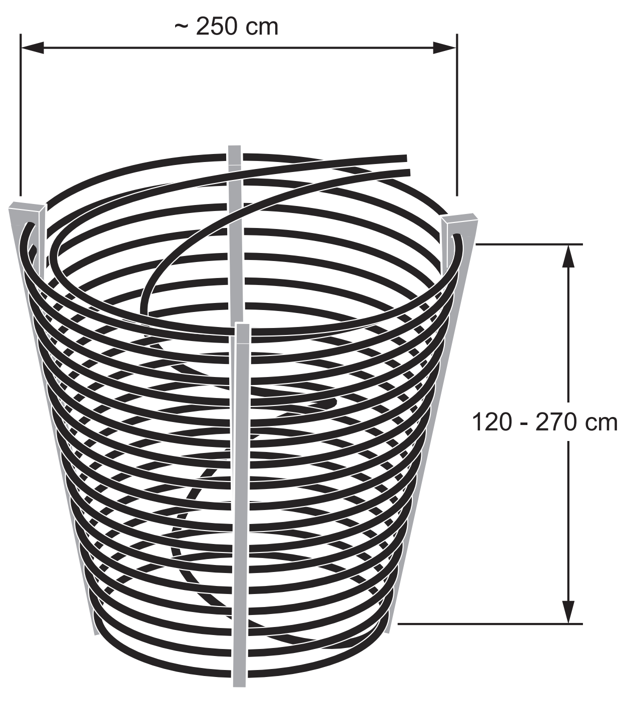


Fig. 82: Geothermal pile cage, schematic drawing

Options for connecting brine collectors/ground sensors

Brine circuits are connected exclusively via distributors/collecting units or using what is known as Tichelmann piping.

Advantages of connecting circuits to distributors/collecting units

- Circuits can be individually filled as a result of isolator devices.
- For circuits of different lengths, the flow rate can be set using flow rate limiters.

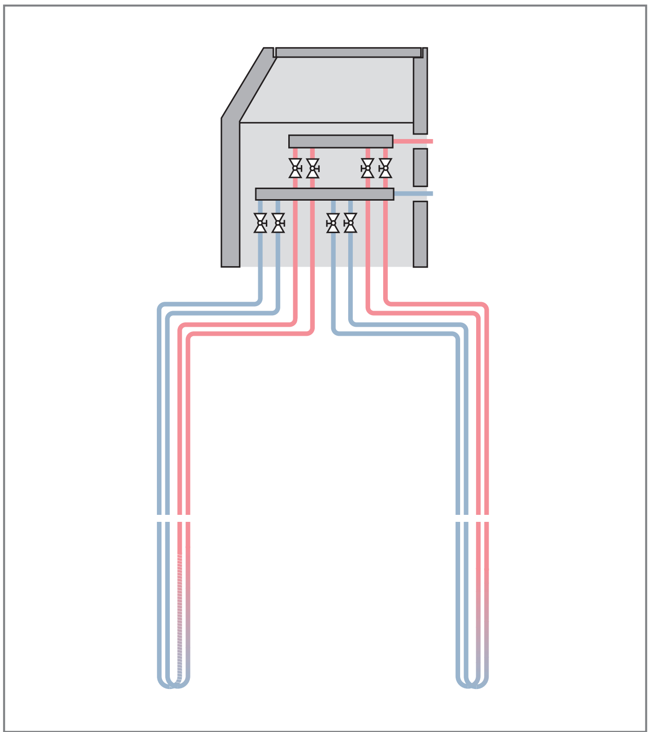


Fig. 83: Collector connection via distributors/collecting units

Advantages of connecting circuits using a Tichelmann system

- Lower costs compared to connection using distributors.
- No shaft as T-pieces/Y-pipes remain in the ground permanently.
- However, a Tichelmann connection can only be recommended for up to four circuits (two dual sensors).

Disadvantages of connecting circuits using a Tichelmann system

- Purging circuits is more difficult.
- Circuits cannot be individually blocked.

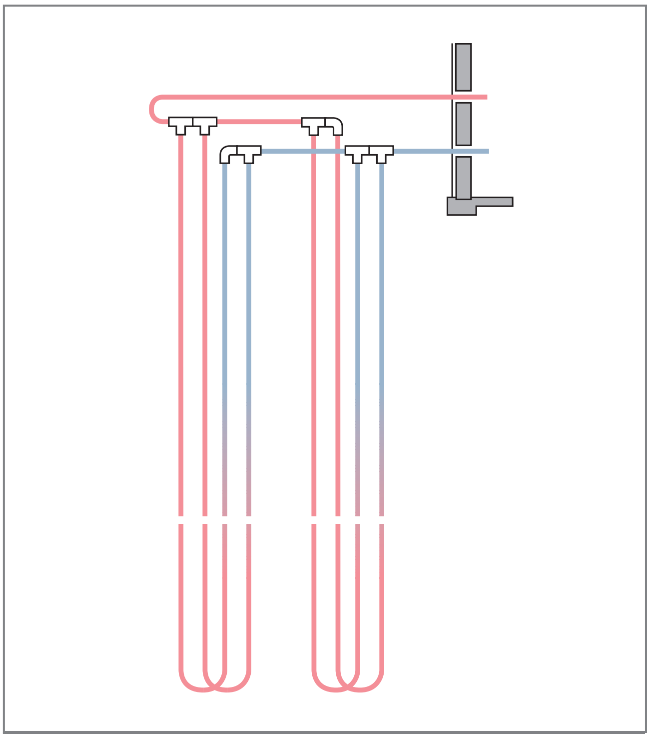


Fig. 84: Collector connection according to the Tichelmann system

Minimum pipe dimensions for the supply line from the heat pump to the manifold/collector

Heat pump type	Up to 20 m	Up to 60 m
VWS 36/4.1, VWF 57/4, 58/4	DA 32 x 2.9 mm*	DA 32 x 2.9 mm*
VWF 87/4, 88/4	DA 32 x 2.9 mm*	DA 40 x 3.7 mm*
VWF 117/4, 118/4	DA 40 x 3.7 mm*	DA 50 x 4.6 mm*
VWF 157/4	DA 40 x 3.7 mm*	DA 50 x 4.6 mm*
VWF 197/4	DA 40 x 3.7 mm*	DA 50 x 4.6 mm*
VWS 220/3	DA 50 x 4.6 mm*	DA 50 x 4.6 mm*
VWS 300/3	DA 63 x 5.8 mm*	**
VWS 380/3	DA 63 x 5.8 mm*	**
VWS 460/3	DA 75 x 6.8 mm*	**
*	PE 100, PN 16, SDR 11	
**	To be dimensioned according to the local conditions	
DA	Outer diameter	
SDR	Relationship between the outer diameter and the wall thickness	
PE 100	10 N/mm², MRS 10 performance category, minimum required strength in N/mm ²	
PN 16	Permitted operating pressure (nominal pressure in bar for an operating period of 50 years at 20 °C)	

Pressure loss calculation

If media such as liquids or gases are transported through pipelines or ducts, the friction between the medium and the adjacent surface (pipe or duct inner wall) causes friction, as a result of the roughness of the surface. It is only possible for the medium to flow once this friction has been overcome. We know this friction as pressure loss.

Digression:

100,000 Pa [pascal] = N/m^2

= 1 bar

= 1000 mbar

= 10 mWC [metres of water column]

= 10,000 mmWC

In practice, you will generally find diagrams indicating the pressure loss for various nominal diameters and flow rates per metre of pipe; this specific variable is the pressure drop „R“ and is stated in mbar/m, mmWC/m or Pa/m, depending on the volume flow.

Due to historical factors, pressure loss is usually stated in mWC because the first heating installations were open systems and the height of the water column was measured, or the height was a measurement of the fill level, as mWC directly depends on the height of the water column.

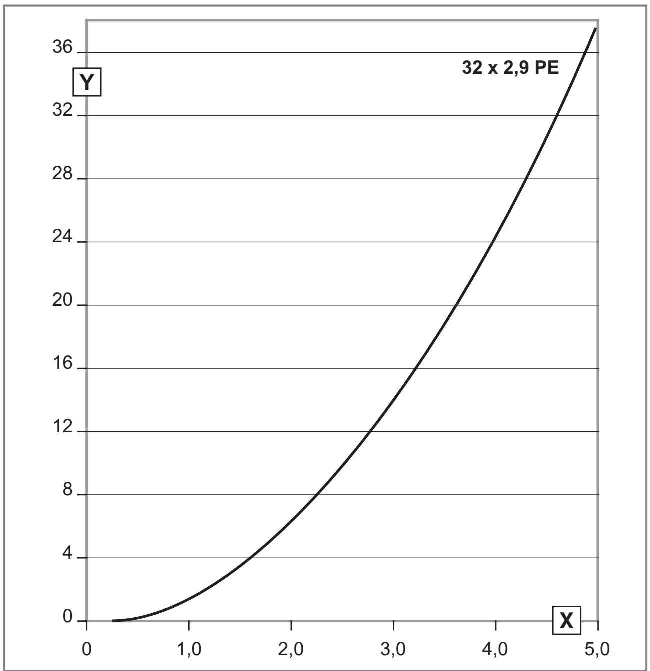


Fig. 85: Pipe friction diagram (32 x 2.9 with brine, 40% glycosol)

X Volume flow [m^3/h]
Y Pressure loss [mbar/m]

Pressure loss:

$\Delta p = ((8 * \lambda * p * l)/(\text{℗}^2 * d^5)) * V^2 = R_t * V^2$

The pressure loss depends on the square of the flow rate, R_t is a constant for the relevant pipe diameter, the fluid and the length l, 1 m in this case.

If the diameter is doubled, the pressure loss returns to $1/2^5 = 1/32$.

Where nominal pipe diameters are stated, such as 32 x 2.9, 32 refers to the outer diameter in mm and 2.9 to the wall thickness, also in mm, i.e. the internal diameter is thus 32 – (2.9 x 2) = 26.2 mm. This applies to all cases where nominal diameters are stated in this form, such as for a copper pipe, 54 x 2.0. Different information is found in countries that do not use SI units.

Note
The pipelines and the sensor must be dimensioned based on the technical data for the heat pump (take the brine pump‘s remaining feed head into account).

8.3 Heat sources for water-to-water heat pumps

Well (ground water use)

Groundwater is the heat source with the highest yield. Thanks to the temperature being constantly at 8 to 10 °C throughout the year, it can achieve the highest level of heat extraction performance when compared to all other systems and increased heat pump efficiency.

An immersion pump is used to guide the ground water via a suction well to the heat pump. This extracts heat from the ground water and then returns the cooled water to the ground water again via an injection well. Suction and injection wells are installed at a distance of approx. 15 m.

The following facts must be taken into account when installing a ground water heat pump:

- Sufficient reserves of ground water at a maximum depth of 15 m must be ensured.
- The maximum water volume that can be removed and the ground water quality are also of crucial importance.
- The ground-water temperature is important for heat pump output.
- The suction well for drawing off water must be arranged upstream of the injection well in the direction of flow of the ground water. Otherwise, there is a risk of deposits forming (iron in the ground water oxidising with oxygen from the air) that can in turn lead to the injection well becoming blocked.
- General disadvantages of this heat source are the planning complexity, the relatively high portion of auxiliary energy for the well pumps, and increased operating costs for high-power ground water pumps.

The use of ground water heat must always be authorised by the lower-level water authority (D) or water rights authority (AT).

Due to fluctuations in the ground water substances and therefore the ground water quality, water/water heat pump installations from Vaillant are only offered with brine heat pumps incl. intermediate heat exchanger.

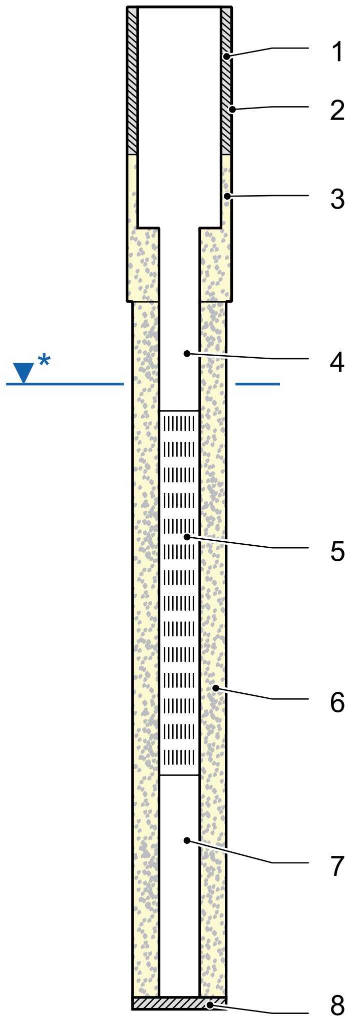


Fig. 86: Structure of a drilled hole for a well

1 Seal with drill cuttings
2 Barrier pipe (steel)
3 Seal with concrete
4 Extension pipe
5 Filter pipe
6 Filter gravel
7 Sump pipe
8 Filling

* Groundwater level

Design principles

Since using groundwater as a heat source provides the highest average temperatures, the output figure and therefore the seasonal performance factor are particularly high in comparison to other heat pump systems.

In most regions, groundwater cooling is encouraged (down to approx. 5 °C), since the groundwater temperatures are increased by cultural influences in many places.

Permits

Drawing off water and reintroducing it into the aquifer constitute use under the law according to Section 3, Art. 1 of the WHG.

The following water management objectives are taken from the WHG:

- The used water generally has to be led back into the same aquifer from which it was removed.
- Harmful contamination of the groundwater must be avoided.
- The only working agents that may be used are those not containing materials in such concentrations that can be damaging to people or the environment in the event of leakages or accidents.
- It should always be ensured that only the water that has been cooled or heated is reintroduced into the used aquifer via a second borehole (dual solution).
- If it is necessary to pass through several groundwater body horizons, it is necessary to hydraulically seal the borehole in such a way that it matches its original state.
- Drilling fluids must not be harmful to groundwater; it is possible to use only pure water.
- The original hydraulic pressure and flow system in the aquifer used should be maintained by reinjecting only the water that was cooled or heated.

Immersion pump feed head

Feed head required for the immersion pump

= Internal pressure loss WP (mWC)

+ Pressure loss in pipelines (mWC)

+ Well depth (m)

Feed head required for the immersion pump

= Internal pressure loss WP (mWC)

+ 10.2 mWC

+ 15 mWC*

* Set maximum depth of the groundwater reserves

Planning

When designing a heat pump system with groundwater as the heat source, three factors must be taken into account:

- Groundwater volume
- Maximum depth of the groundwater veins to be used
- Groundwater quality

Groundwater volume

The required groundwater volume can be calculated using the following formula:

$V_{GW} = ((Q_{th} - P_{el}) * 860)/\Delta T_{GW)}$

V_{GW} = Required groundwater volume (l/h)

Q_{th} = Heat pump heating output (kW)

Q_{el} = Heat pump power consumption (kW)

ΔT_{GW} = Selected groundwater cooling (K)

In practice, the groundwater is cooled by approximately 3 K, which corresponds to a heating output of approximately 240 l/h per kW.

Maximum depth of the groundwater veins to be used

The groundwater for single-occupancy and dual-occupancy houses should not be deeper than 15 m due to the connection power of the immersion pump. However, this must be tested on a case-by-case basis, as extracting groundwater from greater depths may be quite economical for larger properties.

Groundwater quality

The crucial phenomenon that has the greatest effect on the lifetime of a well is the formation of deposits. The phrase „formation of deposits" is understood to mean the deposition or accumulation of insoluble iron and manganese compounds. A prerequisite for the formation of deposits is the presence of iron and manganese ions in the form of compounds dissolved in the groundwater. Chemical deposits form as a result of oxygen being supplied to the groundwater, e.g. where groundwater is fed back into the seepage shaft. For this reason, the ends of the pipelines of the suction and injection wells must lie deep enough below the well-water surface to prevent the water from taking in oxygen from the air. The extracted water must be fed back to the groundwater by means of suction and injection wells, as permanent extraction of water can reduce the groundwater level in the local area and cause damage to buildings.

Corrosion is a complex process and is influenced by various factors. Direct contact between the heat pump and groundwater involves corrosion risks. These risks are essentially determined by the water composition.

Solid particles (e.g. sand) must not enter the heat pump (clogging the evaporator). A flushable fine filter (mesh width 350 µm) must be installed in the inflow to the heat pump.

Definition of hardness ranges for Germany

Hardness range	1 mmol CaCO3/l	°dH
Soft	< 1.5	< 8.4
Medium	1.5 < 2.5	8.4 < 14
Hard	> 2.5	> 14

Calculation of the country-specific water hardness degrees

	Unit	°dH	°e	°fH	ppm	mval/l	mmol/l
German degree	1 °dH	1	1,253	1,78	17,8	0,357	0,1783
English degree	1 °e	0,798	1	1,43	14.3	0,285	0,142
French degree	1 °fH	0,560	0,702	1	10	0.2	0.1
ppm $CaCO_3$ (USA)	1 ppm	0,056	0,07	0.1	1	0.02	0,01
mval/l alkaline earth ions	1 mval/l	2,8	3,51	5	50	1	0.50
mmol/l alkaline earth ions	1 mmol/l	5.6	7,02	10	100	2	1

Heat pump pressure loss

	Unit	VWF 57/4	VWF 58/4	VWF 87/4	VWF 88/4	VWF 117/4	VWF 118/4	VWF 157/4	VWF 197/4
Pressure loss of **fluoCOLLECT**	mbar	194	194	310	310	245	245	410	459
Pressure loss for pipelines/fittings [1]	mbar	350	350	350	350	350	350	350	350
Pressure loss for wells [2]	mbar	1500	1500	1500	1500	1500	1500	1500	1500
Feed head required for the immersion pump	mbar	2050	2050	2160	2160	2095	2095	2260	2310
Nominal volume flow of the heat source circuit	l/h	1290	1290	2320	2320	3000	3000	3590	4800
Lowara GS ... ground water pumps	–	2 GS 4"	2 GS 4"	4 GS 4"	4 GS 4"	4 GS 4"	4 GS 4"	4 GS 4"	6 GS 4"
Grundfos SP ... ground water pumps	–	3A-6	3A-6	2A-18	2A-18	5A-6	5A-6	5A-8	5A-12
Wilo TWI ... ground water pumps	–	4.03-06-B	4.03-06-B	4.03-09-B	4.03-09-B	4.03-09-B	4.03-09-B	4.05-08-B	4.09-07-B
KSB UPA ... ground water pumps	–	100 C 2-8	100 C 2-8	100 C 3-9	100 C 3-9	100 C 4-7	100 C 4-7	100 C 4-9	100 C 7-9

Assumptions for designing immersion pumps:
1) Pressure loss in the filter/pipelines/fittings: 35 kPa = 3.5 m WS
2) Groundwater level depth, max. 15 mm WS = metres of water column (1 kPa = 10 mbar = 102 mm WS)

AlfaNova pressure loss

	Unit	VWS 220/3	VWS 300/3	VWS 380/3	VWS 460/3
		With intermediate heat exchanger			
AlfaNova pressure loss	mbar	19	19	20	20
Pressure loss for pipelines/fittings [1]	mbar	350	350	350	350
Pressure loss for wells [2]	mbar	1500	1500	1500	1500
Feed head required for the immersion pump	mbar	1870	1870	1870	1870
Nominal flow of the heat source circuit	l/h	6417	8760	10800	13080
Lowara GS groundwater pumps...	–	6 GS 4"	8 GS 4"	12 GS 4"	12 GS 4"
Grundfos SP groundwater pumps...	–	8A-7	8A-10	14A-7	14A-7
Wilo TWI groundwater pumps...	–	4.09-07-B	4.09-12-B	4.12-07-B	4.14-10-E3
KSB UPA groundwater pumps...	–	100 C 7-9	100 C 12-8	100 C 12-8	100 C 12-10

Assumptions for designing immersion pumps:
[1] Pressure loss in the filter/pipelines/fittings: 35 kPa = 3.5 m WS
[2] Groundwater level depth, max. 15 mm WS = metres of water column (1 kPa = 10 mbar = 102 mm WS)

Designing the immersion pumps from Xylem (Lowara)

DHW heat pump	Minimum intermediate heat exchanger throughput (m³/h)	Minimum intermediate heat exchanger pressure loss (mWs)	Geodetic height (mWs), well depth (water level > well head)	Pipeline pressure loss (mWs) assumed, incl. pipe guiding to the heating room ceiling 1.5 m	Total pressure loss (mWs)	Xylem immersion pumps
VWF 57/4	1.45	1.1	10	3.5	14.6	2 GS 02 T - F032 0.25 kW
	1.45	1.1	15	3.5	19.6	2 GS 02 T - F032 0.25 kW
	1.45	1.1	20	3.5	24.6	2 GS 02 FT 0.37 kW
VWF 58/4	1.45	1.1	10	3.5	14.6	2 GS 02 T - F032 0.25 kW
	1.45	1.1	15	3.5	19.6	2 GS 02 T - F032 0.25 kW
	1.45	1.1	20	3.5	24.6	2 GS 02 FT 0.37 kW
VWF 87/4	2.24	2.3	10	3.5	15.8	2 GS 02 FT 0.37 kW
	2.24	2.3	15	3.5	20.8	2 GS 02 FT 0.37 kW
	2.24	2.3	20	3.5	25.8	2 GS 03 FT 0.37 kW
VWF 88/4	2.24	2.3	10	3.5	15.8	2 GS 02 FT 0.37 kW
	2.24	2.3	15	3.5	20.8	2 GS 02 FT 0.37 kW
	2.24	2.3	20	3.5	25.8	2 GS 03 FT 0.37 kW
VWF 117/4	3.52	5.2	10	3.5	18.7	4 GS 03 FT 0.37 kW
	3.52	5.2	15	3.5	23.7	4 GS 05 T 0.55 kW
	3.52	5.2	20	3.5	28.7	4 GS 05 T 0.55 kW
VWF 118/4	3.52	5.2	10	3.5	18.7	4 GS 03 FT 0.37 kW
	3.52	5.2	15	3.5	23.7	4 GS 05 T 0.55 kW
	3.52	5.2	20	3.5	28.7	4 GS 05 T 0.55 kW
VWF 157/4	4.54	2.7	10	3.5	16.2	4 GS 05 T 0.55 kW
	4.54	2.7	15	3.5	21.2	4 GS 05 T 0.55 kW
	4.54	2.7	20	3.5	26.2	4 GS 07 T 0.55 kW
VWF 197/4	5.48	3.6	10	3.5	17.1	6 GS 05 T 0.55 kW
	5.48	3.6	15	3.5	22.1	6 GS 05 T 0.55 kW
	5.48	3.6	20	3.5	27.1	6 GS 07 T 0.75 kW
VWS 220/3	6.417	2.0	10	3.5	15.5	6 GS 05 T 0.55 kW
	6.417	2.0	15	3.5	20.5	6 GS 07 T 0.75 kW
	6.417	2.0	20	3.5	25.5	6 GS 07 T 0.75 kW
VWS 300/3	8.76	2.0	10	3.5	15.5	8 GS 07 T 0.75 kW
	8.76	2.0	15	3.5	20.5	8 GS 11 T 1.10 kW
	8.76	2.0	20	3.5	25.5	8 GS 11 T 1.10 kW
VWS 380/3	10.8	2.0	10	3.5	15.5	12 GS 11 T 1.10 kW
	10.8	2.0	15	3.5	20.5	12 GS 11 T 1.10 kW
	10.8	2.0	20	3.5	25.5	12 GS 15 T 1.50 kW
VWS 460/3	13.08	2.0	10	3.5	15.5	16 GS 15 T 1.5 kW
	13.08	2.0	15	3.5	20.5	16 GS 15 T 1.5 kW
	13.08	2.0	20	3.5	25.5	16 GS 15 T 1.5 kW

Designing the immersion pumps from Wilo

DHW heat pump	Minimum intermediate heat exchanger throughput (m^3/h)	Minimum intermediate heat exchanger pressure loss (mWs)	Geodetic height (mWs), well depth (water level > well head)	Pipeline pressure loss (mWs) assumed, incl. pipe guiding to the heating room ceiling 1.5 m	Total pressure loss (mWs)	Wilo immersion pumps
VWF 57/4	1.45	1.1	10	3.5	14.6	TWU 4-0203-CI-QC-DM-GT
	1.45	1.1	15	3.5	19.6	TWU 4-0204-CI-QC-DM-GT
	1.45	1.1	20	3.5	24.6	TWU 4-0207-C-QC-DM
VWF 58/4	1.45	1.1	10	3.5	14.6	TWU 4-0203-CI-QC-DM-GT
	1.45	1.1	15	3.5	19.6	TWU 4-0204-CI-QC-DM-GT
	1.45	1.1	20	3.5	24.6	TWU 4-0207-C-QC-DM
VWF 87/4	2.24	2.3	10	3.5	15.8	TWU 4-0204-CI-QC-DM-GT
	2.24	2.3	15	3.5	20.8	TWU 4-0405-CI-QC-DM-GT
	2.24	2.3	20	3.5	25.8	TWU 4-0405-CI-QC-DM-GT
VWF 88/4	2.24	2.3	10	3.5	15.8	TWU 4-0204-CI-QC-DM-GT
	2.24	2.3	15	3.5	20.8	TWU 4-0405-CI-QC-DM-GT
	2.24	2.3	20	3.5	25.8	TWU 4-0405-CI-QC-DM-GT
VWF 117/4	3.5	5.2	10	3.5	18.7	TWU 4-0405-CI-QC-DM-GT
	3.5	5.2	15	3.5	23.7	TWU 4-0407-C-QC-DM
	3.5	5.2	20	3.5	28.7	TWU 4-0407-C-QC-DM
VWF 118/4	3.5	5.2	10	3.5	18.7	TWU 4-0405-CI-QC-DM-GT
	3.5	5.2	15	3.5	23.7	TWU 4-0407-C-QC-DM
	3.5	5.2	20	3.5	28.7	TWU 4-0407-C-QC-DM
VWF 157/4	4.54	2.7	10	3.5	16.2	TWU 4-0407-C-QC-DM
	5.54	2.7	15	3.5	21.2	TWU 4-0407-C-QC-DM
	5.54	2.7	20	3.5	26.2	TWU 4-0409-C-QC-DM
VWF 197/4	5.48	3.6	10	3.5	17.1	TWI 4.05-06-CI-QC-DM
	5.48	3.6	15	3.5	22.1	TWI 4.05-08-CI-QC-DM
	5.48	3.6	20	3.5	27.1	TWI 4.05-08-CI-QC-DM
VWS 220/3	6.417	2.0	10	3.5	15.5	TWI 4.09-05-CI-QC-DM
	6.417	2.0	15	3.5	20.5	TWI 4.09-05-CI-QC-DM
	6.417	2.0	20	3.5	25.5	TWI 4.09-07-CI-QC-DM
VWS 300/3	8.76	2.0	10	3.5	15.5	TWI 4.09-05-CI-QC-DM
	8.76	2.0	15	3.5	20.5	TWI 4.09-07-CI-QC-DM
	8.76	2.0	20	3.5	25.5	TWI 4.09-07-CI-QC-DM
VWS 380/3	10.8	2.0	10	3.5	15.5	TWI 6.18-02-CI-DM
	10.8	2.0	15	3.5	20.5	TWI 6.18-04-CI-DM
	10.8	2.0	20	3.5	25.5	TWI 6.18-04-CI-DM
VWS 460/3	13.08	2.0	10	3.5	15.5	TWI 6.18-02-CI-DM
	13.08	2.0	15	3.5	20.5	TWI 6.18-04-CI-DM
	13.08	2.0	20	3.5	25.5	TWI 6.18-04-CI-DM

Heat pump system with ground water well system and intermediate heat exchanger

If the ground water contains substances in such a concentration that they corrode/form sludge on the heat pump intermediate heat exchanger, a heat exchanger can be installed between the ground water well system and the heat pump. In the event of damage, the heat exchanger can be easily removed in order to be cleaned without it being necessary to interfere with the heat pump refrigeration circuit. The **fluoCOLLECT** was designed for this. The drop of 3 K (temperature loss via the intermediate heat exchanger) compared to a brine-to-water heat pump can be disregarded due to the high ground-water temperature. Suction and injection wells are installed at a distance of approx. 15 m. The suction well for drawing off water must be arranged upstream of the injection well in the direction of flow of the ground water.

When water from lakes and ponds is used, an intermediate circuit must normally be included.

The intermediate circuit must be filled with brine antifreeze (30% mixture).

Note
With the flexoTHERM, adjustment is guaranteed by selecting the heat source in the installation assistant. This setting is queried.
The frost protection setting on the geoTHERM must be changed from -10 °C to + 4 °C.

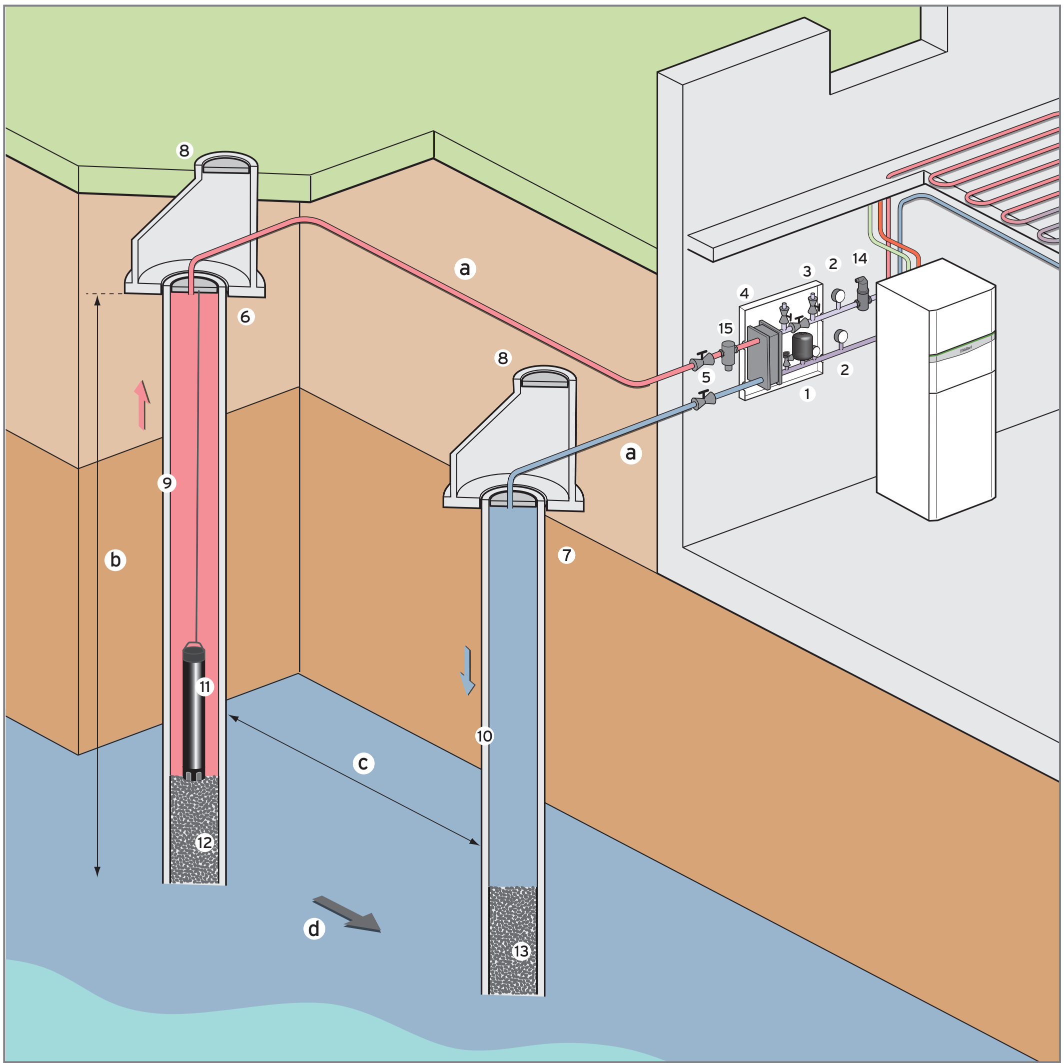


Fig. 87: Basic diagram: Heat pump installation with ground-water well system and intermediate heat exchanger

1 Brine filling unit with manometer and isolation valves
2 Temperature display
3 Brine expansion tank with expansion relief valve
4 Intermediate heat exchanger for isolating the ground-water well system and the heat pump from one another
5 Isolation valves
6 Suction well
7 Injection well
8 Cover with air vent; small animals and surface water must be prevented from entering the well
9 Feed pipe
10 Downpipe, air-tight and corrosion-proof, inserted into the water table
11 Immersion pump
12 Filter pipe filled with gravel
13 Filter pipe
14 Air separator
a Laying the lines with a downward gradient towards the well at a frost-free depth of approximately 1.0 to 1.5 m
b Maximum depth of the ground water should not exceed 15 m
c Well clearance should be at least 15 m
d Groundwater flow direction from the suction well to the injection well

Filters and filling/draining cocks are not shown.

Note
To set the required water volume, we strongly recommend that you install a flow regulator valve and/or a flow rate measuring device at the well head or downstream of the heat pump. If the pressure losses are too low, this drastically reduces the pump's service life. We also recommend that you route the pipe downstream of the heat pump to the ceiling first and, only after doing this, to the injection well (air may collect here).

System diagram for pump circuit

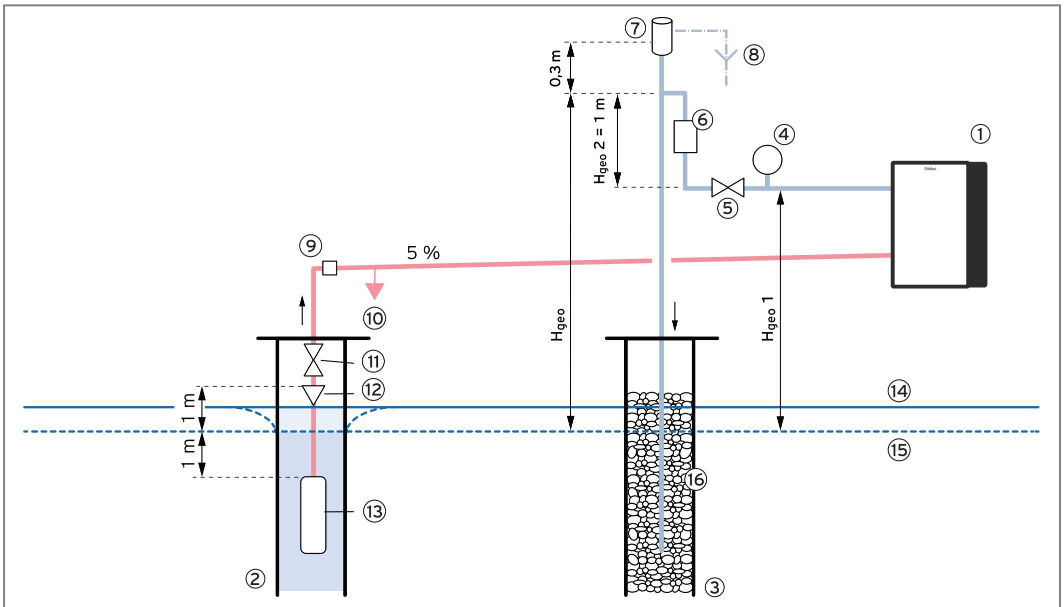


Fig. 88: Basic installation diagram for pump circuit

1 fluoCOLLECT ground water module
2 Non-return well
3 Injection well/seepage shaft
4 Manometer
5 Flow regulator valve
6 Flow rate display (water meter)
7 Ventilation valve
8 Drain in the duct
9 Filter (can be back-flushed)
10 Draining
11 Isolation valve
12 Non-return valve
13 Immersion pump
14 Static water level
15 Dynamic water level
16 Stone filling

Description of the components

- Install the pump in the non-return well so that it is hanging freely on a load-bearing rising pipe
- Water level coverage – stable, dynamic water level at maximum pump output, at least 1 m above the pump
- Inflow of the pump or the motor must occur from below in order to guarantee that the motor is cooled sufficiently, i.e. install the pump above the filter line
- Required minimum flow speed along the motor casing is 0.2 m/s. If this is not achieved when there is a large well diameter, a suitable cooling jacket must be provided
- Design the clearance to the well floor so that it is sufficiently large (at least 0.5-1 m) that no deposited sediment or sludge can be sucked in
- Install the non-return valve 1 m above the dynamic water level (spring-loaded version so that it is leak-tight when the cover height is low)
- Optional restrictor valve. If the excess feed head is more than 4-5 m, it is recommended that you use a stop valve in the non-return well in order to keep the restriction at the flow limiter in the utility room low and therefore prevent disruptive noise emissions in the building
- Keep the horizontal pipeline from the rising pipe to the heat pump's heat exchanger as short as possible and route it so that it rises to the heat pump – min. 5%. The flow speed must be at least 1 m/s so that air cannot settle and collect in the horizontal pipeline. Provide draining.
- A (heat exchanger and) pressure gauge is provided at the heat pump's outlet
- To set and limit the flow rate and to maintain the required minimum pressure, a flow limiter must also be provided. Use high-quality flow limiters; dimensioning within the recommended working area of the relevant valve. Normal stop valves (Y-type valves) or ball valves are not suitable – excessive noise emissions. If the required restriction is over 4-5 m, provide a pre-restriction in the non-return well
- Downstream of the flow limiter, guide the line at least 1 m vertically upwards and integrate it into the return line to the injection well (seepage shaft). According to the water rights authority, the return line should be routed up to the height of immersion pump
- We recommend providing a flow rate display in the vertical line
- Attach the ventilation valve (min. 1") approx. 0.3 m above the junction to the return line
- Guide the air-side connection for the ventilation valve's drain to the duct above the tundish

The ventilation valve prevents the build-up of negative pressure (vacuum) in the return line thanks to the siphoning effect. This is essential in order to prevent the feed head from being too low during operation and therefore prevent the maximum volume from being exceeded and, as a result, prevent damage to the pump.

Requirements for the well-water quality

If you want to use the **VWF 57/4** heat pump with a well-water circuit, install an intermediate heat exchanger for this, e.g. the **fluoCOLLECT VWW 1 1/4 SI**.

A flow rate monitor must be installed in the well-water circuit. The flow rate monitor monitors the water flow in the well-water circuit and must be provided on-site. The flow rate monitor must be installed in the flow direction that is marked on the flow rate monitor.

If you want to use a heat pump as the water/water heat pump, a water analysis must be carried out – irrespective of the legal requirements – in accordance with the following table for evaluating the quality of the well water, and you must decide whether the well water can be used as a heat source. The table is to be used as a guide and does not claim to be complete.

For the **flexoTHERM** and **flexoCOMPACT** heat pumps, a **fluoCOLLECT** ground water module or a heat exchanger that is provided on-site must always be used.

As limit values, the values for nickel prevail because the ground water module contains a nickel-soldered stainless steel plate heat exchanger. If the property „–" (unsuitable) appears in the „Nickel" column or if the property „O" appears twice, operation is not permitted.

Groundwater quality limit values

Water components	Concentration in mg/l	Nickel
Iron, dissolved Fe **	<0.2 >0.2	● –**
Manganese, dissolved Mn **	<0.1 >0.1	● –**
Aluminium, dissolved Al	<0.2 >0.2	● ●
Hydrogen sulphide H_2S	<0.05 >0.05	● –
Sulphite SO_3	<1	●
Ammonia NH_3	<2 2 - 20	● ●
Carbonic acid, free, aggressive CO_2	<5 5 - 20 >20	● ● ●
Oxygen O_2	<2 >2	● ●
Sulphate $[SO_3]^{2-}$	<70 70 - 300 >300	● ● –
Hydrogen carbonate HCO_3^-	<70 70 - 300 >300	● ● ●
Chloride Cl^-	<300 >300	● ○
Nitrate, dissolved NO_3	<100 >100	● ●

Water properties

Water properties ***	Quality	Clear, colourless
Total water hardness	4.0-8.5 °dH (0.72-1.52 mol/m³)	●
pH value	<6.0 6.0 - 7.5 7.5 - 9.0 >9.0	○ ○/● ● ●
Electrical conductivity (at 20 °C)	<10 µS/cm 10-500 µS/cm >500 µS/cm	● ● –

● = Resistance normally good

○ = Risk of corrosion; if several criteria are rated with ○: critical

– = Unsuitable

**) To prevent the formation of deposits, especially in the injection well, a limit value of < 0.2 mg/litre for iron (Fe) and < 0.1 mg/litre for manganese (Mn) must be observed.

***) Cloudiness or settleable substances must not be present in the ground water, irrespective of the statutory regulations. Extremely fine dirt particles that lead to clouding of the water also cannot be eliminated by filters. They may therefore accumulate in the intermediate heat exchanger and adversely affect the heat transfer performance.

8.4 Heat sources for air-to-water heat pumps

Designing air collectors

Outside air requires the least effort to exploit as a heat source.

The air/water heat pump uses the outside air warmed by the sun. Air is available everywhere in unrestricted quantities. Ambient air is subject to high temperature fluctuations depending on the time of the year.

The temperature of this heat source is very low in winter – i.e. at times when the heat demand is at its highest – which makes the air/water heat pump slightly less efficient than the ground-coupled systems.

Design principles

An air/water heat pump can still generate heating heat at an outside air temperature of down to -20 °C. However, even with an optimised design, the heat demand for heating the building is not completely met at extremely low outside air temperatures. An electric back-up heater switches on automatically once the bivalence point is reached.

With the new heat pump compressor, the heat pump is optimally designed for low heat source temperatures – this ensures a high seasonal performance factor SPF.

Permits

A permit is not required for air-to-water heat pumps, but they are subject to registration. However, directives, particularly those concerning sound, must be taken into consideration. One important point to consider during the planning process is the noise that is made by the fans. In this case, during planning, you must take into consideration a suitable installation site and the distances to buildings. Furthermore, the large temperature fluctuations in the heat source (outdoor air) must be taken into account when designing the heat pump.

Building standards must be taken into consideration, e.g. installing heat pumps on garages when there are buildings close by.

The major advantage of air-to-water heat pumps is, firstly, the low investment costs and, secondly, the possibility for the responsible heating specialist company to exploit air as the sole heat source.

It is also possible to use the air-to-water heat pump to renovate old heating installations without any problems. However, the maximum system temperature of heat pump installations must be complied with (approximately 65 °C for **flexoTHERM** or 55 °C for **aroTHERM**).

Thanks to the low space requirement of the indoor units, old heat generators can be easily replaced.

The noise emitted is reduced to a technical minimum and this effect is amplified by adjusting the fan speed according to requirements depending on the required heat pump output in each case.

In contrast to split refrigerant systems, only the brine, but not the refrigerant itself, is fed to the (split) outdoor unit. There is therefore no risk of the lines freezing and no negative influence on the refrigeration process as a result of the pressure loss in the refrigerant pipes, which depends on their length. Furthermore, no heat losses are generated outside the building.

Information on flexoTHERM

The **flexoTHERM** air/water heat pump consists of an inner unit with integrated refrigeration circuit and an outer unit (aroCOLLECT), which absorbs the environmental heat (air).

Thanks to the heat pump being installed inside, service work is easier to carry out, the heat pump is protected against the effects of the weather, and this protects the pump from frost damage even in the event of a power cut.

The distance between the inner and outer unit can be up to 30 m. The outer unit can therefore be installed in a wide variety of ways.

An intermediate brine circuit is used to guide the environmental heat to the evaporator of the refrigeration circuit.

If lines are laid under built-on surfaces (buildings, terraces, paths, etc.), they need to be insulated in order to prevent possible frost heaving, and this insulation needs to be suitable for average temperatures of down to -28 °C.

PE lines can also be laid above-ground. In this case, diffusion-tight insulation is recommended to avoid condensed water (formation of smooth surfaces on paths, terraces, etc.) and to provide UV protection.

It must also be noted that frost may form where the outer unit blows out at outside temperatures of < 5 °C, thereby causing a slip hazard on paths.

Depending on the output range, the air/water heat pump comprises one inner unit and
- one outer unit (up to 10 kW)
- or
- two outer units (15/19 kW).

Calculating the required volume of brine fluid

Use the information in the following table to calculate the required volume of brine fluid.

Plan an allowance of 10 l for the calculated volume in order to facilitate the rinsing process.

Label the vessel for the remaining volume with information about the type and concentration of brine fluid and, after start-up, pass the vessel on to the end user so that they have brine fluid available for when the tank needs to be topped up.

Brine fluid volume for product types

Brine fluid volume in the product in litres (± 1 litre)		Total
VWF 5x/4 + VWL 11/4 SA	2.5 + 19	21.5
VWF 57/4 S1 + VWL 11/4 SA	2.5 + 19	21.5
VWF 8x/4 + VWL 11/4 SA	3.1 + 19	22.1
VWF 87/4 S1 + VWL 11/4 SA	3.1 + 19	22.1
VWF 11x/4 + VWL 11/4 SA	3.6 + 19	22.6
VWF 117/4 S1 + VWL 11/4 SA	3.6 + 19	22.6
VWF 157/4 + 2x VWL 11/4 SA	4.5 + 2 x 19	42.5
VWF 157/4 S1 + 2x VWL 11/4 SA	4.5 + 2 x 19	42.5
VWF 197/4 + 2x VWL 11/4 SA	5.3 + 2 x 19	43.3
VWF 197/4 S1 + 2x VWL 11/4 SA	5.3 + 2 x 19	43.3

Brine fluid volume for pipe types

Pipe type	Brine fluid volume per running metre in litres
DN 40	0,8
DN 50	1,26

Example

VWF 197/4 with **VWL 11/4 SA** and 60 m DN 50 PE pipe provides the following total content in litres:

5.3 + 2 x 19 + 60 x 1.26 + 10 (reserve) = 129 l.

flexoCOMPACT up to 11 kW, one aroCOLLECT outdoor unit

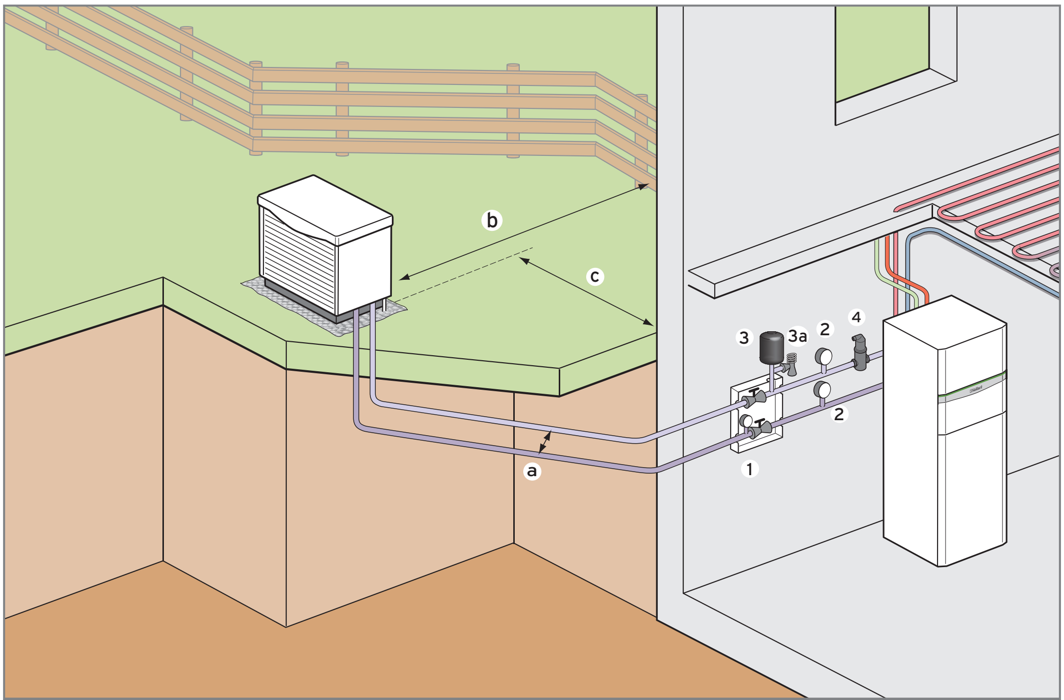


Fig. 89: flexoCOMPACT, 5 to 11 kW

1 Brine filling unit with manometer
2 Temperature display
3 Brine diaphragm expansion vessel
3a Expansion relief valve
4 Air separator
a Clearance between pipes: Min. 0.7 m (in the ground)
b Clearance between the outdoor units and the boundary of the plot of land: Min. 0.5 m, or observe communal regulations. **Note: Three-metre boundary; depends on the relevant federal state.**
c Clearance between the outdoor units and the building: Approx. 0.5 m

The brine line is routed at a depth of ≥0.8 m.

flexoTHERM 157 to 197, two aroCOLLECT outdoor units

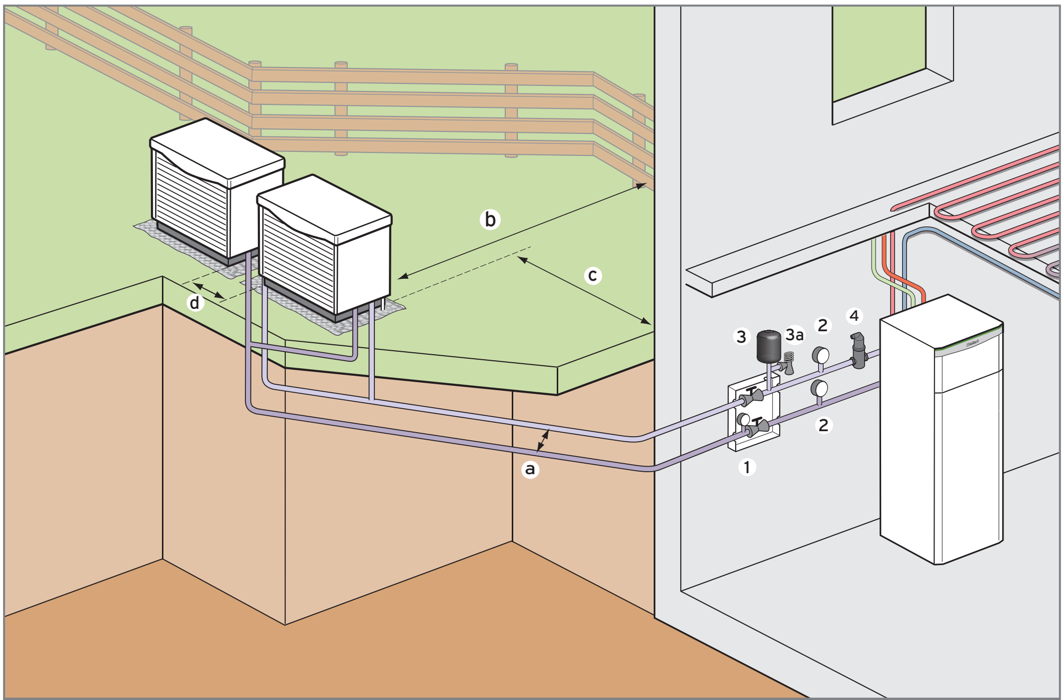


Fig. 90: flexoTHERM, 15 to 19 kW

1 Brine filling unit with manometer
2 Temperature display
3 Brine diaphragm expansion vessel
3a Expansion relief valve
4 Air separator
a Clearance between pipes: Min. 0.7 m (in the ground)
b Clearance between the outdoor units and the boundary of the plot of land: Min. 0.5 m, or observe communal regulations. **Note: Three-metre boundary; depends on the relevant federal state.**
c Clearance between the outdoor units and the building: Approx. 0.5 m
d Clearance between outdoor units: 0.5-5.0 m

The brine line is routed at a depth of ≥ 0.8 m.

Note

The minimum clearance between two outdoor units must be >500 mm. However, to allow better access, the clearance should be ≥1000 mm. The unit is not permitted to blow out towards the wall or in the direction of the second outdoor unit.

Minimum clearances

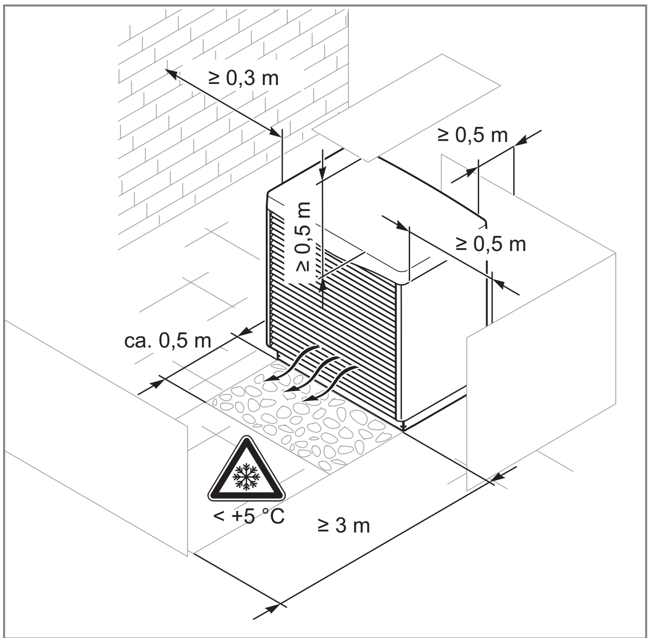


Fig. 91: Minimum clearances for one air/brine collector

Clearances that must be complied with for an air/brine collector

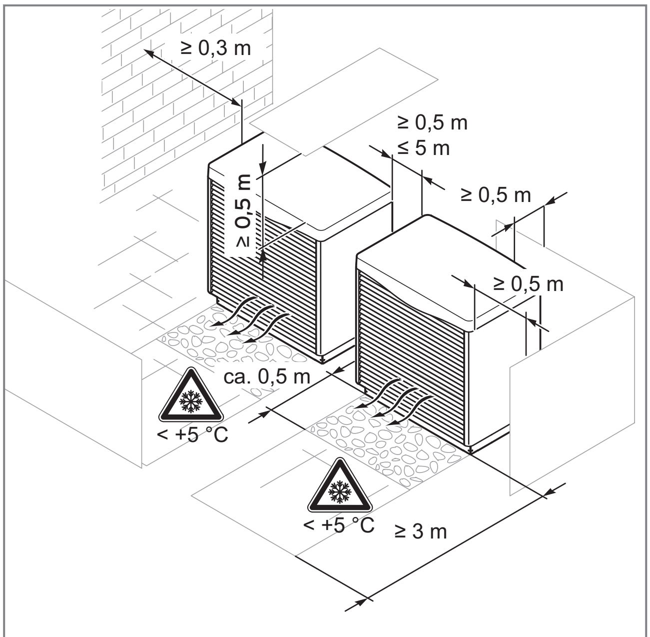


Fig. 92: Minimum clearances for two air/brine collectors

Clearances that must be complied with for two air/brine collectors

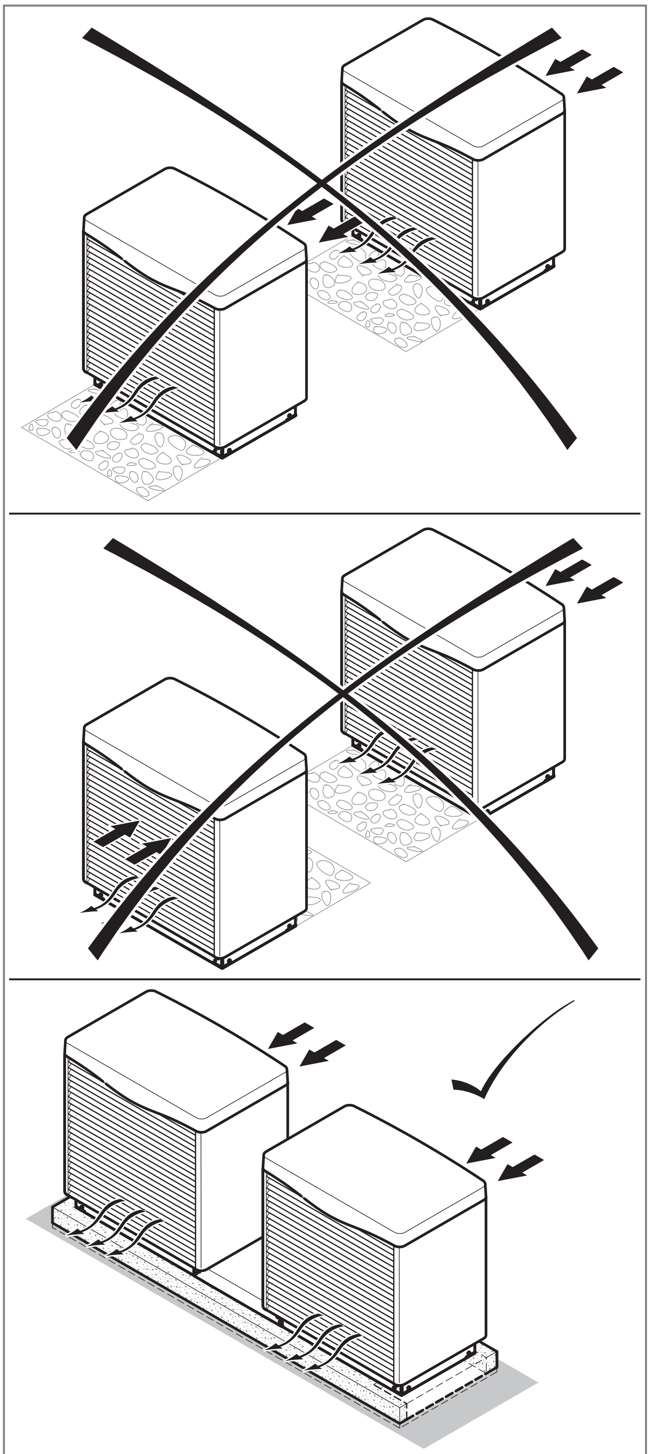


Fig. 93: Positioning

Positioning of the collectors

Use the mounting base, which is available as an accessory, for the installation.

To guarantee sufficient air flow and to facilitate maintenance work, observe the minimum clearances that are specified above.

Ensure that there is sufficient room to install the hydraulic lines.

If the product is to be installed in areas where heavy snow falls, ensure that the snow does not accumulate around the product and that the minimum clearances specified above are observed. If you cannot ensure this, install an additional heat generator in the heating circuit. An elevating base and condensate tray heating are available as accessories.

If you install two air/brine collectors, you must create a concrete foundation and use the connection pipe set that is available as an accessory.

Information on aroTHERM

The **aroTHERM** air/water heat pump is a compact and space-saving monoblock-type air/water heat pump which incorporates the entire technology in the outdoor unit. The heat pump is installed outdoors.

There are various modules available from the accessories range to cover peak demand during periods of extreme outdoor temperatures.

The energy-optimised control provided by the **VRC 700** means that the heating installation is supplied with as much environmental energy as possible.

Outdoor unit installation site

The outdoor unit requires a sufficiently stable, frost-proof and horizontal foundation that meets local requirements and complies with the rules of structural engineering.

We recommend providing an empty pipe for the condensate discharge.

Appropriate openings must be provided in the foundation for the hot brine and cold brine supply lines, the electrical lines and for the condensate discharge. The unit's blow-off side must not be positioned facing the building.

Requirements for the brine fluid

The brine fluid consists of water, mixed with a heat transfer fluid concentrate.

We recommend adding ethylene glycol with corrosion-inhibiting additives. The brine fluids that may be used differ greatly from region to region. For more information, contact the responsible authorities. Vaillant permits only the following brine media when operating the heat pump:

- Max. 44% vol. ethylene glycol

Do not use propylene glycol (Tyfocor LS) to fill the brine circuit.

aroTHERM VWL ../2 with uniTOWER

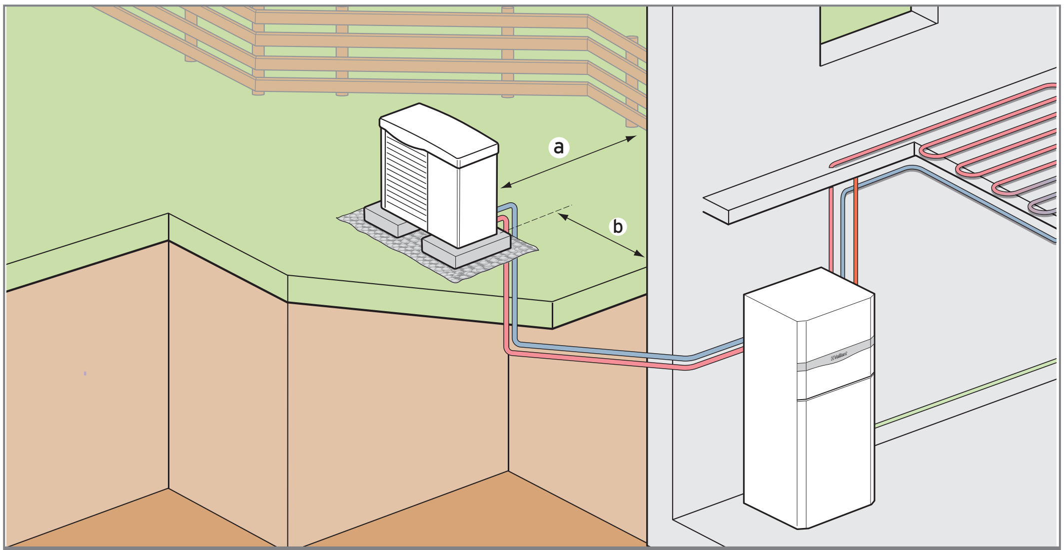


Fig. 94: aroTHERM VWL .../2 A

a Clearance between the outdoor units and the boundary of the plot of land: Min. 0.5 m, or observe communal regulations. **Note: Three-metre boundary; depends on the relevant federal state.**
b Clearance between the outdoor units and the building: Approx. 0.5 m

aroTHERM VWL .../2 with VWZ MEH 61 and VIH RW 300 hydraulic station

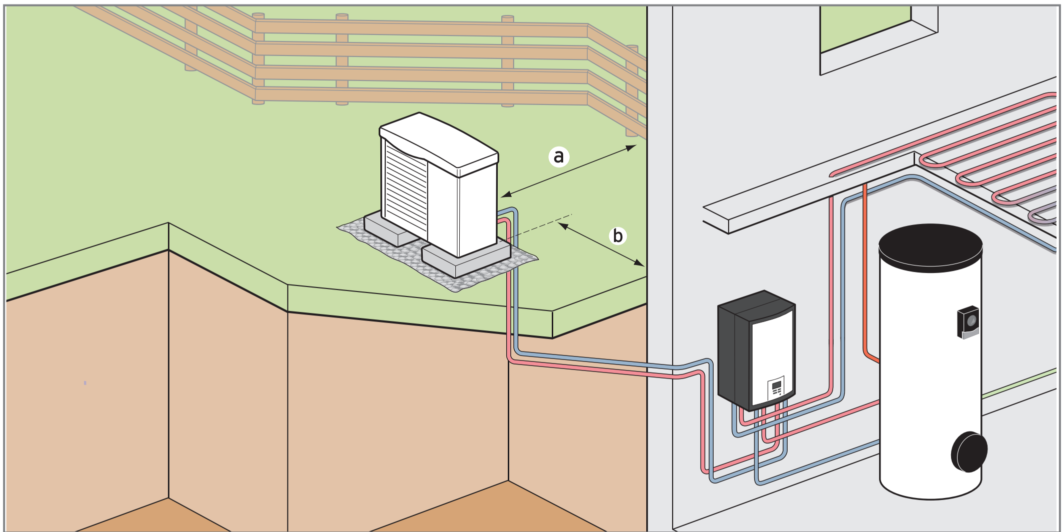


Fig. 95: aroTHERM VWL .../2 A

a Clearance between the outdoor units and the boundary of the plot of land: Min. 0.5 m, or observe communal regulations. **Note: Three-metre boundary; depends on the relevant federal state.**
b Clearance between the outdoor units and the building: Approx. 0.5 m

Note
The line into the building must be insulated in conformity with the EnEV (German Energy Saving Ordinance).
In the event of a power cut, the unit is not protected against frost at temperatures below 0 °C.
To guarantee frost protection at all times, the heating system can be filled with a frost protection agent (up to 44% ethylene glycol), or an intermediate heat exchanger can be used.

aroTHERM split with VWL ..7/5 IS hydraulic station

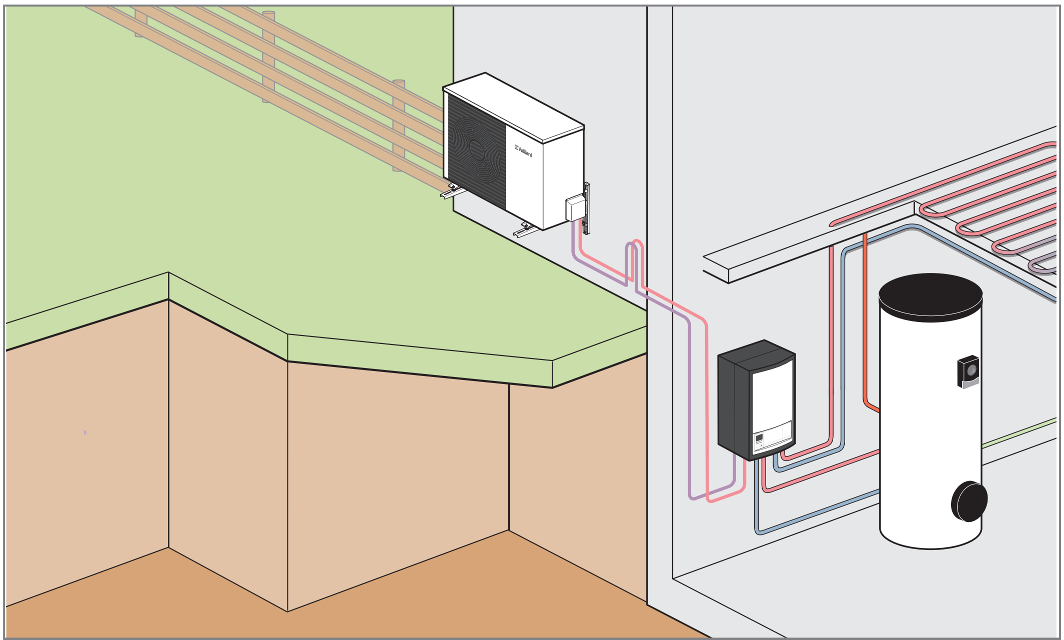


Fig. 96: aroTHERM split with VWL ..7/5 IS hydraulic station – wall-mounting

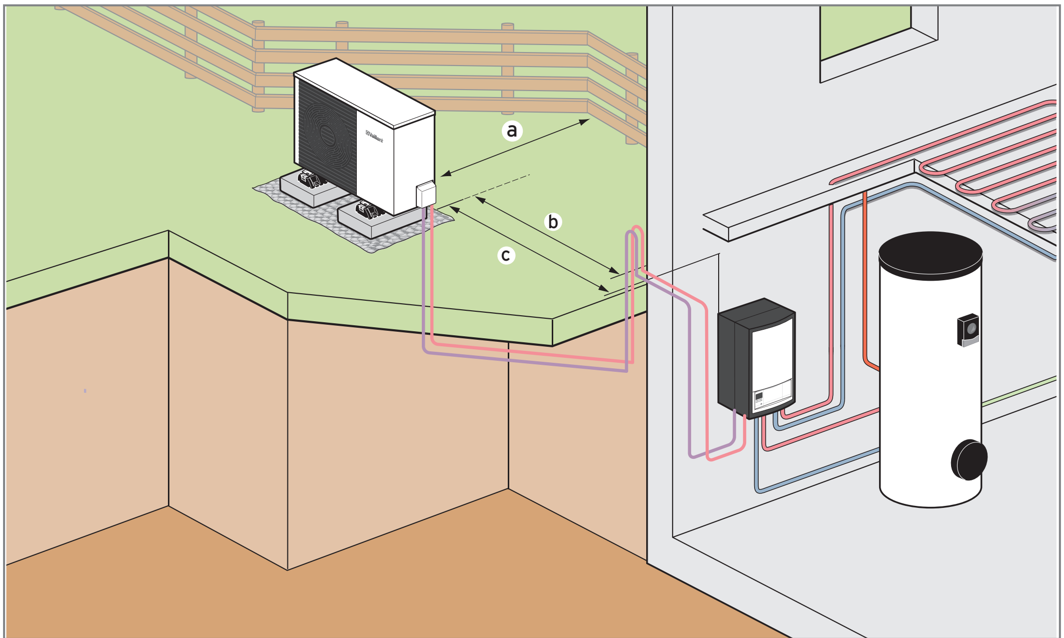


Fig. 97: aroTHERM VWL .../2 A aroTHERM split with VWL ..7/5 IS hydraulic station

a Clearance between the outdoor units and the boundary of the plot of land: Min. 0.5 m, or observe communal regulations. **Note: Three-metre boundary; depends on the relevant federal state.**

b Clearance between the outdoor units and the building: Approx. 0.5 m

c Maximum length of the pipeline from the outdoor unit to the indoor unit < 25 m

aroTHERM split with uniTOWER VWL ..8/5 IS

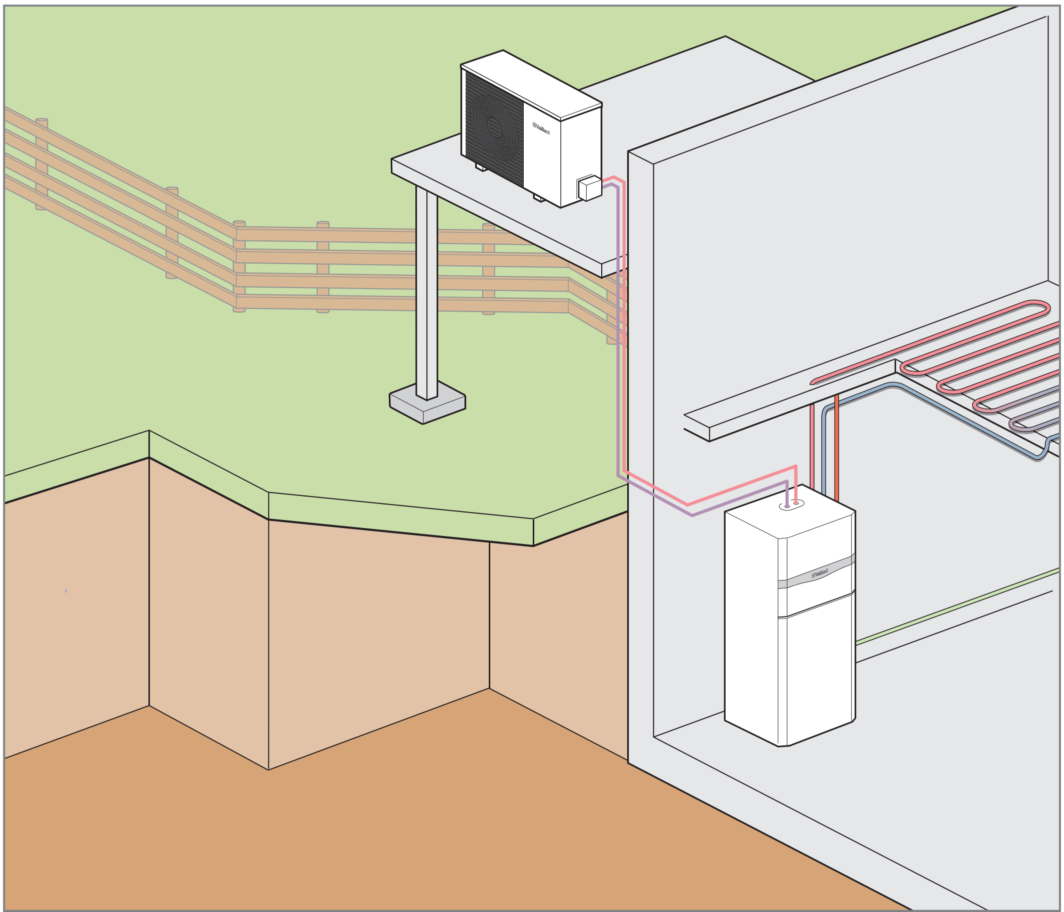


Fig. 98: aroTHERM split with uniTOWER VWL ..8/5 IS

Note
Maximum length of the pipeline from the outdoor unit to the indoor unit < 25 m.
Height difference between the outdoor unit and the indoor unit is a maximum of 10 m.
Observe the communal regulations
The three-metre boundary depends on the relevant federal state.

Installation clearance

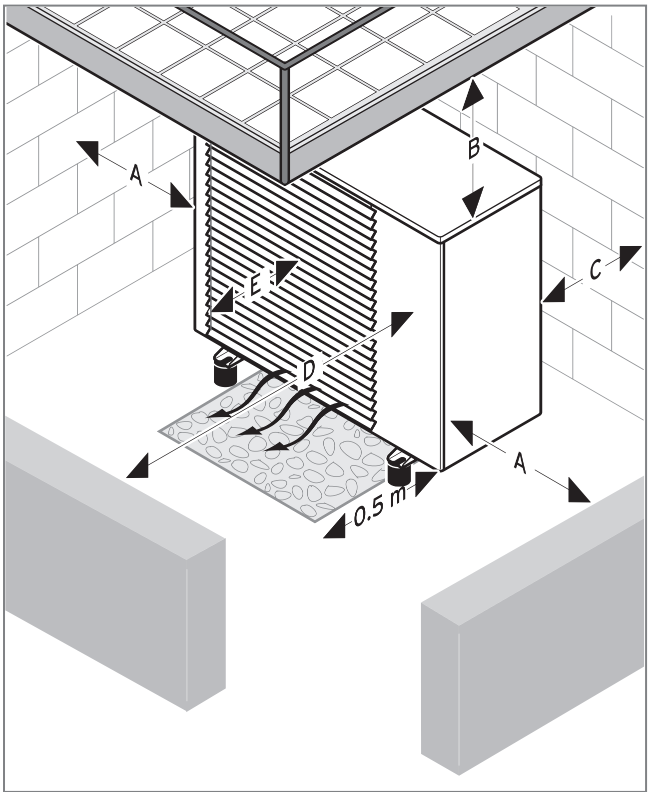


Fig. 99: Installation clearance

Installation clearance

Clearance	Only for heating mode	For heating and cooling mode
A	> 250 mm	> 250 mm
B	> 1000 mm	> 1000 mm
C	> 120 mm*	> 300 mm*
D	> 600 mm	> 600 mm
E	> 300 mm	> 300 mm

*__Caution:__ If the minimum clearances are not maintained, the efficiency of the product may be affected.

To guarantee sufficient air flow and to facilitate maintenance work, observe the minimum clearances that are specified above.

Ensure that there is sufficient room to install the hydraulic lines.

If the product is to be installed in areas where heavy snow falls, ensure that the snow does not accumulate around the product and that the minimum clearances specified above are observed. If you cannot ensure this, install an additional heat generator in the heating circuit. A raised base is available as an accessory. In order to adapt the product to higher levels of snow, only use the Vaillant raised base.

Selecting the installation site

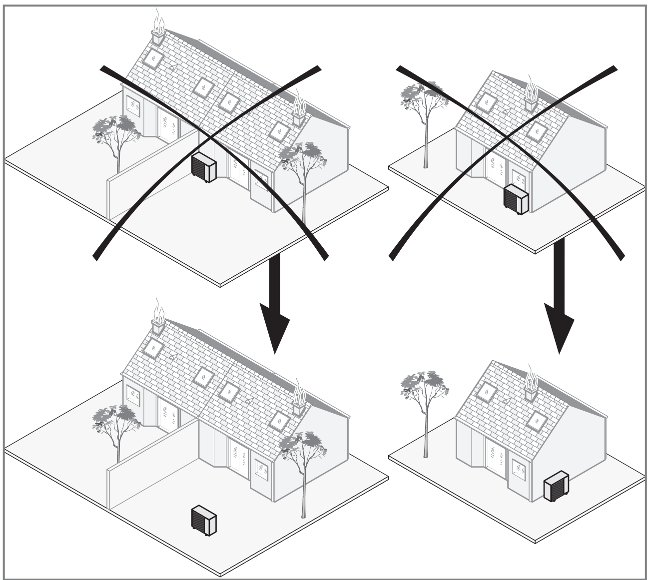


Fig. 100: Recommended installation sites

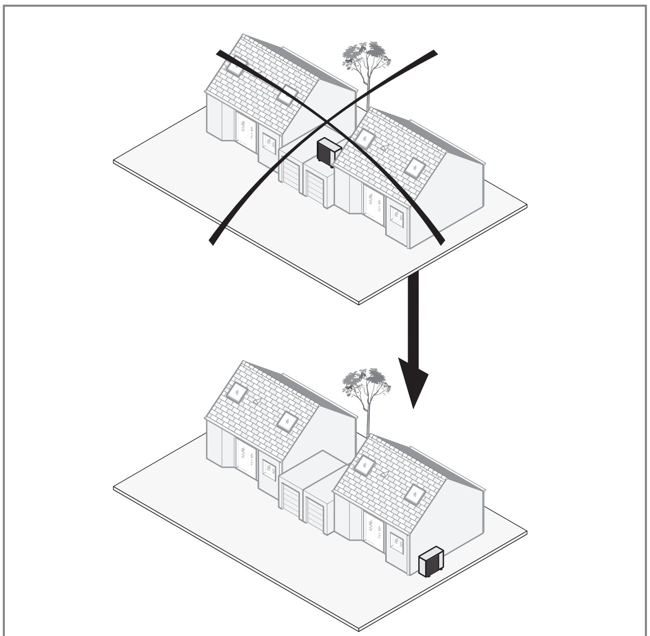


Fig. 101: Recommended installation sites

Observe all valid regulations.

Install the heat pump outside of the building.

Do not install a the heat pump:
- Near a heat source,
- Near flammable materials,
- Near ventilation openings for adjacent buildings,
- Under deciduous trees.

The following installation sites are not suitable:
- Adjacent to a neighbouring building
- Below windows
- On garage roofs between two buildings

Take into account the following points when installing the heat pump:
- Prevailing winds,
- The visual impression on the environment

Avoid places where strong winds blow on the heat pump's air outlet.

Point the fan away from nearby windows. Install noise protection if necessary.

Install the heat pump on one of the following supports:
- Concrete slab,
- Steel T-beam,
- Concrete block,
- Elevating socket (Vaillant accessory),
- Wall bracket (Vaillant accessory)

Do not expose the heat pump to dusty or corrosive air (e.g. close to unsurfaced roads).

Do not install the heat pump close to ventilation shafts.

Prepare the routing for the electrical wires. Note any noise emissions from the fan and compressor

Heat pump operating modes

The operating modes of a heat pump can be classified as follows:

Monovalent mode

The heat pump is the sole heat generator for heating and domestic hot water generation. The heat source must be dimensioned for year-round operation of the system.

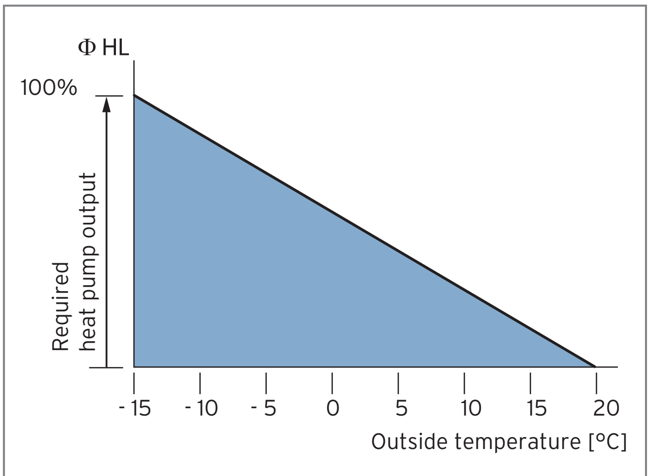


Fig. 102: Monovalent mode

Mono-energy mode

The heat supply is provided by means of two heat generators that use the same energy source. The heat pump is combined with additional electric heating to cover demand peaks. The additional electric heating is installed in the flow side of the utilisation system and is switched on as required by the controller. The proportion of the head demand covered by the additional electric heating should be as small as possible.

Bivalent alternative mode

In addition to the heat pump, a second heat generator is installed that uses a different energy source from that used by the heat pump to cover the heat demand. With such an arrangement, the heat pump only operates until what is known as the alternative point is reached (e.g. outdoor temperature of -4 °C), in order to hand over the task of supplying heat at lower outdoor temperatures to the second heat generator (e.g. a gas or oil boiler). The mode of operation is frequently used in heat source installations with high flow temperatures. The heat pump is able to cover 60 - 70% of the annual heating output in such cases (Central European climatic conditions).

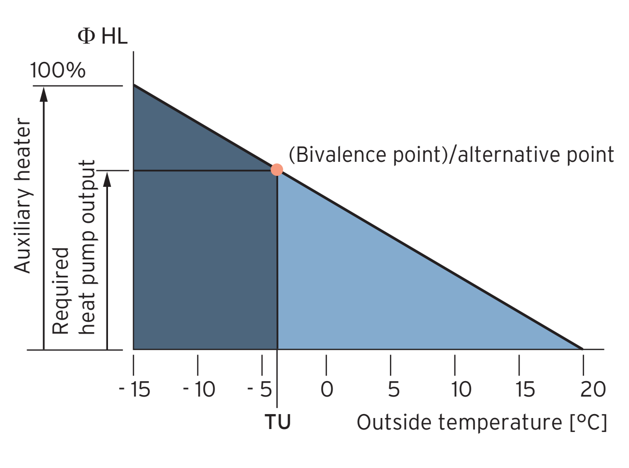


Fig. 103: Bivalent alternative mode

TU = Switch-on temperature of the second heat generator and switch off of the first heat generator.

Bivalent parallel mode

In addition to the heat pump, a second heat generator is installed that uses a different energy source from that used by the heat pump to cover the heat demand. Once a specific outdoor temperature is reached, the second heat generator is switched on to respond to the heat demand. This operating mode requires that the heat pump can continue operating down to the lowest outdoor temperature.

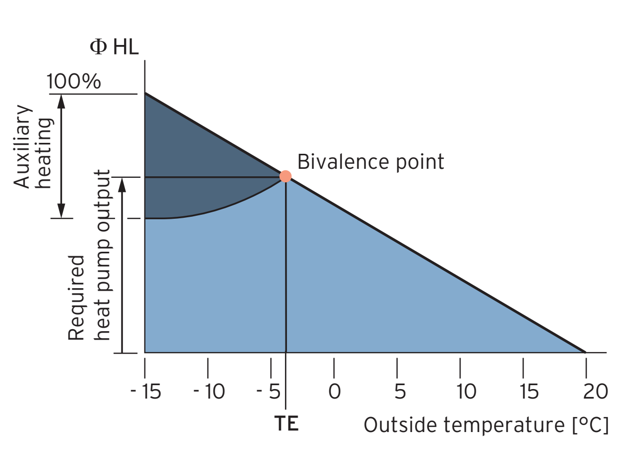


Fig. 104: Bivalent parallel mode

TE = Back-up heater cut-in temperature

Bivalent semi-parallel mode

Down to a specified outdoor temperature (bivalence point), the heat pump alone generates the necessary heat. If the temperature drops below that level, the second heat generator cuts in. If the flow temperature of the heat pump is no longer sufficient, the heat pump switches off. The second heat generator takes on the task of supplying the full heat load.

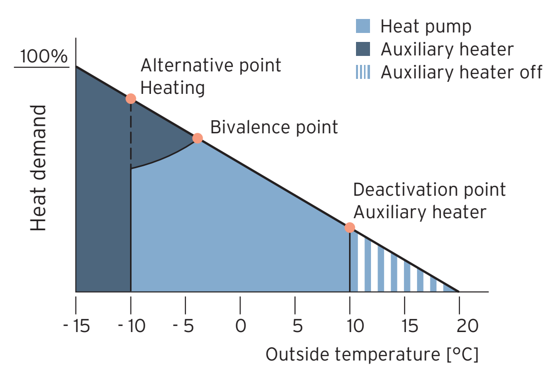


Fig. 105: Bivalent semi-parallel mode

Bivalence point for air heat pumps

The bivalence point (dimensioning point) represents the output limit of an air heat pump depending on the outdoor temperature.

When the bivalence point is not reached, a back-up heater must be connected to cover the required heat demand and/or to reach the required flow temperature.

We differentiate between two bivalence points:

Heating surface bivalence point

The heating surface bivalence point varies according to the system temperature required for the heating surface and is the point where the maximum flow temperature of the heat pump and the required heating curve intersect depending on the outdoor temperature.

Building bivalence point

The building bivalence point is the point where the building characteristic line (property heat demand) and the heating output of the air heat pump intersect depending on the outdoor temperature.

Both bivalence points indicate the outdoor temperature above which a back-up heater is required and the heat demand can no longer be provided in full (monovalent) by the heat pump.

The bivalence point must be determined anew for each property. The line (heating curve or building characteristic line) that intersects the other line for the first time at 55 °C is the bivalence point that should be set on the control.

Determining the bivalence point

Sample calculation

Q = 10.0 kW at -10 °C, heating curve 1.2 (radiator)

This results in a bivalence point of an outdoor temperature of approximately -3 °C. The heat pump would still have sufficient output to cover the heat demand (down to -6 °C) but cannot transfer the heat to the property because the temperatures required for heat transfer are not reached on account of the heating surface characteristics.

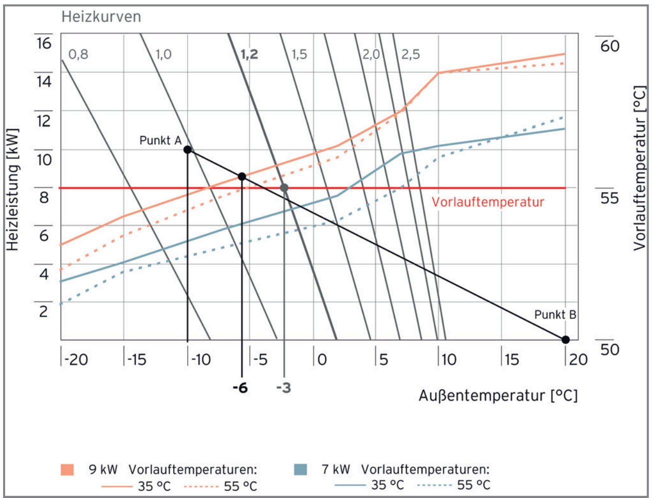


Fig. 106: Calculating the bivalence point for flexoTHERM

Standard outdoor temperature

The standard outdoor temperature is defined as the lowest two-day average that the temperature exceeded or fell below a maximum of 10 times from 1951 to 1979. It varies according to the region and is between -8 and -20 °C in Germany.

For designing heating installations, this is therefore approximately the coldest temperature that should be expected, and the heating installation should be designed according to this temperature.

The table opposite contains extracts of the standard outdoor temperatures Θe for towns with more than 20,000 inhabitants in accordance with DIN EN 12831.

For locations not included here, the value of the closest location listed in the table in a similar climatic location is to be used as the outdoor temperature. An isothermic map can also provide assistance when determining the standard outdoor temperature. The lowest outdoor temperature is required for entry in the power output graph of the air-to-water heat pump.

Determining the standard outside temperature

Town/city	Post-code	Climate zones according to DIN	Standard outside temperature Θe [°C]	Outside temperature annual average [°C]
Aachen	52062	5	-12	8.1
Berlin	10117	4	-14	9.5
Bochum	44787	5	-10	8.1
Brunswick	38100	3	-14	8.5
Bonn	53111	5	-10	8.1
Bremen	28195	3	-12	8.5
Chemnitz	09111	9	-14	7.9
Dortmund	44135	5	-12	8.1
Düsseldorf	40210	5	-10	8.1
Eisenach	99817	7	-16	8.8
Erfurt	99084	9	-14	7.9
Frankfurt am Main	60311	12	-12	10.2
Frankfurt (Oder)	15230	4	-16	9.5
Gelsenkirchen	45881	5	-10	8.1
Gera	07545	9	-14	7.9
Hamm (Westphalia)	59063	5	-12	8.1
Hanau	63450	10	-12	6.3
Hanover	30159	3	-14	8.5
Jena	07743	9	-14	7.9
Karlsruhe	76131	12	-12	10.2
Kassel	34117	7	-12	8.8
Cologne	50667	5	-10	8.1
Königstein im Taunus	61462	10	-12	6.3
Konstanz	78464	13	-12	7.9
Leipzig	04103	4	-14	8.7
Magdeburg	39104	4	-14	9.5
Mannheim	68159	12	-12	10.2
Munich	80331	13	-16	7.9
Münster, Westphalia	48143	5	-12	8.1
Nuremberg	90402	13	-16	7.9
Passau	94032	13	-14	7.9
Remscheid	42853	6	-12	6.8
Saarbrücken	66111	6	-12	6.8
Stuttgart	70173	12	-12	10.2
Ulm (on the Danube)	89073	13	-14	7.9

The lowest postcode for cities with more than one postcode is entered.
Determining the standard outside temperature Θe in accordance with DIN EN 12831 Bl. 1

Tabular overview of flexoTHERM portion of cover

Bivalence point	Output portion	Portion of cover for bivalent/ parallel operation	Portion of cover for bivalent/ alternative operation
-10	0.77	1	0.96
-9	0.73	0,99	0.96
-8	0.69	0,99	0,95
-7	0.65	0,99	0,94
-6	0.62	0,99	0,93
-5	0,58	0,98	0,91
-4	0.54	0,97	0,87
-3	0.50	0.96	0.83
-2	0,46	0,95	0,78
-1	0.42	0,93	0,71
0	0.38	0.9	0,64
1	0,35	0,87	0,55
2	0,31	0.83	0,46
3	0,27	0.77	0,37
4	0,23	0.7	0,28
5	0,19	0,61	0,19

9 Planning the installation of the heat generator

9.1 Planning the installation site – installing the heat pump inside

General requirements for the installation room

The installation room must be dry and frost-proof throughout (environmental temperature of at least 7 °C) and must not exceed a maximum temperature of 25 °C.

The heat pump must be installed on solid ground.

The floor for the heat pump must be level and must offer sufficient load-bearing capacity to bear the weight of the heat pump, including the domestic hot water cylinder and, if required, a multi-functional cylinder.

It must be possible for the lines to be routed in an appropriate manner (for the heat source, domestic hot water and heating).

It is necessary to comply with the room volumes that are required as a minimum (see technical data). In accordance with DIN EN 378 part 1, the minimum volume of the installation room (V_{min}) for heat pumps is calculated as follows:

$V_{min} = G/c$

G = coolant filling volume in kg

c = practical limit value in kg/m³

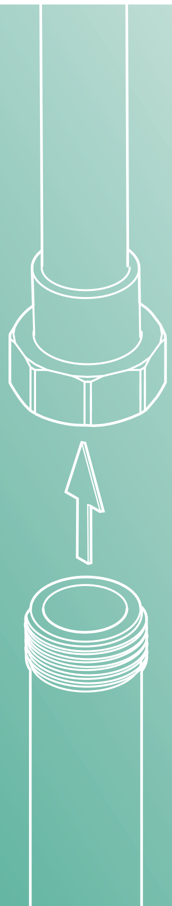
(for R 407C c = 0.31 kg/m³)

(for R 410a c = 0.44 kg/m³)

All of the installation site information also applies to the **geoTHERM** two-unit cascade. In this case, the minimum room volumes required for the combined heat pumps must be added.

The minimum required unit-specific clearances must be complied with under all circumstances (see product information/installation instructions).

In order to keep vibrations and noise in the building to a minimum, heat pumps should be optimally isolated from the shell of the building. Installing heat pumps on lightweight construction ceilings and floors must be avoided as a general principle. Good sound insulation can be achieved using a concrete foundation plate with a rubber mat placed underneath. In the case of floating screed flooring, screed flooring and impact sound insulation around the heat pump should be omitted.



Information on heat source lines

The heat source lines (brine) in the cellar rooms must be insulated so that they are diffusion-tight, as condensation would otherwise accumulate (possible pipe temperature of down to -15 °C, for VWL ...S down to -25 °C).

For insulation in wall ducts, expanding foam or tubular feedthroughs that are not sensitive to cold should be used.

Information on pipe installation

The vibrations that generally arise in the refrigeration circuit when operating a heat pump (oscillating compressor movement) are compensated for as far as possible by the internal insulating elements.

However, in unfavourable installation conditions, residual vibrations may still occur under some circumstances and these may then be transferred via the piping to the adjacent walls in the form of structure-borne sound vibrations. The following points should therefore be observed during installation:

- Pipe brackets for securing the heating and brine piping should not be positioned too near the heat pump in order to prevent the connection from being excessively rigid.
- Cold pipe clips must be used for the brine piping to prevent structural damage caused by condensate.
- In particularly serious cases, installing reinforced hoses (rubber hoses with reinforcement) may provide a solution. The use of stainless steel corrugated hoses is not recommended as, owing to the corrugated form of the hoses, this would cause excessive pressure losses in the heating water and heat source, and efficiency losses would therefore also occur. Allow for space for installing the hoses.
- All pipes must be threaded through walls and ceilings with insulation against structure-borne sound.
- The tubular feedthroughs for this purpose are available for temperatures down to -40 °C.

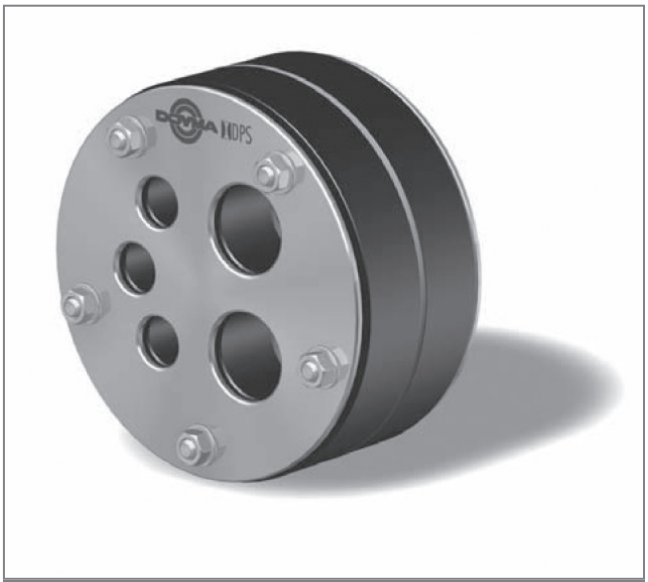


Fig. 107: Tubular feedthroughs for flow/return

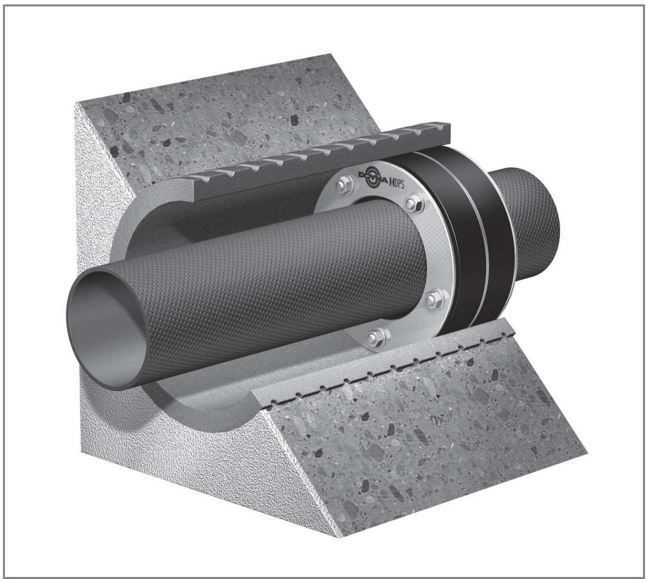


Fig. 108: Schematic installation situation

Installing REHAU accessories

Caulking in wall breaks

To seal pipe inlets for non-pressurised water up to 0.2 bar in masonry, wall sealing rings from REHAU can be used. They are available both for RAUVITHERM and for RAUTHERMEX.

Fig. 109: Wall sealing ring/labyrinth seal

Note
With RAUVITHERM pipes, a butyl strip must also be installed in the contact area of the wall sealing ring on the pipe.

Installation instructions

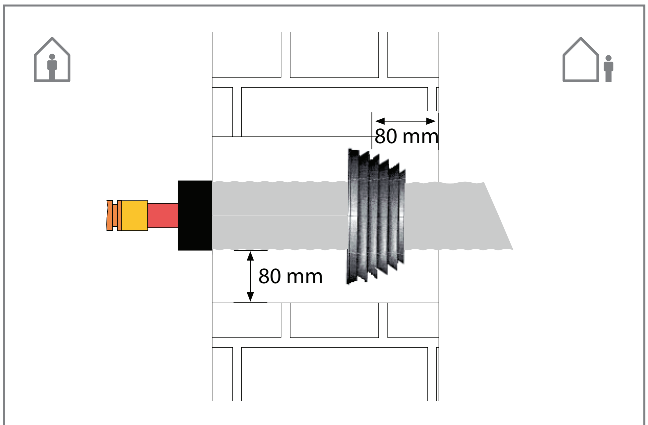


Fig. 110: Cross-section of the wall duct in the wall break

The flat side of the sealing ring points to the inside of the building; the angled, stepped side points outside. The horizontal clearance between the wall sealing ring and the outside of the wall must be at least 80 mm. Seal with commercially available swelling mortar.

For correct backfilling using commercially available swelling mortar, a vertical clearance of approx. 80 mm between the pipe casing and the masonry must be complied with. This results in the dimensions for the breakthroughs provided in the following table.

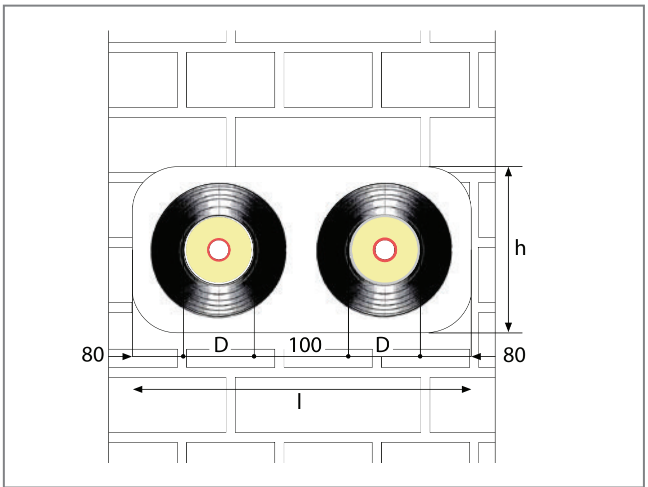


Fig. 111: Dimensions of the wall breakthrough

Dimensions of the wall breakthroughs

Outer diameter of the pipe casing D [mm]	Wall breakthrough for one pipe approx.. h x l [mm]	Wall breakthrough for two pipes approx. h x l [mm]
76	225 x 225	225 x 400
91	250 x 250	250 x 450
111	275 x 275	275 x 500
120	300 x 300	300 x 550
126	300 x 300	300 x 550
142	325 x 325	325 x 600
150	325 x 325	325 x 600
162	325 x 325	325 x 600
175	350 x 350	350 x 650
182	350 x 350	350 x 650
190	350 x 350	350 x 650
202	375 x 375	375 x 700
210	375 x 375	375 x 700
250	400 x 400	400 x 750

Note
You can find the set-up instructions for installing wall sealing rings at www.rehau.com/DE_de/bau/Heizen_Kuehlen/Nah-_Fernwaerme.

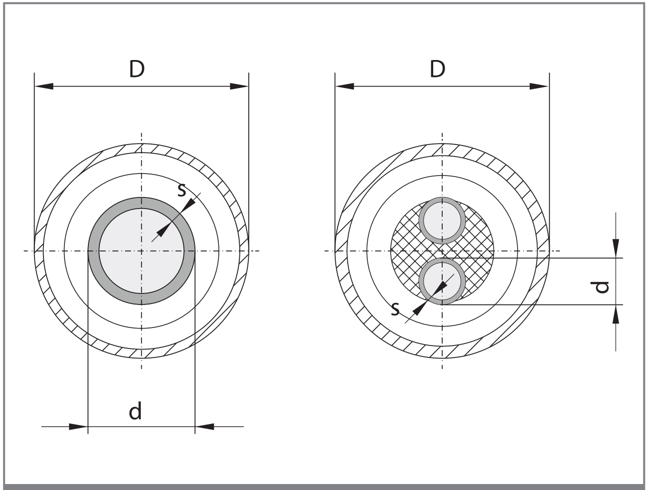


Fig. 112: RAUVITHERM dimensions (cross-section)

RAUVITHERM dimensions

Type	d [mm]	s [mm]	D [mm]	Volume of the inner pipe [l/m]	Weight [kg/m]	Wall thickness of the casing [mm]	Max. pipe coil length 3 m x 1.2 m [m]	U value [W/m·K]
UNO 25/120	25	2.3	113	0.327	0.98	2	290	0.16
UNO 32/120	32	2.9	114	0.539	1.07	2	290	0.19
UNO 40/120	40	3.7	116	0.835	1.22	2	290	0.22
UNO 50/150	50	4.6	144	1.307	1.75	2	230	0.23
UNO 63/150	63	5.8	145	2.075	2.08	2	230	0.28
UNO 75/175	75	6.8	170	2.961	2.99	2	130	0.28
UNO 90/175	90	8.2	175	4.254	3.64	2.5	130	0.34
UNO 110/190	110	10	187	6.362	4.60	2.5	100	0.41
UNO 125/210	125	11.4	209	8.203	6.10	3	80	0.42
DUO 25 + 25/150	25	2.3	144	2 x 0.327	1.66	2	230	0.25
DUO 32 + 32/150	32	2.9	146	2 x 0.539	1.87	2	230	0.26
DUO 40 + 40/150	40	3.7	148	2 x 0.835	2.24	2	175	0.32
DUO 50 + 50/175	50	4.6	177	2 x 1.307	3.31	2.5	130	0.34
DUO 63 + 63/210	63	5.8	208	2 x 2.075	4.77	3	90	0.38

Caulking in core holes

Wall sealing ring and swelling mortar

You can use this method to caulk both RAUVITHERM pipes and RAUTHERMEX pipes with wall sealing ring into the core hole.

Note
With RAUVITHERM pipes, a butyl strip must also be installed in the contact area of the wall sealing ring on the pipe.

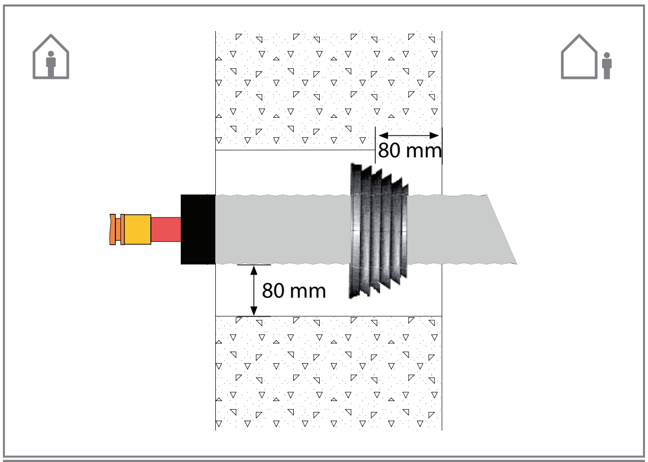


Fig. 113: Cross-section of the wall duct in the core hole

Installation instructions and dimensions for the core hole diameter

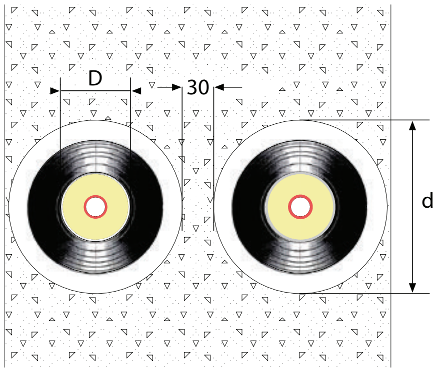


Fig. 114: Dimension of the wall sealing ring core hole

The flat side of the sealing ring points to the inside of the building; the angled, stepped side points outside. The horizontal clearance between the wall sealing ring and the outside of the wall must be at least 80 mm.

For correct backfilling using commercially available swelling mortar, a vertical clearance of approx. 80 mm between the pipe casing and concrete must be complied with. This results in the dimensions for the core hole provided in the following table.

Diameter of the core holes

Outer diameter of the pipe casing D [mm]	Minimum diameter of the core hole d [mm]
76 - 111	250
120 - 150	300
162 - 190	350
202 - 250	400

Sealing flange

You can use the sealing flange to caulk ducts for RAUTHERMEX pipes through concrete walls/components. The sealing takes place in core holes or sensor pockets/ wall sleeves made from plastic.

Fig. 115: Sealing flange

Note
The sealing flange may only be used for RAUTHERMEX pipes.

Installation instructions and dimensions for the core hole diameter

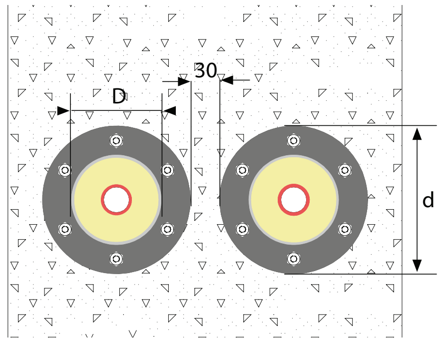


Fig. 116: Dimension of the wall sealing ring sealing flange

Where multiple ducts are next to each other, the clearance between core holes or sensor pockets must be at least 30 mm.

The RAUTHERMEX pipes may have a maximum deviation of 7° in the drill hole.

The position of the pipe in the pipe sleeve or in the core hole must be secured.

Diameter of the core holes

Outer diameter of the pipe casing D [mm]	Diameter of the core hole d [mm]
76	125 ± 2
91	150 ± 2
111 - 142	200 ± 2
162 - 182	250 ± 2
202	300 ± 2
250	350 ± 2

Note
Core holes must be sealed using REHAU drill hole preserving agent before installing the sealing flange.

FA 80 sealing flange for pressurised water up to 1.5 bar

The FA 80 sealing flange is used for pressurised water up to 1.5 bar.

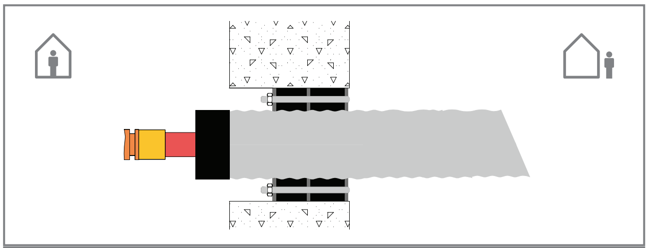


Fig. 117: FA 80 sealing flange

Note
The sealing flange must be flush with the outside of the wall. It must be prevented from protruding out of the external wall.

For wall thicknesses of ≥ 25 cm, the FA 40 sealing flange can also be used to stabilise and secure the position of the pipe in the drill hole.

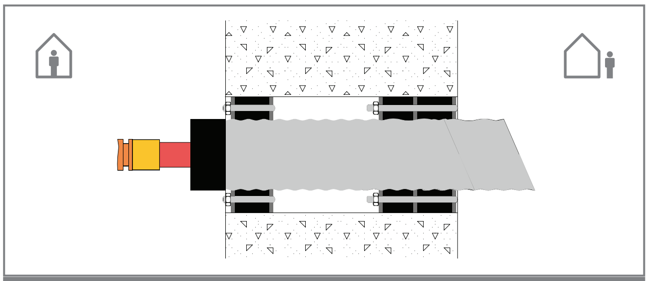


Fig. 118: FA 80 sealing flange with FA 40

FA 40 sealing flange for pressurised water up to 0.5 bar

The FA 40 sealing flange is used for pressurised water up to 0.5 bar.

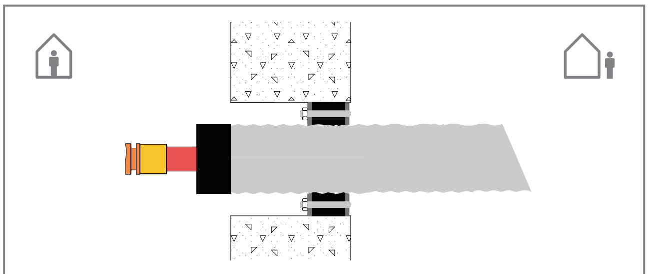


Fig. 119: FA 40 sealing flange

Note
The sealing flange must be flush with the outside of the wall. It must be prevented from protruding out of the external wall.

For wall thicknesses of ≥ 25 cm, another FA 40 sealing flange can also be used to stabilise and secure the position of the pipe in the drill hole.

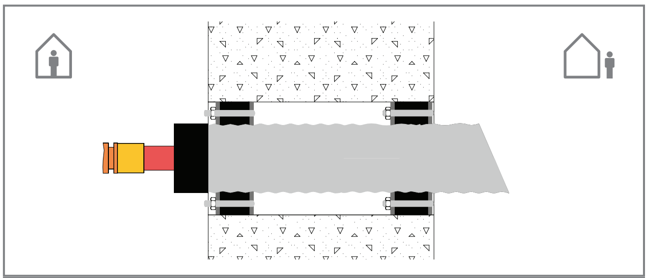


Fig. 120: FA 40 sealing flange, used twice

Sealing flange set-up instructions

Fig. 121: Installing using a torque spanner

Note
To ensure that the seal can be tightened during operation, the nuts for the seal must pointing to the inside of the building.

1. Roll out the RAUTHERMEX pipes.
2. Push the RAUTHERMEX pipes into the seal opening.
3. Secure the RAUTHERMEX pipes in the pipe trench.
4. Raise the sealing flange and position it in the drill hole.
5. Tighten the nuts for the sealing flange using the torque spanner that is set accordingly; see the table below.
6. Tighten the nuts.

Torque for each RAUTHERMEX outer diameter

RAUTHERMEX outer diameter	Screws	Width across flats [mm]	Torque [Nm]
76	M6	10	5
91	M6	10	5
111 - 142	M8	13	10
162 - 182	M8	13	10
202	M8	13	10
250	M8	13	10

Caulking with support sleeve

To integrate the pipes into in-situ concrete components (e.g. floor panels, outer cellar walls, etc.), the PVC support sleeve can be installed with a roughened surface. This opening can be used to subsequently connect the REHAU pipes with the shrink hose. This system is watertight up to a 2 m water column (RAUVITHERM in particular).

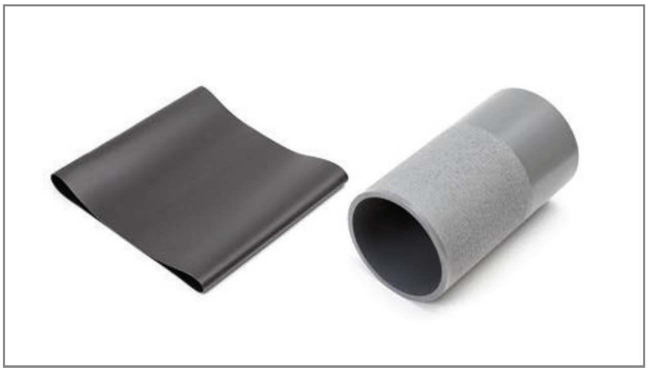


Fig. 122: Support sleeve (roughened surface)

Diameter of the wall opening for support sleeves with a roughened surface

RAUVITHERM dimensions		Diameter of the sleeve [mm]
UNO	DUO	
25 - 40	-	160
50 - 90	25 - 50	225
110 - 125	63	280

Alternatively, a smooth support sleeve with shrink hose and compact seal can be fitted in core holes.

Fig. 123: Support sleeve (smooth surface) with compact seal

Diameter of the core hole for a smooth support sleeve surface

RAUVITHERM dimensions		Diameter of the core hole [mm]
UNO	DUO	
25 - 40	-	250 ± 2
50 - 90	25 - 50	300 ± 2
110 - 125	63	350 ± 2

Fig. 124: Installation example: Support sleeve and compact seal

Support sleeve installation diagram

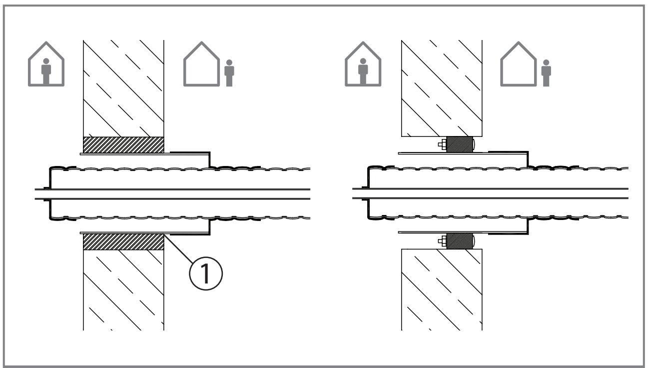


Fig. 125: Installation diagram for support sleeves with a roughened surface (left) and a smooth surface (right)

1 Swelling mortar

The various caulking options allow for maximum flexibility of the pipe routing directly into the building.

Fig. 126: Flexible pipe routing into the building

House connection (flexible)

The RAUVITHERM installation set in the DUO 32, 40 and 50 mm dimensions is suitable for flexibly and directly connecting a building to heating networks.

Fig. 127: House connection set (flexible)

Dimensions

The vertical side length is 1.5 m.

For the horizontal side length, pre-assembled 5, 10, 15, 20 and 25 m coiled bundles are available.

Materials

Medium pipe	Cross-linked polyethylene (PE-Xa)
Insulating material	Cross-linked PEX foam plates

Dimensions of the house connection elbow (flexible)

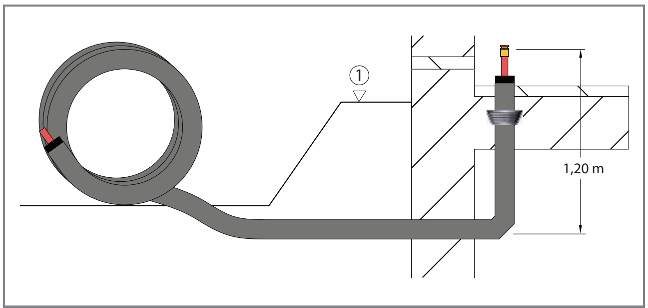


Fig. 128: Dimensions of the house connection elbow (flexible)

1 Upper edge of the building

Direct connection of external heat pumps

The flexible house connection set is also suitable for the direct connection of heat pumps that are installed outside.

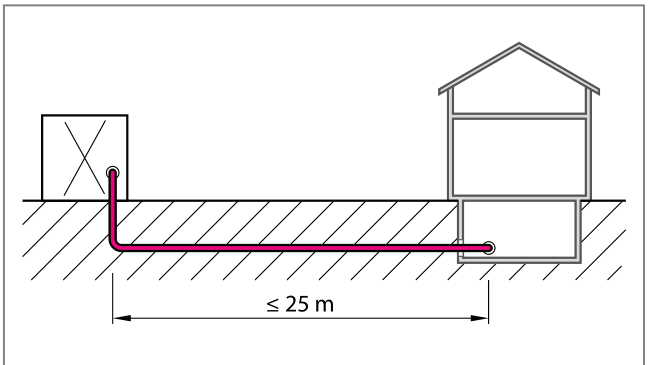


Fig. 129: Connecting the heat pump with a house connection set

Note
The enclosed compression fittings may only be used in accessible areas and it must be possible to inspect them at any time.

Transport to the installation site

Note
Risk of damage due to improper transportation. Regardless of the mode of transport, the heat pump must never be tilted by more than 45°. Otherwise, this may lead to faults in the refrigerant circuit during subsequent operation. In the worst case scenario, this may lead to a fault in the whole installation.

When planning the transportation and fitting of all of the system components, the maximum door widths and the access routes through the house, via the garden, ground floor/basement, confined spaces, railings/banisters, staircases, etc. to the installation room must be taken into consideration. For cylinders in particular, the diameter, the tilt dimension and the height must be taken into particular consideration.

The split mounting concept makes it easy to fit the installations: Undoing a few connections enables the units to be quickly separated and reassembled.

flexoTHERM/flexoCOMPACT installation room

The general requirements described above apply to the installation room of the indoor unit.

If the heating heat pump is operated as an air-to-water heat pump, particular requirements apply when installing the **aroCOLLECT** outdoor unit outside (see section 9.2).

Select a dry room that is frost-proof throughout and in which the maximum installation height is not exceeded and the environmental temperature is neither above nor below the permitted range.

- Permissible environmental temperature: 7 to 25 °C
- Permissible relative air humidity: 40 to 75%

Ensure that the installation room has the required minimum volume.

geoTHERM installation room

In addition to the general instructions for planning installation rooms for heat pumps, the following points must be observed for the **geoTHERM** VWS 220/3 - 460/3:

Maximum installation height: 2000 m above mean sea level.

aroSTOR installation room

In addition to the general instructions for planning installation rooms for heat pumps, the following points must be observed for the **aroSTOR** hot water heat pump:

- If the product is operated as room-sealed, it must not come within 500 m of any coastline.
- Do not place the product in the vicinity of another unit which could damage it (e.g. next to a unit which releases vapour or grease), or in a room with a high level of exposure to dust or in a corrosive environment.
- If the installation room does not meet the required minimum volume (20 m³), pipelines are required for the air that is extracted and the air that is conducted away.
- In order to avoid noise disturbance, do not install the product near bedrooms.

Selecting air duct systems

Caution.
Risk of material damage caused by incorrect installation.
Do not connect the product to extractor hoods.

1. Use only commercially available, insulated air ducts with suitable heat insulation, to prevent energy loss and condensation from forming on the air ducts.

- Inner diameter of the air ducts: ≥ 160 mm

Total length of the air ducts	
	For air supply and air exhaust
Conditions: Flexible pipes	≤ 10 m
Conditions: Smooth pipes	≤ 20 m

Note
Each elbow equates to an additional pipe length of 1 m.

2. To prevent water or foreign bodies from penetrating the pipelines, install essential protection devices at the openings of the air ducts (protective grating for vertical walls, roof terminals).
3. If the product is connected to a piping system which exceeds a specified total length (5 m for flexible pipes, 10 m for smooth pipes), set the ventilator speed to stage two.

Installing the complete pipe system

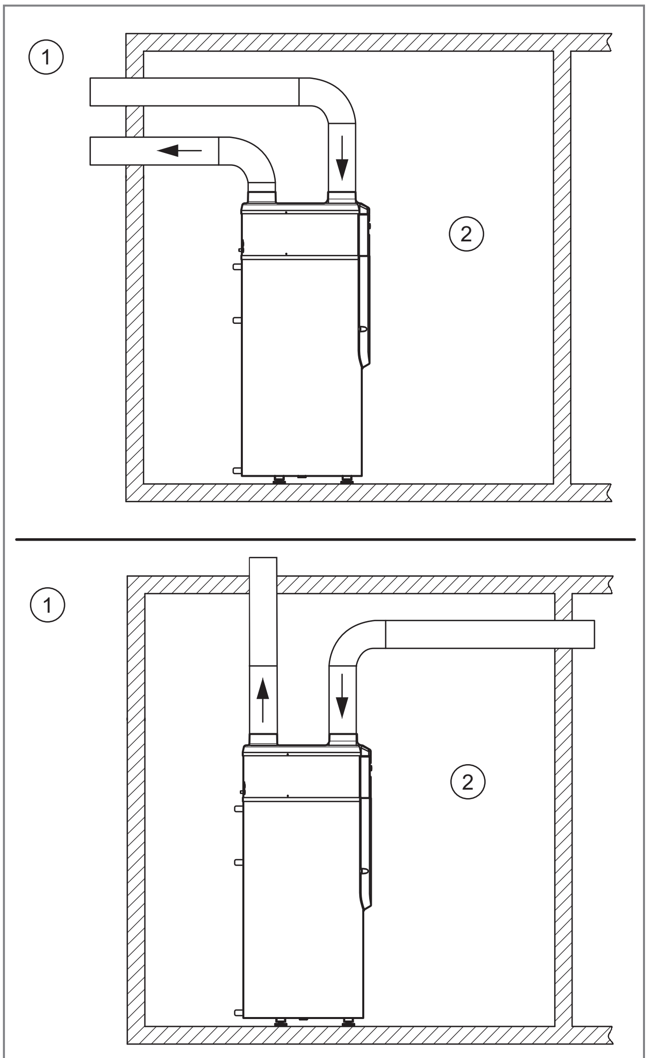


Fig. 130: Complete pipe system

1 External area
2 Internal area (heated or not heated)

The air inlet and outlet are located in the external area.

This installation is suitable for small rooms (supply or storage room, etc.).

Use this configuration with priority because no part of the room cools down and the ventilation remains unimpaired.

Room height at installation site	
Conditions: Horizontal extraction	≥ 2.43 m
Conditions: Vertical extraction	≥ 2.00 m

» Check whether the pipe configurations depicted above are feasible depending on ceiling height.

» In order to prevent leak air from being extracted by recirculation, maintain a clearance between the ends of the air ducts.

- Clearance: ≥ 0.5 m

Installing the partial pipe system

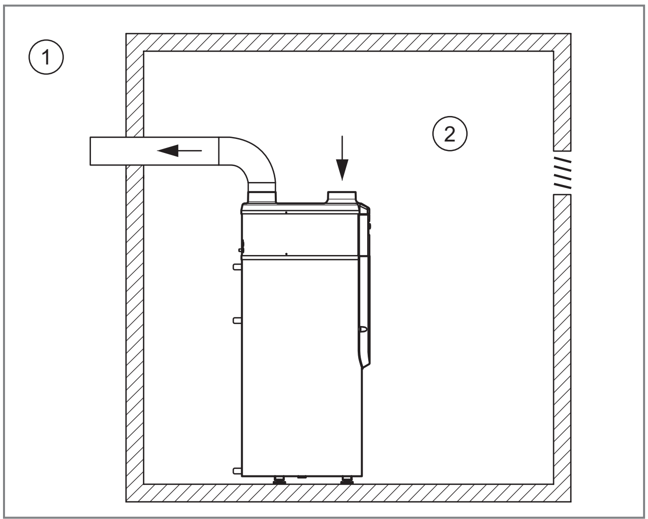


Fig. 131: Partial pipe system

1 External area
2 Internal area (heated or not heated)

The hot air is drawn into the room and the cold air is released outside.

This installation uses the room's heat without cooling it down.

- Room height at installation site: ≥ 2.00 m
- Room volume at installation site: ≥ 20 m³

» Avoid having negative pressure in the installation room, so that air is not extracted from surrounding heated rooms.

» Check whether the existing ventilation can compensate for the withdrawn amounts of air.
  - Air flow: ≤ 450 m³/h

» If required, adjust the ventilation.

Installing without a piping system

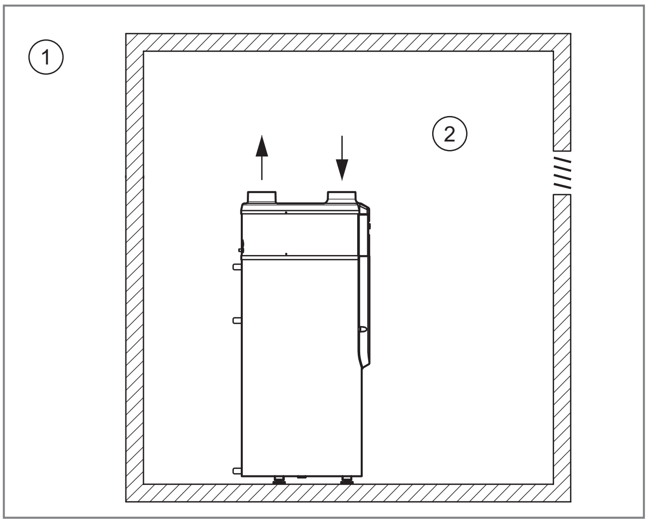


Fig. 132: Without the pipe system

1 External area
2 Internal area (heated or not heated)

The air is drawn into and conducted away from the same room .

This installation uses a room's heat and releases the colder and drier air back into the room.

- Room height at installation site: ≥ 2.20 m
- Room volume at installation site: ≥ 20 m³

Note
Even at outside temperatures above 0 °C, there is a risk of frost in the installation room.

9.2 Planning the installation site – installing the heat pump/outdoor unit outside

Some requirements that must be noted when planning the installation site result from the **aroTHERM** air/water heating heat pump and the **aroCOLLECT** outdoor unit for the **flexoCOMPACT exclusive** and **flexoTHERM exclusive** air/water heating heat pumps being installed outside.

The minimum required clearances must be complied with under all circumstances (see installation instructions/section on planning the heat source).

The heat pump/outdoor unit requires a sufficiently stable, frost-proof and horizontal foundation that meets local requirements and complies with the rules of structural engineering. We recommend providing an empty pipe for condensate discharge. Appropriate openings must be provided in the foundation for the hot brine and cold brine supply lines, the electrical lines and for the condensate discharge. The unit's blow-off side must not be positioned facing the building.

Do not install the heat pump/outdoor unit:
- Near a heat source,
- Near flammable materials,
- Near ventilation openings for adjacent buildings,
- Under deciduous trees,
- In dusty or corrosive air (e.g. near unsecured streets),
- Or near exhaust air shafts.

Also note the following points:
- Prevailing winds,
- Noise emissions from the fan and compressor
- The visual impression on the environment.

Avoid places where strong winds blow on the heat pump's air outlet.

Do not point the fan in the direction of nearby windows. Install noise protection if necessary.

Install the heat pump on steel beams, concrete blocks or using a wall bracket (accessory only for aroTHERM).

Ensure that no water accumulates beneath the heat pump and that the ground in front of the heat pump can absorb water well in order to avoid ice formation.

The condensate volume for each outdoor unit is max. 20 l/h in summer when the air humidity is high.

Creating the foundation

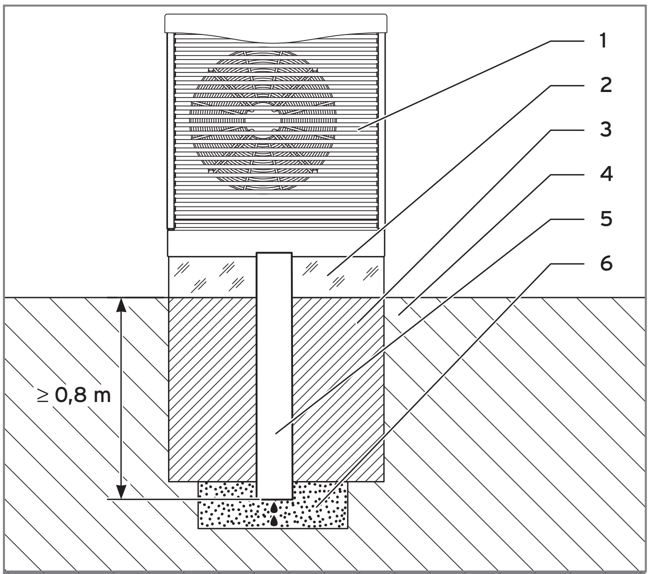


Fig. 133: Foundation: Cross-section

1 Air/brine collector
2 Foundation
3 Compacted gravel
4 Ground
5 Condensate drain pipe
6 Gravel bed in a frost-free area

1. Prepare the ground for the foundation in accordance with the illustration.

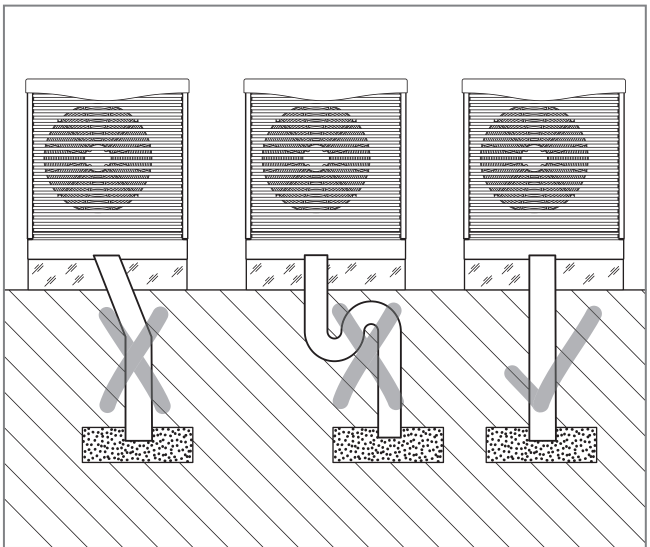


Fig. 134: Routing the condensate drain pipe

2. As a condensate drain pipe, route a pipe that drops vertically and that is ≥ DN 110. Route this pipe as far as the frost-free ground. To lay the pipe at ground level and so that it comes out of the mounting base at the side, use the accessory that is available for this.

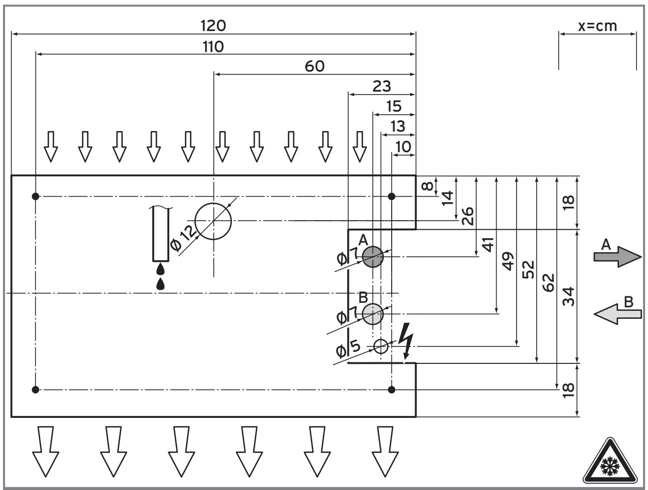


Fig. 135: Foundation: Connection dimensions

A Connecting the air/brine collector to the heat pump (hot brine)
B Connecting the heat pump to the air/brine collector (cold brine)

3. Create a frost-free and stable foundation or set the product on paving slabs. When doing so, observe the rules of structural engineering and the instructions that are enclosed with the recommended VWL S installation set for PE pipes.

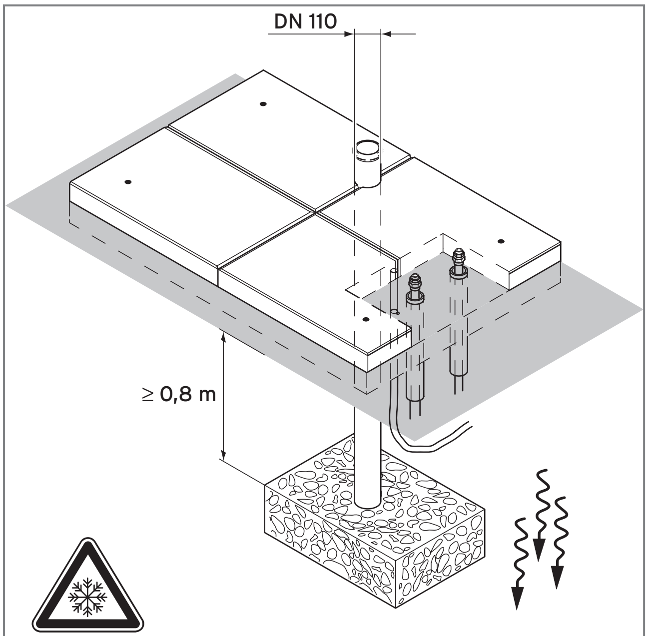


Fig. 136: Connections: Foundation using paving slabs

4. Establish the connections for a foundation made of paving slabs in accordance with the illustration.

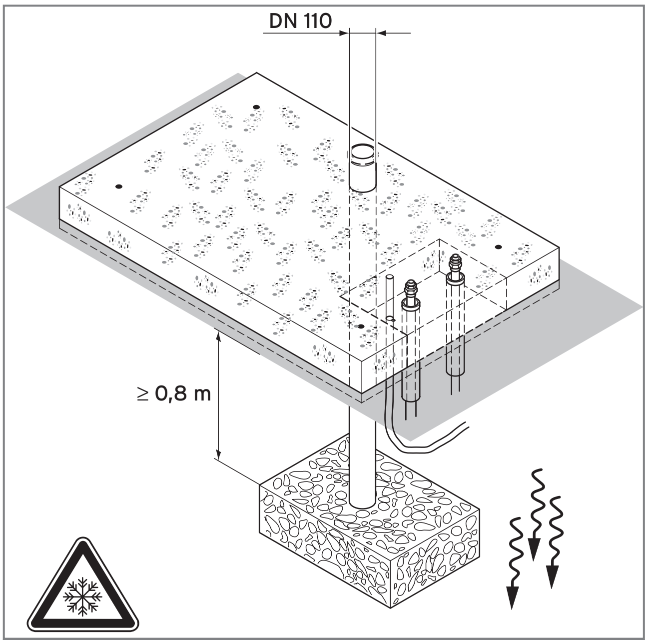


Fig. 137: Connections: Foundation using concrete

5. Establish the connections for a concrete foundation in accordance with the illustration.

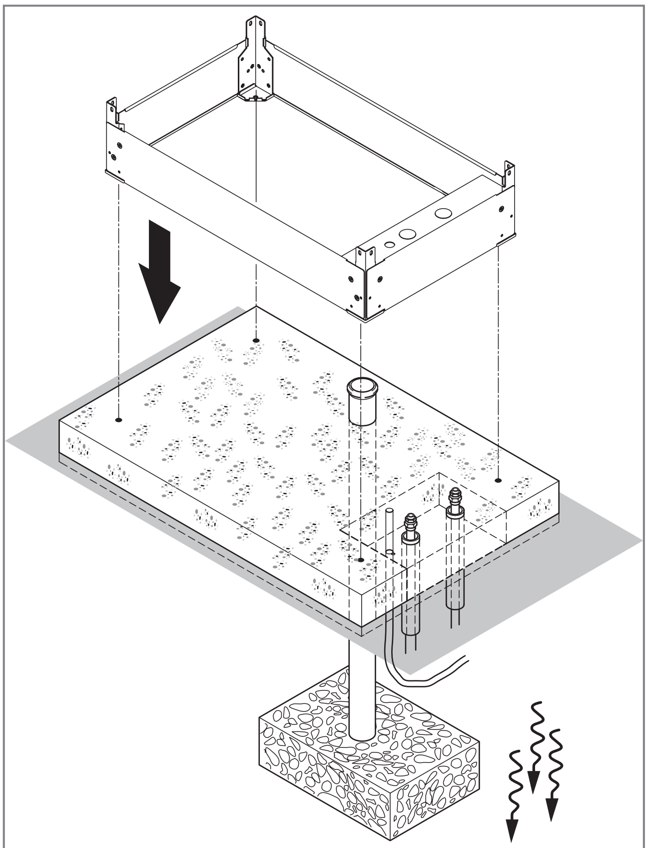


Fig. 138: Installing a base

6. Install the base that is available as an accessory.

Outdoor installation of two aroCOLLECT outdoor units with Tichelmann installation set

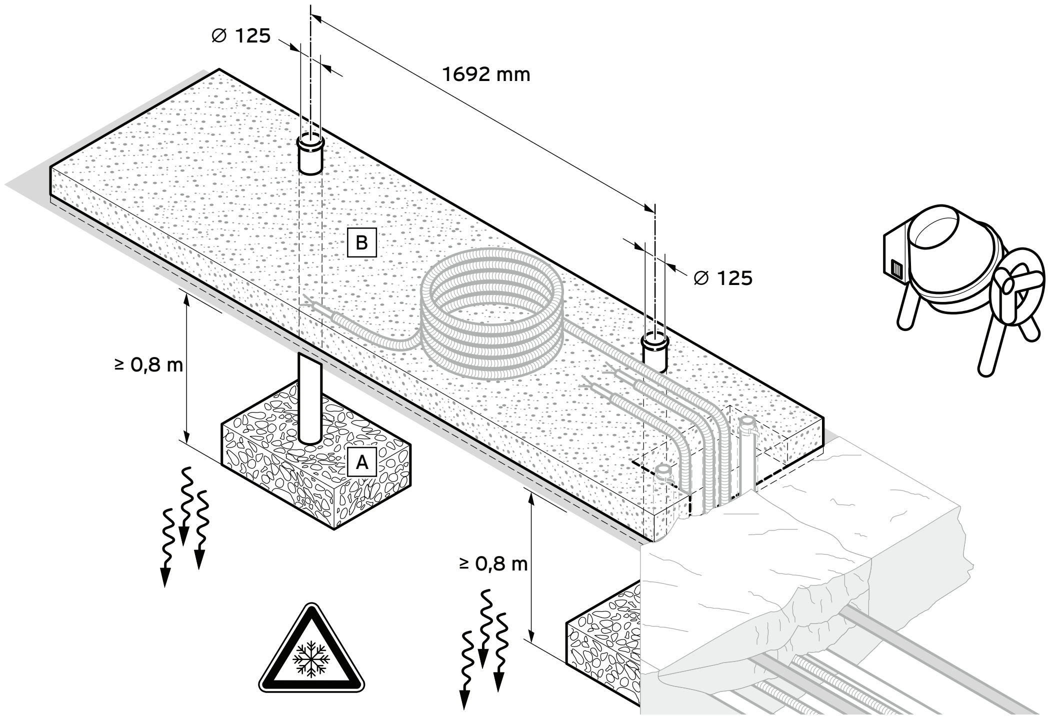


Fig. 139: Foundation plan for two aroCOLLECT outdoor units

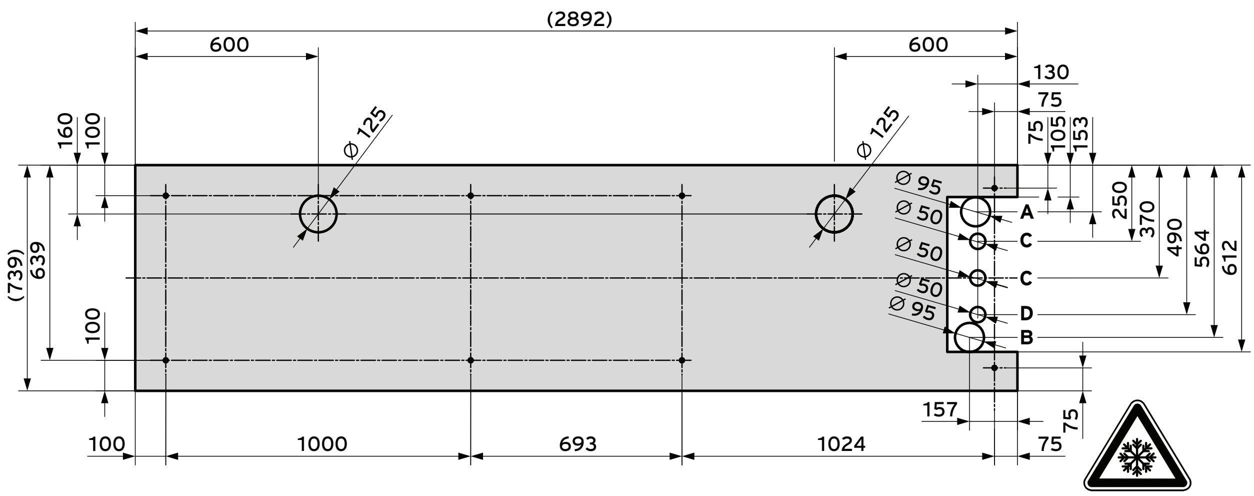


Fig. 140: Foundation of the connection dimensions for two aroCOLLECT outdoor units for the installation set (0020205408) with the Tichelmann system

A Connecting the air/brine collector to the heat pump (hot brine)
B Connecting the heat pump to the air/brine collector (cold brine)
C 400 V electrical connection
D eBUS

Note
For easier installation, use the Tichelmann installation set (0020205408).

aroCOLLECT flat roof installation

For flat-roof installation of the outdoor unit, frost-free draining of the condensate is required up to approx. 1 m below the soil level using electrical trace heating. To prevent condensate or (in winter) ice formation on the brine pipes, the outdoor brine pipes in this installation must be provided with diffusion-tight, weather-resistant heat insulation with an insulation thickness of approx. 10 mm.

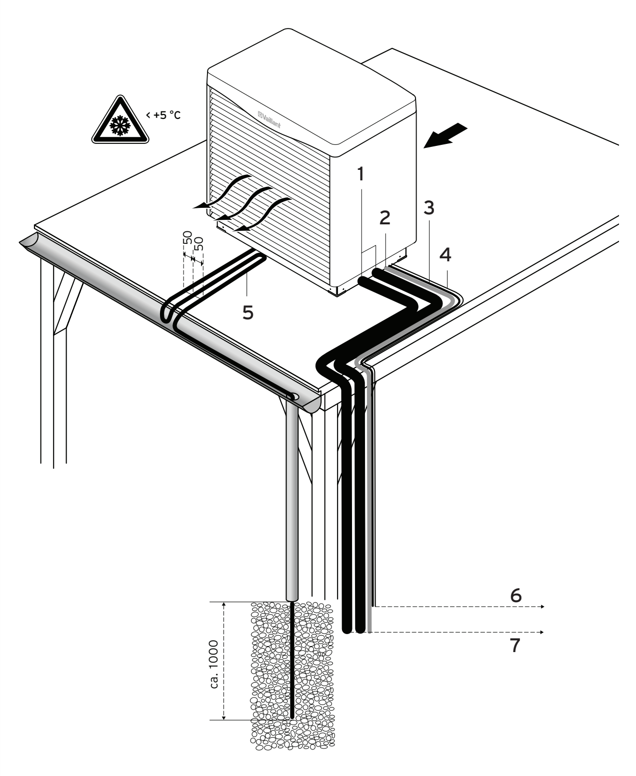


Fig. 141: aroCOLLECT flat roof installation

1 Brine pipes with heat insulation from the outdoor unit to the indoor unit
2 eBUS
3 400 V/50 Hz, 3/N/PE~ outdoor unit power supply
4 230 V/50 Hz, 1/N/PE~ heating strip power supply
5 Electrical heating strip for condensate discharge
6 For power supply
7 For the indoor unit

For a ground-level PE pipe connection of the **aroCOLLECT** outdoor unit, the installation set with order number 0020112803 is required. This consists of:

- 2 x S 28 connection pipe x 1.5 mm G 5/4
- 1 x base panel with cut-outs
- 2 x R 5/4 brass threaded joint

Ensure that everything is sufficiently secured in place and storm-protected.

For flat roofs with gravel filling, an installation set is available for flat-roof installation (order number 0020087826). This consists of:

- 2 x gravel tray
- 2 x S 28 mm flat-roof connection pipe x 1.5 mm, G 5/4
- 1 x base panel for flat-roof installation
- 1 x heat insulation for connection pipes
- 4 x fitting for securing the gravel tray to the outdoor unit
- 2 x brass threaded joint, R 5/4

The electrical gutter trace heating is controlled via a relay (accessory) that is connected to the red terminals of the outdoor unit (max. 200 W). The trace heating is then switched on only below an air intake temperature of +5 °C and only during the thawing procedure. The trace heating can be connected directly to the PCB at an output of up to 200 W. We recommend using a relay.

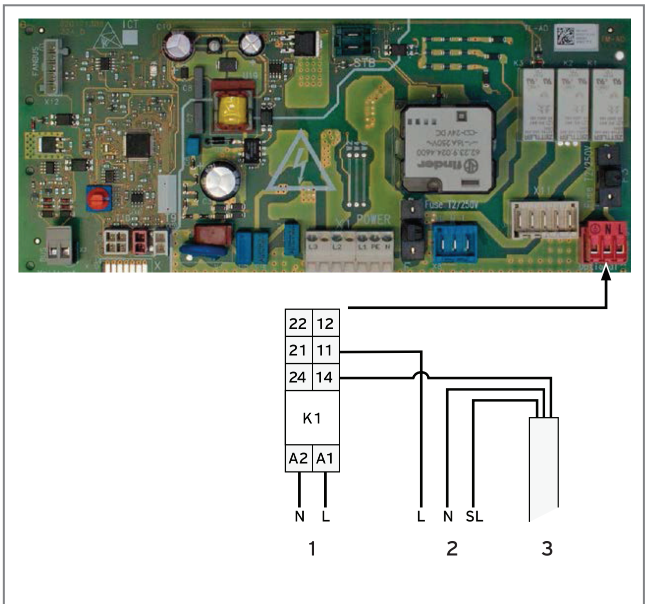


Fig. 142: PCB for the aroCOLLECT outdoor unit

1 Electronics box connection in the outdoor unit
2 Trace heating mains voltage from the E manifold
3 Gutter trace heating strip to protect the building against frost

Installing the connection pipes using installation sets

Two installation sets are available for installing the connection pipes.

Depending on the total pipe length that is required, you can choose between DN 40 or DN 50 outer diameters.

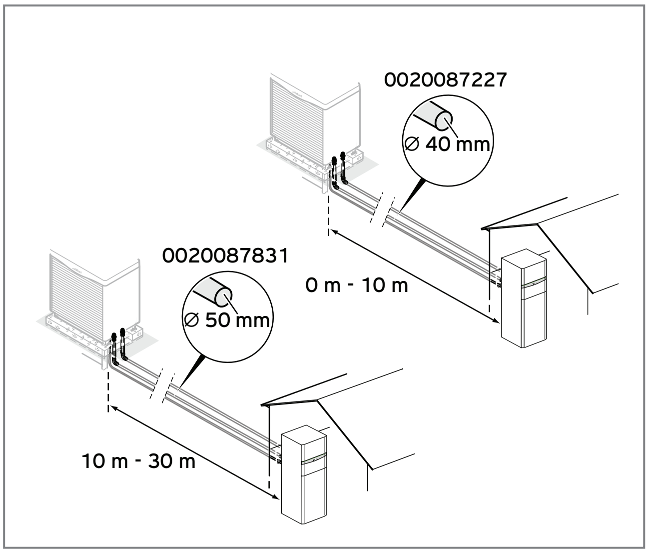


Fig. 143: Selecting the aroCOLLECT installation set

Installation with the DA40 and DA50 installation set

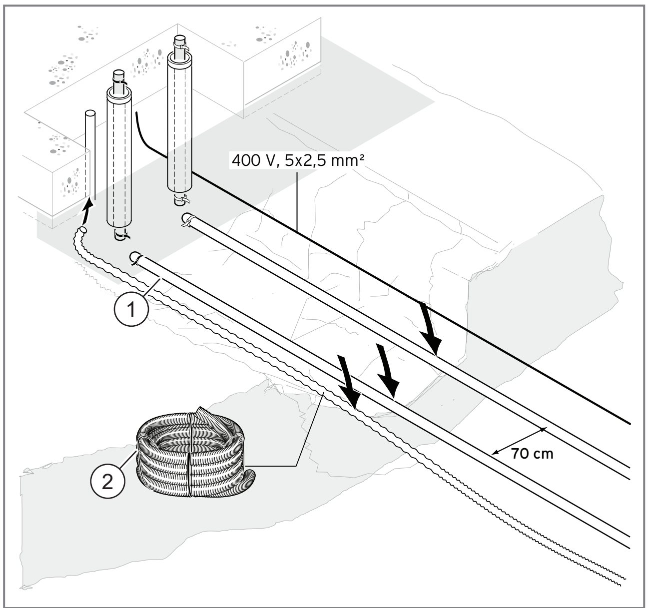


Fig. 144: Installation with the DA40 and DA50 installation set

1 Brine pipes
2 Protective hose for eBUS

Routing the connection pipes

> **Caution.**
> **Risk of material damage caused by ground lifting up as a result of frozen ground.**
> At operating temperatures close to freezing level, the ground in the area of the PE pipes may freeze and therefore damage the structure as a result of the ground lifting up.
> Insulate all of the PE lines that are to be routed under buildings, terraces, pathways, etc. so that they are vapour-diffusion-tight.
> If possible, route PE pipes in the ground with a clearance of 70 cm from each other and from adjacent supply lines (except for electrical lines).

The total length (connection pipes from the heat pump to the product and from the product to the heat pump) must be no greater than 60 m.

- » Keep the clearance between the product and the heat pump as short as possible and minimise the use of elbows and angles. This is because each additional pressure loss that is caused by the use of these reduces efficiency.
- » Route the PE pipes in accordance with the applicable technical directives.
- » For a total line length of between ≥20 m and 60 m, use a PE pipe with DN 50 (e.g. PE 80/100, outer diameter 50 mm, wall thickness 4.6 mm). Up to a total line length of ≤20 m, you can also use a PE pipe with DN 40 (e.g. PE 80/100, outer diameter 40 mm, wall thickness 3.7 mm).
- » When using more than eight PE elbows, use an extra 2 m of pipeline for each elbow.
- » When using copper pipes, use only copper pipes that have a cross-section of ≥35 mm. If you use a smaller cross-section (e.g. copper 28 mm), this will result in pressure losses (2 m copper 28 = 8 m copper 35).
- » If required, when routing the PE pipes above-ground, ensure that they are protected against UV radiation.

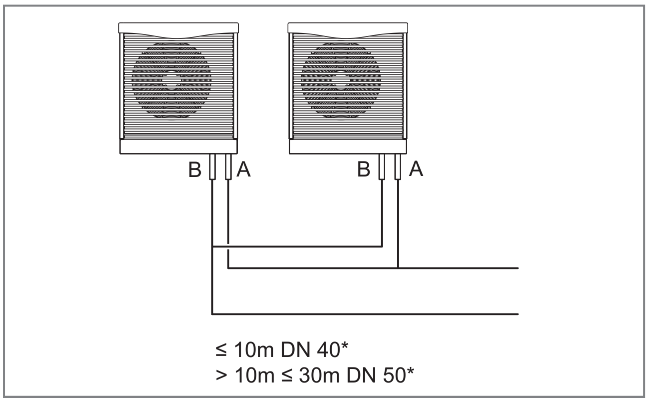


Fig. 145: Installing two air/brine collectors

* = one way

» Connect the air/brine collector in accordance with the Tichelmann principle. This means that the air/brine collector with the shorter flow has the longest return.

Caution.
Risk of material damage caused by a leak.
When tightening screwed connections, ensure that O-rings are inserted correctly as, otherwise, they may pop out or become jammed, become damaged, or cause leaks. Insert the O-rings properly and untwisted into the cap nuts for the air/brine collector's brine connections.

» Screw the union nuts to the connection adaptors on the „hot brine“ and „cold brine“ brine lines in the brine circuit (cross-reference) on the mounting base.
» To purge each individual air/brine collector, install two shut-off units.

Installing the product

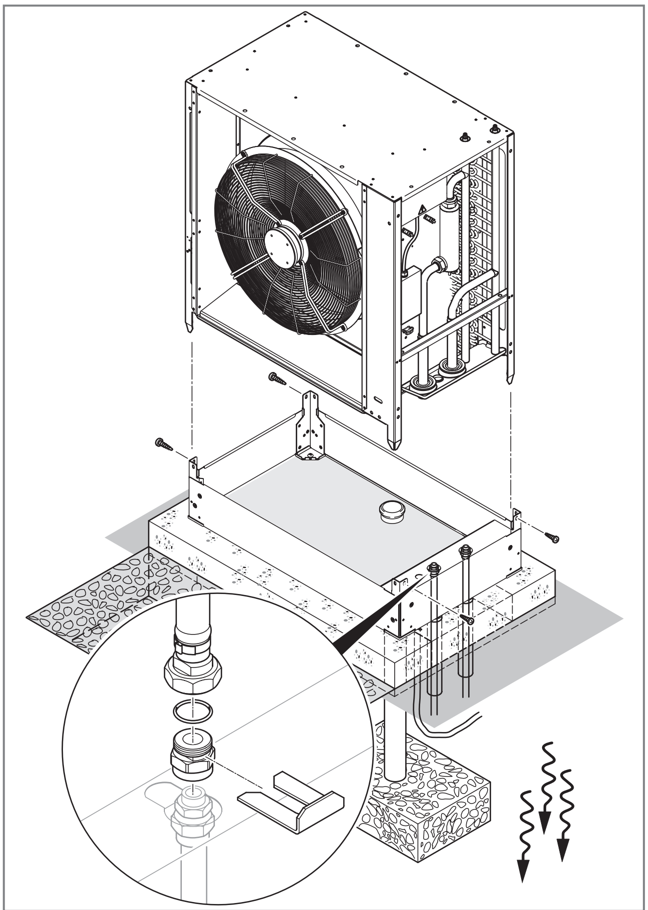


Fig. 146: Installing the product

1. Place the product on the base that is available as an accessory.
2. Connect the brine lines to the product as shown.
3. Screw the product to the base.

Installing brine lines in the building

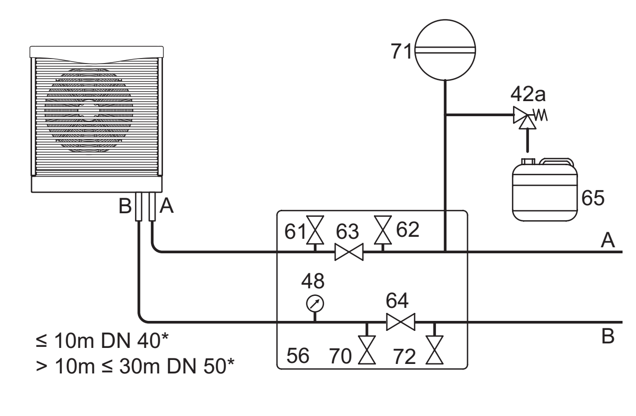


Fig. 147: Fittings in the brine circuit

42a Expansion relief valve
48 Pressure gauge
56 Heat pumps for brine filling unit (accessory)
61 Stop valve
62 Stop valve
63 Stop valve
64 Stop valve
65 Brine collecting container
70 Stop valve
71 Brine diaphragm expansion tank
72 Stop valve
A From the heat source to the heat pump (hot brine)
B From the heat pump to the heat source (cold brine)
* One way

1. Install the brine lines between the product and the heat pump within the building and using all of the associated components in accordance with the applicable technical directives.

Note
Do not install dirt filters in the brine circuit for a prolonged period of time. The brine fluid is cleaned during the filling process.

2. Reduce the pre-charge pressure of the brine diaphragm expansion tank (which is available as an accessory) from 0.25 MPa (2.5 bar) to 0.10 MPa (1.0 bar).
3. Insulate all of the brine lines and the connections for the heat pump and product so that they are vapour-diffusion-tight.

Note
Vaillant recommends that you install the Vaillant heat pump brine filling unit. By doing this, it is then possible to carry out a preparatory partial bleed of the brine circuit, e. g. the flow and return of the brine circuit to the product.

On-roof installation

Vaillant recommends the VWZ EH heating element.

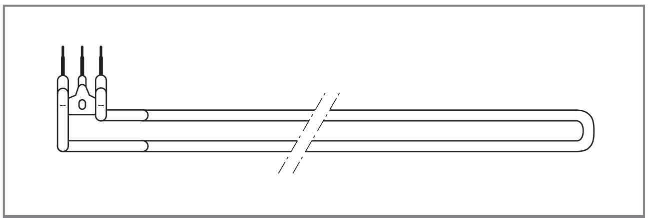


Fig. 148: VWZ EH heating element

Installing elevated bases is not recommend due to increased wind loads.

9.3 Planning the installation site for aroTHERM and aroTHERM split

Complying with minimum clearances

» To guarantee sufficient air flow and to facilitate maintenance work, observe the minimum clearances that are specified.
» Ensure that there is sufficient room to install the hydraulic lines.

Minimum clearances, floor installation and flat roof installation

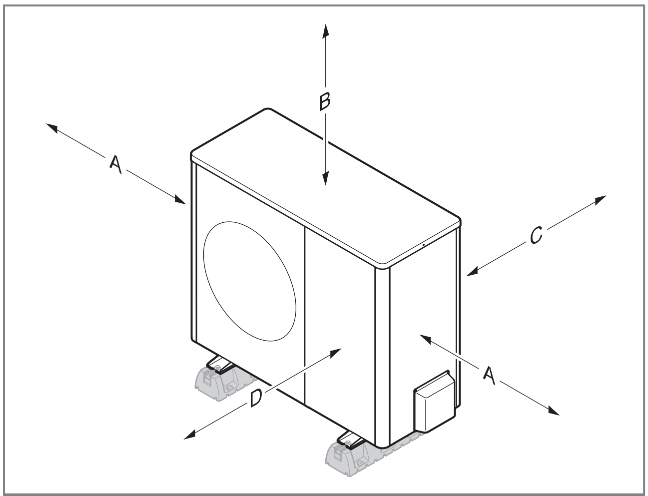


Fig. 149: Floor installation and flat roof installation

Minimum clearances

Minimum clearance	Heating mode	Heating and cooling mode
A	500 mm	500 mm
B	1000 mm	1000 mm
C	120 mm [1)]	250 mm
D	600 mm	600 mm

1) 250 mm is recommended for dimension C in order to guarantee good access during the electrical installation.

Minimum clearances, wall-mounting

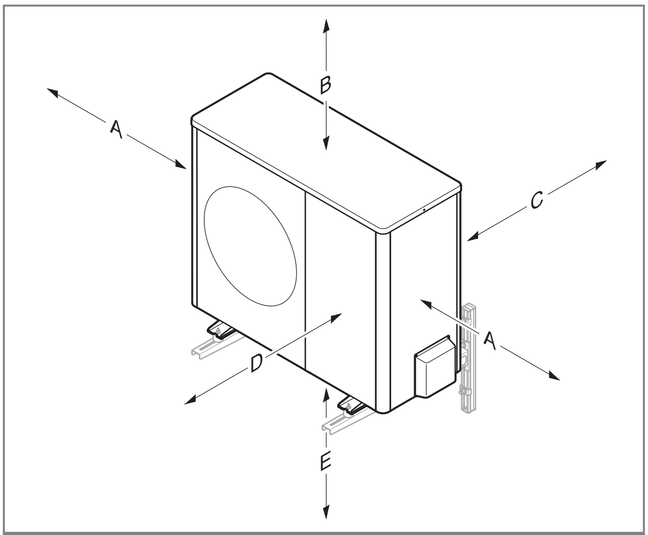


Fig. 150: Wall-mounting

Minimum clearances

Minimum clearance	Heating mode	Heating and cooling mode
A	500 mm	500 mm
B	1000 mm	1000 mm
C	120 mm [1)]	250 mm
D	600 mm	600 mm
E	300 mm	300 mm

1) 250 mm is recommended for dimension C in order to guarantee good access during the electrical installation.

Conditions for the installation type

The product is suitable for these installation types:

- Floor installation
- Wall-mounting
- Flat roof installation

The following conditions must be observed for this installation type:

- Wall-mounting with the wall bracket from the accessories is not permitted for products VWL 105/5 and VWL 125/5.
- The flat roof installation is not suitable for extremely cold or snowy regions.

Requirements for the installation site

Danger!
Risk of injury due to ice formation.
The air temperature at the air outlet is below the outdoor temperature. This can lead to ice formation.
Select a site and an orientation at which the air outlet is at least 3 m away from walkways, plastered surfaces and down-pipes.

- Observe the permissible height difference between outdoor unit and indoor unit.
- Keep away from flammable substances or flammable gases.
- Keep away from heat sources. Avoid using preloaded extract air (e.g. from an industrial plant or bakery).
- Keep away from ventilation openings or extract-air shafts.
- Keep away from deciduous trees and shrubs.
- Do not expose the outdoor unit to dusty air.
- Do not expose the outdoor unit to corrosive air. Keep away from animal stalls or stables. Maintain a distance of at least 1 km from the seashore.
- Please note that the installation site must be below 2000 m above sea level.
- Please note the noise emissions. Maintain sufficient clearance from noise-sensitive areas of the adjacent building. Select a location that is as far away from the windows of adjacent building as possible. Select a location that is as far away from your own bedroom as possible.

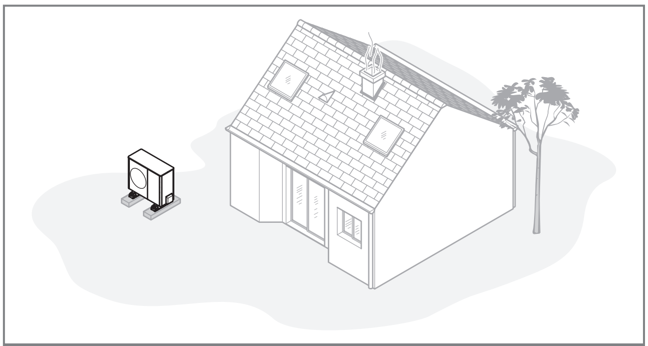


Fig. 151: Floor installation

- Avoid choosing an installation site that is in the corner of a room, between walls or between fences.
- Prevent the return intake of air from the air outlet.
- Ensure that water cannot collect on the subsoil. Ensure that the subsoil can absorb water well.
- Plan a bed of gravel and rubble for the condensate discharge.
- Select a site which is free from significant accumulations of snow in winter.
- Select a site at which the air inlet is not affected by strong winds. Position the unit as crosswise to the main direction of wind as possible.
- If the installation site is not protected against the wind, you should plan to set up a protective wall.
- Please note the noise emissions. Avoid corners of rooms, recesses or sites between walls. Select a site with excellent sound absorption (e.g. thanks to grass, hedges, fencing).
- Route the hydraulic lines and electrical wires underground. Provide a safety pipe that leads from the outdoor unit through the wall of the building.

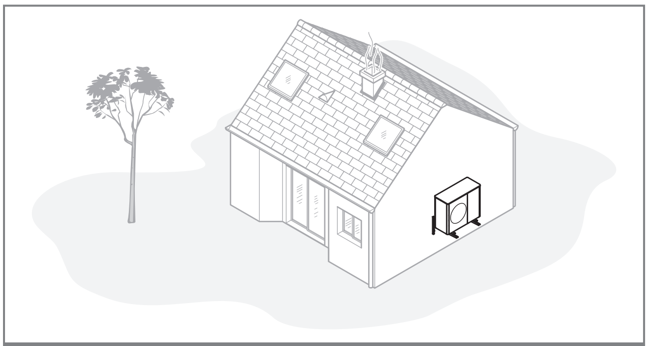


Fig. 152: Wall-mounting

» Ensure that the wall fulfils the static requirements. Please note the weight of the wall bracket (accessory) and the outdoor unit.
» Avoid choosing an installation position which is near to a window.
» Please note the noise emissions. Maintain sufficient clearance from reflective building walls.
» Route the hydraulic lines and electrical wires. Provide a wall duct.

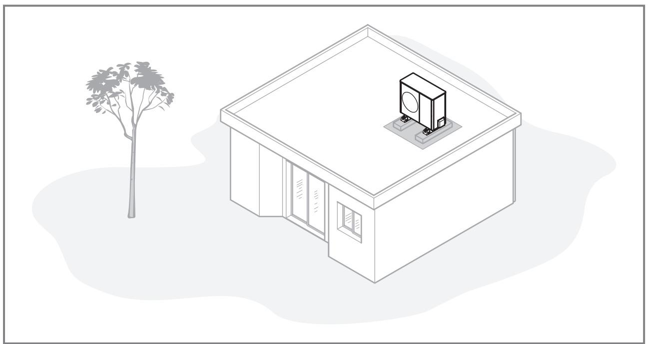


Fig. 153: Flat roof installation

» Only install the product in buildings with a solid construction and that have cast concrete ceilings throughout.
» Do not install the product in buildings with a wooden structure or with a lightweight roof.
» Select a location that is easily accessible so that maintenance and service work can be carried out.
» Select a location that is easily accessible so that foliage or snow can be regularly removed from the product.
» Select a location that is close to a downpipe.
» Select a site at which the air inlet is not affected by strong winds. Position the unit as crosswise to the main direction of wind as possible.
» If the installation site is not protected against the wind, you should plan to set up a protective wall.
» Please note the noise emissions. Maintain sufficient clearance from adjacent buildings.

» Route the hydraulic lines and electrical wires. Provide a wall duct.

Floor mounting

Creating a foundation

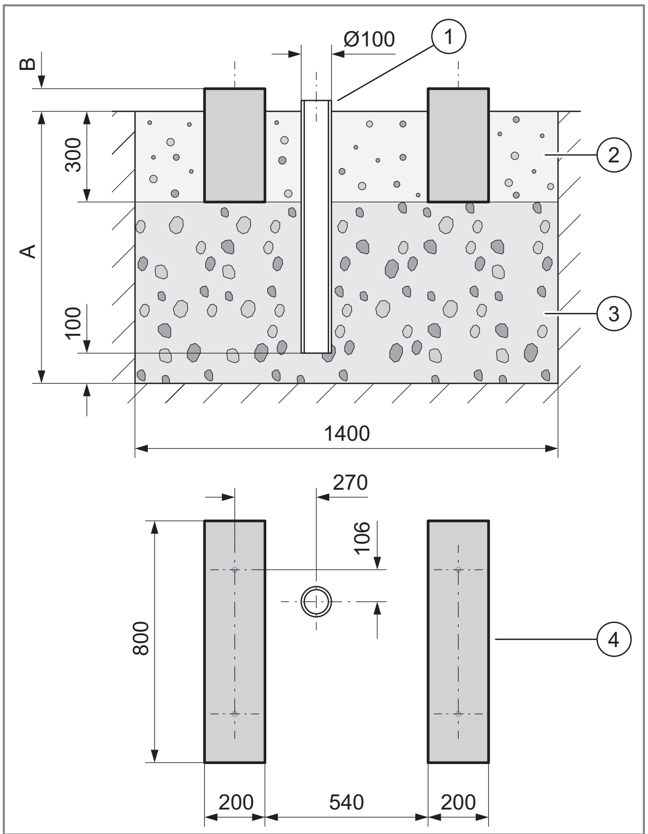


Fig. 154: Creating a foundation

» Dig a hole in the ground. The recommended dimensions can be found in the illustration.
» Insert a downpipe **(1)** (diversion of the condensate).
» Add a layer of coarse rubble **(3)** (water-permeable, frost-free foundation). Calculate the depth **(A)** in accordance with local conditions.
  – Minimum depth: 900 mm
» Calculate the height **(B)** in accordance with local conditions.
» Create two concrete strip foundations **(4)**. The recommended dimensions can be found in the illustration.
» Place a gravel bed **(2)** between and beside the strip foundations (for condensate drainage).

Installing the product, small rubber feet

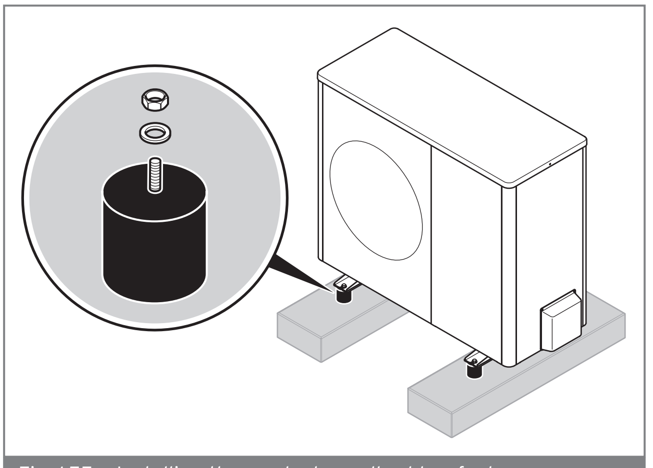


Fig. 155: Installing the product, small rubber feet

1. Use the small rubber feet from the accessories. Use the enclosed set-up instructions.
2. Screw the rubber feet to the foundation.
3. Install the product. Align the product exactly horizontally.
4. Screw the rubber feet to the product.

Installing the product, large rubber feet

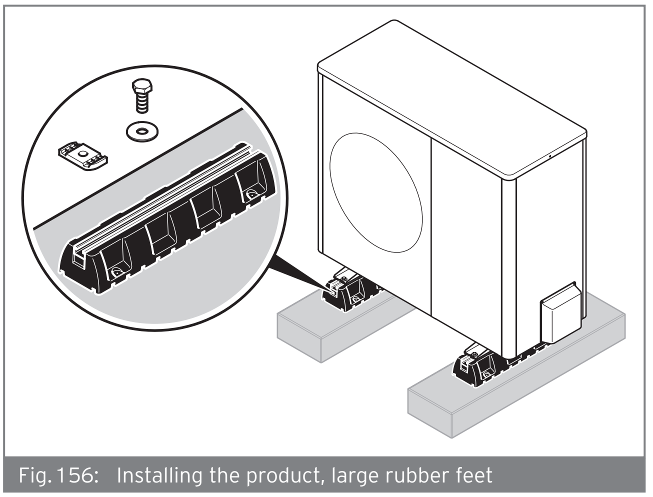


Fig. 156: Installing the product, large rubber feet

1. Use the large rubber feet from the accessories. Use the enclosed set-up instructions.
2. Screw the rubber feet to the foundation.
3. Install the product. Align the product exactly horizontally.
4. Screw the rubber feet to the product.

Setting up the product, raised base for snowy regions

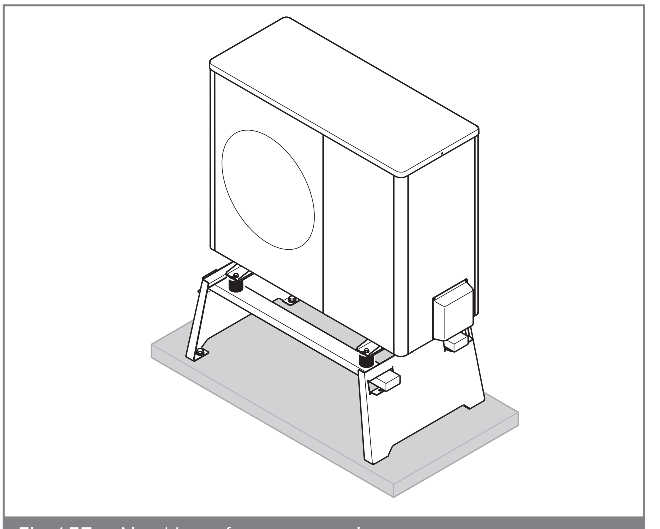


Fig. 157: Aised base for snowy regions

1. Use the raised base from the accessories. Use the enclosed set-up instructions.
2. Screw the raised base to the foundation.
3. Install the product. Align the product exactly horizontally.
4. Screw the raised base to the product.

Preparing the condensate discharge

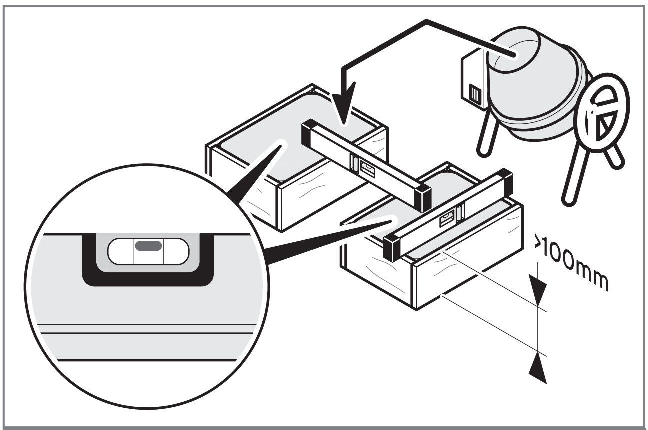


Fig. 158: Condensate discharge

Danger!
Risk of injury due to frozen condensate.
Frozen condensate on paths may cause falls.
Ensure that condensate does not discharge onto paths and that ice cannot build up there.

The condensate is discharged centrally underneath the product.

The condensate is heated inside the product and routed into the condensate discharge.

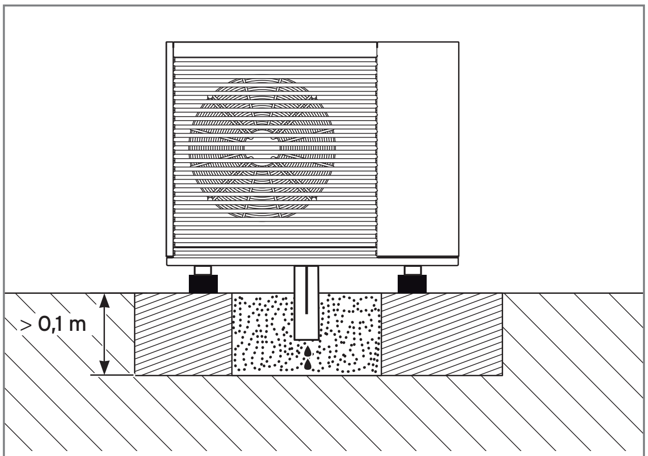


Fig. 159: Gravel bed condensate discharge

» Prepare the condensate discharge using a drain line or in a gravel bed.

Connecting the condensate drain pipework

Note
Observe all valid national regulations and rules.

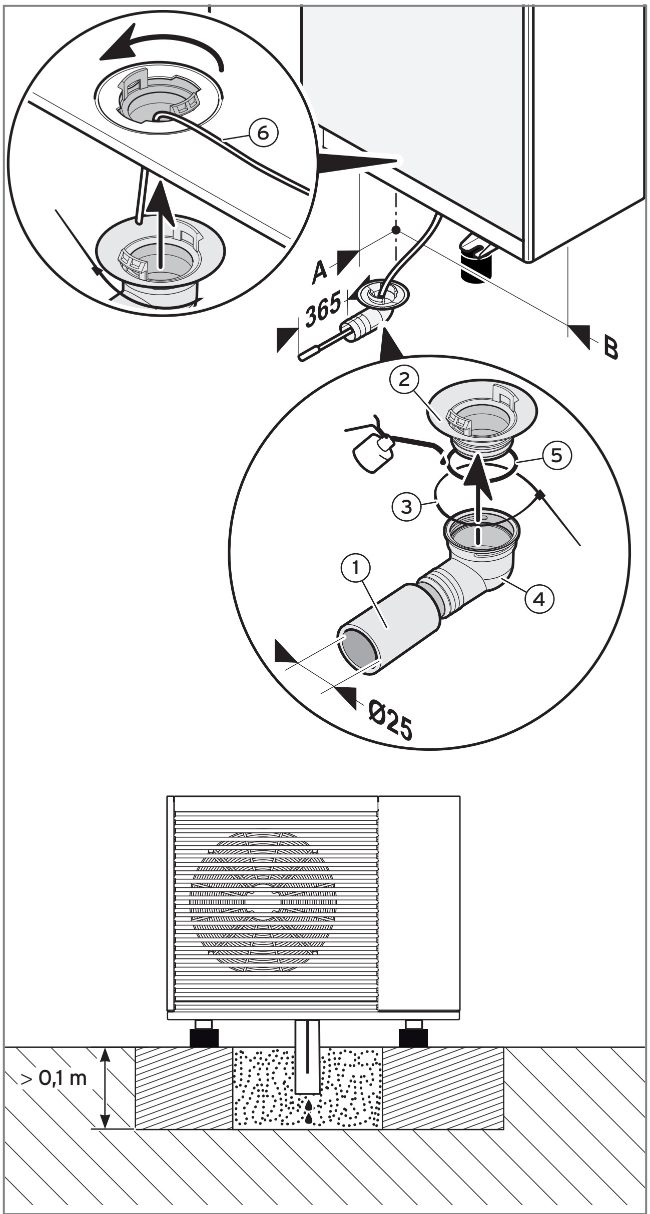


Fig. 160: Connecting the condensate discharge

1 Condensate drain pipe
2 Adaptor
3 Cable tie
4 Elbow
5 Seal
6 Heating wire

1. Observe the various installation dimensions for the products.
2. Pull the heating wire **(6)** in the condensate pan until it is in the elbow **(4)**.
3. Connect the elbow **(4)** and adaptor **(2)** to the seal **(5)** and secure them both using a cable tie **(3)**.
4. Connect a condensate drain pipe to the elbow.
5. Install the heating wire in the condensate drain pipe **(1)** in order to prevent the condensate from freezing in the line.
6. Connect the adaptor **(2)** with the product‘s floor plate and secure it with a 1/4 rotation.
7. Make sure that the condensate drain pipe ends in a gravel bed.

Note
The condensate drain pipe must not be longer than 365 mm, otherwise it may freeze over.

8. Route the condensate drain pipework with a downward gradient.

Wall-mounting

Installing the product

Applicability: Product VWL 35/5 to VWL 75/5

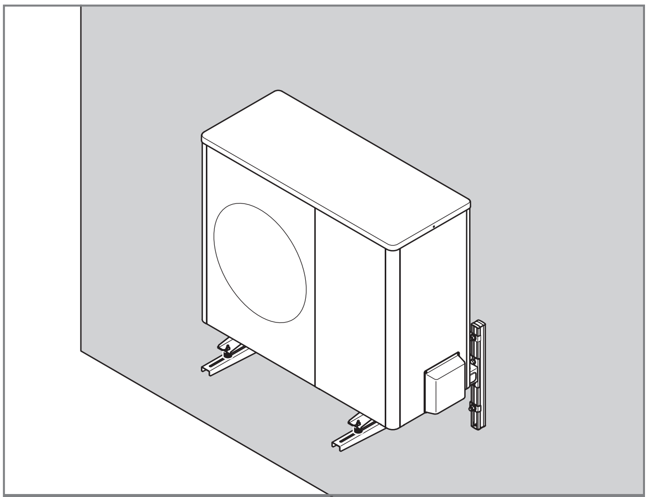
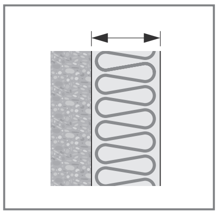
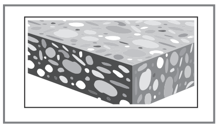
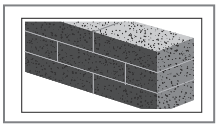
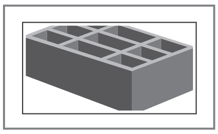
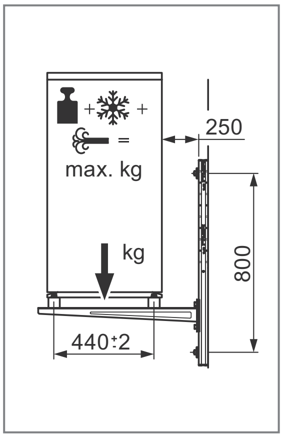


Fig. 161: Wall-mounting

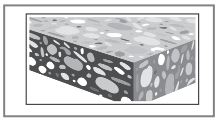
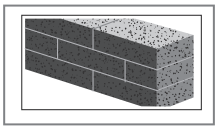
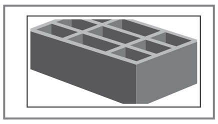
1. Check the design and load-bearing capacity of the wall. Note the weight of the product.
2. Use the wall bracket that is suitable for wall mounting from the accessories. Use the enclosed set-up instructions.
3. Ensure that the product is aligned exactly horizontally.

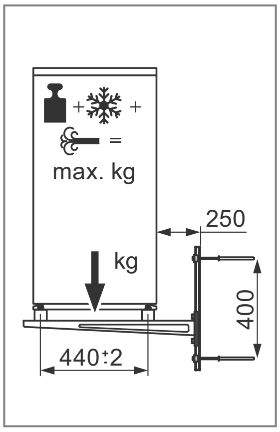
Wall-mounting for insulated walls

Max. 160 mm		EN 771	DIN 105	Hilti	Max. kg
		Min. C20/25	Min. C20/25	HIT HY 170 + HIK HIT-C-F M12 x 450 10.9	173 kg
		CL 12 G1 B 0.11 240 x 115 x 113 CS 12 G1 B 0.11 240 x 115 x 113	KS12, 2DF & MZ12, 2DF	HIT HY 170 + HIK HIT-C-F M12 x 450 10.9	
		-	-	Query at Hilti required	< 173 kg



Wall-mounting for uninsulated walls

	EN 771	DIN 105	Hilti	Max. kg
	Min. C16/20	Min. C16/20	HRD-HR 10 x 140	173
	CL 12 G1 B 0.11 240 x 115 x 113 CS 12 G1 B 0.11 240 x 115 x 113	K12, 2DF & MZ12, 2DF	x	
	-	-	Query at Hilti required	< 173



Installing the condensate discharge pipe

Danger!
Risk of injury due to frozen condensate.
Frozen condensate on paths may cause falls. Ensure that condensate does not discharge onto paths and that ice cannot build up there.

1. Connect the condensate discharge tundish to the product's floor plate, and secure this in place by turning it by a 1/4 rotation.
2. Below the product, create a gravel bed into which any condensate can drain.

Flat roof installation

Installing the product

1. Use the large rubber feet from the accessories. Use the enclosed set-up instructions.
2. Align the product exactly horizontally.

Installing the condensate discharge pipe

1. Connect the condensate discharge pipe to a downpipe over a short distance.
2. Depending on the local condition, install electrical trace heating in order to keep the condensate discharge pipe frost-free.

Planning information for flat roof installation

The components of the heat pump must always be accessible in order to carry out maintenance work.

When accessing the roof installation from inside (e.g. via a light dome), you must also guarantee the minimum access route (b).

The movement space (d) up to and around the unit must be designed to be non-slip without a risk of damage to the roof skin.

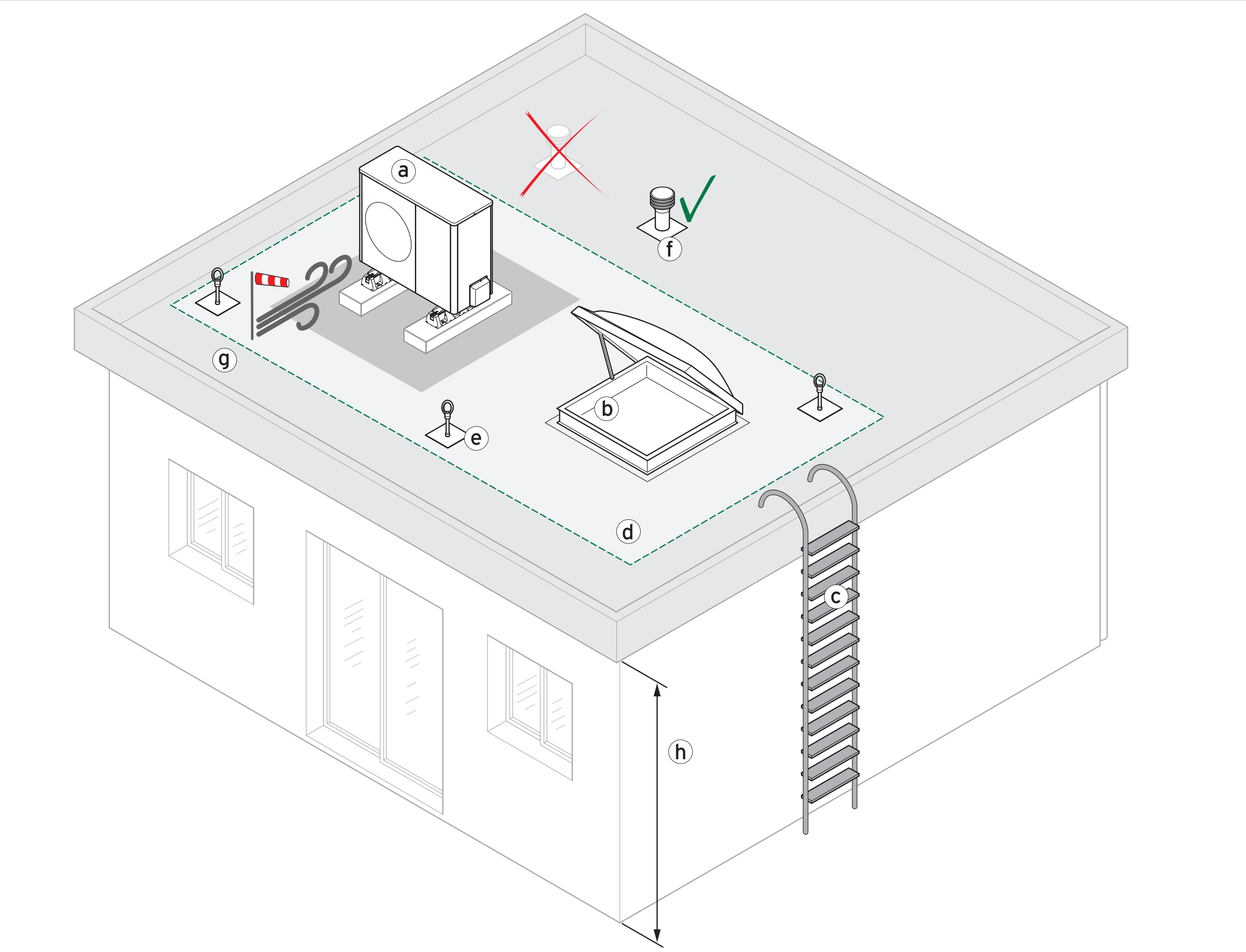


Fig. 162: Flat roof installation

Secure the heat pump to concrete slabs in order to prevent the roof skin from being damaged. The number and weight of the slabs depends on the heat pump's output.

- 5 kW = min. 155 kg
- 8 kW = min. 200 kg
- 15 kW = min. 344 kg

When work is carried out, moisture and dirt must be prevented from getting into the room below.

When installing the unit (a) above a height of 2.5 m (e.g. flat roofs), special prerequisites apply. The feasibility must be clarified beforehand. Above a height of 2.5 m (h), the secured ladder (c) must be designed in such a way that start-up, maintenance and repair work can be carried out by one person with the required tool and material, even in snowy conditions. In addition, a proper fixing device (e) must be available for personal safety.

Note the following points:
- Do not set up the unit at the edge of the roof (g)
- Duct ventilation (f) must not occur in the intake area of the heat pump
- Discharge must not occur towards the light dome
- Condensate discharge must be guaranteed
- Discharge must not occur against the main direction of wind

Routing refrigerant pipes

Outdoor unit

Conditions: Floor installation

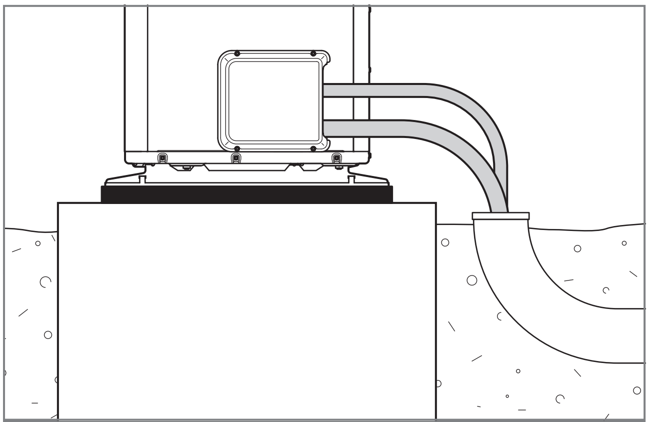


Fig. 163: xxx

» Route the refrigerant pipe from the outdoor unit through a suitable safety pipe in the ground, as shown in the figure.
» Bend the pipes only once into their final position. Use a bending spring or a bending tool to avoid kinks.

Conditions: Wall-mounting

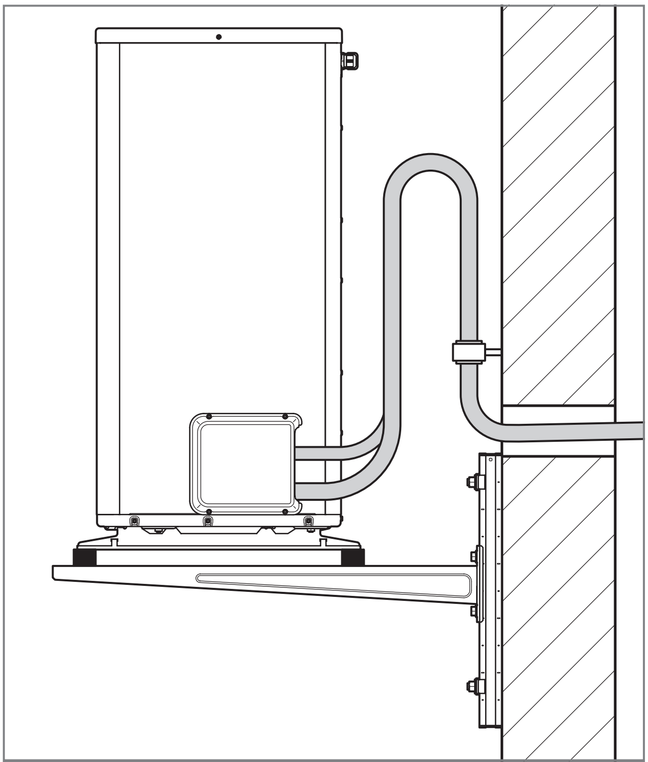


Fig. 164: xxx

» Route the refrigerant pipes from the outdoor unit through the wall of the building.
» Bend the pipes only once into their final position. Use a bending spring or a bending tool to avoid kinks.
» Ensure that any vibration is balanced. To do so, bend the pipes in such a way that an omega-shaped elbow is created, as shown in the figure.
» Ensure that the refrigerant pipes do not come into contact with the wall.
» To secure these, use an insulated wall bracket (cold insulation bracket).
» Route the refrigerant pipes in the wall duct with a slight downward gradient to the outside.

Indoor unit

» Route the refrigerant pipes from the wall duct to the indoor unit (see installation instructions for the indoor unit).

Snow load

Snow load zones

The characteristic values for snow loads (Sk) are determined for regional zones (snow load zones) which have different intensities.

A distinction is made between five different snow load zones: Zone 1, 1a, 2, 2a and 3. The intensity of the snow loads increases from zone 1 to zone 3.

In the North German Plain, snow loads of up to multiple times the calculated values are measured in rare cases. The relevant authority can fix the calculated values in the regions in question and these values must then also be assessed as extraordinary effects according to DIN EN 1991-1-3/NA: 2010-12.

Certain locations in snow load zone 3 may also see values higher than those derived from the equation. You can get information on the snow load in these locations from the relevant local authorities. This concerns, for example, areas such as the Harz Mountains or high-altitude regions in the Fichtel Mountains, Reit im Winkl, Obernach am Walchensee, etc.

(Source: http://schneelast.info/node/1)

The snow load zones can be found in the following table.

Town/city	Snow load zone	Height in metres above mean sea level
Aachen	2	173
Augsburg	1a	494
Bergisch Gladbach	1	129
Berlin	2	34
Bielefeld	2	120
Bochum	1	93
Bonn	1	60
Bottrop	1	49
Brunswick	2	74
Bremen	2	3
Bremerhaven	2	0
Chemnitz	3	309
Cottbus	2	71
Darmstadt	1	144
Dortmund	1	93
Dresden	2	113
Duisburg	1	32
Düsseldorf	1	36
Erfurt	2	195
Erlangen	2	326
Essen	1	77
Frankfurt	1	117
Freiburg	2	273
Fürth	2	293
Gelsenkirchen	1	43
Gera	2	204
Hagen/Hamm (Westph.)	2 (1)	156
Halle	2	89

Town/city	Snow load zone	Height in metres above mean sea level
Hamburg	2	6
Hanover	2	55
Heidelberg	1	114
Heilbronn	2	188
Herne	1	61
Hildesheim	2	88
Ingolstadt	1a	372
Jena	2	179
Kaiserslautern	2	253
Karlsruhe	1	119
Kassel	2	164
Kiel	2	5
Koblenz	1	72
Cologne	1	53
Krefeld	1	39
Leipzig	2	112
Leverkusen	1	52
Lübeck	2	9
Ludwigshafen	1	97
Magdeburg	2	50
Mainz	1	110
Mannheim	1	101
Moers	1	30
Mönchengladbach	1	55
Mülheim	1	263
Munich	1a	518
Münster	1	55
Neuss	1	43
Nuremberg	1	309
Oberhausen	1	48
Offenbach (Main)	1	106
Oldenburg	2	8
Osnabrück	2	97
Paderborn	2	159
Pforzheim	2	290
Potsdam	2	70
Recklinghausen	1	76
Regensburg	1a	359
Remscheid	2	312
Reutlingen	2	379
Rostock	3	13
Saarbrücken	1a	190
Salzgitter	2	107
Schwerin	2	38
Siegen	2a	290
Solingen	1	188
Stuttgart	2	245
Ulm	1	478
Witten	1	135
Wolfsburg	2	63
Wuppertal	1	244
Würzburg	1	177
Zwickau	2	267

Calculating the snow loads (Sk)

The following formula is used to determine the value for snow loads (S_k) based on the snow load zone. If the calculated value is smaller than the minimum value, this calculated value must be adopted.

You can find information on snow load zones, for example, at: www.schneelast.info.

Calculating the snow loads

Snow load zone	Calculation formula	Minimum snow load value in kN/m²
Zone 1	S_k = 0.19 + 0.91 x ((A+140)/760)^2	> 0.65 (kN/m^2)
Zone 1a	S_k = 1.25 x [0.19 + 0.91 x ((A+140)/760)^2]	> 0.81 (kN/m^2)
Zone 2	S_k = 0.25 + 1.91 x ((A+140)/760)^2	> 0.85 (kN/m^2)
Zone 2a	S_k = 1.25 x [0.25 + 1.91 x ((A+140)/760)^2]	> 1.06 (kN/m^2)
Zone 3	S_k = 0.31 + 2.91 x ((A+140)/760)^2	> 1.10 (kN/m^2)
*A = Ground level in metres above sea level		

Checking the installation site (snow load zone and height above mean sea level)

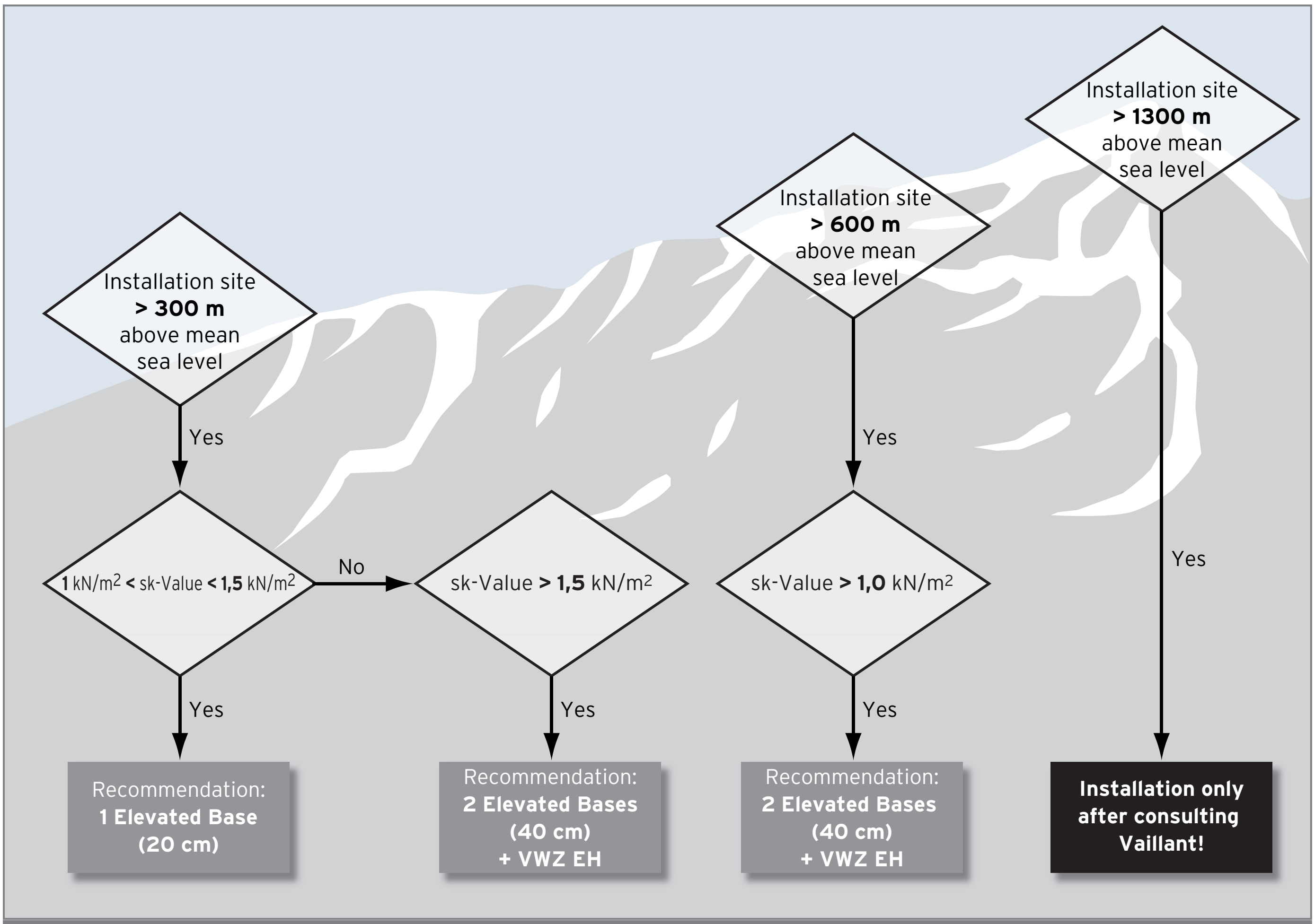


Fig. 165: Checking the installation site

9.4 Noise emissions

In contrast to brine-to-water heat pumps and water-to-water heat pumps, the noise emissions have to be taken into account when planning for air/water heat pumps.

The sound power level and the sound pressure level are used to assess the noise emission. The following parameters have an effect on the noise emission and should be taken into account in planning.

- Heat pump
- Transmission characteristics of the noise
  - Airborne noise
  - Structure-borne noise
- Installation conditions
  - Outdoor installation
- Surroundings
  - Sound propagation in user's own dwelling
  - Noise emission into neighbouring buildings

Noise transmission in the building

Sound can propagate in a building through:

- Structure-borne noise via the floor and walls
- The surrounding air

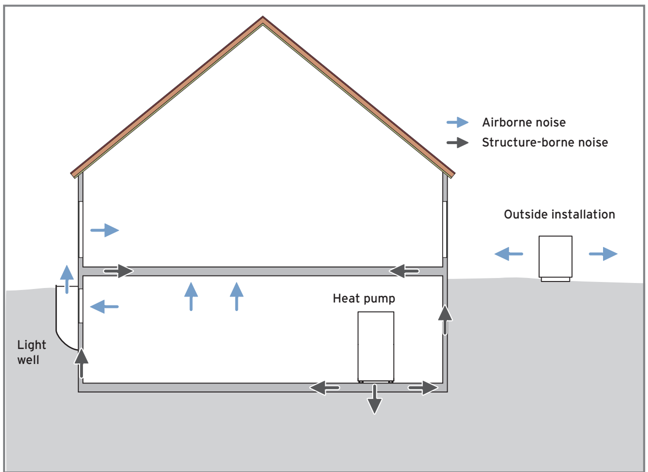


Fig. 166: Noise transmission paths in the building

Measures for reducing noise in the building

In order to keep vibrations and noise in the building to a minimum, heat pumps should be optimally isolated from the shell of the building. Installing heat pumps on lightweight construction ceilings/floors or a wooden ceiling should generally be avoided.

Good sound insulation can be achieved using a concrete foundation plate with a rubber mat placed underneath. In the case of floating screed flooring, screed flooring and impact sound insulation around the heat pump should be omitted.

Due to their resonance effect, conventional „boiler pedestals" are not a suitable noise control measure for heat pumps.

In extremely reverberative rooms (e.g. a fully tiled room), installing sound-absorbing materials can reduce the sound that is transmitted to other rooms.

No underfloor heating should be routed below the heat pump.

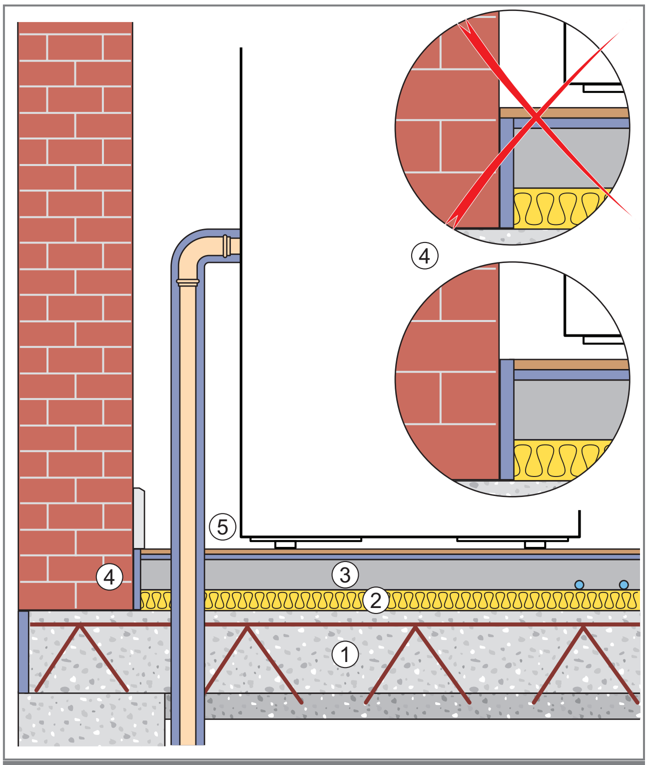


Fig. 167: Decoupling the heat pump - concrete ceiling

1 Concrete ceiling
2 Impact sound insulation
3 Floating screed
4 Edge insulation strips
5 Connection pipe with heat insulation

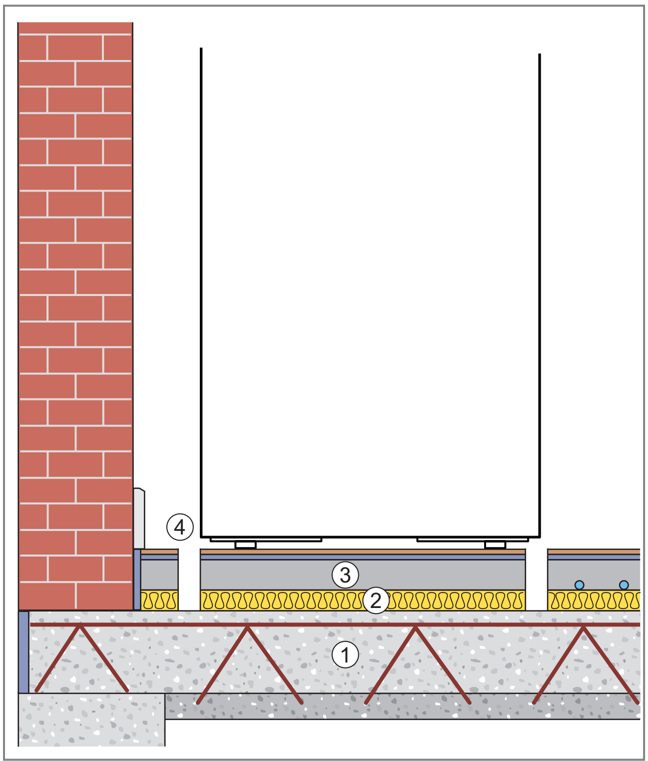


Fig. 168: Decoupling the heat pump with foundation

1 Concrete ceiling
2 Impact sound insulation
3 Foundation
4 Cut-out

Noise transmission outside buildings

The noise outside of buildings propagates through the atmosphere.

Noise propagation is affected by the meteorological conditions and the acoustic properties of the floor.

When positioning heat pumps, take account of the Noise Level Ordinance and the local regulations.

Decrease in noise level depending on distance

Converting sound power level to sound pressure level:

Depending on the ambient conditions, the sound pressure level at a distance of 1 m away may be around 5 dB(A) - 8 dB(A) lower than the sound power level.

Limit values for trade and industry, values given in dB(A)

Type of area	Permitted max. sound pressure level L_{WA} in dB(A)	
	Day	Set-back
Hospitals, spas	45	35
Schools, retirement homes	45	35
Small gardens, parks	55	55
Purely residential areas	50	35
General residential areas	55	40
Small housing estates	55	40
Special residential areas	60	40
Town centre districts	60	45
Village locations	60	45
Mixed areas	60	45
Commercial/industrial areas	65	50
Industrial areas	70	70

Noise reduction function

The system is equipped with a noise reduction function, using which the compressor speed can be lowered during night-time operation in order to counteract unacceptably high noise emission levels.

Up to three time periods for noise reduction can be set on the **VRC 700** system control. Within these time periods, the sound pressure level of the heat pump is reduced by approx. 3 dB by lowering the compressor speed (aroTHERM).

This noise reduction function is generally intended to ensure that there are still ways of reducing noise in difficult ambient conditions (sensitive neighbours, relatively close proximity of buildings with unfavourable alignment. etc.). If that „reserve capability“ is already utilised in the planning calculations, there will be virtually no capacity for responding to any complaints about noise at a later stage.

Ambient conditions

Noise propagation in user's own dwelling

Propagation of noise from the heat pump in the user's home depends on the installation location of the heat pump and the air/water collector, and the noise-insulating properties of the building walls, ceilings and floors. As well as airborne noise, structure-borne noise must also be taken into account.

With walls that have a mass per unit area of less than 200 kg/m², lightweight construction walls and dry-lined walls in particular, a mounting frame for installing the heat pump pre-wall should be used in order to prevent vibrations and the resulting noise emissions.

The mounting frame is fixed only to the wall at floor and ceiling level in order to minimise vibration. The heat pump should not be installed in the immediate vicinity of noise-sensitive rooms (e.g. bedrooms, living rooms).

Airborne noise transmission is the primary consideration for the air/water collector. That too is dependent on the installation location and the noise insulation properties of the building walls, ceilings and floors.

Noise emission into neighbouring buildings

Where heat pumps are installed outside, air must be prevented from being blown out directly into neighbouring properties (terraces, balconies, bedroom windows, etc.).

Rooms requiring noise protection

Rooms requiring noise protection are living rooms that require protection against noises, e.g.:

- Living rooms, including lounges, breakfast kitchens;
- Bedrooms, including bedrooms in short-stay accommodation;
- Wards in hospitals and sanatoriums;
- Classrooms in schools, in universities and similar establishments;
- Offices (excluding open-plan offices);
- Consulting rooms, meeting rooms and similar work rooms

Measuring point

The definitive noise emissions location is 0.5 m in front of the centre of the opened window (outside of the building) of the affected room that requires most noise protection. They must be determined using the site plan and must be checked on site.

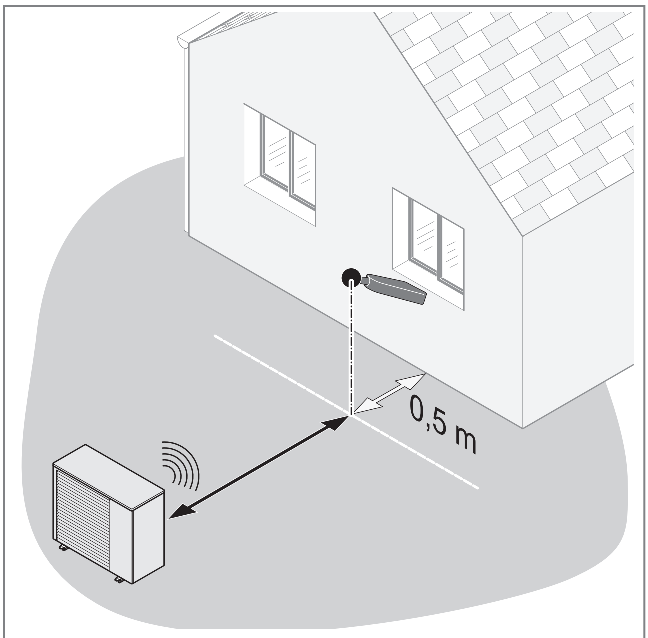


Fig. 169: Measuring point

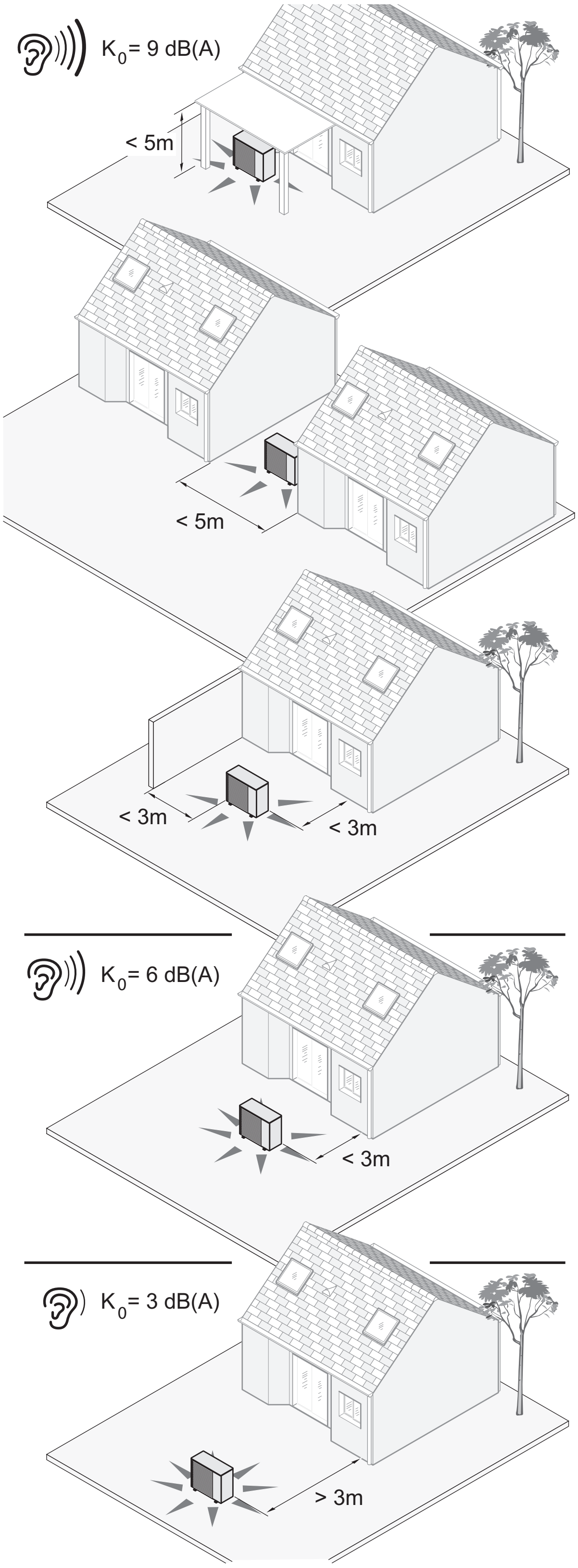
Sound reflection in outdoor areas

When installing air/water heat pumps, the sound pressure level can sometimes be increased by unfavourable circumstances. Unfavourable surface materials, such as concrete, paving or asphalt, may increase the sound pressure level by reflection.

In particular, the number of adjacent vertical surfaces substantially increases the sound pressure level compared to ground installation.

The guide factor rises exponentially from ground installation and wall installation to installation in a corner, as the graphic shows. It shows the sound pressure level of an outdoor unit in dB(A) in relation to the distance away and the fan speed for the different types of heat pump in open air installation.

Additional allowances for the sound pressure level depending on the installation situation



Room angle dimension K_0

The values shown apply in exactly the same way for the air outlet on a heat pump that is installed indoors.

+9 dB(A) heat pump under a canopy
Height of the canopy up to 5 m

+9 dB(A) heat pump between two walls
Clearance between the walls up to 5 m

+9 dB(A) heat pump in a corner
Clearance to the unit up to 3 m in each case

+6 dB(A) wall-hung heat pump
Clearance to the unit up to 3 m

+3 dB(A) heat pump installed freely
No wall closer than 3 m

Measures for reducing noise outside of buildings

Planted areas (e.g. lawns or bushes) can noticeably reduce the sound pressure level. Structural barriers (e.g. fences, walls, palisades, etc.) can reduce direct sound propagation.

Note that the installation site for air-to-water heat pump should not be directly below windows of noise-sensitive rooms.

flexoTHERM and flexoCOMPACT sound power levels

For **flexoTHERM** and **flexoCOMPACT** heat pumps with **aroCOLLECT**, planning should take account of the following sound power levels (heating mode).

Sample calculation

$$L_r = L_{w,aeq} + K_T + K_0 - 20 \times \log(s_m) - 11\ dB(A) + K_R$$

Key

$L_{w,aeq}$	Heat pump sound power level in accordance with the manufacturer details
K_T	Supplement for the tone and information incorporation in accordance with the manufacturer details (0/3/6 dB(A)) – country-specific –
K_0	Room angle dimension from the installation situation (increase via reflection by 3/6/9 dB(A)) in accordance with the illustration
s_m	Removing the source of the noise to the definitive emissions location (0.5 m in front of the centre of the opened window of the nearest affected room that requires most noise protection) -11 dB(A): Equivalent sound pressure level on the surface of a ball with a radius of 1 m
K_R	Supplement of 6 dB(A) for times of increased sensitivity (in day mode only) – country-specific –

flexoTHERM VWF 8x/4 and VWL 11/4 SA

flexoTHERM VWF 8x/4 and VWL 11/4 SA manufacturer details		
Day sound power level	$L_{w,aeq,T}$	61 dB(A)
Night sound power level	$L_{w,aeq,N}$	46 dB(A)
Tonality: Audible	K_T	0 dB(A)
Installation conditions:		
Wall-hung heat pump	K_0	6 dB(A)
Distance	S_m	6 m
Increased sensitivity (for day mode only)	K_R	6 B(A)
General residential area:		
Day immission guideline value:		55 dB(A)
Night immission guideline value:		40 dB(A)

Evaluating noise emissions in day mode

$L_{r,T}$ = 61 dB(A) + 0 dB(A) + 6 dB(A) - 20 x log(6) - 11 db(A) + 6 dB(A) = 46.4 dB(A)

The value falls below the guideline value 55 dB(A) for day mode by 8.6 dB(A).

Evaluating noise emissions in night mode:

$L_{r,N}$ = 46 dB(A) + 0 dB(A) + 6 dB(A) - 20 x log(6) - 11 db(A) = 25.4 dB(A)

The value falls below the guideline value for night mode of approx. 40 dB(A) by 14.6 dB(A).

Note
If required, flexoTHERM and flexoCOMPACT with aroCOLLECT can also be operated permanently in noise reduction mode. The reduction in output is max. 5%.

Evaluation level

VWF 5x/4 and VWL 11/4 SA incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWF 5x/4 and VWL 11/4 SA			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	54	3	52.0	46.0	42.5	40.0	38.0	36.4	33.9	32.0	30.4	28.5
		6	55.0	49.0	45.5	43.0	41.0	39.4	36.9	35.0	33.4	31.5
		9	58.0	52.0	48.5	46.0	44.0	42.4	39.9	38.0	36.4	34.5
Set-back	40	3	32.0	26.0	22.5	20.0	18.0	16.4	13.9	12.0	10.4	8.5
		6	35.0	29.0	25.5	23.0	21.0	19.4	16.9	15.0	13.4	11.5
		9	38.0	32.0	28.5	26.0	24.0	22.4	19.9	18.0	16.4	14.5

VWF 8x/4 and VWL 11/4 SA incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWF 8x/4 and VWL 11/4 SA			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	61	3	59.0	53.0	49.5	47.0	45.0	43.4	40.9	39.0	37.4	35.5
		6	62.0	56.0	52.5	50.0	48.0	46.4	43.9	42.0	40.4	38.5
		9	65.0	59.0	55.5	53.0	51.0	49.4	46.9	45.0	43.4	41.5
Set-back	46	3	38.0	32.0	28.5	26.0	24.0	22.4	19.9	18.0	16.4	14.5
		6	41.0	35.0	31.5	29.0	27.0	25.4	22.9	21.0	19.4	17.5
		9	44.0	38.0	34.5	32.0	30.0	28.4	25.9	24.0	22.4	20.5

VWF 11x/4 and VWL 11/4 SA incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWF 11x/4 and VWL 11/4 SA			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	67	3	65.0	59.0	55.5	53.0	51.0	49.4	46.9	45.0	43.4	41.5
		6	68.0	62.0	58.5	56.0	54.0	52.4	49.9	48.0	46.4	44.5
		9	71.0	65.0	61.5	59.0	57.0	55.4	52.9	51.0	49.4	47.5
Set-back	53	3	45.0	39.0	35.5	33.0	31.0	29.4	26.9	25.0	23.4	21.5
		6	48.0	42.0	38.5	36.0	34.0	32.4	29.9	28.0	26.4	24.5
		9	51.0	45.0	41.5	39.0	37.0	35.4	32.9	31.0	29.4	27.5

VWF 15x/4 and 2x VWL 11/4 SA incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWF 15x/4 and 2x VWL 11/4 SA			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	62	3	60.0	54.0	50.5	48.0	46.0	44.4	41.9	40.0	38.4	36.5
		6	63.0	57.0	53.5	51.0	49.0	47.4	44.9	43.0	41.4	39.5
		9	66.0	60.0	56.5	54.0	52.0	50.4	47.9	46.0	44.4	42.5
Set-back	48	3	40.0	34.0	30.5	28.0	26.0	24.4	21.9	20.0	18.4	16.5
		6	43.0	37.0	33.5	31.0	29.0	27.4	24.9	23.0	21.4	19.5
		9	46.0	40.0	36.5	34.0	32.0	30.4	27.9	26.0	24.4	22.5

VWF 19x/4 and 2x VWL 11/4 SA incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWF 19x/4 and 2L 11/4 SA			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	67	3	65.0	59.0	55.5	53.0	51.0	49.4	46.9	45.0	43.4	41.5
		6	68.0	62.0	58.5	56.0	54.0	52.4	49.9	48.0	46.4	44.5
		9	71.0	65.0	61.5	59.0	57.0	55.4	52.9	51.0	49.4	47.5
Set-back	53	3	45.0	39.0	35.5	33.0	31.0	29.4	26.9	25.0	23.4	21.5
		6	48.0	42.0	38.5	36.0	34.0	32.4	29.9	28.0	26.4	24.5
		9	51.0	45.0	41.5	39.0	37.0	35.4	32.9	31.0	29.4	27.5

aroTHERM sound power level

For the **aroTHERM** heat pump, planning should take account of the following sound power levels (heating mode).

VWL 55/3 V incl. increase for tone incorporation (3 dB (A)) and times of increased sensitivity

VWL 55/3			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	58	3	59.0	53.0	49.5	47.0	45.0	43.4	40.9	39.0	37.4	35.5
		6	62.0	56.0	52.5	50.0	48.0	46.4	43.9	42.0	40.4	38.5
		9	65.0	59.0	55.5	53.0	51.0	49.4	46.9	45.0	43.4	41.5
Set-back	55	3	50.0	44.0	40.5	38.0	36.0	34.4	31.9	30.0	28.4	26.5
		6	53.0	47.0	43.5	41.0	39.0	37.4	34.9	33.0	31.4	29.5
		9	56.0	50.0	46.5	44.0	42.0	40.4	37.9	36.0	34.4	32.5

VWL 85/3 V incl. increase for tone incorporation (3 dB (A)) and times of increased sensitivity

VWL 85/3			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	60	3	61.0	55.0	51.5	49.0	47.0	45.4	42.9	41.0	39.4	37.5
		6	64.0	58.0	54.5	52.0	50.0	48.4	45.9	44.0	42.4	40.5
		9	67.0	61.0	57.5	55.0	53.0	51.4	48.9	47.0	45.4	43.5
Set-back	57	3	52.0	46.0	42.5	40.0	38.0	36.4	33.9	32.0	30.4	28.5
		6	55.0	49.0	45.5	43.0	41.0	39.4	36.9	35.0	33.4	31.5
		9	58.0	52.0	48.5	46.0	44.0	42.4	39.9	38.0	36.4	34.5

VWL 115/2 400 V and VWL 115/2 230 V incl. increase for tone incorporation (3 dB (A)) and times of increased sensitivity

VWL 115/2 400 V and VWL 115/2 230 V			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	66	3	67.0	61.0	57.5	55.0	53.0	51.4	48.9	47.0	45.4	43.5
		6	70.0	64.0	60.5	58.0	56.0	54.4	51.9	50.0	48.4	46.5
		9	73.0	67.0	63.5	61.0	59.0	57.4	54.9	53.0	51.4	49.5
Set-back	63	3	58.0	52.0	48.5	46.0	44.0	42.4	39.9	38.0	36.4	34.5
		6	61.0	55.0	51.5	49.0	47.0	45.4	42.9	41.0	39.4	37.5
		9	64.0	58.0	54.5	52.0	50.0	48.4	45.9	44.0	42.4	40.5

VWL 155/2 400 V and VWL 155/2 230 V incl. increase for tone incorporation (3 dB (A)) and times of increased sensitivity

VWL 155/ 400 V and VWL 155/2 230 V			Distance from heat source in m									
Output in %	Sound power level in dB(A)	Guide factor Q	1	2	3	4	5	6	8	10	12	15
			Evaluation level in dB(A)									
Day	66	3	67.0	61.0	57.5	55.0	53.0	51.4	48.9	47.0	45.4	43.5
		6	70.0	64.0	60.5	58.0	56.0	54.4	51.9	50.0	48.4	46.5
		9	73.0	67.0	63.5	61.0	59.0	57.4	54.9	53.0	51.4	49.5
Set-back	63	3	58.0	52.0	48.5	46.0	44.0	45.4	39.9	38.0	36.4	34.5
		6	61.0	55.0	51.5	49.0	47.0	45.4	42.9	41.0	39.4	37.5
		9	64.0	58.0	54.5	52.0	50.0	48.4	45.9	44.0	42.4	40.5

aroTHERM split sound power level

For the **aroTHERM split** heat pump, planning should take account of the following sound power levels (heating mode).

VWL 35/5 V incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWL 35/5 AS 230 V (S2)					Distance from heat source in m									
	Sound power level in dB(A)	K_T	K_R	K_O	1	2	3	4	5	6	8	10	12	15
					Evaluation level									
Day mode	55	0	6	3	53	47	43.5	41	39	37.4	34.9	33	31.4	29.5
				6	56	50	46.5	44	42	40.4	37.9	36	34.4	32.5
				9	59	53	49.5	47	45	43.4	40.9	39	37.4	35.5
Night mode	47	0	0	3	39	33	29.5	27	25	23.4	20.9	19	17.4	15.5
				6	42	36	32.5	30	28	26.4	23.9	22	20.4	18.5
				9	45	39	35.5	33	31	29.4	26.9	25	23.4	21.5

VWL 55/5 V incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWL 55/5 AS 230 V (S2)					Distance from heat source in m									
	Sound power level in dB(A)	K_T	K_R	K_O	1	2	3	4	5	6	8	10	12	15
					Evaluation level									
Day mode	55	0	6	3	53	47	43.5	41	39	37.4	34.9	33	31.4	29.5
				6	56	50	46.5	44	42	40.4	37.9	36	34.4	32.5
				9	59	53	49.5	47	45	43.4	40.9	39	37.4	35.5
Night mode	47	0	0	3	39	33	29.5	27	25	23.4	20.9	19	17.4	15.5
				6	42	36	32.5	30	28	26.4	23.9	22	20.4	18.5
				9	45	39	35.5	33	31	29.4	26.9	25	23.4	21.5

VWL 75/5 V incl. increase for tone incorporation (0 dB (A)) and times of increased sensitivity

VWL 75/5 AS 230 V (S2)					Distance from heat source in m									
	Sound power level in dB(A)	K_T	K_R	K_O	1	2	3	4	5	6	8	10	12	15
					Evaluation level									
Day mode	56	0	6	3	54	48	44.5	42	40	38.4	35.9	34	32.4	30.5
				6	57	51	47.5	45	43	41.4	38.9	37	35.4	33.5
				9	60	54	50.5	48	46	44.4	41.9	40	38.4	36.5
Night mode	48	0	0	3	40	34	30.5	28	26	24.4	21.9	20	18.4	16.5
				6	43	37	33.5	31	29	27.4	24.9	23	21.4	19.5
				9	46	40	36.5	34	32	30.4	27.9	26	24.4	22.5

10 Planning the heating system

When planning a suitable heating system, the type of heat consumers (surface heaters and/or radiators) to be used must always be specified. The system temperatures must be ascertained in order to do this.

A single heating circuit can be connected directly to the heat generator.

In contrast to direct feeding into the heating circuit, using system separation separates the water circuits in the heating system into a heat generator circuit and a heat consumption circuit. The heat exchanger provides the link between the heat generator and the heat consumer.

The types of heating circuit that can be selected transfer heat in different ways, either via radiators or via surface heaters. Types of radiators include column radiators, panel radiators and convection heaters, as well as heated towel rails.

Types of surface heaters include underfloor heaters, wall heaters and ceiling heaters, which, in contrast to radiators, are built into the surfaces that enclose a room.

10.1 Structure of the heating system

The hydronic structure of a heating system is composed of the heat generator (A), the heat distributor and the heat distribution network (B) and the heat consumers (C).

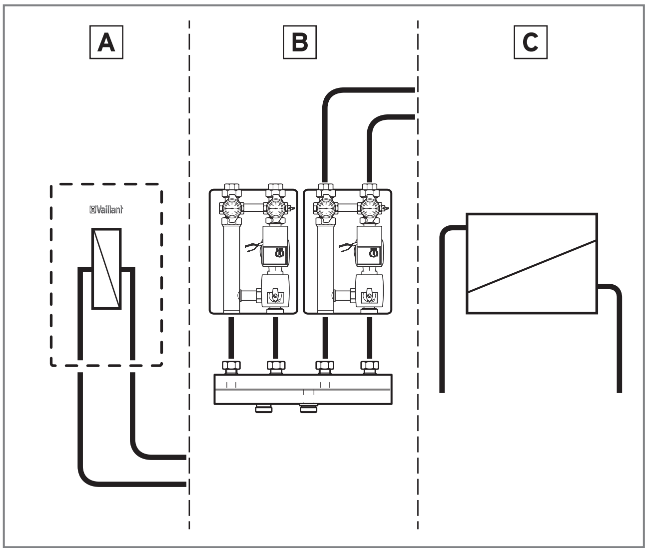
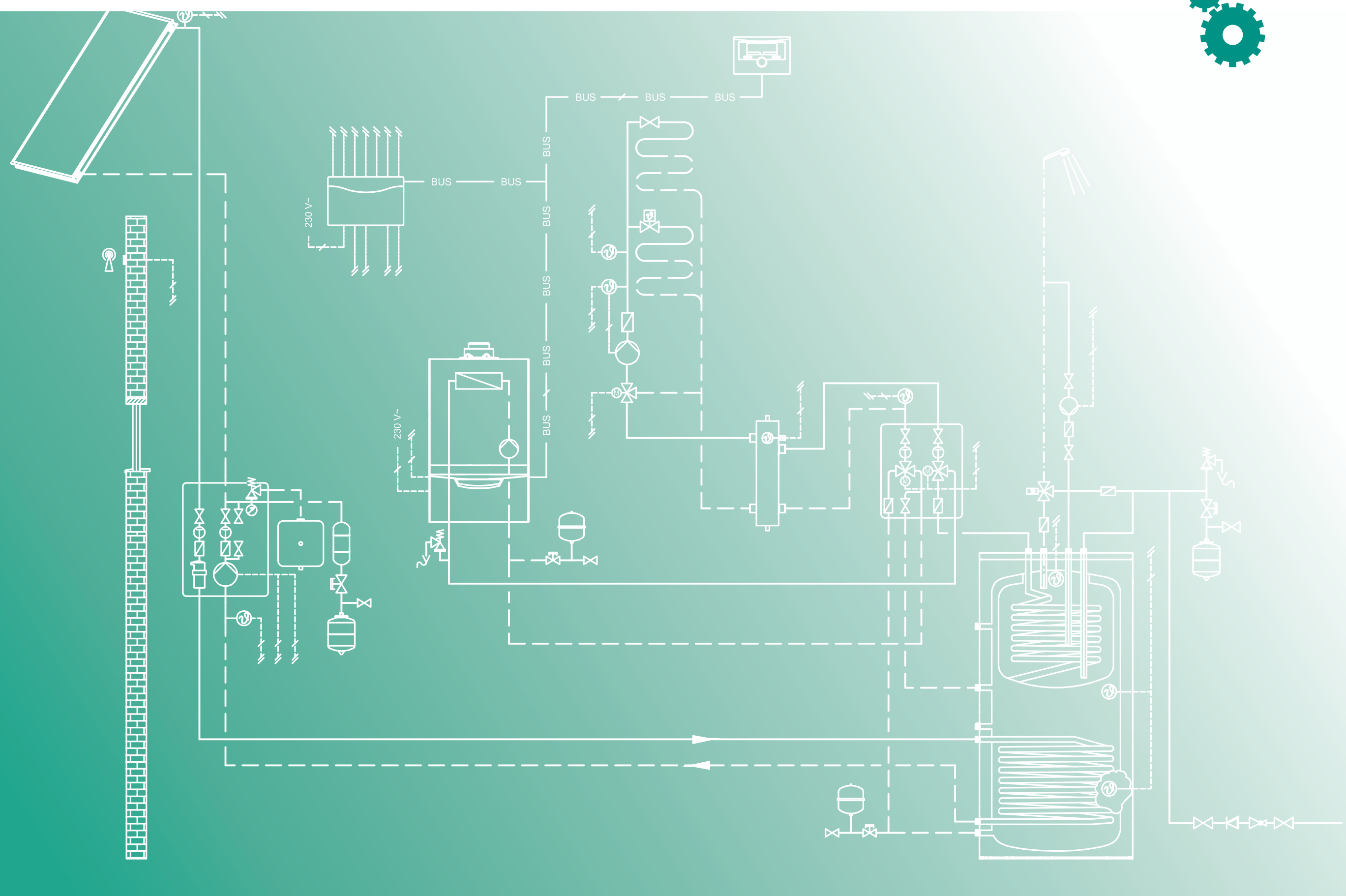


Fig. 170: Schematic structure of a heating system



The following are required in the individual areas:

Heat generator

- The volume flow and the flow/return temperature of the heat generator must meet the requirements of the heating system.
- The running times should be as long as possible to prevent frequent cycling (improving the annual utilisation).
- It must be possible to operate the heat generator regardless of the heat consumption.

Heat distributor

- The heat distributor provides a link between the heat generator and the heat consumer
- Heating circuits with identical or varying system temperatures and the same heat requirements can be connected to a common heat distributor
- Heat losses must be reduced by arranging the pipe network in the optimum way
- Optimal heat distribution to the consumers is ensured by calculating the pipe network (check the pump volume flow and pressures losses Δp)

Heat consumer

- Hydronic balancing must take place. The heat consumer must correspond to the room's heating load and be designed according to the specified system temperatures.

10.2 Planning the heat consumers

Different types of heat consumers are available for heating the rooms. These can be categorised according to their appearance:

Planning the heat consumers

Appearance		
Visible	**Covered**	**Invisible**
Radiators	Convection heater	Underfloor heating
Ceiling radiant panels	Fan convection heater	Wall heating
		Façade heating
		Ceiling heating
		Component activation

All types of heat consumers work differently and this needs to be considered while planning.

To select the right system for the particular property, the advantages and disadvantages of radiators and underfloor heating systems are compared below.

Advantages of radiators

- Heat up quickly thanks to the high flow and return temperatures
- Lower investment costs than underfloor heating systems
- Can be installed anywhere
- Easy to operate and control the room temperature

Disadvantages of radiators

- Lower boiler efficiency owing to high flow and return temperatures
- Circulate a large amount of dust through around 70% air circulation
- Cold floors
- Cold external walls
- Highest temperature is achieved just below the ceiling of the room

Advantages of underfloor heating

- Increased efficiency owing to low flow and return temperatures
- Comfortable floor temperature (no cold feet!)
- Can be used in conjunction with alternative sources of energy (heat pump, solar thermal energy)
- Does not circulate dust through the air
- More comfortable room climate
- Saves energy thanks to the lower room temperatures required
- Invisible
- Cooling function possible (for heat pumps)

Disadvantages of underfloor heating

- Takes longer to heat up owing to the low flow and return temperatures (dependent on the floor covering, the floor structure, the thickness of the pipes/material, the spacing between pipes)
- Use in old buildings is limited as the heating output required may not be able to be provided by underfloor heating
- Higher investment costs

Retrofitting underfloor heating

It is possible to retrofit underfloor heating by milling channels into the screed flooring or by using a low-profile system.

The preferred variant depends on the structural situation.

- It is possible to retrofit underfloor heating into existing screed flooring by milling channels into the screed flooring. All types of screed flooring are suitable for this method, except for mastic asphalt screed.
- Underfloor heating with a very low installation height is available to be retrofitted to screed or tiled floors which are already insulated. The carrier elements are affixed to the exposed screed or directly to tiles or other stone surfaces.

Heat convection and heat radiation

Heat consumers can also be divided into heat convectors and heat radiators depending on the way in which they emit heat.

In the convection process, the air around the radiator is heated up and rises to just below the ceiling of the room. This is where the temperature of the room is hottest.

The heated air then gradually cools and falls down on the opposite side of the room, flowing across the floor as cold air and back to the radiator, where it is heated up again.

Particles of dust and pollen are transported during the process, which may cause problems for people suffering from allergies and asthma.

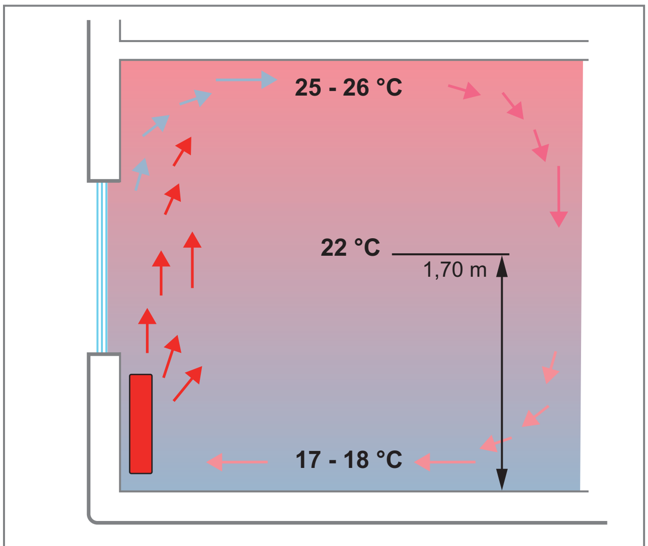


Fig. 171: Diagram showing how convection heating works

Heat radiation or infrared radiation does not heat the air but rather all the objects in the room, such as people's bodies, furniture and the walls. The heated objects emit heat into the surroundings and create a comfortable room temperature.

The low air temperature with heating via heat radiation also provides a pleasant and comfortable sensation of heat and creates a natural climate in the living rooms. The heat measured in the room can be relatively low as the heat is usually felt as being two or three degrees higher than it actually is.

The average room temperature can be measured at a height of around 1.7 m for both heat convection and heat radiation.

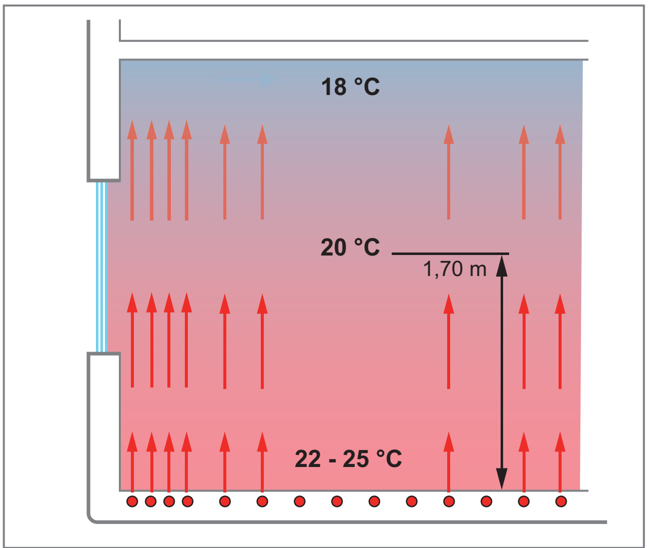


Fig. 172: Diagram showing how heat radiation works

Heating surfaces with convection and radiation

Heat is transferred through a combination of heat convection and heat radiation depending on the type of heat consumer used.

Heating surfaces

Heating surfaces	Amount of radiation	Convection
Column radiators	21 - 36 %	79 - 64 %
Panel radiators: - Single-panel without convection section	40 - 57 %	60 - 43 %
- Double-panel without convection section	33 - 42 %	67 - 58 %
- Double-panel and multiple-panel with convection section	18 - 30 %	82 - 70 %
Convection heaters	11 %	89 %
Radiant panels	60 - 70 %	40 - 30 %
Underfloor heating	55 - 70 %	45 - 30 %

Common system temperatures

The system temperatures must be ascertained (flow and return temperatures) before starting to design the heating surfaces. The system temperatures apply to the entire heating system or an entire control system as the case may be. This means that all of the heat consumers or heat exchangers in the system need to be designed to handle these temperatures.

Common system temperatures are (flow/return temperature):
- In accordance with old standard: 90/70 °C (design parameters in old buildings)
- In accordance with new standard: 75/65 °C

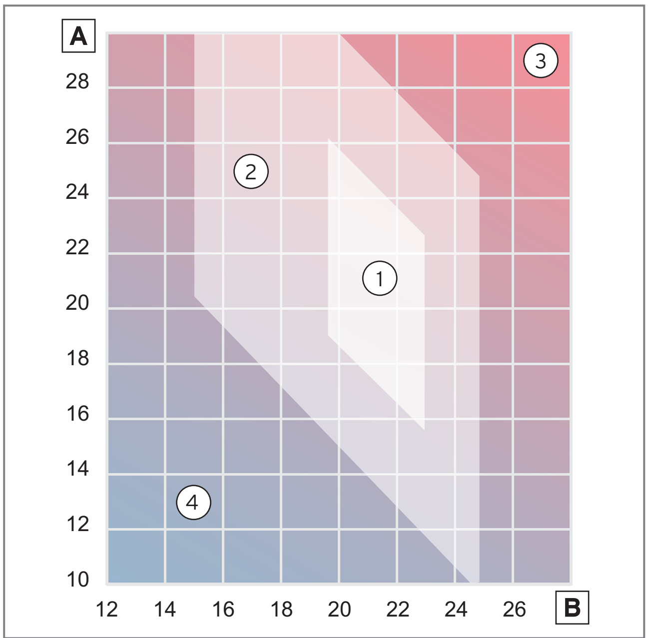


Fig. 173: Thermal comfort

A Average surface temperature of the surfaces enclosing the room [°C]
B Room air temperature [°C]
1 Comfortable
2 Still comfortable
3 Uncomfortably hot
4 Uncomfortably cold

The level of thermal comfort depends on a number of influential factors. People's clothing, the activity they are engaged in and the structure of their body all play a key role, as do the humidity in the room and the speed at which the air is moving. Varying temperatures have a strong effect on the body and are uncomfortable. Thermal comfort and a pleasant atmosphere in the room have been obtained if the human body does not sweat in the summer or freeze in the winter.

Most people feel well in winter when the room temperature is between 20 and 22 °C, and feel well in summer when the room temperature is between 23 and 27 °C.

Transferring the optimal amount of heat in the right place is key for achieving a high level of comfort and cosiness in the winter. Modern radiators and surface heaters meet these requirements. A surface heater/cooler ensures that the room will stay a pleasant temperature in the summer as well.

Cooling

Heat pump technology is increasingly being used for heating and hot water generation.

This technology can also be used to extract heat from rooms in order to cool them.

The heat can be passively or actively extracted in conjunction with a brine/water, water/water or air/water heat pump.

System solution

Heat pumps with an integrated cooling function are ideal as a particularly economical and compact solution. They are equipped with all of the components required for heating, cooling and hot water generation.

Heat pumps not equipped with an integrated cooling function can be combined with components on site. The heat exchanger is designed in accordance with the potential system cooling output at the following temperatures:
- Primary 18 °C/21 °C
- Secondary 21 °C/18 °C

Advantages and disadvantages of active and passive cooling

Advantages of active cooling:
- Higher cooling output
- Possibility of dehumidifying the room air using fan coil convectors

Disadvantages of active cooling:
- More energy required
- Cold-insulated separating buffer cylinder required

Advantages of passive cooling:
- If there is an existing heat source system (ground sensor or ground collector), this provides an inexpensive cooling function
- Low energy consumption
- Ground sensor regeneration possible

Disadvantages of passive cooling:
- No defined cold output,as both the heat source and the cooling surfaces (underfloor heating system) are designed for heating mode
- The room air is not dehumidified
- Relative room humidity used to activate cooling (dew point), resulting in low cooling potential on humid, warm days

Cooling with heat source

Cooling with ground sensors/ground collectors

When passive cooling with this heat source, you must note that near-surface ground collectors have only limited suitability for cooling.

As the ground sensors are designed for heating mode, their cooling output is lower.

Active cooling with near-surface ground collectors (ground collectors, compact collectors, energy cages and other systems that are suitable for surface use) is prohibited by Vaillant. These systems are not suitable for active cooling (see also VDI 4640 Sheet 2 and other specifications, laws and ordinances).

Cooling with groundwater

Groundwater can be used to cool both actively and passively. In doing so, you must also note that the intake ground water must not exceed 20 °C (see also VDI 4640 Sheet 1 and the Wasserhaushaltsgesetz (German Water Management Act) as well as any other specifications, laws and ordinances).

Cooling with air

With the air heat source, only active cooling is possible. The outdoor air can be used as a heat sink by a reversible air/water heat pump. The room air can be cooled and dehumidified, if required, using fan coils.

With all three heat sources, an underfloor heating system can be used as a consumption circuit.

Types of cooling surfaces

Surface heating systems and cooling panels are suitable for passive and active cooling.

However, the minimum flow temperature of 15 to 18 °C for cooling panels and surface heaters limits the potential cooling output.

For active cooling, cold-water fan coil convectors or cold-water ceiling cassette air-conditioning units can also be installed.

Mass flow

The mass flow of the heating medium is calculated using the heating load required for the room in question. The mass flow supplies the heating surface with the energy it requires. This quantity is calculated using the general formula for the heat flow:

The formula for water is:

$Q = m * c * \Delta\Theta$

Where:

Q = Heat flow [Wh/h] corresponding to Φ_{HL}

m = Mass flow [kg/h]

c = Specific heat capacity of water 1.163 Wh/kg K

$\Delta\Theta$ = Temperature difference between the flow and return ($\Theta V - \Theta R$) in K

The mass flow can be calculated by rearranging the formula.

$m = Q / (1.163 \times (\Theta V - \Theta R))$ in kg/h

The formula shows that the size of the mass flow depends directly on the selected difference between the flow temperature and the return temperature:

The higher the temperature difference, the lower the mass flow.

The mass flow is needed
- To calculate the pipe network and
- To balance the system hydronically.

Calculating the pipe network

The pipe network and the various hydraulic components in the heating system are responsible for distributing the flows of heating water between the numerous heat consumers.

The selected flow speeds must not be too high when making the calculation. This will ensure that the flows do not make any noise during operation and that pressure losses will be limited, which will keep the energy required by the heating pumps at a low level.

Guideline values for flow speeds are between 0.3 m/s and 1.0 m/s in the main distributor lines and between 0.5 m/s and 0.8 m/s in the radiator connection lines. Average pressure drops are between 50 Pa/m and 100 Pa/m, and up to 200 Pa/m in large systems (pressure drops per metre of pipe).

To make the calculation, the pipe network being planned is divided into logical sections. The pressure losses in all of the sections are calculated using the flow of heating water, the selected pipe size and the usual resistances.

The result is a hydronically unfavourable pipe section in which the calculated pressure loss in all the sections connected to it is at its highest. This pressure loss is used to determine the feed head required for the pump.

The pump builds up the calculated pump pressure in all of the pipe sections. This generates larger mass flows in the pipe sections with a low pressure loss. The high pressure needs to be reduced in order to obtain roughly equal intended mass flows in the pipe sections. This makes it necessary to calculate the „overpressures“ that are generated. The pressure loss calculation from step 5 onwards (see following calculation) is used to do this for each pipe section.

At what places excessive overpressures can be reduced and which means can be used to do so, i.e. how the system can be hydronically balanced, must then be considered.

Example of pipework calculation

The pipework calculation for a heating installation with a two-pipe system is examined using the following illustration.

The following information must be available in order to do this:

- Heating load calculated in accordance with DIN EN 12831 complete with the resulting output of each radiator/heating surface without design supplement (total heat demand in the example = 65 kW, heating circuit in question = 16 kW, radiator HK 10 = 1500 W)
- Temperature spread between the flow and return temperatures (in example $\Delta\Theta$ = 20 K)
- A diagram showing the piping required and the corresponding length specifications (shown in the illustration as shortened for one heating circuit)
- Type and power of heat transfer (radiators with a thermostatic radiator valve and adjustable return screw fitting in the example)

The general calculation procedure is demonstrated below.

Determining the unfavourable pipe section

This is normally on the radiator that is furthest away. The unfavourable pipe section has the highest pressure loss.

This pressure loss is used to calculate the required pump pressure. The pump builds this pressure up in all of the pipe sections.

Example: Radiator **HK 10**

Calculating the flows of heating water in the individual radiators

(Normal heat demand without 15% supplement)

The flows of heating water in the sections can be calculated using the following formula.

$V = Q / c * \Delta\Theta$

Example: Radiator (HK 10)

$V = 1500\,W / (1.163\,Wh/kg\,K * 20\,K)$

= 64.488 kg/h

Sections

Enter the sections with the section name (letters), section length and flows of heat and heating water that flow through the individual sections.

Example: Total pipe length **65 m**

Selecting the provisional pipe sizes

Using the values calculated in step 2, the pipe cross-section for the last section of the pipeline to the radiator is determined using the pressure loss diagram and considering the maximum pressure loss (in the example $R_{max.}$ = 100 Pa/m).

In the example, using the pressure loss diagram for the section of the pipeline to the radiator HK 10 gives the pipe dimensions as **CU 12 x 1**.

Calculating the pressure losses in the heating pipeline

The following values are assumed to calculate the flows of heating water in each section:

- Δp = Constant
- Pipe friction resistance
- R = Max. 100 Pa/m

A 45% supplement is included for formed sections (elbows, T-pieces, etc.).

The pressure loss in the pipe section is calculated using the pipe friction resistance (R) and the length of the pipeline: $\Delta p = R * l$

To obtain a more detailed calculation, the sum of the ζ values are added at this point.

However, as this point is only being estimated and a lump supplement of 45% has been applied for formed sections, the pressure loss in the pipelines is calculated using

$\Delta p = R * l * 1.45$

The other sections in the heating pipeline are also calculated in this way. Once calculated, the flows of heating water, the pressure losses and the pipe cross-sections are incorporated into the pipe diagram.

The pressure losses in fittings, radiators, distributors, etc. that are still missing are then taken from the manufacturer's diagrams.

Selecting the correct mixer

Selecting the correct mixer requires the total pressure loss and the mass flow of the heating pipeline. These values can be used to select the right mixer. You can find more information on the selection of Vaillant pipe groups available in the „Accessories“ section.

Selecting the heating pump

The minimum pump pressure and the pump's minimum delivery rate need to be calculated in order to design the heating pump correctly.

The minimum pump pressure is equal to the total pressure loss in the unfavourable pipe section.

The minimum delivery rate is equal to the total mass flow of the heating group/heating system.

The right Vaillant pipe group can be selected using these values. You can find more information in the „Accessories“ section.

Pressure losses

Considering the **pressure losses in the other pipe sections** in order to set up hydronic balancing.

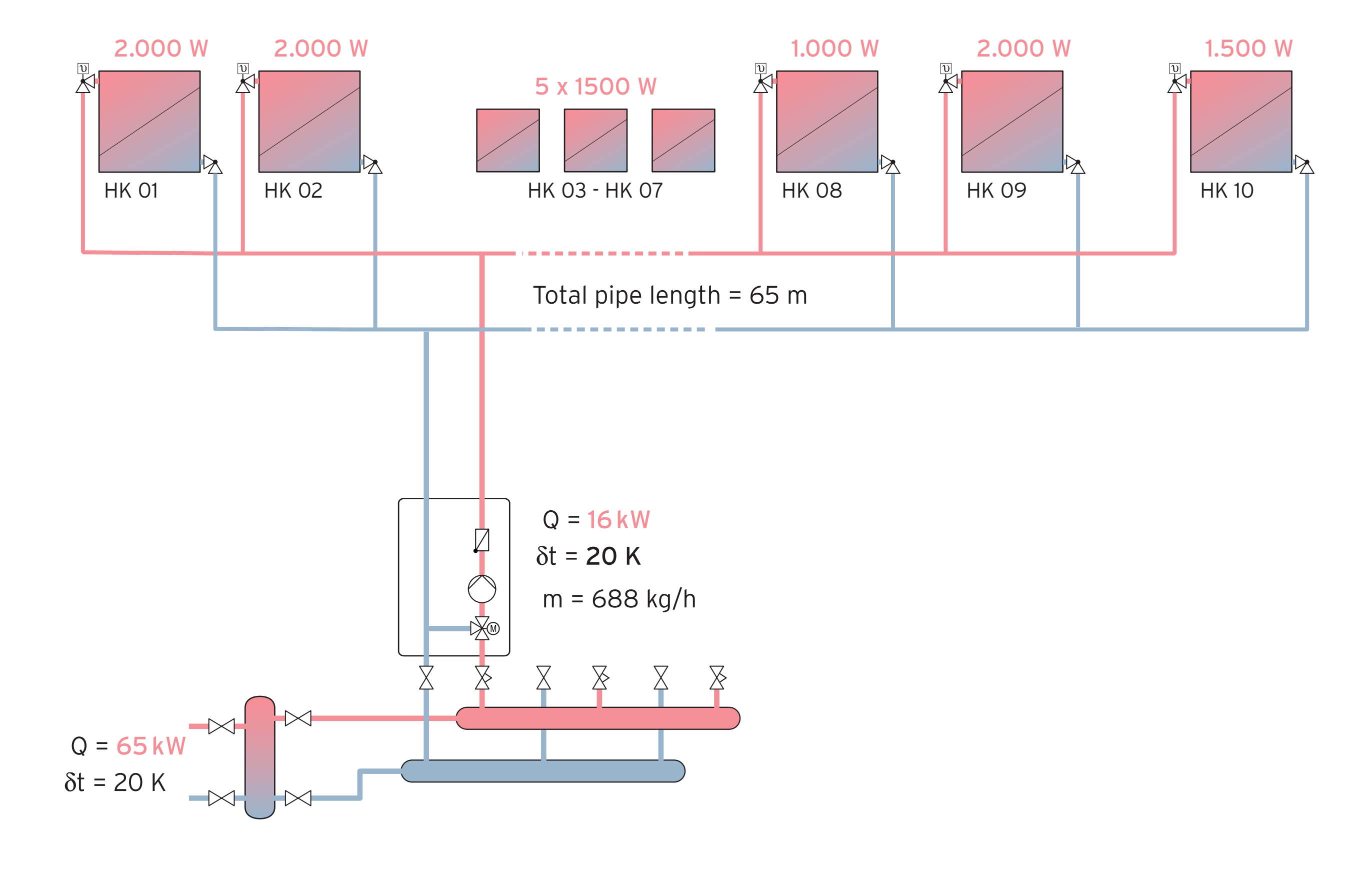
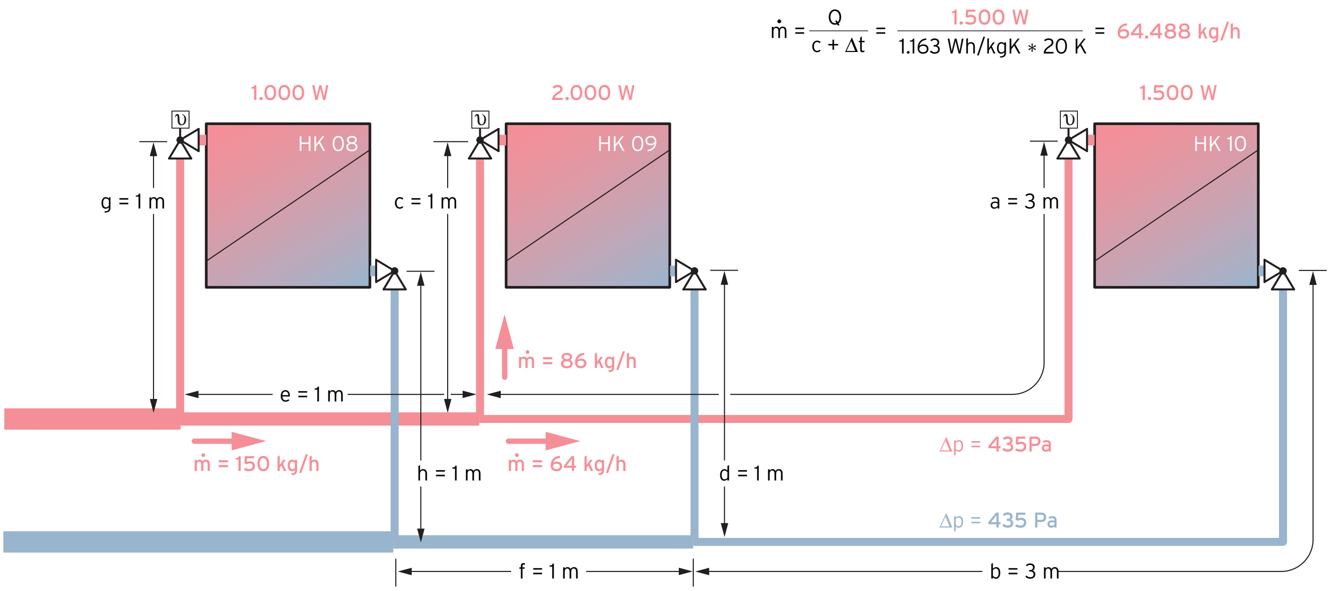


Fig. 174: Pipe dimensioning and calculating the pressure loss for pipe section 1 of 2



e: with R_{max} = **100 Pa/m**
results from the pipe friction diagram at 150 kg/h:
Copper pipe **CU 15∗1**

Pressure loss in sections c to g
with **R = 100 Pa/m + 45 %** for formed sections:
Δp = 145 Pa/m ∗ 1 m = **145 Pa**

a & b: with R_{max} = **100 Pa/m**
results from the pipe friction diagram at 64 kg/h:
Copper pipe **CU 12∗1**

Pressure loss in sections a and b
with **R = 100 Pa/m + 45 %** for formed sections:
Δp = 145 Pa/m ∗ 3 m = **435 Pa**

Fig. 175: Pipe dimensioning and calculating the pressure loss for pipe section 2 of 2

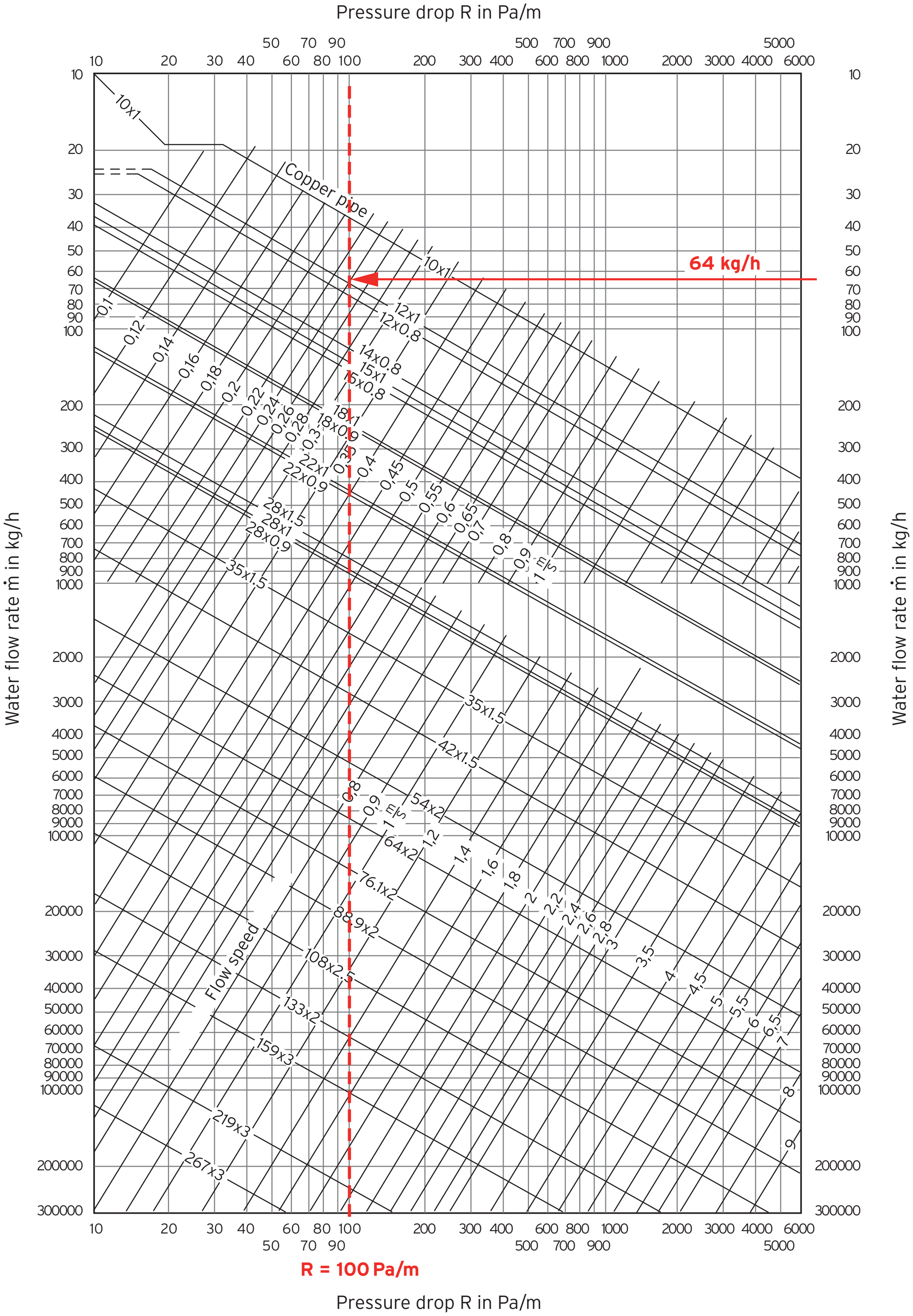


Fig. 176: Pipe friction diagram for copper pipes (water temperature 80 °C, roughness ϵ = 0.0015 mm)

10.3 System separation

There may be system separation in the heat generation circuit and the heat consumption circuit for various reasons:

- To protect the boiler's heat exchanger against deposits caused by residue in the system (scale).
- In systems with heating circuits in the floor and oxygen-permeable heating pipes.
- To separate the pressure-side heat/volume flows in multi-circuit systems and systems with various different heating circuits (radiators, underfloor heating).
- To transfer heat between various different heating media (e.g. the heating water and chlorinated water in a swimming pool).

The following can be used for system separation:

- Low loss header
- Heat exchanger
- Buffer cylinder

System separation by heat exchanger

The heat exchanger completely separates the heat generation circuit from the heat consumption circuit connected downstream.

It is always advisable to use one in underfloor heating installations which consist of plastic tube banks that are oxygen permeable or of plastic climate-controlled floors.

The system should also be separated using a heat exchanger if uncoated buffer cylinders are to be integrated in the heating circuit to protect the boiler against dirt deposits.

The heat generation circuit and the heating circuit are dimensioned independently of each other depending on the specific type of system being used.

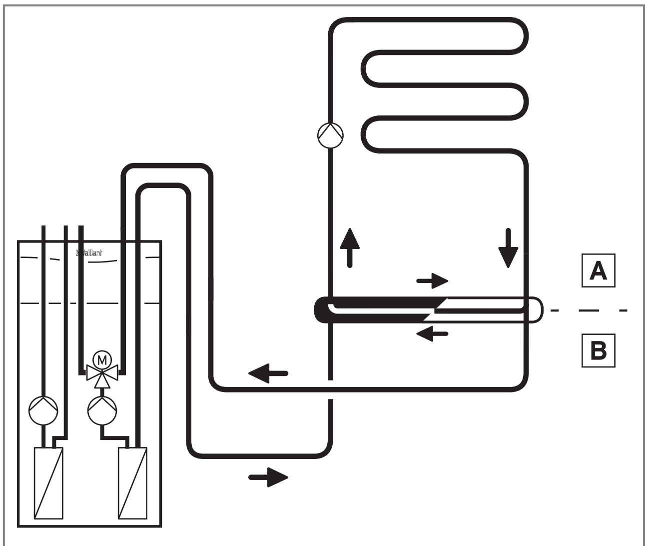


Fig. 177: System separation by heat exchanger: One-circuit

A Heat generation circuit
B Consumption circuit

Note
If other heating circuits are connected in parallel to the underfloor circuit, they can only be supplied by the pump inside the heat generator if the heating circuits have been hydronically balanced.

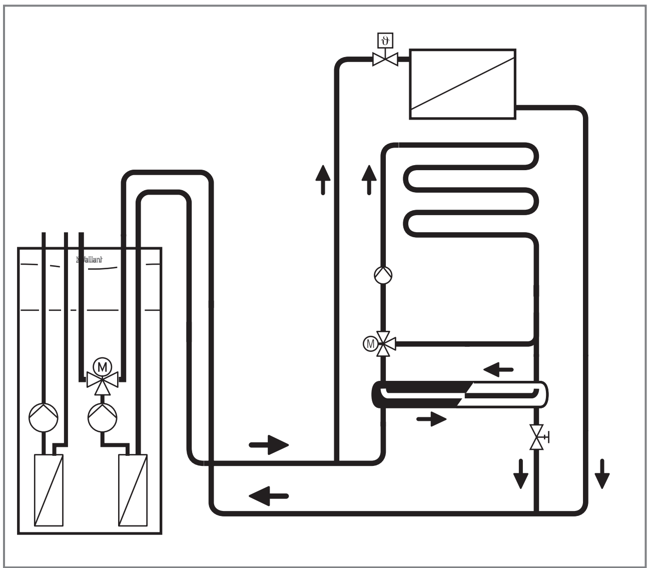


Fig. 178: System separation by heat exchanger: Two-circuit

Heat generator circuit (A)

The heat generator pump needs to deliver the required water volume against the pressure loss in the heat generation circuit.

The pressure loss in the heat exchanger (to be provided on site) can be found in the manufacturer's documentation.

The pump diagrams can be used to calculate the remaining feed head for the pump to determine the nominal diameter of the pipe depending on the volume of water flowing around the heat generation circuit.

Consumption circuit (B)

In the heat consumption circuit, which is supplied via the heat exchanger, the heating pump (to be provided on site) needs to deliver the water volume of this circuit, including the heat exchanger, against its pressure loss. The pump must be designed accordingly.

Separation by buffer cylinder

Buffer cylinders are large water cylinders in which the heated heating water is stored temporarily and held for use by the heat consumers.

Like low loss headers, buffer cylinders are used to separate the volume flows between the heat generation circuit and the heat consumption circuit hydronically.

In addition to providing hydronic separation, buffer cylinders enable multiple – even different – heat sources to be integrated into the heating installation.

Connecting to a buffer cylinder enables a solar system to be combined with a heat pump and for other heat sources, such as solid fuel boilers or combined heat and power systems, to be incorporated.

This is becoming increasingly important in Germany owing to recently imposed legal obligations on incorporating renewable energy sources into heating installations.

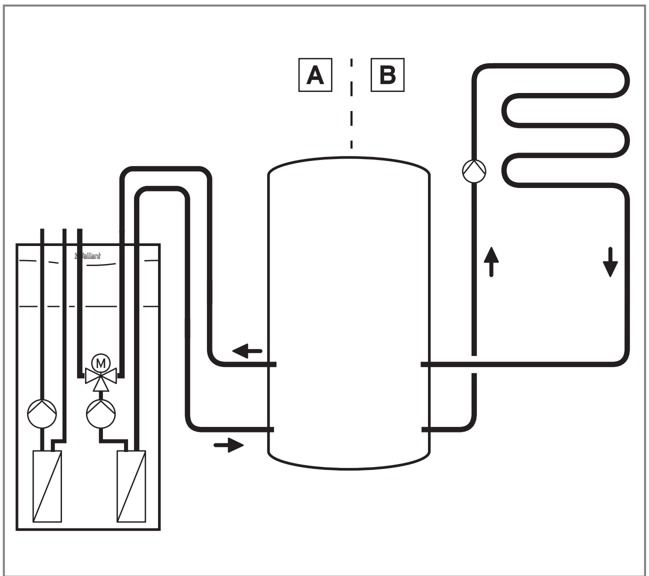


Fig. 179: Separation by buffer cylinder: One-circuit system

A Heat generation circuit
B Consumption circuit

Other reasons for using a buffer cylinder are:
- To optimise the running times of the heat generators in order to reduce the switch-on/switch-off hystereses
- To separate the times at which heat is generated and heat is consumed (e.g. to make water draw-off during hot water generation independent of heat generator operation)
- To maintain efficient operation of a log-fired boiler (wood gasification boiler, wood-burning stove with water tank) and ensure that heat is drawn off
- To ensure that the volume flows in the heat generation circuit are kept constant (e.g. maintain a constant volume flow for a heat pump).

- To bridge energy supply company anti-cycling times in systems with heat pumps

Buffer cylinders can be heated directly or indirectly via pipe coils in the cylinder. With indirect heating, the heat generator is hydronically separated from the heating water. Solar systems are always separated from the heating water as they are operated using solar fluid.

Separation by a separating cylinder

The VWZ MPS 40 decoupler module can be used as a separating cylinder to hydraulically separate the heat pump and heating installation.

This ensures that a minimum circulation rate is always maintained even with sealed underfloor circuits.

In a heating system in bivalent mode, the auxiliary boilers can be hydraulically connected to the decoupler module.

It can also be used as a return flow series cylinder. It is used to increase the water volume in the heating installation and thus extend the running time of the heat pump.

The minimum circulation water rate must be ensured by a suitable bypass valve if the individual room control system closes the underfloor heating circuits.

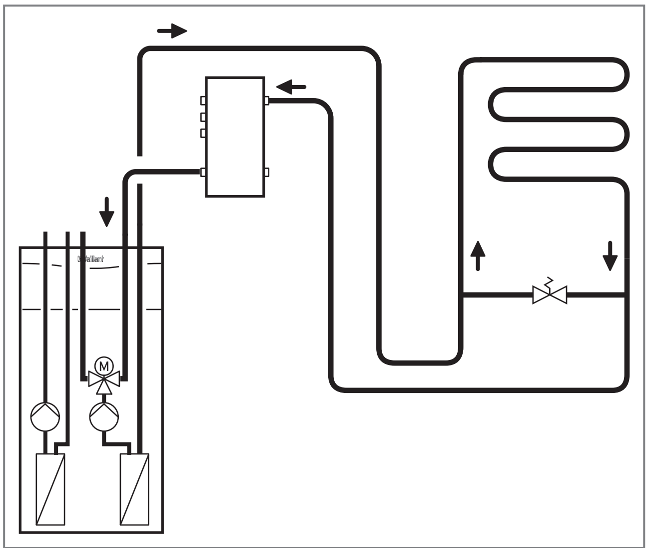


Fig. 180: flexoTHERM with return flow series cylinder

10.4 Planning the heat distribution/hydronic circuits/heating circuits

Requirements for the heating water

VDI directive 2035, sheet 1

VDI 2035, sheet 1 provides recommendations on how to prevent damage caused by scaling in water heating installations. It applies to drinking water heating installations according to DIN 4753 and to hot water heating installations according to DIN EN 12828 inside a building if the flow temperature does not exceed 100 °C as intended.

Causes of scaling

The factors which are decisive for scaling are the water composition, the volume of filling and supplementary water, the wall temperatures on the heat transfer surfaces, and the operating conditions. In contrast to corrosion, the material characteristics are only of secondary importance for scaling. Scaling (deposition of $CaCO_3$) can be caused by the following reaction:

$Ca^2 + 2\ HCO_3 = CaCO_3 + CO_2 + H_2O$

when water containing alkaline earth and hydrogen carbonate ions is heated. The risk of scaling increases as the temperature increases. The crucial factor is not the outlet or flow temperature but the wall temperature at the heat transfer surface of the heat generator. Damage caused by scaling can occur if design/planning, structural design, operating conditions and water composition are not matched to each other. In order to quantify scaling, the water analysis results must be requested, e.g. from the water supply company. It is not enough simply to know the hardness range according to the German Act on the Environmental Compatibility of Detergents and Cleaning Agents (WRMG).

To assess scaling more accurately, the values for the concentration of calcium, the KS4.3 acid capacity, and the volumes of filling and supplementary water are required. It is also possible to perform a simplified assessment solely on the basis of the „total alkaline earths" and „total hardness" parameters.

Effects of scaling in hot water heating installations

Scaling reduces the passage of heat through the scale coating in heat generators of hot water heating installations. The resultant reduction in cross-section leads to an increased flow resistance, thereby reducing the heat output and causing boiling noises. On directly heated heat transfer surfaces in particular (heat exchanger located in the unit), local overheating and crack formation caused by this can occur. This would result in the heat exchanger having to be replaced.

Guideline values/recommendations for hot water heating installations

In hot water heating installations, the risk of damage caused by scaling is limited as a result of the quantity of alkaline earth and hydrogen carbonate ions being smaller compared to drinking water heating installations. Practice has shown that, depending on the following factors:

- Total heating output of a hot water heating installation,
- Specific system volume (nominal capacity in litres/ heating output; on systems with more than one boiler, the lowest individual heating output must be set),
- Volume of filling and supplementary water, and
- Type and design of the heat generator (e.g. circulation water heater), damage caused by scaling may occur.

Water hardness

The water hardness is the concentration of alkaline earth ions. These are mainly calcium and magnesium. In accordance with the German Act on Detergents and Cleaning Agents (WRMG), water hardness is classified as soft (up to 8.4 °d total hardness), moderately hard (up to 14°d total hardness) or hard (above 14°d total hardness). The higher the degree of hardness, the more ions contained in the water. The designation °d (German degree of hardness) is outdated and, nowadays, the technical designation of total alkaline earths in mmol/l is frequently used.

Water hardness

Total hardness		Assessment according to WRMG
[mmol/l]	[°d]	
‹1.5	‹8.4	Soft
2	11.2	Moderately hard
›2.5	›14	Hard
3	16,8	Hard

Water quality

The operator/contractor has to hand the following documents, which must be drawn up by the planner, over to the installer before the system is filled:

- Planning agreement according to HOAI, VOB/C, EN12828 article 4.1 and 4.3.2.1
- Service book according to VOB/C, VDI 2035

These units do not place any requirements on the heating water that are higher than those mentioned in VDI 2035. You can find the limit values according to the standard in the following table.

Heating water limit values (table 1 in VDI 2035/1)

Total heating output	Total hardness at 20 l/kW smallest boiler heating surface [2]		Total hardness at ≥ 20 l/kW < 50 l/kW [2]		Total hardness at ≥ 50 l/kW [2]	
kW	**°dH**	**mol/m³**	**°dH**	**mol/m³**	**°dH**	**mol/m³**
≤ 50	No requirement or		11.2	2	0.11	0.02
	≤16.8° [1]	≤ 3 [1]				
≥ 50 < 200	11.2	2	8.4	1.5	0.11	0.02
≥ 200 to ≥ 600	8.4	1.5	0.11	0.02	0.11	0.02
≥ 600	0.11	0.02	0.11	0.02	0.11	0.02

[1] On systems with circulation water heaters and for systems with electric heating elements

[2] Of the specific system volume (nominal capacity in litres/heating output; on systems with more than one boiler, the lowest individual heating output must be set). These values only apply up to three times the system volume for filling and supplementary water. If this is exceeded, the water must be handled in accordance with the specifications from the VDI, in precisely the same way as it is when the limit values named in the table are exceeded (softening or desalination)

Checking the water quality

Example 1:

In its original condition, a heating installation has a capacity of 300 l.

The heating output is 18 kW.

The specific system volume is: 300 l/18 kW = **17 l/kW**

In this case, the permitted water hardness is < 16.8 °dH -> **no requirement**

Example 2:

A 1000 l thermal solar system is also integrated (buffer cylinder). The system volume is now 1300 l

The specific system volume changes to approximately **72 l/kW**.

The permitted water hardness is now < 0.11 °dH -> **water treatment is required.**

In this case, technical measures must be taken to protect the heat generator and the entire heating installation (e.g. using an intermediate heat exchanger, stationary or mobile heating filling)

Start-up preparation

In accordance with VOB/C and VDI 2035, the system must be thoroughly rinsed with filling or supplementary water before it is started up (see EN 14336). The initial water used for the filling and supplementary water is drinking water. The start-up parameters must be documented in a service book (in the scope of delivery of the service file with the boiler). This service book must be handed over to the system operator by the installer or planner once the system has been started up. The operator is responsible for keeping the service book from this point on. The service book is a system component.

Water treatment according to VDI 2035

VDI 2035, sheet 1 and sheet 2, stipulate three water treatment options:

- Softening – desalination
- Hardness stabilisation
- Hardness precipitation

Softening

VDI 2035 describes softening as the preferred method. This method involves all of the hardening agents in the water – calcium and magnesium salts – being replaced by sodium. All of the other parts remain in the water. No more hardness can be precipitated. However, the pH value will increase in the heating water. This is due to the sodium bicarbonate, which becomes sodium carbonate as a result of bicarbonate splitting and raises the pH value to above 9-9.5. This is good for standard steel and copper alloys, but not for aluminium. However, boiler heat exchangers are mainly made of aluminium nowadays and disintegrate at pH values above 8.5.

Purified water

Purified water is another option. This method involves all of the substances in the water being replaced. Nowadays, there are ion exchangers which can be used for this procedure, and these consist of cationic and anionic resins that are mixed thoroughly and are located in disposable cartridges. Since the purified water does not contain any buffers, a protective substance that sets a pH value of below 8.5 must be used. In this regard, VDI 2035/1, section 4.4.2 stipulates: If partially or fully purified water is available, this can be used when appropriate measures for setting the heating water pH value are taken. If there are aluminium materials in the system, further measures (e.g. adding inhibitors) may be necessary to prevent corrosion, during both softening and desalination. Measures for protection against corrosion are described in VDI 2035, sheet 2.

Hardness stabilisation

VDI 2035, sheet 1 prescribes hardness stabilisation in order to prevent scaling. In contrast to softening, the limescale is therefore not removed from the system. The manufacturer's specifications must be complied with in respect of metering and monitoring.

Hardness precipitation

Hardness precipitation involves adding to the heating water materials which cause the hardness to precipitate. In practice, this method is hardly ever employed (formation of sludge).

Maintenance according to VDI 2035

The pressure systems and water systems in hot water heating installations must be serviced at least once per year. The operator is responsible for maintenance.

If the guideline values are exceeded, the filling and supplementary water must be softened.

Desalination or softening must preferably be carried out in the following cases:

- The total alkaline earths from the filling and supplementary water analysis are above the guideline value, and/or
- Larger volumes of filling and supplementary water are to be expected, and/or
- The specific system volume is > 20 l/kW heating output (on systems with more than one boiler, the lowest individual heating output must be set).

Corrosion protection as a result of water treatment

For heating water conditioned by adding highly alkalinising materials, aluminium and its alloys may be at risk of corrosion (according to DIN 2035, sheet 2).

Caution. The use of unsuitable heating water may cause aluminium corrosion and therefore result in leaks. In contrast to steel, grey cast iron or copper, for example, unalloyed aluminium reacts in the heating circuit with alkaline heating water (pH value > 8.5) to produce substantial corrosion due to the formation of aluminate. When using unalloyed aluminium, make sure that the pH value of the heating water is between 8.2 and a maximum of 8.5.

The pH value of the heating water must not exceed a pH value of 8.5 for unalloyed aluminium and a pH value of 9 for alloyed aluminium. The pH value describes the concentration of hydrogen ions in the water. Low pH values (pH <7) are acidic, higher pH values (pH >7) are alkaline. pH = 7 is neutral.

Guideline values for the heating water (according to VDI 2035/2)

	Low-salt	Saline
Electrical conductivity at 25 °C in µS/cm	< 100	100 - 1500
Appearance	Free of sedimentary materials	
pH value at 25 °C	8,2 - 9,5 [1)]	8,2 - 9,5 [1)]
Oxygen in mg/l	< 0.1	< 0.02

[1)] For aluminium and aluminium alloys, the range of pH values is restricted. The pH for unalloyed aluminium is ≤ 8.5, the pH for selected aluminium alloys (e.g. ALSi10Mg) is ≤ 9.0.

It is not normally necessary to increase the pH value.

Suitable units for treating the filling and supplementary water

We always recommend that the system is filled by a specialist company in the case of systems with a critical water quality and/or with a high specific water content (e.g. when buffer cylinders are used) to ensure the quality of the filling and supplementary water. There are mobile water treatment systems for this purpose, which can provide the required volume of desalinated or softened filling water (see directory of manufacturers).

When selecting a softening agent, ensure that this is suitable for use with AlSi materials (observe the manufacturer's instructions).

The following values must be assumed for systems with buffer cylinders :

Water hardness for buffer cylinder

	Unit	Low-salt
Electrical conductivity at 25 °C	in µS/cm	< 100
Total hardness at > 50 l/kW smallest boiler heating surface	°dH	0.11
	mol/m³	0.02
pH value at 25 °C		8,2 - 9,5 [1]

[1] The pH for unalloyed aluminium is ≤ 8.5, and the pH for selected aluminium alloys is ≤ 9.0

These values apply to the filling and supplementary water, and a record of checking the values must be documented in the service book after an operating period of three months and once per year for maintenance purposes.

Caution:

Existing systems usually do not comply with the values stated above. This is why it is necessary to measure at least the following heating water parameters before a renovation:

- Total hardness
- Electrical conductivity
- pH value

These values must be compared with the new requirements and appropriate measures must be derived from this (expert advice must be sought).

The following questions must also be resolved:

- Have inhibitors (corrosion protection agents), biocides, hardness stabilisers or frost protection agents been added to the heating system?
- Does the system have known corrosion problems?

If one of these points applies, expert advice must be sought.

If the water has been treated by adding chemicals, you must check with the manufacturing company (water treatment company) that these are harmless in order to decide on a water treatment measure, which then must be documented.

Components in the consumption circuit

In practice, the heating system will only work correctly if all the important components are present and have been fitted in the intended places.

Some of these elements will be examined in closer detail below.

Important components in the consumption circuit

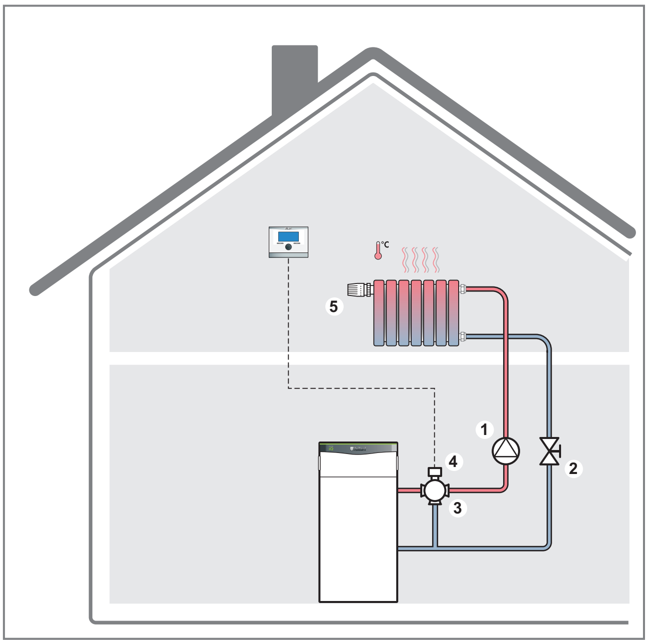


Fig. 181: Important components in the consumption circuit

1 Circulation pump
2 Control valve
3 Actuator (3-way valve)
4 Actuating drive
5 Thermostatic radiator valve with attachment

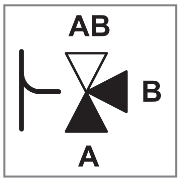
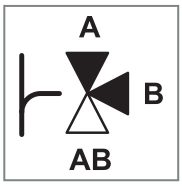
Regulating unit

The regulating unit consists of a regulator and an actuator. It is responsible for adjusting the volume flow between the heat generators and the power demanded by the heat consumer between 0 and 100%.

Every control element has a control gate that can be open to a greater or lesser degree – or simply open or closed. Cocks (turning movement) or valves (stroke movement) are used as regulators. In the case of valves, a distinction is made between straight-port valves and 3-port valves.

With straight-port valves, a change in the stroke is used to increase or decrease the flow cross-section, resulting in a variable volume flow.

3-port valves have a valve gate through which a constant volume flows (shown in the diagram as not filled-in or marked „AB“) and two valve gates through which variable volumes flow (shown in the diagram as filled-in or marked „A“ or „B“). The result of changing the stroke will vary depending on whether the valve is used as a mixer valve or a distribution valve.

Mixing	**Mixer valve**
The outgoing volume flow remains constant and is mixed together from two flows of varying volume out of gates A and B. AB = constant outflow	
Distribution	**Distribution valve**
A constant inlet volume flow is divided into two outlet flows of varying (different) volume by gates A and B. AB = constant inflow	

Control valve

Control valves are used to set constant volume flows in multi-circuit hydronic systems. Each heating pipeline is set to the pre-calculated nominal volume flow before the heating system is started up. This is also known as „hydraulic balancing“.

It is important to carry out hydraulic balancing because it will ensure that the installation works perfectly.

Circulation pump

The output of modern circulation pumps (high-efficiency pumps) can be varied by automatic speed adjustment (variable volume flow).

A hydronic circuit will only work correctly if the circulation pump:

- Has been correctly dimensioned,
- Has been correctly fitted and connected (check the rotating magnetic field with three-phase current pumps).

In some circuits there is a risk of the pumps overheating, especially in places where they work against closed valves.

A solution in such situations is to use variable-speed pumps or install small adjustable bypasses, which only allow minimal circulation when the throttle valves are closed. A pump can also be switched on and off via a limit switch in the actuator.

Magnetite separator

We recommend installing a magnetite filter to protect high-efficiency pumps and control valves.

Magnetite can build up in heating systems with steel pipes, radiators or buffer cylinders. It is therefore advisable to use a magnetite separator in these systems to protect the high-efficiency pumps both inside and outside the unit. The separator must always be installed directly in the return to the heat generator.

Magnetite (also called lodestone, loadstone, ferrous-ferric oxide or iron [II, III] oxide) is made up of tiny particles of sludge that can cause the relevant components in the heating system to malfunction or suffer excessive wear. The soiling consists primarily of corrosive particles that are attracted by the magnetic fields in pumps, valves and control valves. Other constituents in the sludge are pumped through the installation, where they cause increased wear and then collect on vital components.

This results in unnecessarily high energy consumption and recurring complaints about the installation not being fully functional, encountering faults and breaking down.

Diaphragm expansion vessels

The total water volume of the heating system must be ascertained in order to design a diaphragm expansion vessel correctly.

Calculate the following to do this:

- Water content of the radiators,
- Water content of the heat generators,
- Water content of the pipeline, including accessories (e.g. distributor).

There are two possible ways of calculating the water content of radiators and underfloor heating systems:

- Precise calculation using the manufacturer‘s specifications
- Estimation:

The total water volume can then be used to calculate the expansion volume and therefore the volume that the diaphragm expansion vessel need to have.

Contact the manufacturer of the diaphragm expansion vessel for the calculation formula and/or design tables.

Note:

Boilers with integrated diaphragm expansion tanks must always be checked to ensure that these have been sufficiently dimensioned. If not, another diaphragm expansion vessel will need to be incorporated into the plans for the heating system.

Intermediate heat exchanger

If an intermediate heat exchanger is used, a brine/water heat pump must be used. The intermediate circuit is filled with a mixture of 1,2 propylene glycol and water, as is the case for a ground collector.

The following table shows an example of the design of Zilmet plate heat exchangers. The heat exchanger consists of profiled plates that are pressed together between the stand and the pressure plate by means of clamping bolts. The heat insulation for the intermediate heat exchangers must be vapour-diffusion-tight and must be provided on site.

This should have the following properties:

- Insulation thickness: 50 mm
- Temperature range: Up to 130 °C
- Material: Rigid polyurethane foam

Designing the intermediate heat exchanger

Exchanger type	Z3 T	Z3 T
Application for heat types	**VWS 220/3, VWS 300/3,VWS 380/3**	**VWS 460/3**
Medium on the warm side	Water	Water
Medium on the cold side	30% propylene glycol/ water mixture	30% propylene glycol/water mixture
Heat output	27/35.5/43.8 kW	52.2 kW
Primary circuit (water) inlet temperature	8 °C	8 °C
Primary circuit (water) outlet temperature	5 °C	5 °C
Secondary circuit (brine) inlet temperature	2 °C	2 °C
Secondary circuit (brine) outlet temperature	5 °C	5 °C
Volume flow on the warm side	8.63/10/12 m^3/h	14.00 m^3/h
Volume flow on the cold side	9.73/11.38/13.66 m^3/h	15.78 m^3/h
Pressure loss on the warm side	22.1/24.3/25 kPa	25.48 kPa
Pressure loss on the cold side	36.6/41/42.1 kPa	42.19 kPa
Flow direction	Countercurrent flow	Countercurrent flow
Plate material	AISI 316	AISI 316
Connection	ISO R 1 1/4	ISO R 2
Design pressure on the warm side	10 bar	10 bar
Design pressure on the cold side	10 bar	10 bar
Length	780 mm	780 mm
Width	340 mm	340 mm
Height	69.3/76/89 mm	102.3 mm
Weight	116.8/118.4/121.6 kg	124.8 kg

High-efficiency circulation pumps for geoTHERM

When using heat source pumps, the following remaining feed heads should be expected for a 30% water/glycol mixture at 0 °C.

The following table gives an example of the design of Wilo pumps.

Designing the heat source pumps – Brine circuit

geoTHERM	Recommended pump	Mass flow with 30% glycol and at 0 °C, given a temperature difference of 3 K (m^3/h)	Pressure loss in the unit (mbar)	Remaining feed head [mbar]
VWS 220/3	Stratos 32/1-12	5100	300	690
	Stratos 40/1-12	5100	300	800
VWS 300/3	Stratos 32/1-12	7600	355	380
	Stratos 40/1-12	7600	355	630
VWS 380/3	Stratos 40/1-12	8500	360	580
	Stratos 50/1-12	8500	360	640
VWS 460/3	Stratos 40/1-12	10700	450	380
	Stratos 50/1-12	10700	450	480

Designing the heat source pumps – heating circuit

geoTHERM	Recommended pump	Mass flow with 5 K temperature difference (m^3/h)	Pressure loss in the unit (mbar)	Remaining feed head [mbar]
VWS 220/3	Stratos 25/1-8	3800	80	580
	Stratos 25/1-12	3800	80	790
VWS 300/3	Stratos 25/1-8	5400	100	360
	Stratos 25/1-12	5400	100	860
VWS 380/3	Stratos 25/1-12	6500	110	820
	Stratos 40/1-12	6500	110	1160
VWS 460/3	Stratos 25/1-12	7800	200	690
	Stratos 40/1-12	7800	200	1100

11 Control technology

11.1 What do control systems do?

Control systems are the „brains“ behind every heating installation and ensure that it will be operated efficiently and according to requirements.

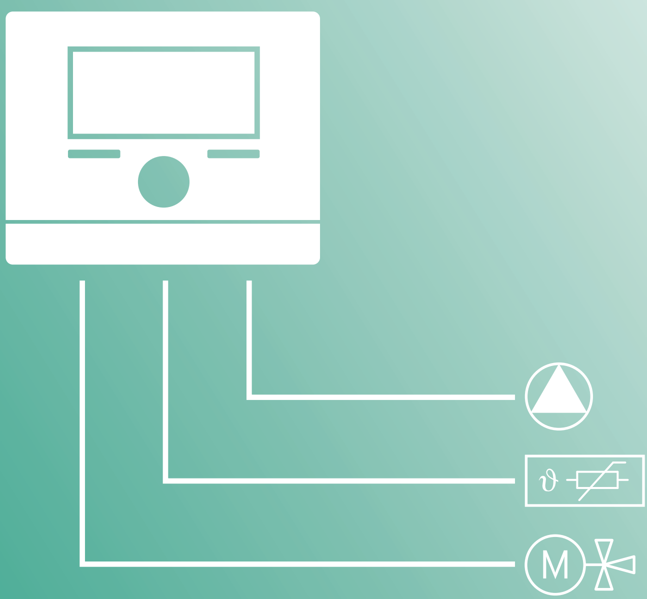
Modern Vaillant controls are flexible, modular, self-configuring systems that can be adapted to any possible – and even future – requirements.

For example, an existing boiler can be easily combined with other components to incorporate renewable energies or meet increasing demands on comfort. It is just as simple to integrate a back-up boiler into a heat pump installation and to control it centrally via the control system.

eBUS system interfaces facilitate working with the individual system components. eBUS also offers an advantage in terms of installation safety: Only one two-wire line is required, which can be connected in a way that protects it against reverse polarity.

With the right control, every heating installation can be operated quickly and safely. All of your comfort requirements are met at the touch of a button or the turning of a knob. The displays in the blue-backlit display are intuitive.

Fig. 182: VRC 700 weather-compensated system control



11.2 Weather-compensated control

VRC 700 system control

The VRC 700 is a weather-compensated control for heating, cooling, ventilation and domestic hot water generation.

The eBUS control is designed for use with units that are equipped with eBUS electronics.

All the required settings for the installation are adjusted and applied on the control.

The VRC 700 control can be combined with other modules to create larger systems. When used in conjunction with the VR 70 mixer and solar module, the VRC 700 can also be used to control two circuits or extended in order to become a solar control.

When used in conjunction with the VR 71 mixer and solar module, the VRC 700 can control up to three mixed heating circuits plus solar systems.

When used in conjunction with additional mixer and solar modules, the VRC 700 can control up to nine regulated heating circuits.

The VR 91 is used as a remote control unit.

Control operation is subdivided into three user-specific levels.

The control also has heat pump functions. In hybrid systems that consist of a heat pump and boiler, the VRC 700 guarantees the energy management for the optimum use of free environmental heat.

An integrated actuation function for Vaillant recoVAIR VAR .../4 ventilation units means that a heating and ventilation system can be jointly controlled using the VRC 700.

It can be installed in the boiler or installed in the living area as a remote control.

VRC 700f radio heating control

As a weather-compensated radio heating control, the VRC 700f takes on the same tasks and functions as the VRC 700.

The wireless outdoor sensor/transmitter and radio data transmission provide the wireless contact; the components do not need to be wired.

The eBUS control can be used without additional modules for domestic hot water generation (cylinder charging) and in a non-regulated heating circuit.

The VRC 700f/4 can also be extended by connecting it to the VR 70 or VR 71 mixer and solar modules.

The VR 91f remote control is used to remotely control a heating circuit.

11.3 Solar control system

The integrated weather-controlled energy balance control controls not just the solar system but the entire heating system. The system is controlled according to the outside temperature in order to combine the heating installation and the solar system in the optimum way.

The graphic display shows the current operating statuses, the solar yield and sensor diagnostics at all times.

The heating programmes can be configured individually, which means that the user's personal heat demand can be programmed quickly and easily. The integrated radio-controlled clock switches the system between summer and winter time fully automatically.

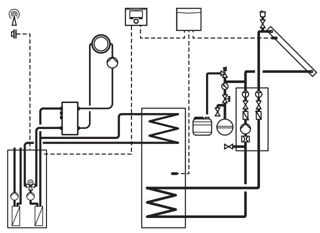
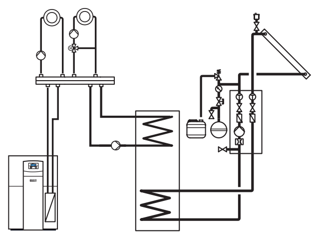
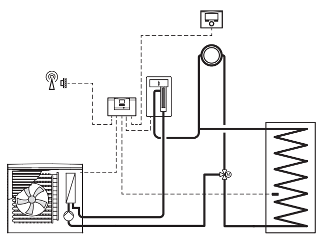
11.4 Selecting a control

Selecting a control

To ensure that the heating installation is controlled intelligently, the requirements for the building and the system must be taken into consideration when selecting the control system.

The following table can help you choose an effective control system to use in conjunction with a heat generator. All controls are connected via eBUS.

Effective control system in conjunction with a heat pump

Control system	Heat pump	System requirement	System advantages
VRC 700 weather-compensated system control	flexoTHERM flexoCOMPACT aroTHERM	1x eBUS heat generator 1x domestic hot water cylinder 1x non-regulated heating circuit 	Intelligent control system for weather-compensated operation of the heating installation Heating programmes can be adjusted to each individual heating circuit eBUS electronics ensure the system can be flexibly adjusted and added to Can be used with the VR 70 mixer and solar module as a two-circuit control or as a solar control Can be used with the VR 71 mixer and solar module for up to three mixed heating circuits plus solar systems When used in conjunction with other mixer and solar modules, the VRC 700 can control up to nine regulated heating circuits
Integrated weather-compensated energy balance control	geoTHERM	1x eBUS heat generator 1x solar domestic hot water cylinder One regulated heating circuit 1x non-regulated heating circuit 	Intelligent and convenient way to couple a heating installation with a solar system Suitable for solar domestic hot water generation and combination systems for solar heating support Heating programmes can be set individually and controlled by radio time signal Bus coupler required for a cascade system Option to supplement the control with the VR 60/3 wiring centre and VR 80/90 room control unit to expand the heating installation
VWZ AI heat pump control interface module	aroTHERM	1x aroTHERM 1x non-regulated heating circuit 	

11.5 System overviews

System overview of the VRC 700f/4 with VR 71, 2 x VR 91f and VR 920

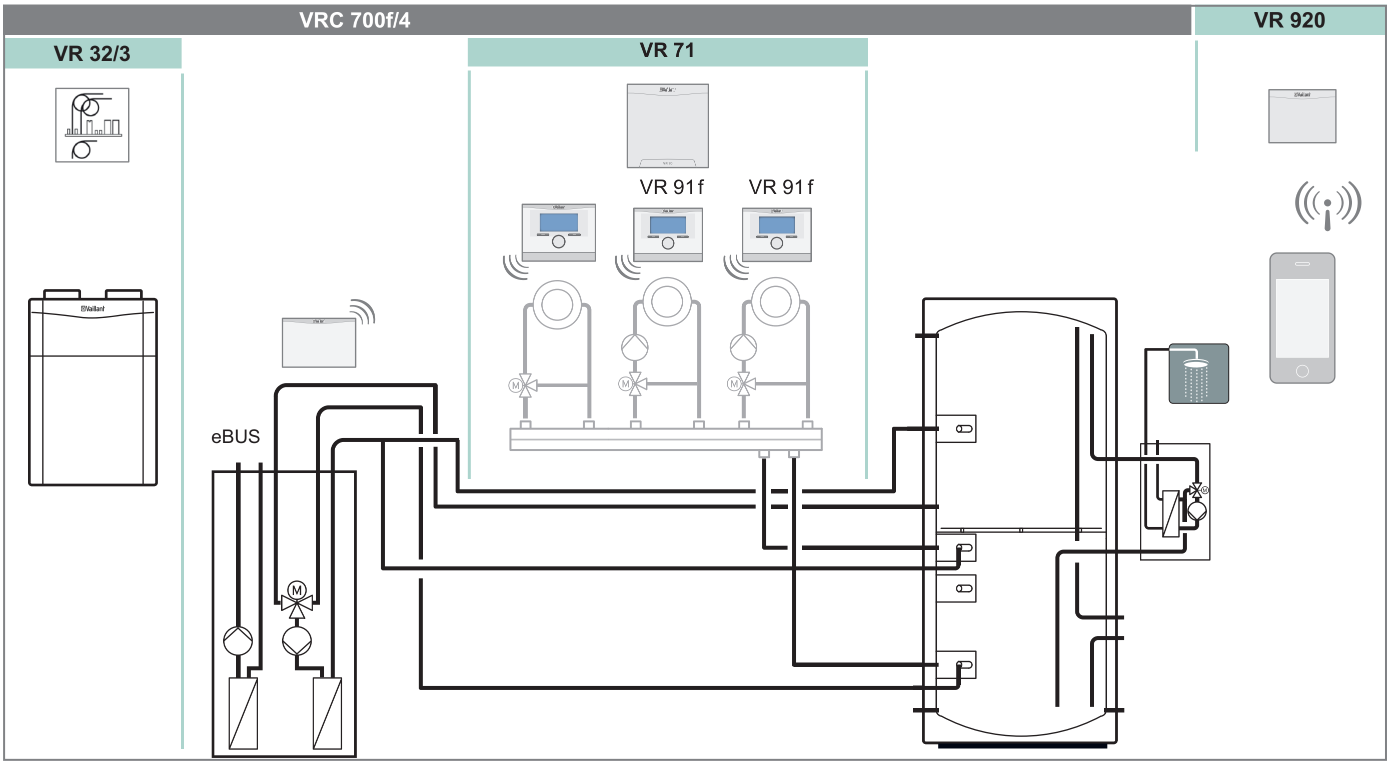


Fig. 183: System overview of the VRC 700f/4 with VR 71, 2 x VR 91f and VR 920

System overview of the VRC 700/5 with VR 70 for one optional solar system and VR 920

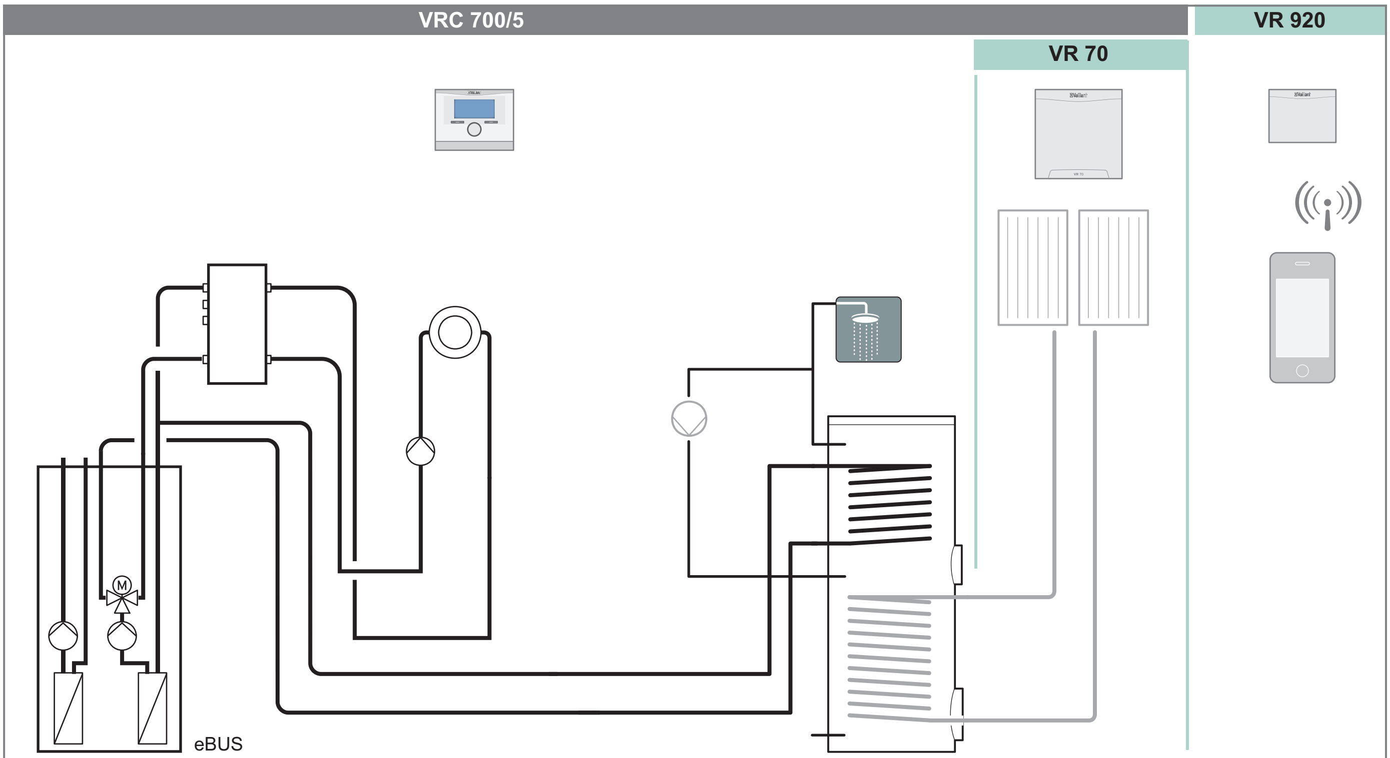


Fig. 184: System overview of the VRC 700/5 with VR 70 for one optional solar system and VR 920

System overview of the VRC 700/5 with VR 70 for two optional heating circuits

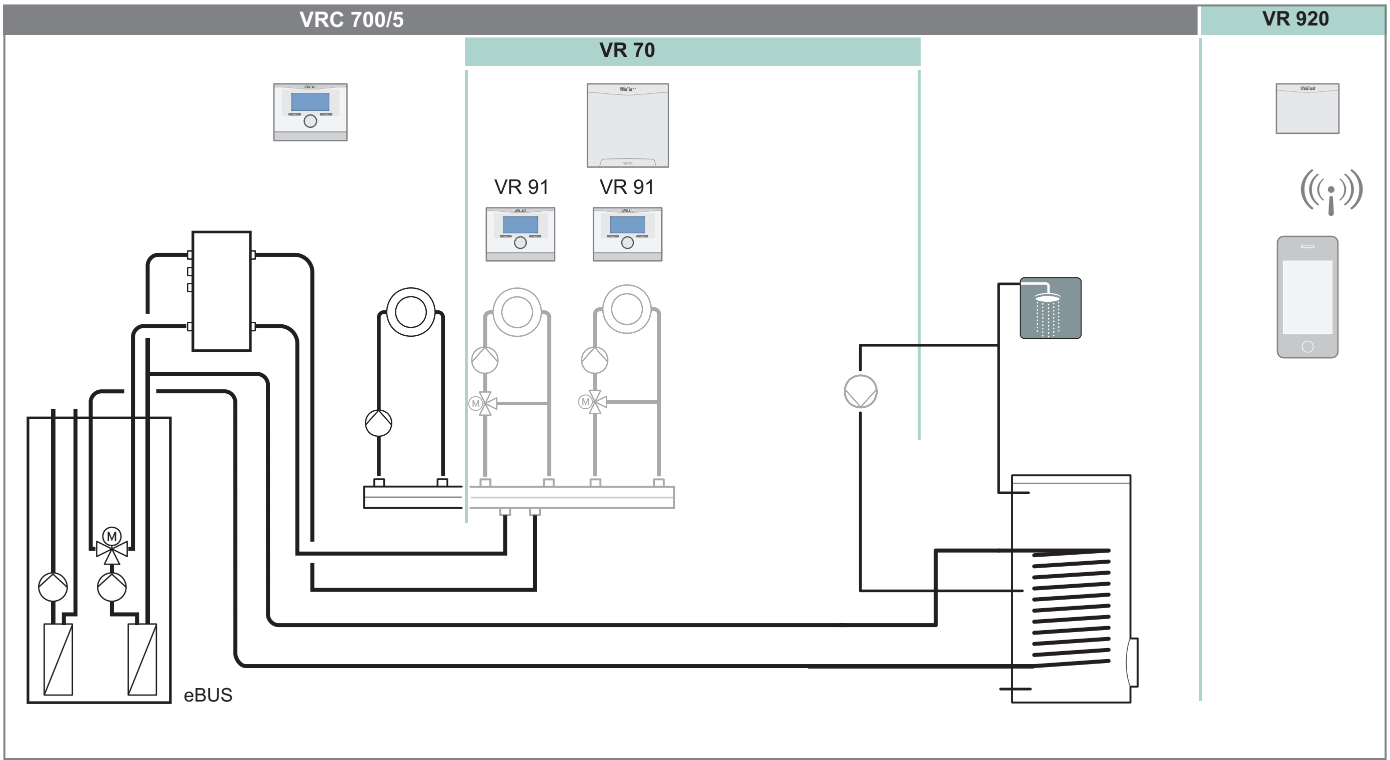


Fig. 185: System overview of the VRC 700/5 with VR 70 for two optional heating circuits and VR 920

System overview of the VRC 700/5 with VR 71, 2 x VR 91 and cascade control system

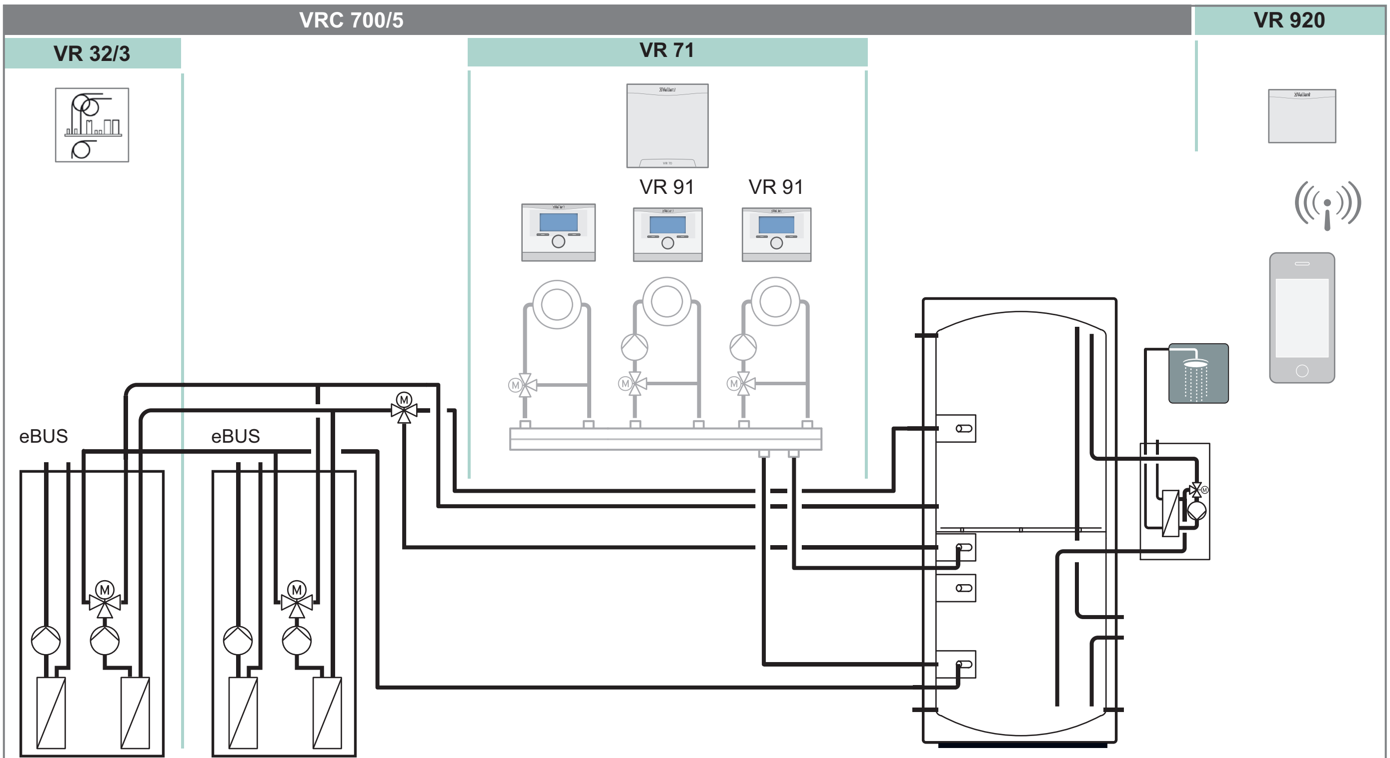


Fig. 186: System overview of the VRC 700/5 with VR 71, 2 x VR 91 and cascade control system

System overview of the geoTHERM with integrated weather-controlled energy balance controller

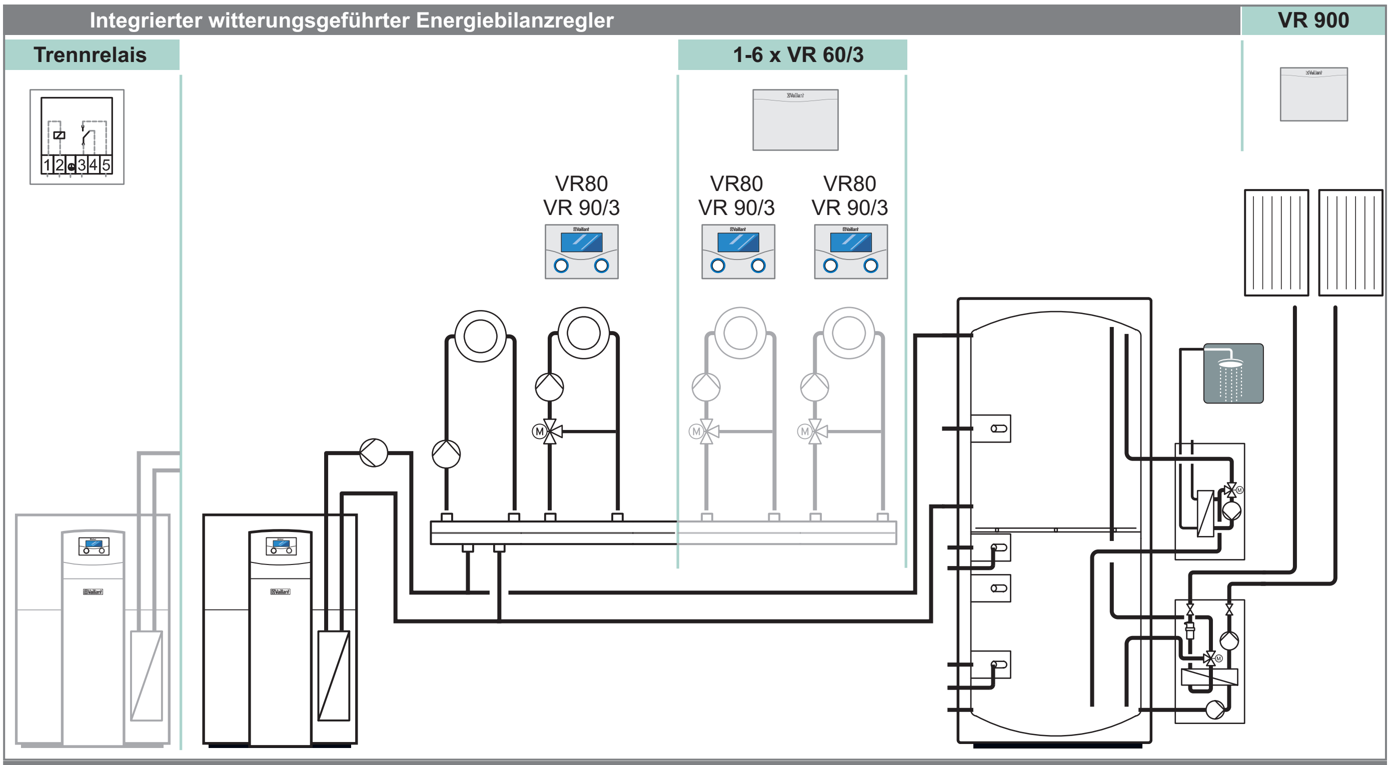


Fig. 187: System overview of the geoTHERM with integrated weather-controlled energy balance controller

11.6 Product descriptions

VRC 700/5 product description

Fig. 188: VRC 700/5

Technical data	Unit	VRC 700/5
Operating voltage Umax.	V	24
Control power consumption	mA	< 50
Maximum permissible environmental temperature	°C	60
Relative room humidity	%	20 - 95
Connection cable cross-section	mm²	0.75 - 1.5
Dimensions with wall-mounting casing:		
Height	mm	115
Width	mm	147
Depth	mm	50
IP rating	–	IP 20
Protection class for the control	–	III
Order no.	–	0020242192

Special features

- Weather-compensated control with plain text display
- One concept for all units (gas, oil, heat pumps, etc.)
- Convenient operation via an app for Android and iOS (only possible with the VR 920 communication module)
- The operator control element can also be used as a remote control
- Intuitive operation without the need for prior knowledge
- Extra-wide, illuminated plain text display
- Noise reduction for the heat pump
- Fast start-up and system configuration thanks to guided questions in the installation assistant
- eBUS interface
- Graphical solar yield display
- Graphical environmental yield and energy consumption indicator
- Input of the energy prices for HT and LT electricity, and tariff for the back-up heater
- Can be used for domestic hot water generation (cylinder charging) without an additional module and in a non-regulated heating circuit
- VR 70 wiring centre: Expansion to up to two controlled heating circuits, expansion to a solar control for heating and domestic hot water; simple buffer management and allSTOR exclusive buffer management
- VR 71 wiring centre: Expansion to up to three controlled heating circuits, expansion to a solar control for heating and domestic hot water; simple buffer management and allSTOR exclusive buffer management
- It is possible to cascade one VR 71 and up to three VR 70 modules, meaning that it is possible to achieve systems with up to nine mixed heating circuits.
- triVAI function (calculating the most efficient way of generating heat; gas/electricity cost comparison)
- Constant monitoring of system efficiency
- Humidity prevention control in conjunction with the flexoTHERM VWF... 7/4; flexoCOMPACT VWF... 8/4 and aroTHERM for humidity prevention in cooling mode
- Cascade system of up to seven eBUS heat generators of the same type and output (gas/oil/heat pump)
- Integrated actuation of Vaillant recoVAIR ventilation units
- Integrated actuation of hybrid systems

Equipment

- Adaptive heating curve
- Integrated actuation of hybrid systems
- Integrated room temperature control (heating and cooling; manual and automatic)
- Room temperature control for adjusting the flow temperature
- Weekly programme
- Time programme for heating circuits, cylinder charging circuit and circulation circuit
- Holiday programme
- Ventilation boost function
- Party function
- One-time cylinder charging outside of time programming
- Thermal disinfection (weekly time control)
- Anti-legionella function for bivalent solar cylinders

Potential applications

- Can be used as a solar control with the VR 70 mixer and solar module
- Can be used to control a single circuit or to control two circuits (mixed) with the VR 70 mixer and solar module
- Can be used to control a single circuit or to control three circuits (mixed) with the VR 71 mixer and solar module
- It is possible to cascade one VR 71 and up to three VR 70 modules, meaning that it is possible to achieve systems with up to nine mixed heating circuits.
- For all Vaillant boilers with an eBUS interface
- The VR 91 remote control unit can be added to control a heating circuit remotely
- A control can be used for ventilation, renewable energies and conventional heating equipment with an eBUS interface
- Buffer control of the allSTOR exclusive multi-functional cylinder
- A VR 32/3 bus coupler is required to integrate a recoVAIR ventilation unit or a hybrid unit
- To cascade conventional (gas/oil) heat generators with eBUS electronics and the flexoTHERM heat pump, a VR 32/3 is required for every heat generator from the second one onwards
- To cascade the aroTHERM heat pumps, a VR 32 B is required for every heat pump from the second one onwards

Note
For underfloor heating, a VRC 9642 surface-mounted thermostat is also required for the underfloor heating circuit.

VRC 700/5 and control module combinations

The following combinations are possible:

- VR 70 and 1 x VR 91

or

- VR 71 and 1 x VR 91 or 2 x VR 91

or

- VR 71 and 3 x VR 70 and 8 x VR 91

VRC 700f/4 product description

Fig. 189: VRC 700f/4

Technical data	Unit	VRC 700f/4
Battery type		LR06
Transmission frequency	MHz	868
Transmission power	mW	≤ 10
Range outdoors	m	≤ 100
Range indoors	m	≤ 25
Maximum permissible environmental temperature	°C	60
Relative room humidity	%	35 ... 90
Dimensions with wall-mounting casing:		
Height	mm	115
Width	mm	147
Depth	mm	50
IP rating	–	IP 20
Protection class for controls	–	III
Order no.	–	0020218359

Technical data	Unit	Radio receiver unit
Max. operating voltage	V	24
Power consumption	mA	< 50
Connection cable cross-section	mm²	0.75 - 1.5
Transmission frequency	MHz	868
Transmission power	mW	≤ 10
Range outdoors	m	≤ 100
Range indoors	m	≤ 25
Maximum permissible environmental temperature	°C	60
Relative room humidity	%	35 ... 90
Dimensions with wall-mounting casing:		
Height	mm	115
Width	mm	147
Depth	mm	50

Special features

- Weather-compensated radio eBUS control with plain text display
- Convenient operation via an app for Android and iOS (only possible with the VR 920 Internet module)
- Intuitive operation without the need for prior knowledge
- Fast start-up and system configuration thanks to guided questions in the installation assistant
- Can be used for domestic hot water generation (cylinder charging) without an additional module and in a non-regulated heating circuit
- Can be added to with VR 70 and VR 71 modules
- triVAI parameter for optimising the efficiency of the hybrid system
- Moisture sensor control in conjunction with the geoTHERM VWL... 5/4; flexoTHERM VWF... 7/4; flexoCOMPACT VWF... 8/4 and aroTHERM for humidity prevention in cooling mode
- Integrated actuation of Vaillant recoVAIR ventilation units
- Integrated actuation of hybrid systems
- Cascade system of up to seven conventional (gas/oil) eBUS heat generators of the same type and output
- Cascade system of up to seven heat pumps (flexoTHERM or aroTHERM) of the same type and output. A back-up boiler (eBUS boiler) can also be incorporated.

Equipment
- Adaptive heating curve
- Room temperature modulation for adjusting the flow temperature
- Weekly programme
- Extra-wide, illuminated plain text display
- Time programme for heating circuits, cylinder charging circuit and circulation circuit
- Holiday programme
- Ventilation function
- Party function
- One-time cylinder charging outside of time programming
- Thermal disinfection
- Anti-legionella function for bivalent solar cylinders
- Screed-drying function
- Graphical solar yield indicator, environmental yield and energy consumption indicator

Potential applications
- Can be used as a solar control with the VR 70 mixer and solar module (one direct/regulated heating circuit)
- Can be used as a solar control with the VR 71 mixer and solar module (three regulated heating circuits)
- For all Vaillant boilers with an eBUS interface
- The VR 91 remote control unit can be added to control a heating circuit remotely
- A control can be used for ventilation, renewable energies and conventional heating technology with an eBUS interface
- A VR 32/3 bus coupler is required to integrate a recoVAIR ventilation unit or a hybrid unit
- To cascade conventional (gas/oil) heat generators with eBUS electronics and the flexoTHERM heat pump, a VR 32/3 is required for every heat generator from the second one onwards
- To cascade the aroTHERM heat pumps, a VR 32 B is required for every heat pump from the second one onwards

Note
For underfloor heating, a VRC 9642 surface-mounted thermostat is also required for the underfloor heating circuit.

VRC 700f/4 and control module combinations

The following combinations are possible:
- VR 70 and 1 x VR 91f

or
- VR 71 and 1 x VR 91f or 2 x VR 91f

VR 70 mixer and solar module product description

Fig. 190: VR 70 mixer and solar module

VR 70 mixer and solar module: Order no. 0020184843

The mixer and solar module expands the functions of the VRC 700(f).

This module enables a VR 91(f) remote control unit to be connected to the system.

Using the wiring centre makes it possible to set/select the following functions:
- Conf. 1: One non-mixed heating circuit, one mixed heating circuit and domestic hot water cylinder charging
- Conf. 3: Multi-functional buffer cylinder with one non-mixed and one mixed heating circuit
- Conf. 5: Two mixed heating circuits added
- Conf. 6: Solar domestic hot water generation with one non-mixed heating circuit
- Conf. 12: Solar heating support with one mixed heating circuit

A VR 11 (collector sensor) needs to be used for the „COL“ sensor; all other sensors require a VR 10 (standard sensor).

VR 70 configuration – configuring the actuator outputs and sensor inputs

Conf. VR 70	Assigning the actuator outputs						Assigning the sensor inputs						
	R1	R2	R3	R4	R5	R6	S1	S2	S3	S4	S5	S6	S7
1	HC1P	HC2P	MA	–	$HC2_{op}$	$HC2_{cl}$	DHW1/ Buf_{Bt}	DEM1	DEM2	–	Sys_{Flow}/ Buf_{Top}	FS2	–
3	MA	HC2P	LP/3WV	–	$HC2_{op}$	$HC2_{cl}$	$Buf_{Top-DHW}$	Buf_{BtDHW}	Buf_{BtCH}	Sys_{Flow}	Buf_{TopCH}	FS2	–
5	HC1P	HC2P	$HC1_{op}$	$HC1_{cl}$	$HC2_{op}$	$HC2_{cl}$	Sys_{Flow}	DEM1	DEM2	–	FS1	FS2	–
6	COLP	LegP	MA	–	ZV1	–	DHW1	DHW_{Bt}	–	Sys_{Flow}	COL	Solar yield	PWM
12	COLP	HC1P	TDO	3WV	$HC1_{op}$	$HC1_{cl}$	Solar yield	Buf_{Bt}	TD1	TD2	COL	FS1	PWM

Key

HC1P/HC2P/HC3P	Heating pump for heating circuit 1/2/3
$HC1_{cl}$/$HC2_{cl}$/$HC3_{cl}$	Close mixer for heating circuit 1/2/3
$HC1_{op}$/$HC2_{op}$/$HC3_{op}$	Open mixer for heating circuit 1/2/3
DEM1/DEM2/DEM3	External heating switch-off for heating circuit 1/2/3
FS1/FS2/FS3	Flow temperature sensor for heating circuit 1/2/3
MA	Multi-function output
DHW1	Cylinder temperature sensor
DHW_{Top}	Top cylinder temperature sensor for DHW cylinder
DHW_{Bt}	Bottom cylinder temperature sensor for DHW cylinder
Sys_{Flow}	System flow temperature (low loss header)
ZV1	Zone valve for zone 1
Buf_{Top}	Top cylinder sensor for the buffer cylinder
Buf_{Bt}	Bottom cylinder sensor for the buffer cylinder
Buf_{TopDHW}	Top cylinder sensor for the DHW section of the allSTOR buffer cylinder
Buf_{BtDHW}	Bottom cylinder sensor for the DHW section of the allSTOR buffer cylinder
Buf_{TopCH}	Top cylinder sensor for the heating section of the allSTOR buffer cylinder
Buf_{BtCH}	Bottom cylinder sensor for the heating section of the allSTOR buffer cylinder
TD1/TD2	1st/2nd temperature sensor for a ΔT control system
TDO	Output for an actuator for a ΔT control system
LP/3WV	Charging pump or 3-port valve switch to DHW cylinder
COLP1	Collector pump
COL1	Collector temperature sensor
LegP	Anti-legionella pump
Yield	Solar yield sensor
PWM1	PWM actual value input/target value output of the PWM pump 1 (only in combination with the VMS 70 solar pump station)

Settings for the basic system diagram and VR 70 configuration

VRC 700f/4 and VRC 700/5 configuration: Basic system diagram		No VR 70/71	Configuring the VR 70				
			1	3	5	6	12
			2 heating circuits	allSTOR exclusive	2 x mixed heating circuits	Solar domestic hot water generation	Solar heating support
		1 direct heating circuit	1 direct and/ or one mixed heating circuit	1 direct and/ or one mixed heating circuit	Up to 2 mixed heating circuits	1 direct heating circuit	1 x mixed heating circuit
1	**System with gas- or oil-fired boiler** **Domestic hot water control via the boiler,** i.e. cylinder sensor and cylinder charging pump connected to the boiler	●	● Buffer management possible	/	●	/	/
	System with gas- or oil-fired boiler + solar domestic hot water generation **Domestic hot water control via the VRC 700,** i.e. cylinder sensor and cylinder charging pump connected to the VR 70/VR 71	/	/	● Buffer management possible	/	●	/
2	**System with gas- or oil-fired boiler** **Domestic hot water control via the VRC 700,** i.e. cylinder sensor and cylinder charging pump connected to the VR 70/VR 71	/	●	/	/	/	●
6	**3 kW hybrid system** (alternative mode of operation) Domestic hot water from back-up boiler only	●	●	/	/	/	/
7	**3 kW hybrid system** (parallel mode of operation) With two circuits/zones Domestic hot water from back-up boiler only	/	●	/	/	/	/
8	**Monoenergetic heat pump system** Back-up boiler requires the pump in the heat pump Domestic hot water via a heat pump and back-up heater	●	● Buffer management possible	● Buffer management possible	●	●	/
	Simple hybrid system Back-up boiler requires the pump in the heat pump Domestic hot water from back-up boiler only	●	/	/	/	/	/
9	**Simple hybrid system** Back-up boiler requires the pump in the heat pump Domestic hot water from back-up boiler only	/	● Buffer management possible	/	●	/	/
10	**Monoenergetic heat pump system with system separation** Back-up boiler requires the pump from the heat exchanger module Domestic hot water from heat pump only	●	● Buffer management possible	/	●	/	/
	Simple hybrid system with system separation Back-up boiler requires the pump from the heat exchanger module Domestic hot water from back-up boiler only	●	● Buffer management possible	/	●	/	/

● Setting possible
/ Settings not possible

VRC 700f/4 and VRC 700/5 configuration: Basic system diagram		No VR 70/71	Configuring the VR 70				
			1	3	5	6	12
11	**Monoenergetic heat pump system with system separation** Back-up boiler requires the pump in the heat pump Domestic hot water via a heat pump and back-up boiler	●	● Buffer management possible	/	●	●	/
12	**Full hybrid system** Back-up boiler does not require the pump in the heat pump Domestic hot water via a heat pump and back-up boiler (Domestic hot water partially controlled by the boiler)	/	● Buffer management possible	/	●	/	/
13	**Full hybrid system with system separation** Back-up boiler does not require the pump in the heat pump Domestic hot water via a heat pump and back-up boiler (Domestic hot water partially cont-rolled by the boiler)	/	● Buffer management possible	/	●	/	/
16	**Full hybrid system with system separation as an option** Back-up boiler does not require the pump in the heat pump Domestic hot water via a heat pump and back-up boiler (Domestic hot water controlled by the VRC 700)	/	● Buffer management possible	● Buffer management possible	/	/	/
	Monoenergetic heat pump system with system separation Back-up boiler requires the pump from the heat exchanger module Domestic hot water via a heat pump and back-up boiler	/	● Buffer management possible	● Buffer management possible	/	/	/
●	Setting possible						
/	Settings not possible						

Assigning basic system diagrams to heat generators

Basic system diagram	Heat generator
1, 2	Conventional heat generator
6, 7, 8, 9	3 kW hybrid system
8, 9, 12, 16	flexoTHERM heat pump
8, 9, 10, 11, 12, 13, 16	aroTHERM heat pump

If you are cascading the VR 70 mixer and solar modules, the individual modules must be assigned their own unique addresses using the address switch:

- VR 70, address 1 = address switch to 1
- VR 70, address 2 = address switch to 2
- VR 70, address 3 = address switch to 3

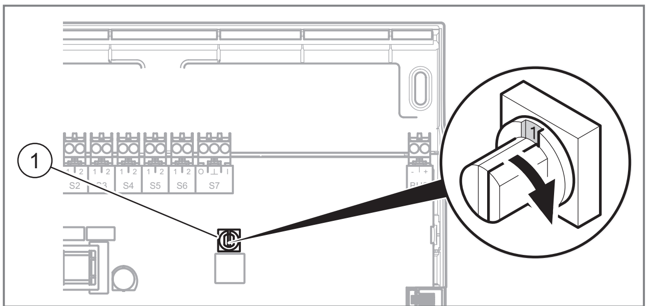


Fig. 191: Setting the bus address

1 Address switch

VR 71 mixer and solar module product description

Fig. 192: VR 71 mixer and solar module

Order no. 0020184846

The VR 71 mixer and solar module is used to expand the VRC 700(f) control.

Two VR 91(f) remote control units can also be connected. This set-up enables ErP class VIII to be achieved (increases the efficiency of the system by 5%).

Using the wiring centre makes it possible to set/select the following functions:

- Conf. 2: Solar domestic hot water generation with three mixed heating circuits
- Conf. 2: Solar heating support with three mixed heating circuits
- Conf. 3: Three mixed heating circuits added
- Conf. 6: Multi-functional buffer cylinder with three mixed heating circuits

VR 71 configuration – configuring the actuator outputs

Conf. VR 71	Assigning the actuator outputs											
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**
2	HC1P	HC2P	HC3P	MA	COLP1	LP/3WV	$HC1_{op}$	$HC1_{cl}$	$HC2_{op}$	$HC2_{cl}$	$HC3_{op}$	$HC3_{cl}$
3	HC1P	HC2P	HC3P	MA	–	LP/3WV	$HC1_{op}$	$HC1_{cl}$	$HC2_{op}$	$HC2_{cl}$	$HC3_{op}$	$HC3_{cl}$
6	HC1P	HC2P	HC3P	MA	–	LP/3WV	$HC1_{op}$	$HC1_{cl}$	$HC2_{op}$	$HC2_{cl}$	$HC3_{op}$	$HC3_{cl}$

VR 71 configuration – configuring the sensor inputs

Conf. VR 71	Assigning the sensor inputs												
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**
2	Sys_{Flow}	FS1	FS2	FS3	DHW_{Top}	DHW_{Bt}	COL1	Yield	–	TD1	TD2	PWM1	–
3	Sys_{Flow}/ Buf_{Top}	FS1	FS2	FS3	Buf_{Bt}	DEM1	DEM2	DEM3	DHW1	–	–	–	–
6	Sys_{Flow}/	FS1	FS2	FS3	Buf_{TopCH}	Buf_{BtCH}	$Buf_{Top-DHW}$	Buf_{BtDHW}	DEM1	DEM2	DEM3	–	–

Key

HC1P/HC2P/HC3P	Heating pump for heating circuit 1/2/3
$HC1_{cl}/HC2_{cl}/HC3_{cl}$	Close mixer for heating circuit 1/2/3
$HC1_{op}/HC2_{op}/HC3_{op}$	Open mixer for heating circuit 1/2/3
DEM1/DEM2/DEM3	External heating switch-off for heating circuit 1/2/3
FS1/FS2/FS3	Flow temperature sensor for heating circuit 1/2/3
MA	Multi-function output
DHW1	Cylinder temperature sensor
DHW_{Top}	Top cylinder temperature sensor for DHW cylinder
DHW_{Bt}	Bottom cylinder temperature sensor for DHW cylinder
Sys_{Flow}	System flow temperature (low loss header)
ZV1	Zone valve for zone 1
Buf_{Top}	Top cylinder sensor for the buffer cylinder
Buf_{Bt}	Bottom cylinder sensor for the buffer cylinder
Buf_{TopDHW}	Top cylinder sensor for the DHW section of the allSTOR buffer cylinder
Buf_{BtDHW}	Bottom cylinder sensor for the DHW section of the allSTOR buffer cylinder
Buf_{TopCH}	Top cylinder sensor for the heating section of the allSTOR buffer cylinder
Buf_{BtCH}	Bottom cylinder sensor for the heating section of the allSTOR buffer cylinder
TD1/TD2	1st/2nd temperature sensor for a ΔT control system
TDO	Output for an actuator for a ΔT control system
LP/3WV	Charging pump or 3-port valve switch to DHW cylinder
COLP1	Collector pump
COL1	Collector temperature sensor
LegP	Anti-legionella pump
Yield	Solar yield sensor
PWM1	PWM actual value input/target value output of the PWM pump 1 (only in combination with the VMS 70 solar pump station)

Settings for the basic system diagram and VR 71 configuration

VRC 700(f) configuration: Basic system diagram		No VR 70/71	VR 71 configuration			
			2		3	6
			Solar domestic hot water generation	Solar heating support	3 x mixed heating circuits	allSTOR exclusive
		1 direct heating circuit	Up to 3 mixed heating circuits			
1	**System with gas- or oil-fired boiler** **Domestic hot water control via the boiler,** i.e. cylinder sensor and cylinder charging pump connected to the boiler	●	/	/	● Buffer management possible	/
	System with gas- or oil-fired boiler + solar domestic hot water generation **Domestic hot water control via the VRC 700,** i.e. cylinder sensor and cylinder charging pump connected to the VR 70/VR 71	/	●	/	/	● Buffer management possible
2	**System with gas- or oil-fired boiler** **Domestic hot water control via the VRC 700,** i.e. cylinder sensor and cylinder charging pump connected to the VR 70/VR 71	/	/	●	● Buffer management possible	/
6	**3 kW hybrid system** (alternative mode of operation) Domestic hot water from back-up boiler only	●	/	/	/	/
7	**3 kW hybrid system** (parallel mode of operation) With two circuits/zones Domestic hot water from back-up boiler only	/	/	/	/	/
8	**Monoenergetic heat pump system** Back-up boiler requires the pump in the heat pump Domestic hot water via a heat pump and back-up heater	●	●	/	● Buffer management possible	● Buffer management possible
	Simple hybrid system Back-up boiler requires the pump in the heat pump Domestic hot water from back-up boiler only	●	/	/	/	/
9	**Simple hybrid system** Back-up boiler requires the pump in the heat pump Domestic hot water from back-up boiler only	/	/	/	● Buffer management possible	/
10	**Monoenergetic heat pump system with system separation** Back-up boiler requires the pump from the heat exchanger module Domestic hot water from heat pump only	●	/	/	● Buffer management possible	/
	Simple hybrid system with system separation Back-up boiler requires the pump from the heat exchanger module Domestic hot water from back-up boiler only	●	/	/	● Buffer management possible	/
11	**Monoenergetic heat pump system with system separation** Back-up boiler requires the pump in the heat pump Domestic hot water via a heat pump and back-up boiler	●	●	/	● Buffer management possible	/
●	Setting possible					
/	Settings not possible					

VRC 700(f) configuration: Basic system diagram		No VR 70/71	VR 71 configuration			
			2		3	6
12	**Full hybrid system** Back-up boiler does not require the pump in the heat pump Domestic hot water via a heat pump and back-up boiler (Domestic hot water partially controlled by the boiler)	⁄	⁄	⁄	● Buffer management possible	⁄
13	**Full hybrid system with system separation** Back-up boiler does not require the pump in the heat pump Domestic hot water via a heat pump and back-up boiler (Domestic hot water partially controlled by the boiler)	⁄	⁄	⁄	● Buffer management possible	⁄
16	**Full hybrid system with system separation as an option** Back-up boiler does not require the pump in the heat pump Domestic hot water via a heat pump and back-up boiler (Domestic hot water controlled by the VRC 700)	⁄	⁄	⁄	● Buffer management possible	● Buffer management possible
	Monoenergetic heat pump system with system separation Back-up boiler requires the pump from the heat exchanger module Domestic hot water via a heat pump and back-up boiler	●	⁄	⁄	● Buffer management possible	● Buffer management possible
●	Setting possible					
⁄	Settings not possible					

Assigning basic system diagrams to heat generators

Basic system diagram	Heat generator
1, 2	Conventional heat generator
6, 7, 8, 9	3 kW hybrid system
8, 9, 12, 16	flexoTHERM heat pump
8, 9, 10, 11, 12, 13, 16	aroTHERM heat pump

Product description of VWZ AI heat pump control interface module

Fig. 193: VWZ AI VWL X/2 heat pump control interface module

Article number

Product	Article number
VWZ AI VWL X/2 A West	0020117049
VWZ AI VWL X/2 A East	0020139944

Technical data

	VWZ AI VWL X/2 A
Operating voltage U_{max}	230 V
Power consumption	≤ 2 V·A
Contact loading of the output relay	≤ 2 A
Total current	≤ 4 A
Sensor operating voltage	3.3 V
Cross-section of eBUS line (extra-low voltage)	≥ 0.75 mm²
Cross-section of sensor line (extra-low voltage)	≥ 0.75 mm²
Cross-section of 230 V supply line (pump or mixer mains cable)	≥ 1.5 mm²
Level of protection	IP 20
Protection class	II
Maximum ambient temperature	40 °C
Height	174 mm
Width	272 mm
Depth	52 mm

Equipment

- eBUS interface
- Appliance interface with display and control buttons
- VR 10 temperature sensor

Potential applications

Wall-hung heat pump control interface module for the **aroTHERM** and **geoTHERM VWS 36/4.1** heat pumps with integrated PCB.

The heat pump control interface module is already integrated in the **VWZ MEH 61** hydraulic station and in the **uniTOWER** VIH QW 190.

Product description for geoTHERM integrated weather-controlled energy balance controller

Fig. 194: geoTHERM appliance interface

Technical data	Unit	
Operating voltage Umax.	V/Hz	230/50
Controller power consumption	VA	4
Contact loading of the output relay	max. A	2
Total current	max. A	6.3
Shortest switching interval	min	10
Reserve power supply	min	15
Permissible ambient temperature	max. °C	40
Minimum cross-section of the sensor lines	mm²	0.75
Minimum cross-section of the 230 V supply lines	mm²	1.5
Dimensions with wall-mounting casing:		
Level of protection	–	IP 20
Protection class for the controller	–	I
Order no.	–	Integrated into **geoTHERM** heat pump

Equipment

- Integrated weather-controlled energy balance controller
- Graphical plain text display, illuminated
- Graphical solar yield display
- Digital radio-controlled clock, weekly programme, three heating times per day for time-dependent control of heating/hot water and circulation pump
- Bidirectional data exchange, heating and heating mode fault
- Grout drying function
- Regulated heating circuits individually configurable for fixed value controlling, increase in return flow or use as a cylinder charging circuit
- eBUS interface
- Special functions such as economy, party and single cylinder charging
- Holiday programme
- Integrated buffer manager for the **allSTOR** VPS/3 multi-functional cylinder with drinking water station and solar charging system
- 1x external sensor with radio time signal receiver (DCF)
- 4x VR 10 standard sensor

Potential applications

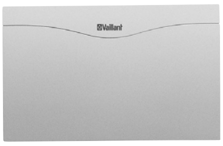
- Integrated two-cascade control system in conjunction with a cut-off relay

Information

- Additional sensors may be required depending on the system configuration (VR 10/VR 11).
- A direct heating circuit is of limited use in solar heating support. Observe the system temperatures.

11.7 Control accessories

Combination options for controls with additional modules

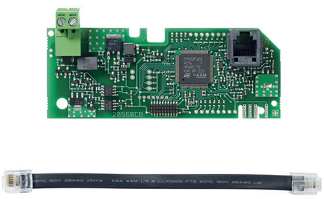
Accessories	Weather-compensated system control VRC 700	auroMATIC 620/3 weather-compensated solar system control and integrated geoTHERM energy balance control
VR 70 wiring centre 	● Connection via eBUS	–
VR 71 wiring centre 	● Connection via eBUS	–
VR 60/3 wiring centre 	–	● Connection via eBUS
VR 91 remote control unit 	● Connection via eBUS	–
VR 91f remote control 	● Connection via radio	–
VR 80 remote control unit 	–	● Connection via eBUS

● can be used
– cannot be used

Accessories	Weather-compensated system control VRC 700	auroMATIC 620/3 weather-compensated solar system control and integrated geoTHERM energy balance control
VR 90/3 remote control unit 	–	● Connection via eBUS
Multi-functional accessories for the "2 in 7" module 	● Wiring centre for additional connections Direct connection to the heat generator	●
Cut-off relay for two-unit heat pump cascade 	–	● This is required as of the second heat generator in cascade solutions
Internet communication module		
VR 920 	●	● As of year of construction 2007

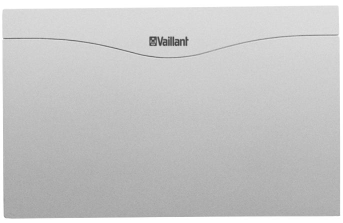
● can be used
– cannot be used

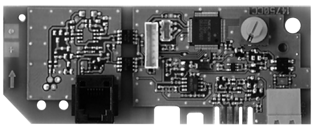
Accessories for the VRC 700

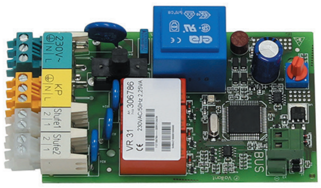
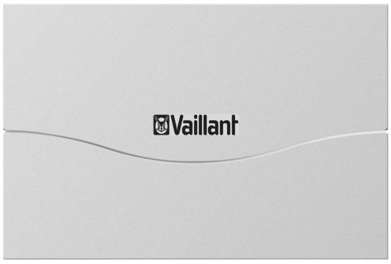
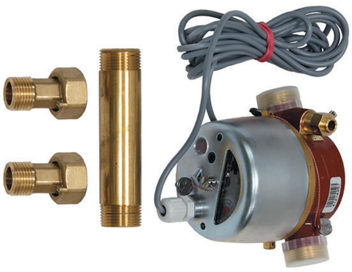
	Accessories	Order no.
	**VR 70 mixer and solar module for adding two mixing circuits or a solar system with one regulated heating circuit** **Special features** - Flexible extension module - eBUS interface **Product equipment** - Mixer and solar module - VR 10 (2x) standard sensor **Potential applications** - One non-regulated and one regulated heating circuit or - One regulated heating circuit in conjunction with a buffer cylinder (allSTOR VPS exclusive) or - 2 regulated heating circuits or - 1 non-regulated heating circuit with solar domestic hot water generation or - 1 regulated heating circuit with solar heating support Can be used for the VRC 700 **Note:** **A VR 1 1 collector sensor is required when using a thermal solar system.**	0020184843
	**VR 71 mixer and solar module for adding three mixing circuits** **Special features** - Flexible extension module - eBUS interface **Product equipment** - Mixer and solar module - VR 10 (4x) standard sensor - VR 1 1 (1) collector sensor **Potential applications** - 3 mixed heating circuits in conjunction with solar domestic hot water generation or - 3 mixed heating circuits in conjunction with solar heating support or - 3 mixed heating circuits or - 3 mixed heating circuits in conjunction with a buffer cylinder Can be used for VRC 700 and VRC 700f/4	0020184846
	**VR 39 additional module** **Special features** - Wiring centre for connecting an existing or new Vaillant heat generator with a 7-8-9 interface, bidirectionally to an eBUS control - Can be installed in the electronics box **Product equipment** - Plug-in module - Connection cable **Potential applications** Can be used for the VRC 700 **Note:** **Cannot be used with wiring centres.**	0020139898
	**VR91 remote control unit for controlling a heating zone or a heating circuit** Can be used for the VRC 700 Wired remote control for a zone (room temperature control by setting the target value) or a heating circuit in combination with the VRC 700 control. Zone assignment: One zone can be assigned to a VR 91. The controls must be installed in the relevant room; the thermostat function must also be switched on when using the VRC 700. The controls set the temperatures for the zones.	0020171333

	Accessories	Order no.
	**VR 91(f) remote control unit for controlling a heating zone or a heating circuit** Can be used for the VRC 700f(4) Wireless remote control for a zone (room temperature control by setting the target value) or a heating circuit in combination with the VRC 700f(4) control. Zone assignment: One zone can be assigned to a VR 91f. The controls must be installed in the relevant room; the thermostat function must also be switched on when using the VRC 700(4). The controls set the temperatures for the zones.	0020231565
	**VR 920 Internet communication module** **Special features** Access to the Vaillant profiDIALOG remote diagnostics portal for eBUS-enabled heat generators as of 2007 Remote parameter setting on, analysing and alerting from one to six separate boilers that are connected to a common Vaillant eBUS control and the VR 38 eBUS power supply unit Remote parameter setting on, analysing and alerting multi-circuit heating installations with eBUS control Radio communication (868 MHz) with ambiSENS thermostat possible Communication via EEBUS with Qivicon or the SMA Sunny Home Manager **Potential applications** For all Vaillant heat generators with eBUS interface as of 2007 Compatible control VRC 700, VRC 630, integrated energy balance control (geoTHERM VWS) Compatible with profiDIALOG Up to six heating systems can be integrated with the VR 38 eBUS power supply unit	0020197116

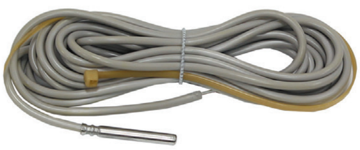
Accessories for the VRC 630/3 and auroMATIC 620/3

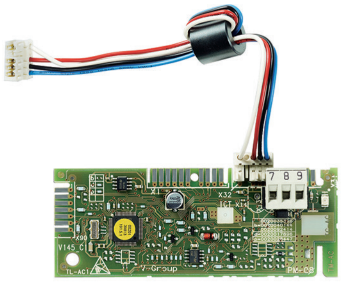
	Accessories	Order no.
	**VR 60/3 wiring centre for expanding the system by two controlled heating circuits** **Equipment** The wiring centre consists of the wiring centre and two VR 10 standard sensors **Special features** - eBUS interface - Programming the heating-circuit-specific connections via a centralised unit (auroMATIC 620/3 or VRC 630/3), optionally using a VR 90/3 or VR 80 remote control unit that can be connected to each heating circuit - Regulated heating circuits individually configurable for fixed value controlling, increase in return flow or use as a cylinder charging circuit **Possible application** - A maximum of six wiring centres can be used in one system. Can be used for the auroMATIC 620, VRC 630, geoTHERM/zeoTHERM energy balance control as an integrated system control.	306782
	**VR 80 remote control unit for changing the operating mode** **Special features** - eBUS interface - Operating mode switching - For controlling a heating circuit within a VRC control system remotely **Possible application** - A maximum of eight remote control units (VR 80 or VR 90/3) can be used in one system. Can be used for the auroMATIC 620, VRC 630, geoTHERM/zeoTHERM energy balance control as an integrated system control.	306766

	Accessories	Order no.
	**VR 90/3 remote control unit and room temperature modulation with plain text display** **Special features** - For controlling a heating circuit within a VRC control system remotely - Ability to program all the settings specific to the heating circuit(s) - Can be used for room temperature modulation - eBUS interface **Possible application** - A maximum of eight remote control units (VR 80 and VR 90/3) can be used in one system. Can be used for the auroMATIC 620, VRC 630, geoTHERM/zeoTHERM energy balance control as an integrated system control.	0020040079
	**VR 32/3 modulating eBUS bus coupler** For cascading heat generators with eBUS interface Can be used for VRC 700, auroMATIC 620, VRC 630, VWS 36/4.1 **Note:** **With two or more heat generators, a bus coupler is required.**	0020139895
	**Cascade relay for motorised flue non-return flap** Time relay for actuating the motorised flue non-return flap for ecoCRAFT... /3-E in Vaillant flue gas cascade systems (up to three units can be cascaded) For installing outside the heat generator **Product equipment** - Splashproof wall-mounting casing (IP X 4) - Mounting rail incl. for relay and grommets - Adjustable time relay - Installation material **Possible application** As an accessory for the ecoCRAFT VKK /3-E in Vaillant flue gas cascade systems with a motorised flue non-return flap; can be used for the ecoCRAFT exclusive. **Note**: **When creating a cascade system, each ecoCRAFT exclusive VKK /3-E requires a motorised flue non-return flap and a cascade relay for the motorised flue non-return flap.**	0020150855
	**VR 30/3 modulating bus coupler** For cascading modulating heat generators Maximum of eight modulating bus couplers **Note:** **With three or more heat generators, a bus coupler must be used.** **Cannot be used with Vaillant boilers that have eBUS interfaces.**	0020139894

	Accessories	Order no.
	**VR 31 switching bus coupler for cascading heat generators** For all Vaillant switching heat generators with a 3-4-5 interface	306786
	**VR 55 wall-mounting base** As an accessory for mounting the energy balance control on the wall as a remote control unit, including a cover plate for the wall-mounting casing.	306790
	**Volume flow sensor for measuring heat** Can be used for the auroMATIC 620 **Note:** **Not required in allSTOR stations.**	0020095183
	**VR 11 collector temperature sensor** As an accessory for the auroMATIC to connect a second collector field or solid fuel boiler	306788
	**Cut-off relay for two-unit cascade** Can be used for geoTHERM VWS > 20 kW	0020084114

General control system accessories

	Accessories	Order no.
	**VR 10 standard sensor** Can be used as a flow temperature sensor (surface-mounted sensor) or an immersion sensor Can be used for auroMATIC, VRC 470f, VRC 630, VRC 700 and integrated controls	306787
	**VRC 9642 surface-mounted thermostat with switching contact and enclosed strap fastening** Adjustment range + 10 to + 90 °C, contact loading 230 V, switching differential (static) 5 K, can be used for the auroMATIC 620, VRT 370 and 370f, VRC 470f, VRC 630, VRC 700 **Note:** **Required for underfloor heating.**	009642
	**2 in 7 multi-functional module** Option for actuating "2 in 7" functions (can be installed in the electronics box) circulation pump/external heating pump, cylinder charging pump, external solenoid valve, operating/fault display, extraction hood, flue non-return flap/response. Can be used for the atmoTEC exclusive, atmoTEC plus, auroCOMPACT, ecoCOMPACT, ecoCRAFT exclusive, ecoTEC exclusive, ecoTEC plus VC 146 - 316, ecoTEC plus VCI, ecoTEC plus VCW, ecoVIT exclusive, icoVIT exclusive, flexoTHERM **Note:** **Can only be used with Vaillant boilers that have eBUS electronics.**	0020017744
	**VR 36 additional module (eBUS adaptor) for an existing control (3-4-5 interface)** For connecting a non-eBUS-enabled control (3-4-5 interface) to an eBUS unit; for installation in the electronics box. Can be used for the atmoTEC exclusive, atmoTEC plus, ecoTEC exclusive VC 156 - 326, ecoTEC plus	0020117036

	Accessories	Order no.
	**VR 37 additional module (eBUS adaptor) for an existing control (7-8-9 interface, analogue)** For connecting a non-eBUS-enabled control (7-8-9 interface) to an eBUS unit; for installation in the electronics box. Can be used for the atmoTEC exclusive, atmoTEC plus, ecoTEC exclusive VC 156 - 326, ecoTEC plus	0020139835
	**VR 38 additional module with eBUS power supply unit for increasing the eBUS power supply** The VR 38 power supply unit must be installed when connecting multiple installations – consisting of an eBUS heat generator and an eBUS control – to the VR 920 communication module. Each heat generator requires a VR 32/3 bus coupler. Up to six installations can be connected. To be used when cascading up to four domestic hot water stations, in combination with a buffer cylinder, if an eBUS control (VRS 620/X) is not connected. An independent system can be created. Can be used for the VR 920	0020139836
	**Anti-legionella pump connection cable** Can be used to connect the external anti-legionella pump to the integrated control in the VMS 8 solar pump station	0020183366

12 Domestic hot water generation

A domestic hot water generation system comprises a domestic hot water generator (including its cold water supply pipe), the domestic hot water distribution lines to the draw-off points and any secondary return pipes, including the required safety devices.

Domestic hot water generation can be decentralised or centralised (in a similar way to how heat can be supplied).

Decentralised domestic hot water generation

Decentralised domestic hot water generators are usually installed directly next to a draw-off point (sink, bath) and designed to supply a single consumer or installed in a subunit and designed to supply a group of consumers (e.g. in a granny annexe). Gas (e.g. gas-fired wall-hung boilers) and electricity (e.g. electric instantaneous water heaters) can be used as energy sources for decentralised domestic hot water generation.

Centralised domestic hot water generation

Houses and apartment buildings are usually fitted with a centralised domestic hot water generation system. In this configuration, all the draw-off points are connected in a shared line network and supplied by one or more domestic hot water generators.

12.1 Domestic hot water generation system designs

Hot water generation systems are classified as follows depending on their design:

1. Monovalent cylinders
2. Bivalent cylinders
3. Centralised flow systems
4. Cylinder charging systems

Monovalent domestic hot water cylinder

Thermal energy is transferred from the heating water to the domestic hot water by a heating coil.

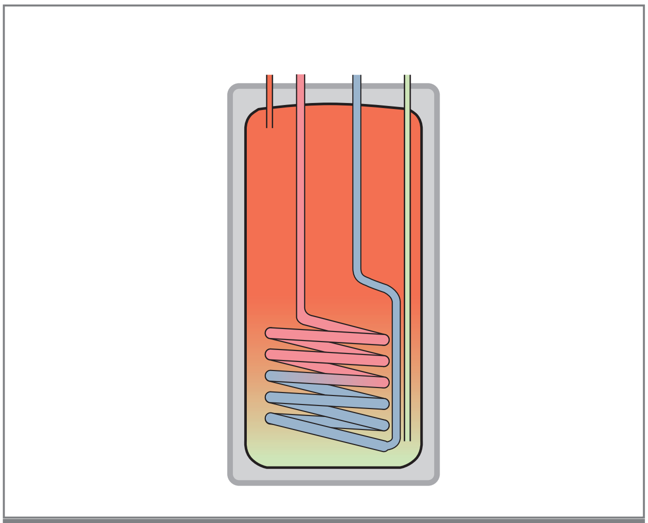
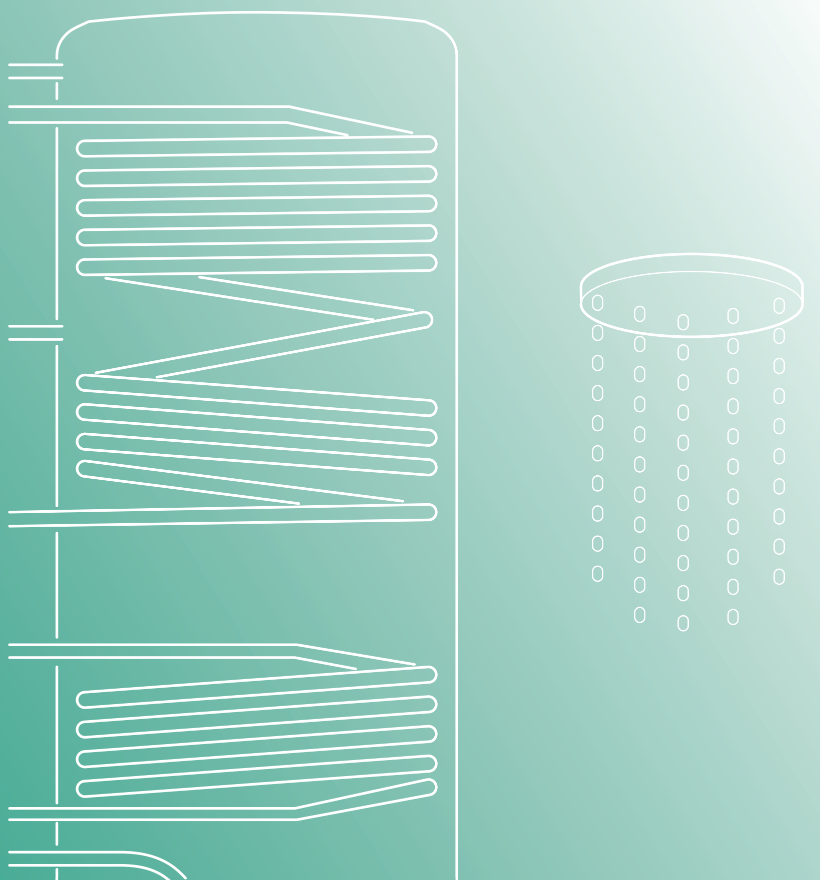


Fig. 195: Domestic hot water cylinder – e.g. uniSTOR



Bivalent domestic hot water cylinder

Thermal energy is transferred to the domestic hot water by two heating coils arranged one above the other.

The upper heating coil is connected to the heat generator, while the lower one is connected to renewable energy sources.

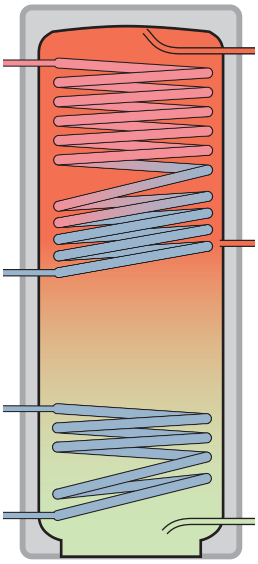


Fig. 196: Bivalent domestic hot water cylinder – using uniSTOR VIH SW as an example

Centralised flow systems

In centralised flow systems, the cylinder contains heating water. The potable water is routed via a heat exchanger through which the heating water flows, and is heated in the process.

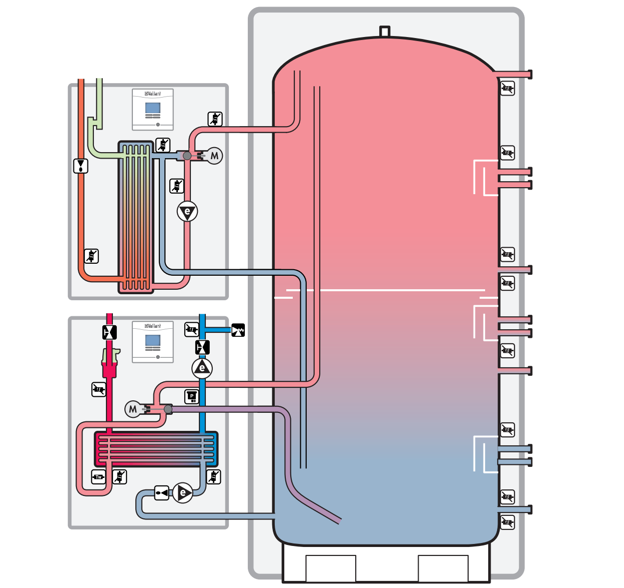


Fig. 197: Central flow system – e.g. allSTOR

The **allSTOR exclusiv VPS .../3-7** multi-functional cylinder in combination with the **auroFLOW exclusive VPM .../2 S** solar loading module and hygienic domestic hot water generation via the **aguaFLOW exclusive VPM .../.../2 W** domestic hot water station.

If there is increased domestic hot water demand, the **VPM 30/35/2 W** or **VPM 40/45/2 W** domestic hot water station should be used in combination with the **allSTOR exclusive VPS/3-7**.

Cylinder charging systems

In this type of charging system, the heat exchanger is positioned externally, i.e. outside of the domestic hot water cylinder. The system basically works by charging the cylinder from top to bottom (in layers).

This principle is used by Vaillant in the auroCOMPACT for solar domestic hot water generation.

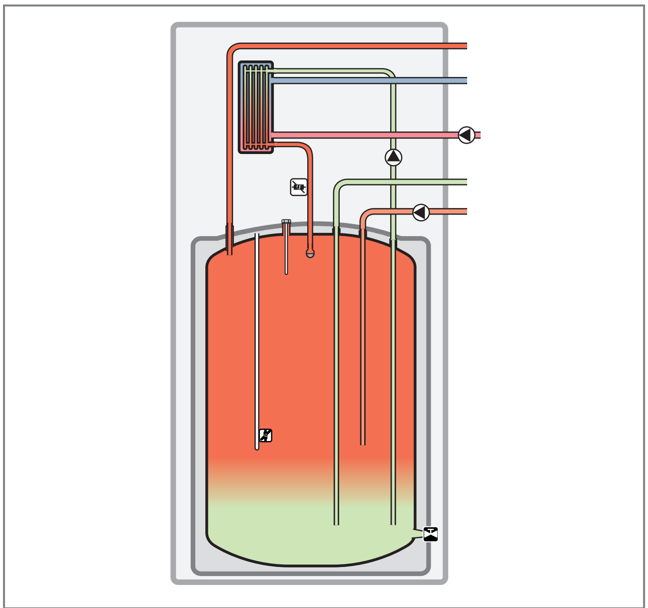


Fig. 198: Cylinder charging system – e.g. actoSTOR

12.2 Small systems

Small systems are defined as follows:

- The capacity of the domestic hot water cylinder or hot water generator is less than or equal to 400 litres
- The capacity of the longest pipeline is less than or equal to 3 litres

Both criteria must be met. If not, the system is classed as a large system.

It is recommended that the domestic hot water in the standby section of the cylinder and the entire potable water distribution network is kept at a constant temperature of 60 °C.

Potable water installations in single- and dual-occupancy houses count as small systems regardless of the size of the domestic hot water cylinder and the capacity or length of the pipelines. The German Drinking Water Ordinance therefore states that they do not need to be inspected.

12.3 Large systems

The German Drinking Water Ordinance defines large systems as follows:

- The capacity of the domestic hot water cylinder or hot water generator is greater than 400 litres and/or
- The capacity of the longest pipeline is greater than 3 litres

Only one of these two criteria must be met. Drinking water systems with centralised flow rate heaters therefore also count as large systems if the pipeline between the heater and the furthest draw-off point contains more than 3 litres of water.

In large systems like these, the hot water in the standby section of the cylinder and the entire drinking water distribution network must be kept at a constant temperature of 60 °C.

The lowest temperature in the entire drinking water network (also in the circulation return) must be a maximum of 5 K below the outlet temperature of the cylinder.

12.4 Potable water heating system with heat pumps

In addition to heat-pump-specific indirect domestic hot water cylinders, there are other system combinations that take into consideration specific requirements such as daytime consumption, peak consumption, distribution system and space requirements.

The systems that are offered for potable water heating ensure that the specific requirements are met for safely and efficiently providing hot water using a heat pump.

Many systems can also be combined with an additional, renewable energy source. In order to utilise solar thermal energy, a bivalent cylinder with an integrated second heat exchanger can be used, for example.

The heat-pump-specific domestic hot water generation systems will be described below, along with their advantages and disadvantages in terms of the heat pump.

Domestic hot water heat pumps

Domestic hot water heat pumps use the heat present in the room air to generate domestic hot water. They are designed to provide a domestic hot water supply in single-occupancy houses.

The compressor is normally above the cylinder in these compact units.

If necessary, an electric back-up heater takes over heating the potable water to the required temperature.

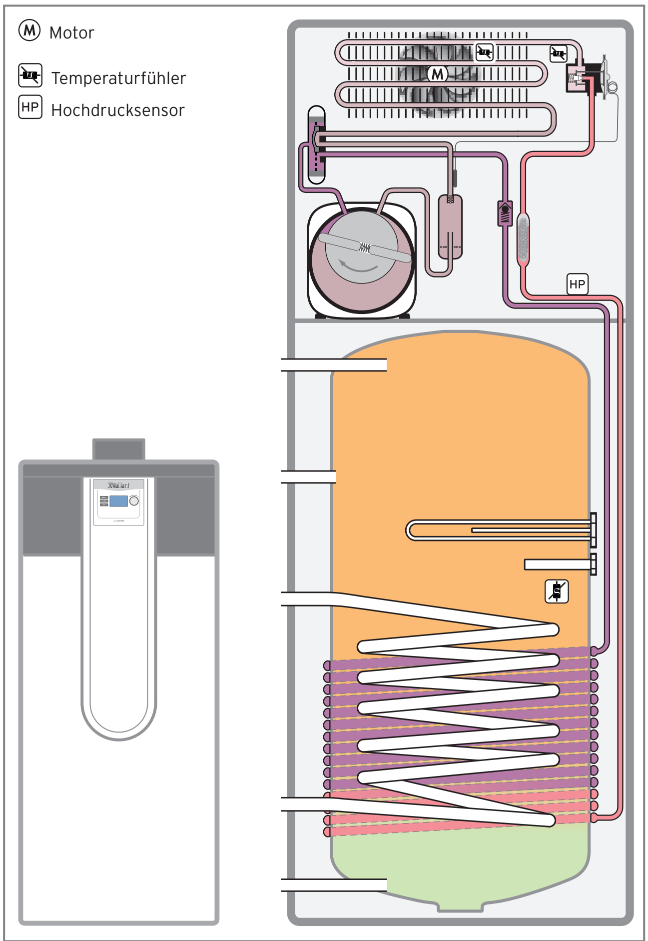


Fig. 199: Domestic hot water heat pump – Example: aroSTOR

Domestic hot water heat pumps using recirculation air

Domestic hot water heat pumps using recirculation air utilise the thermal energy in the ambient air to heat potable water. The cooled air is fed back into the room in the process.

Without the pipe system

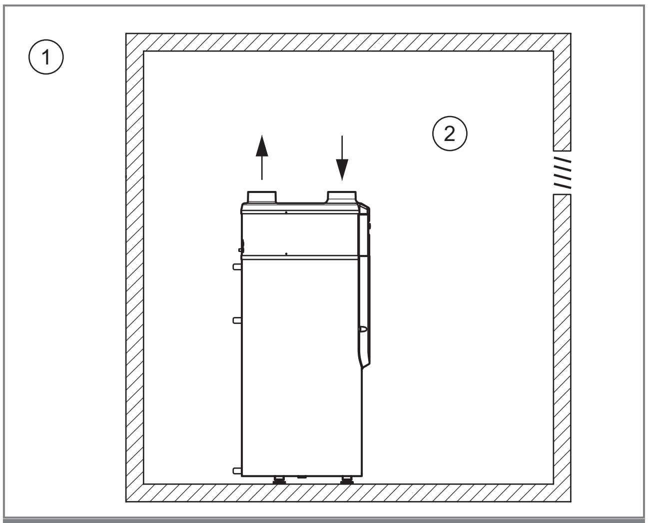


Fig. 200: Without the pipe system

1 External area
2 Internal area (heated or not heated)

Domestic hot water heat pumps using recirculation air should only be planned in installation rooms with a capacity of more than 15 m³/kW.

The domestic hot water heat pump is intended for air circulation as standard.

Advantages:

- Easy to install
- Stand-alone solution for domestic hot water generation
- Installation room is cooled
- Air in the installation room is dehumidified

Domestic hot water heat pumps using extract air

Domestic hot water heat pumps using extract air take in air from the bathroom, toilet, kitchen or other rooms and utilise the thermal energy it contains to heat potable water.

Complete pipe system

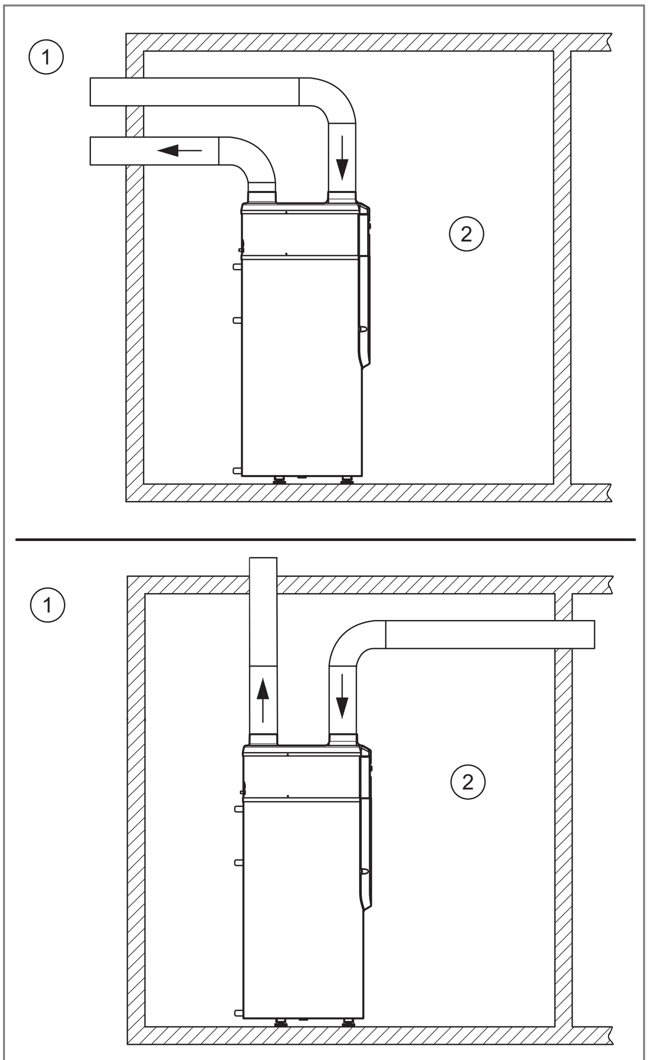


Fig. 201: Complete pipe system

1 External area
2 Internal area (heated or not heated)

The cooled extract air is discharged outside via a simple system of channels, while the supply air required in the rooms is ensured by outdoor-air openings.

If desired, the air can also be extracted from the outside area and then discharged back outside in order not to affect room ventilation.

Advantages:
- Simple ventilation system

Partial pipe system

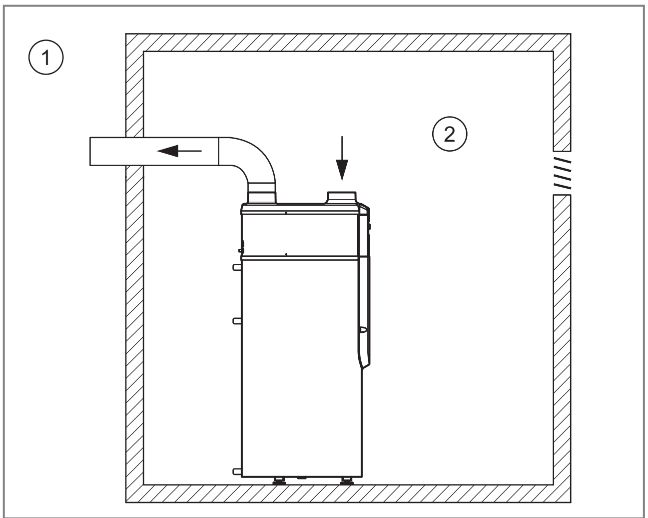


Fig. 202: Partial pipe system

1 External area
2 Internal area (heated or not heated)

The hot air is drawn into the room and the cold air is released outside.

Advantages:
- Easy to install
- Uses the room heat
- No cooling of the room

Air-to-water heat pump powered by self-generated photovoltaic energy

The self-generated energy from a photovoltaic installation is used to power an air-to-water heat pump, allowing users to utilise a larger amount of the electricity they generate themselves from their photovoltaic installation.

Intelligent energy management significantly increases efficiency in this regard. The Vaillant **aroSTOR** air-to-water heat pump can be precisely controlled by an external energy manager using two potential-free inputs. The intelligent energy management system also times the air-to-water heat pump's recharging cycle to coincide with the photovoltaic installation's most productive times.

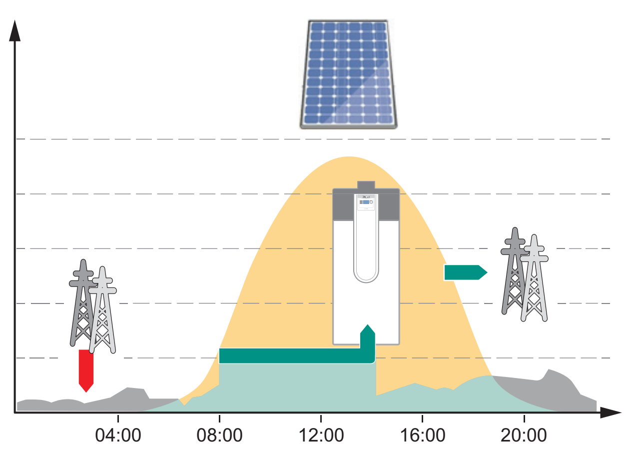


Fig. 203: Air-to-water heat pump in a photovoltaic installation

Advantages:

- Low operating costs thanks to use of self-generated energy

Domestic hot water cylinder with heat pump and electric back-up heater

The heat pump covers the entire domestic hot water demand until the maximum flow temperature is reached.

Any excess demand is covered by an electrical immersion heater which can be built into the cylinder or directly into the heat pump.

This cost-effective solution can reach a domestic hot water temperature of greater than 60 °C if required/desired using an additional electrical immersion heater.

Electrical immersion heater integrated into the domestic hot water cylinder

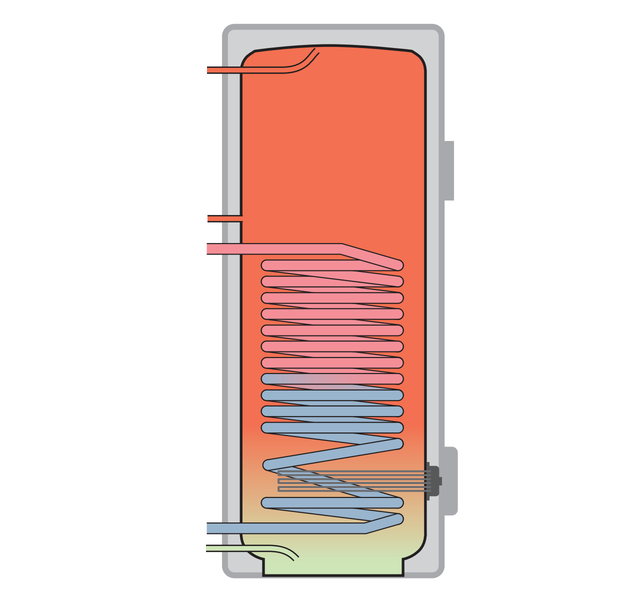


Fig. 204: Electrical immersion heater integrated into the domestic hot water cylinder

Advantages:

- Higher domestic hot water temperatures can be generated

Disadvantages:

- Electrical immersion heater increases energy consumption

Electric back-up heater in the heat pump

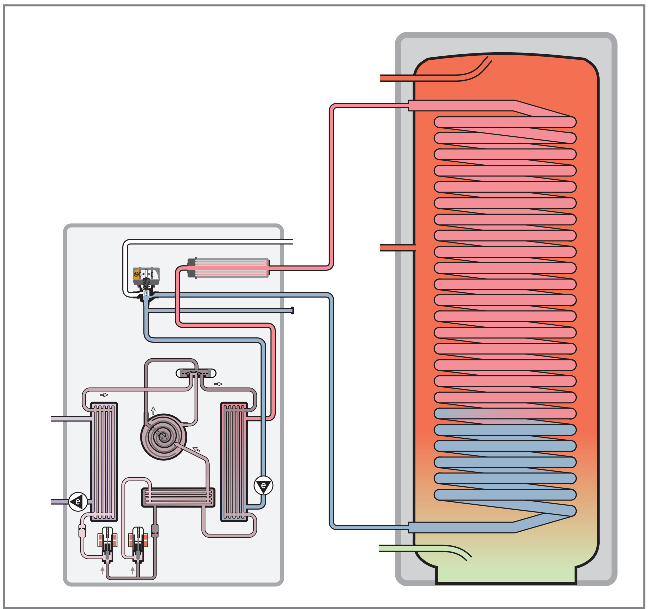


Fig. 205: Electric back-up heater in the heat pump

Advantages:
- Electric back-up heater can also be used for heating mode
- Less risk of limescale formation as the immersion heater is not in direct contact with the domestic hot water

Disadvantages:
- Electrical immersion heater increases energy consumption

Compact hot water pump with integrated drinking water cylinder

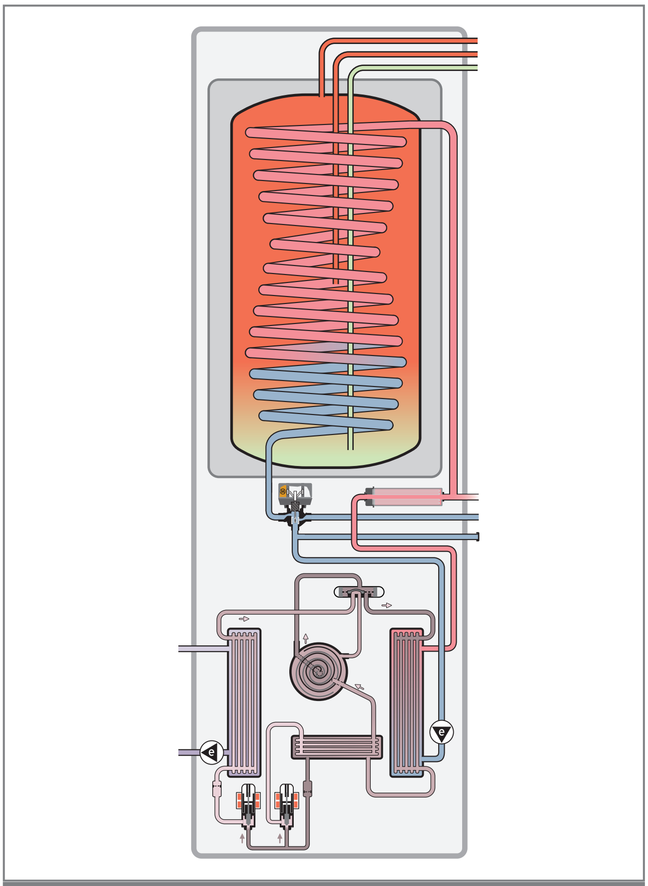


Fig. 206: Compact hot water pump with integrated drinking water cylinder – Example: flexoCOMPACT

Advantages:
- Electric heating rod can also be used for heating mode
- Less risk of limescale formation as the heating rod is not in direct contact with the hot water
- Requires less space, easy to install, no additional components necessary
- Synchronised system in a compact design

Disadvantages:
- Electric heating rod increases energy consumption

Drinking water cylinder with external boiler (flow temperature increase)

The heat pump takes over the basic load for drinking water generation and can work in an efficient range. The flow temperature must increased for hot water temperatures greater than 60 °C. This is carried out by an external heat generator, which is connected in series with the heat pump and brings additional thermal energy into the system.

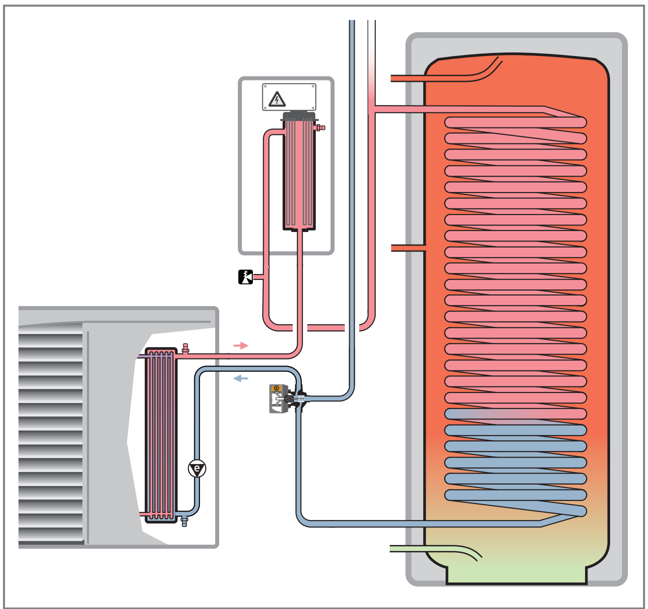


Fig. 207: Drinking water cylinder with external boiler – Example: aroTHERM

Advantages:

- Peaks in hot water demand are covered by the second heat generator

Disadvantages:

- Investments costs are higher because a second heat generator is required

uniTOWER compact unit with aroTHERM split

The heat pump takes over the domestic hot water generation and can work in an efficient range.

The uniTOWER is a compact unit with domestic hot water cylinder, heat distribution components and demand-based control of the **aroTHERM split** heat pump and the heating installation with **VRC 700**.

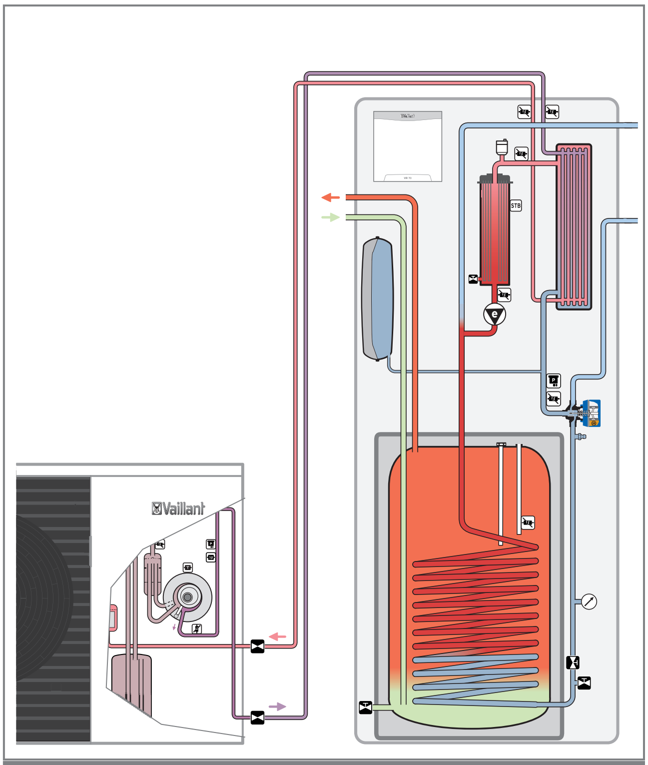


Fig. 208: uniTOWER compact unit with aroTHERM split

Advantages:

- Peaks in domestic hot water demand are covered by the second heat generator
- Requires less space, easy to install, no additional components necessary
- Synchronised system in a compact design

Disadvantages:

- Electrical immersion heater increases energy consumption

Bivalent cylinder with solar-thermal system – Electric heating rod integrated into the heat pump

Bivalent cylinders are equipped with two pipe coils. The upper part of the domestic hot water cylinder is heated by the heat pump, while the lower part of the cylinder can be heated by the heat exchanger in the solar system.

With this type of system it is important to ensure that the entire contents of the cylinder can be heated to over 60 °C at least once a day to guarantee legionella protection (anti-legionella circuit). This can be carried out by an electric auxiliary heater where required. The electric auxiliary heater can be integrated into the heat pump or built into the cylinder as an electric heating rod.

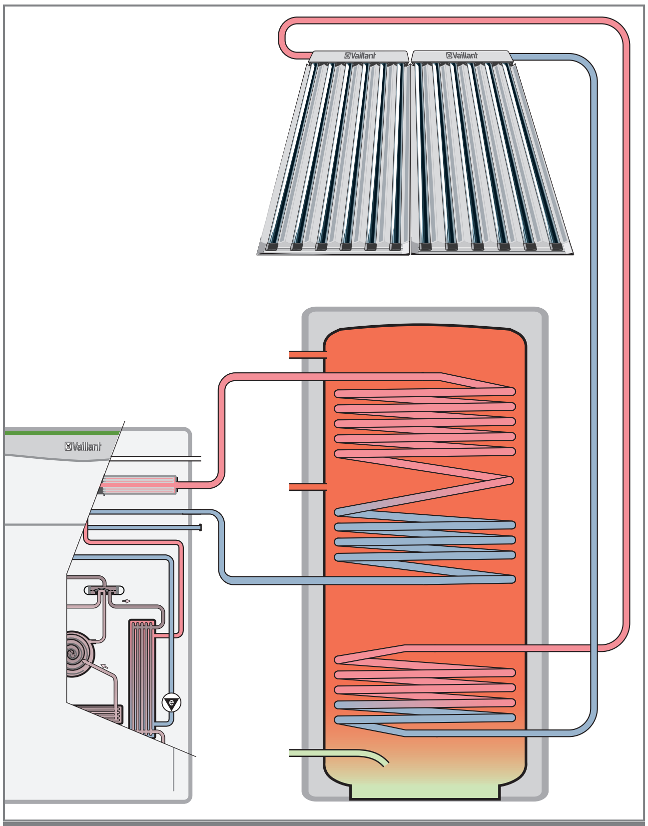


Fig. 209: Bivalent cylinder with solar-thermal system – Example: flexoTHERM

Advantages:

- Electric heating rod can also be used for heating mode
- Less risk of limescale formation as the heating rod is not in direct contact with the hot water
- Solar-assisted drinking water generation lowers operating costs

Disadvantages:

- Additional solar-thermal system increases investment costs

Bivalent cylinder with additional heat generator

The basic load for hot water generation is covered by the heat pump. The second heat generator takes over cylinder charging in the range where the heat pump works less efficiently.

This system enables the heat pump to be operated very efficiently. Hot water temperatures of greater than 60 °C can be reached.

An anti-legionella circuit is provided for drinking water.

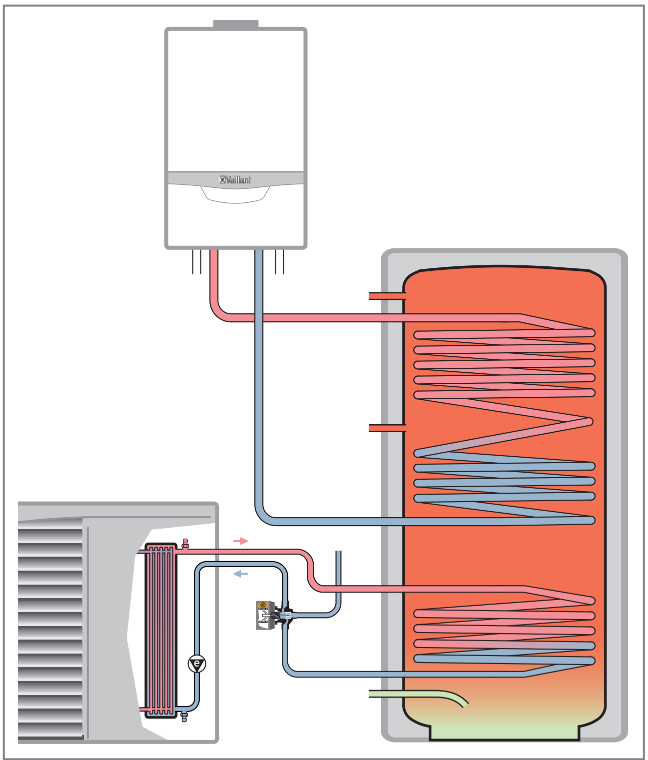


Fig. 210: Bivalent cylinder with additional heat generator – Example: aroTHERM

Advantages:

- High peaks in hot water demand can be covered by the second heat generator
- The second heat generator can support the heating system (e.g. hybrid system)
- There is the option to switch between the heat pump and the second heat generator depending on the energy price

Disadvantages:

- Investments costs are higher because two heat generators are required

Domestic hot water station

The heat pump supplies a buffer cylinder with thermal energy. The heating water is drawn out of the buffer cylinder and into a domestic hot water station, where potable water is heated using the through-flow principle.

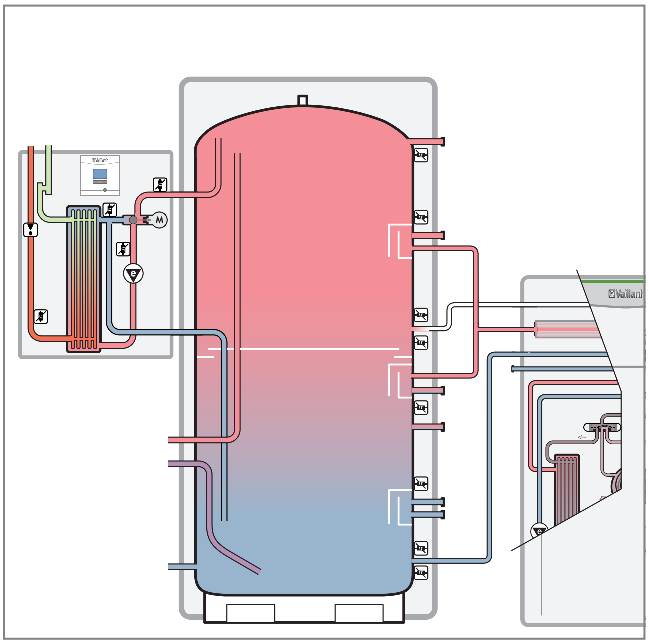


Fig. 211: Buffer cylinder and domestic hot water station - using

Advantages:

- Potable water is heated hygienically as it is not stored

Disadvantages:

- Higher cylinder temperatures may need to be maintained in order to comply with the generally recognised rules of good engineering practice

12.5 Planning information for the domestic hot water installation

Domestic hot water temperature

Legionella in potable water may harm human health and cause serious pulmonary disorders. The bacteria that cause these can almost always be found in domestic hot water and potable water. Using domestic hot water temperatures of 60 °C or above and an anti-legionella circuit, however, makes it very difficult for the pathogen to multiply.

The anti-legionella circuit provides thermal disinfection of the pipeline. The anti-legionella circuit normally heats all of the potable water or domestic hot water in the domestic hot water cylinder and secondary return pipes to over 70 °C once a week for a few minutes. The anti-legionella circuit ensures that the potable water or domestic hot water in the domestic hot water cylinder is free from legionella in accordance with the German Drinking Water Ordinance (TrinkwV).

It must also be ensured that all of the materials used to generate domestic hot water meet the requirements of the Drinking Water Ordinance. These components must be approved by the German Association for the Gas and Water Industry (DVGW).

Nominal pressure

DIN 1988-2 requires pipes, fittings and accessories in potable water installations to be designed with a nominal pressure of 10 bar.

Installing domestic hot water cylinders with a nominal pressure of 6 bar is the only exception to this. In this case, an expansion relief valve and a pressure reducer must then be installed. A pressure reducer may not need to be installed if water is supplied in such a way that the operating pressure cannot rise above 4.8 bar at the connection point of the domestic hot water cylinder.

Safety equipment

For safety reasons, each domestic hot water cylinder connected must be fitted with a type-approved expansion relief valve (maximum 10 bar).

The expansion relief valve is fitted in the cold water supply pipe upstream of the domestic hot water cylinder.

Connections that can be shut off must not be installed between the expansion relief valve and the domestic hot water cylinder.

An **exception** to this is instantaneous water heaters with a nominal capacity of less than 3 litres that are fitted with a heating system that responds quickly when adjusted. An expansion relief valve does not need to be installed if these are fitted with a type-approved flow monitor (see DIN 4753-1).

Flow rate water heaters with an outlet that is always open and open cylinder water heaters with a capacity of up to 10 litres do not need any safety equipment in the cold water supply pipe.

The required discharge pipes must be routed via a drainage system or a tundish. You can find more details on routing and dimensioning the discharge pipes in DIN 1988.

Diaphragm expansion vessels

Diaphragm expansion vessels bearing the DIN-DVGW test symbol may be installed in the cold water supply pipe to the domestic hot water cylinder.

An expansion relief valve must still be installed even if a diaphragm expansion vessel has been installed.

DIN 1988 stipulates that the only system components which should be installed are those that the installation requires; this means that, for safety reasons, there is no need to install a diaphragm expansion vessel.

Line systems and the secondary return pipe

Both DIN 1988-3 and the DVGW working sheet W 553 „Rating circulation systems in centralised drinking water heating systems" must be observed when dimensioning line systems.

As a general rule, choose lines with the smallest possible cross-section and make the paths to the draw-off points as short as possible.

To reduce heat loss, pipelines must be insulated in accordance with regulations.

Lines that are no longer needed must be disconnected. Circulation volume flows must be constantly adjusted.

Three-litre secondary return pipe rule

DVGW stipulates that circulation systems are only required in installations that have more than 3 l of water in the domestic hot water pipe.

The following table shows that it is theoretically possible to use line lengths of up to 38 m without requiring a secondary return pipe.

Circulation line standards

Dimension	Line	Volume/m	Max. length (< 3 l)
DN 10	Cu 12 x 1	0.079 l/m	Approx. 38 m
DN 12	Cu 15 x 1	0.133 l/m	Approx. 23 m
DN 15	Cu 18 x 1	0.201 l/m	Approx. 15 m
DN 20	Cu 22 x 1	0.314 l/m	Approx. 10 m
DN 25	Cu 28 x 1.5	0.491 l/m	Approx. 6 m
DN 32	Cu 35 x 1.5	0.804 l/m	Approx. 7.3 m
DN 40	Cu 42 x 1.5	1.195 l/m	Approx. 2.5 m
DN 50	Cu 54 x 2	1.963 l/m	Approx. 1.5 m

The pipe length from the domestic hot water cylinder to the draw-off point that is furthest away must be considered when calculating the water content. The water content is checked using the calculated line lengths and the dimensions of the pipes in the system.

The corresponding calculation process is shown in the following illustration.

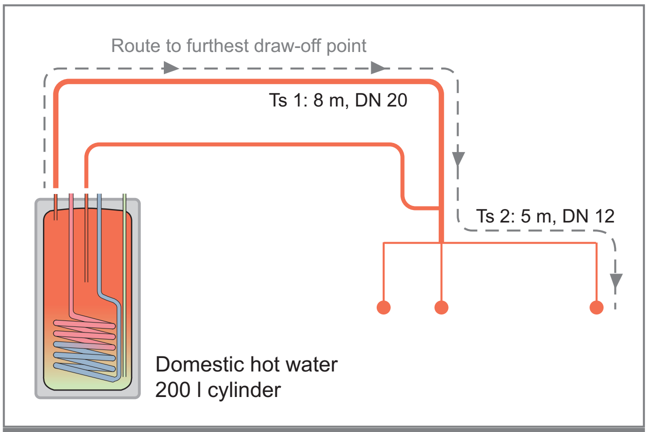


Fig. 212: Three-litre circulation rule

Sample calculation

Section 1, DN 20: 8 m * 0.314 l/m = 2.51 l

Section 2, DN 12: 5 m * 0.133 l/m = 0.67 l

Total line length: 2.51 l + 0.67 l = 3.18 l

Result: Secondary return pipe required.

12.6 What are protection anodes?

Protection anodes in hot water generators are almost always magnesium rods that are fitted in the heater to protect it against corrosion.

Where and why are protection anodes used?

Anodes are used in enamelled hot water generators, for example, to protect weak spots in the enamel. Even today, drinking water cylinders cannot be enamelled in such a way as to prevent small weak spots from developing in the enamel. Installing anodes protects these weak spots in drinking water cylinders and, as a side effect, coats them with a new layer of protective material. This layer is created by the formation of hydroxyl ions around the cathodes, which can cause calcium carbonate to break down. The calcium carbonate then covers the weak spots in the enamel. However, calcium carbonate can only be formed if there is sufficient calcium bicarbonate in the electrolyte (drinking water).

Cylinders made from stainless steel do not actually need any additional protection against corrosion using cathodes. Chrome (chrome content min. 12%) combining with the oxygen in the water at the surface forms a continuous layer of chromium oxide (passive layer) that prevents corrosion and reforms in the event of mechanical damage. Some manufacturers still recommend using additional cathode protection (magnesium or impressed current anode) because foreign particles (e.g. steel particles in houses with a galvanic drinking water installation) contaminating the surface can impair or prevent this passive layer from forming.

Where does the material that has broken down go?

The material that has broken down settles on the bottom of the hot water generator as sludge. Hot water generators should therefore be checked and cleaned regularly. Only the on-site competent person can decide when and how often a hot water generator needs to be cleaned. The hot water generator should, however, generally be opened once every five years to allow a visual inspection to be carried out. The sludge at the bottom of the cylinder should be removed preferably before but at the very latest when the second anode wears out. The walls of the cylinder can also be visually inspected. If contamination that can be attributed to the intake of dirt particles is found in the cylinder, the cylinder inflow should be fitted with a drinking water filter.

What material are protection anodes made from?

Anodes in drinking water tanks are made from magnesium. They are purchased in the form of rods or thick chains. Magnesium anodes are usually installed in the form of rods as these have a longer service life than chains. If the first chain link in a chain anode disintegrates first, the entire chain will fall into the cylinder and cease to be effective. Magnesium is used because it is near the bottom of the standard electrode potential table and is therefore the least noble metal.

Examples from the standard electrode potential table: Gold +1.42 V – Mercury +0.79 V – Hydrogen +-0 V – Iron -0.44 V – Magnesium -2.34 V.

How long does it take for an anode to disintegrate?

Unfortunately, it is impossible to answer this question exactly as numerous factors have an effect on anode disintegration. The composition of the water and the water volume flowing through the cylinder play a key role. If a cylinder has been correctly dimensioned according to the user's water requirements, the anode should not completely disintegrate within two years with average drinking water use. If the anode disintegrates more quickly, this may mean that the water is very aggressive or has a high oxygen content; it might also indicate that the contents of the cylinder are being completely replaced multiple times through the day. Water from dams makes for a special kind of drinking water as it is very soft and therefore has a low calcium bicarbonate content. Calcium bicarbonate forms a protective layer over the weak spots in the enamel, which then continues to prevent corrosion even once the magnesium anode has worn out.

How does an anode work?

The galvanic element needs to be explained first in order to understand how an anode works. The galvanic element consists of two metals (cathode, anode) that are connected by an electrically conductive liquid (electrolyte).

The metal with the lower voltage (anode) disintegrates in the electrolyte. The particles of metal that disintegrate off move through the electrolyte to the metal with the higher voltage (cathode). The voltage level is specified in the standard electrode potential table. This has gold near the top with +1.42 V and magnesium near the bottom with -2.34 V. Oxygen is neutral with +-0 V.

In an enamelled cylinder, the cylinder wall acts as the cathode and the magnesium rod as the anode. The drinking water acts as the electrolyte. The particles coming off the magnesium anode move through the electrolyte to the damaged areas in the enamel, where the unprotected steel acts as the cathode. The magnesium anode is also known as the „sacrificial anode" because of the fact that it disintegrates (is „sacrificed").

Is there an alternative to using protection anodes?

Impressed current anodes can now also be used. These are inert anodes that are made from a non-vulnerable material (e.g. titanium coated with mixed oxide, magnetite). These anodes need to be supplied with direct current in order to work. Unlike sacrificial anodes, impressed current anodes do not change the oxygen content of the electrolyte as the amount of oxygen created by the inert anode is the same as the amount consumed.

12.7 Vaillant domestic hot water cylinders – Overview

				uniTOWER				uniSTOR exclusive/ plus			uniSTOR	uniSTOR exclusive/ plus				
			Integrated domestic hot water cylinder	VIH QW 190/1 E (1,3 m^2*)	VWL 58/5 IS (1,3 m^2*)	VWL 78/5 IS (1,3 m^2*)	VWL 128/5 IS (1,3 m^2*)	VIH R 120/6 H or B (0,7 m^2*)	VIH R 150/6 H or B (0,9 m^2*)	VIH R 200/6 H or B (1 m^2*)	VIH RW 200 (1,81 m^2*)	VIH RW 300/3 MR or BR (3,12 m^2*)	VIH RW 400/3 MR or BR (4,42 m^2*)	VIH RW 500/3 MR or BR (5,9 m^2*)	VIH SW 400/3 MR or BR (3,24 m^2*)	VIH SW 500/3 MR or BR (4,42 m^2*)
Heat pumps with integrated domestic hot water cylinder	**aroSTOR**	VWL BM 290/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWL B 290/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
	flexoCOMPACT, brine-to-water 5.2 - 11.3 kW	VWF 58/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWF 88/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWF 118/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
	flexoCOMPACT, air-to-water 5.4 - 9.6 kW	VWF 58/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWF 88/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWF 118/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
	flexoCOMPACT, water-to-water 6.3 - 13.5 kW	VWF 58/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWF 88/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWF 118/4	●	/	/	/	/	/	/	/	/	/	/	/	/	/
Flexible heat pumps	**flexoTHERM**, brine-to-water 5.2 - 19.3 kW	VWF 57/4	/	/	/	/	/	/	/	/	●	●	○	○	●	○
		VWF 87/4	/	/	/	/	/	/	/	/	–	●	●	●	●	●
		VWF 117/4	/	/	/	/	/	/	/	/	–	●	●	●	●	●
		VWF 157/4	/	/	/	/	/	/	/	/	–	–	●	●	–	●
		VWF 197/4	/	/	/	/	/	/	/	/	–	–	–	●	–	–
	flexoTHERM, air-to-water 5.4 - 17.9 kW	VWF 57/4	/	/	/	/	/	/	/	/	●	●	○	○	●	○
		VWF 87/4	/	/	/	/	/	/	/	/	–	●	●	●	●	●
		VWF 117/4	/	/	/	/	/	/	/	/	–	●	●	●	●	●
		VWF 157/4	/	/	/	/	/	/	/	/	–	–	●	●	–	●
		VWF 197/4	/	/	/	/	/	/	/	/	–	–	–	●	–	–
	flexoTHERM, water-to-water 6.3 - 23.4 kW	VWF 57/4	/	/	/	/	/	/	/	/	●	●	○	○	●	○
		VWF 87/4	/	/	/	/	/	/	/	/	–	●	●	●	●	●
		VWF 117/4	/	/	/	/	/	/	/	/	–	●	●	●	●	●
		VWF 157/4	/	/	/	/	/	/	/	/	–	–	●	●	–	●
		VWF 197/4	/	/	/	/	/	/	/	/	–	–	–	●	–	–
Large HP	**geoTHERM**, brine-to-water 22.0 - 45.7 kW	VWS 220/3	/	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWS 300/3	/	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWS 380/3	/	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWS 460/3	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Air HP	**aroTHERM**, air-to-water 5.0 - 15.0 kW	VWL 55/3	/	●	/	/	/	/	/	/	●	●	○	○	●	○
		VWL 85/3	/	●	/	/	/	/	/	/	●	●	○	○	●	○
		VWL 115/2	/	●	/	/	/	/	/	/	●	●	●	○	●	●
		VWL 155/2	/	●	/	/	/	/	/	/	●	●	●	●	●	●
Air HP split	**aroTHERM split** air/water 3.5 kW-12.0 kW	VWL AS 35/5	/	/	●	/	/	/	/	/	●	●	○	○	●	○
		VWL AS 55/5	/	/	●	/	/	/	/	/	●	●	○	○	●	○
		VWL AS 75/5	/	/	/	●	/	/	/	/	●	●	●	○	●	●
		VWL AS 105/5	/	/	/	/	●	/	/	/	●	●	●	●	●	●
		VWL AS 125/5	/	/	/	/	●	/	/	/	●	●	●	●	●	●
3 kW HP	**geoTHERM** brine-to-water 2.2 kW-2.4 kW	VWS 36/4.1	/	●	●	●	●	●	●	●	●	/	/	/	/	/

● Recommended / ○ Recommended under certain circumstances / – Not recommended / / None selected / * Heat exchanger surface

			allSTOR exclusive						allSTOR plus						aguaFLOW		
			VPS 300 /3-7	VPS 500 /3-7	VPS 800 /3-7	VPS 1000 /3-7	VPS 1500 /3-7	VPS 2000 /3-7	VPS 300 /3-5	VPS 500 /3-5	VPS 800 /3-5	VPS 1000 /3-5	VPS 1500 /3-5	VPS 2000 /3-5	VPM 20/25/2 W	VPM 30/35/2 W	VPM 40/45/2 W
Heat pumps with integrated domestic hot water cylinder	aroSTOR	VWL BM 290/4	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
		VWL B 290/4	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	flexoCOMPACT brine-to-water 5.2 kW-11.3 kW	VWF 58/4	/	/	/	/	/	/	●	●	●	/	/	/	/	/	/
		VWF 88/4	/	/	/	/	/	/	○	●	●	/	/	/	/	/	/
		VWF 118/4	/	/	/	/	/	/	–	●	●	/	/	/	/	/	/
	flexoCOMPACT air-to-water 5.4-9.6 kW	VWF 58/4	/	/	/	/	/	/	●	●	●	/	/	/	/	/	/
		VWF 88/4	/	/	/	/	/	/	●	●	●	/	/	/	/	/	/
		VWF 118/4	/	/	/	/	/	/	○	●	●	/	/	/	/	/	/
	flexoCOMPACT water-to-water 6.3-13.5 kW	VWF 58/4	/	/	/	/	/	/	●	●	●	/	/	/	/	/	/
		VWF 88/4	/	/	/	/	/	/	○	●	●	/	/	/	/	/	/
		VWF 118/4	/	/	/	/	/	/	–	●	●	/	/	/	/	/	/
Flexible heat pumps	**flexoTHERM** brine-to-water 5.2 kW-19.3 kW	VWF 57/4	/	●	●	○	○	○	/	●	●	○	○	○	○	○	○
		VWF 87/4	/	○	●	○	○	○	/	○	●	○	○	○	○	○	○
		VWF 117/4	/	○	●	○	○	○	/	○	●	○	○	○	○	○	○
		VWF 157/4	/	○	○	●	○	○	/	○	○	●	○	○	○	○	○
		VWF 197/4	/	–	○	●	○	○	/	–	○	●	○	○	○	○	○
	flexoTHERM air-to-water 5.4-17.9 kW	VWF 57/4	○	●	●	○	○	○	○	●	●	○	○	○	○	○	○
		VWF 87/4	○	○	●	○	○	○	○	○	●	○	○	○	○	○	○
		VWF 117/4	○	○	●	○	○	○	○	○	●	○	○	○	○	○	○
		VWF 157/4	–	○	○	●	○	○	–	○	○	●	○	○	○	○	○
		VWF 197/4	–	–	○	●	○	○	–	–	○	●	○	○	○	○	○
	flexoTHERM, water-to-water 6.3-23.4 kW	VWF 57/4	/	●	●	○	○	○	/	●	●	○	○	○	○	○	○
		VWF 87/4	/	○	●	○	○	○	/	○	●	○	○	○	○	○	○
		VWF 117/4	/	○	●	○	○	○	/	○	●	○	○	○	○	○	○
		VWF 157/4	/	○	○	●	○	○	/	○	○	●	○	○	○	○	○
		VWF 197/4	/	–	○	●	○	○	/	–	○	●	○	○	○	○	○
Large heat pump	**geoTHERM** brine-to-water 22.0 kW-45.7 kW	VWS 220/3	/	/	○	○	○	○	/	/	○	○	○	○	○	○	○
		VWS 300/3	/	/	–	–	○	○	/	/	–	–	○	○	○	○	○
		VWS 380/3	/	/	–	–	○	○	/	/	–	–	○	○	○	○	○
		VWS 460/3	/	/	–	–	○	○	/	/	–	–	○	○	○	○	○
Air HP	**aroTHERM** air-to-water 5.0 kW-15.0 kW	VWL 55/2	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		VWL 85/2	○	●	○	○	○	○	●	○	○	○	○	○	○	○	○
		VWL 115/2	○	●	●	○	○	○	●	○	○	○	○	○	○	○	○
		VWL 155/2	○	○	●	●	○	○	●	●	○	○	○	○	○	○	○
Air HP split	**aroTHERM split** air/water 3.5 kW-12.0 kW	VWL AS 35/5	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		VWL AS 55/5	○	●	○	○	○	○	●	○	○	○	○	○	○	○	○
		VWL AS 75/5	○	●	●	○	○	○	●	○	○	○	○	○	○	○	○
		VWL AS 105/5	○	○	●	●	○	○	●	●	○	○	○	○	○	○	○
		VWL AS 125/5	○	○	●	●	○	○	●	●	○	○	○	○	○	○	○
3 kW HP	**geoTHERM** brine-to-water 2.2 kW-2.4 kW	VWS 36/4.1	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

● Recommended / ○ Recommended under certain circumstances / – Not recommended / / None selected / * Heat exchanger surface

12.8 Heat-up times for the domestic hot water cylinder and heat generator – Overview

Heat pumps	Design parameters	Domestic hot water cylinder	Cylinder volume [litres]	Heating output at B0/ W35 [kW]	Heating output at A2/ W35 [kW]	Heating output at W10/ W35 [kW]	Domestic hot water output 10 °C to 40 °C [litres/10 min.]	Heat-up time for the domestic hot water cylinder 10 °C to 40 °C [min]	Mixed water volume at 40 °C with cylinder temperature of 50 °C, cold water 10 °C [litres]
flexoCOMPACT Brine/water 5.2-11.3 kW	VWF 58/4	Integrated	171	5.3	–	–	25	68	226
	VWF 88/4	Integrated	171	8.9	–	–	42	41	226
	VWF 118/4	Integrated	171	11.2	–	–	53	32	226
flexoCOMPACT Air-to-water 5.4-9.6 kW	VWF 58/4	Integrated	171	–	5.7	–	27	63	226
	VWF 88/4	Integrated	171	–	7.8	–	37	46	226
	VWF 118/4	Integrated	171	–	10.3	–	49	35	226
flexoCOMPACT Water/water 6.3-13.5 kW	VWF 58/4	Integrated	171	–	–	6.4	30	56	226
	VWF 88/4	Integrated	171	–	–	10.0	47	36	226
	VWF 118/4	Integrated	171	–	–	12.9	61	28	226
flexoTHERM Brine/water 5.2-19.3 kW	VWF 57/4	VIH RW 200	193	5.3	–	–	25	77	255
	VWF 57/4	VIH RW 300/3	281	5.3	–	–	25	112	372
	VWF 57/4	VIH RW 400/3	375	5.3	–	–	25	149	496
	VWF 57/4	VIH SW 500/3	460	5.3	–	–	25	183	608
	VWF 57/4	VIH SW 400/3	372	5.3	–	–	25	148	492
	VWF 57/4	VIH SW 500/3	456	5.3	–	–	25	182	603
	VWF 87/4	VIH RW 300/3	281	8.9	–	–	42	67	372
	VWF 87/4	VIH RW 400/3	375	8.9	–	–	42	89	496
	VWF 87/4	VIH RW 500/3	460	8.9	–	–	42	109	608
	VWF 87/4	VIH SW 400/3	372	8.9	–	–	42	88	492
	VWF 87/4	VIH SW 500/3	456	8.9	–	–	42	108	603
	VWF 117/4	VIH RW 300/3	281	11.2	–	–	53	53	372
	VWF 117/4	VIH RW 400/3	375	11.2	–	–	53	71	496
	VWF 117/4	VIH RW 500/3	460	11.2	–	–	53	87	608
	VWF 117/4	VIH SW 400/3	372	11.2	–	–	53	70	492
	VWF 117/4	VIH SW 500/3	456	11.2	–	–	53	86	603
	VWF 157/4	VIH RW 400/3	375	14.5	–	–	69	55	496
	VWF 157/4	VIH RW 500/3	460	14.5	–	–	69	67	608
	VWF 157/4	VIH SW 500/3	456	14.5	–	–	69	66	603
	VWF 197/4	VIH RW 500/3	460	19.7	–	–	93	49	608

Heat-up times for the domestic hot water cylinder and heat generator – Overview

Heat pumps	Design parameters	Domestic hot water cylinder	Cylinder volume [litres]	Heating output at B0/ W35 [kW]	Heating output at A2/ W35 [kW]	Heating output at W10/ W35 [kW]	Domestic hot water output 10 °C to 40 °C [litres/10 min.]	Heat-up time for the domestic hot water cylinder 10 °C to 40 °C [min]	Mixed water volume at 40 °C with cylinder temperature of 50 °C, cold water 10 °C [litres]
flexoTHERM Air-to-water 5.4-17.9 kW	VWF 57/4	VIH RW 200	193	–	5.7	–	27	71	255
	VWF 57/4	VIH RW 300/3	281	–	5.7	–	27	104	372
	VWF 57/4	VIH RW 400/3	375	–	5.7	–	27	139	496
	VWF 57/4	VIH RW 500/3	460	–	5.7	–	27	170	608
	VWF 57/4	VIH SW 400/3	372	–	5.7	–	27	138	492
	VWF 57/4	VIH SW 500/3	456	–	5.7	–	27	169	603
	VWF 87/4	VIH RW 300/3	281	–	7.8	–	37	76	372
	VWF 87/4	VIH RW 400/3	375	–	7.8	–	37	101	496
	VWF 87/4	VIH RW 500/3	460	–	7.8	–	37	124	608
	VWF 87/4	VIH SW 400/3	372	–	7.8	–	37	101	492
	VWF 87/4	VIH SW 500/3	456	–	7.8	–	37	123	603
	VWF 117/4	VIH RW 300/3	281	–	10.3	–	49	58	372
	VWF 117/4	VIH RW 400/3	375	–	10.3	–	49	77	496
	VWF 117/4	VIH RW 500/3	460	–	10.3	–	49	94	608
	VWF 117/4	VIH SW 400/3	372	–	10.3	–	49	76	492
	VWF 117/4	VIH SW 500/3	456	–	10.3	–	49	93	603
	VWF 157/4	VIH RW 400/3	375	–	13.9	–	66	57	496
	VWF 157/4	VIH RW 500/3	460	–	13.9	–	66	70	608
	VWF 157/4	VIH SW 500/3	456	–	13.9	–	66	69	603
	VWF 197/4	VIH RW 500/3	460	–	17.4	–	82	56	608
flexoTHERM Water/water 6.3-23.4 kW	VWF 57/4	VIH RW 200	193	–	–	6.4	30	64	255
	VWF 57/4	VIH RW 300/3	281	–	–	6.4	30	93	372
	VWF 57/4	VIH RW 400/3	375	–	–	6.4	30	124	496
	VWF 57/4	VIH RW 500/3	460	–	–	6.4	30	152	608
	VWF 57/4	VIH SW 400/3	372	–	–	6.4	30	123	492
	VWF 57/4	VIH SW 500/3	456	–	–	6.5	30	150	603
	VWF 87/4	VIH RW 300/3	281	–	–	10.0	47	59	372
	VWF 87/4	VIH RW 400/3	375	–	–	10.0	47	79	496
	VWF 87/4	VIH RW 500/3	460	–	–	10.0	47	97	608
	VWF 87/4	VIH SW 400/3	372	–	–	10.0	47	79	492
	VWF 87/4	VIH SW 500/3	456	–	–	10.0	47	96	603
	VWF 117/4	VIH RW 300/3	281	–	–	12.9	61	46	372
	VWF 117/4	VIH RW 400/3	375	–	–	12.9	61	61	496
	VWF 117/4	VIH RW 500/3	460	–	–	12.9	61	75	608
	VWF 117/4	VIH SW 400/3	372	–	–	12.9	61	61	492
	VWF 117/4	VIH SW 500/3	456	–	–	12.9	61	75	603
	VWF 157/4	VIH RW 400/3	375	–	–	16.8	80	47	496
	VWF 157/4	VIH RW 500/3	460	–	–	16.8	80	58	608
	VWF 157/4	VIH SW 500/3	456	–	–	16.8	80	57	603
	VWF 197/4	VIH RW 500/3	460	–	–	23.0	109	42	608

Heat pumps	Design parameters	Domestic hot water cylinder	Cylinder volume [litres]	Heating output at B0/ W35 [kW]	Heating output at A2/ W35 [kW]	Heating output at W10/ W35 [kW]	Domestic hot water output 10 °C to 40 °C [litres/10 min.]	Heat-up time for the domestic hot water cylinder 10 °C to 40 °C [min]	Mixed water volume at 40 °C with cylinder temperature of 50 °C, cold water 10 °C [litres]
aroTHERM Air-to-water 5.0-15.0 kW	VWL 55/3	VIH QW 190/1	188	–	3.1	–	15	128	249
	VWL 55/3	VIH RW 200	193	–	3.1	–	15	131	255
	VWL 55/3	VIH RW 300/3	281	–	3.1	–	15	191	372
	VWL 55/3	VIH RW 400/3	375	–	3.1	–	15	255	496
	VWL 55/3	VIH RW 500/3	460	–	3.1	–	15	313	608
	VWL 55/3	VIH SW 400/3	372	–	3.1	–	15	253	492
	VWL 55/3	VIH SW 500/3	456	–	3.1	–	15	310	603
	VWL 85/3	VIH QW 190/1	188	–	4.6	–	22	86	249
	VWL 85/3	VIH RW 200	193	–	4.6	–	22	89	255
	VWL 85/3	VIH RW 300/3	281	–	4.6	–	22	129	372
	VWL 85/3	VIH RW 400/3	375	–	4.6	–	22	172	496
	VWL 85/3	VIH RW 500/3	460	–	4.6	–	22	211	608
	VWL 85/3	VIH SW 400/3	372	–	4.6	–	22	171	492
	VWL 85/3	VIH SW 500/3	456	–	4.6	–	22	209	603
	VWL 115/2	VIH QW 190/1	188	–	5.1	–	24	78	249
	VWL 115/2	VIH RW 200	193	–	5.1	–	24	80	255
	VWL 115/2	VIH RW 300/3	281	–	5.1	–	24	116	372
	VWL 115/2	VIH RW 400/3	375	–	5.1	–	24	155	496
	VWL 115/2	VIH RW 500/3	460	–	5.1	–	24	190	608
	VWL 115/2	VIH SW 400/3	372	–	5.1	–	24	154	492
	VWL 115/2	VIH SW 500/3	456	–	5.1	–	24	189	603
	VWL 155/2	VIH QW 190/1	188	–	8.2	–	39	48	249
	VWL 155/2	VIH RW 200	193	–	8.2	–	39	50	255
	VWL 155/2	VIH RW 300/3	281	–	8.2	–	39	72	372
	VWL 155/2	VIH RW 400/3	375	–	8.2	–	39	97	496
	VWL 155/2	VIH RW 500/3	460	–	8.2	–	39	118	608
	VWL 155/2	VIH SW 400/3	372	–	8.2	–	39	96	492
	VWL 155/2	VIH SW 500/3	456	–	8.2	–	39	117	603

Domestic hot water generation

Heat-up times for the domestic hot water cylinder and heat generator – Overview

Heat pumps	Design parameters	Domestic hot water cylinder	Cylinder volume [litres]	Heating output at B0/ W35 [kW]	Heating output at A2/ W35 [kW]	Heating output at W10/ W35 [kW]	Domestic hot water output 10 °C to 40 °C [litres/10 min.]	Heat-up time for the domestic hot water cylinder 10 °C to 40 °C [min]	Mixed water volume at 40 °C with cylinder temperature of 50 °C, cold water 10 °C [litres]
aroTHERM split Air-to-water 3.0-12.0 kW	VWL AS 35/5	VWL 58/5 IS	188	–	2.5	–	12	159	249
	VWL AS 35/5	VIH RW 200	193	–	2.5	–	12	163	255
	VWL AS 35/5	VIH RW 300/3	281	–	2.5	–	12	237	372
	VWL AS 35/5	VIH RW 400/3	375	–	2.5	–	12	317	496
	VWL AS 35/5	VIH RW 500/3	460	–	2.5	–	12	388	608
	VWL AS 35/5	VIH SW 400/3	372	–	2.5	–	12	314	492
	VWL AS 35/5	VIH SW 500/3	456	–	2.5	–	12	358	603
	VWL AS 55/5	VWL 58/5 IS	188	–	3.4	–	16	117	249
	VWL AS 55/5	VIH RW 200	193	–	3.4	–	16	120	255
	VWL AS 55/5	VIH RW 300/3	281	–	3.4	–	16	174	372
	VWL AS 55/5	VIH RW 400/3	375	–	3.4	–	16	233	496
	VWL AS 55/5	VIH RW 500/3	460	–	3.4	–	16	286	608
	VWL AS 55/5	VIH SW 400/3	372	–	3.4	–	16	231	492
	VWL AS 55/5	VIH SW 500/3	456	–	3.4	–	16	283	603
	VWL AS 75/5	VWL 78/5 IS	188	–	4.6	–	22	86	249
	VWL AS 75/5	VIH RW 200	193	–	4.6	–	22	89	255
	VWL AS 75/5	VIH RW 300/3	281	–	4.6	–	22	129	372
	VWL AS 75/5	VIH RW 400/3	375	–	4.6	–	22	172	496
	VWL AS 75/5	VIH RW 500/3	460	–	4.6	–	22	211	608
	VWL AS 75/5	VIH SW 400/3	372	–	4.6	–	22	171	492
	VWL AS 75/5	VIH SW 500/3	456	–	4.6	–	22	209	603
	VWL AS 105/5	VWL 128/5 IS	188	–	–	–	–	–	249
	VWL AS 105/5	VIH RW 200	193	–	–	–	–	–	255
	VWL AS 105/5	VIH RW 300/3	281	–	–	–	–	–	372
	VWL AS 105/5	VIH RW 400/3	375	–	–	–	–	–	496
	VWL AS 105/5	VIH RW 500/3	460	–	–	–	–	–	608
	VWL AS 105/5	VIH SW 400/3	372	–	–	–	–	–	492
	VWL AS 105/5	VIH SW 500/3	456	–	–	–	–	–	603
	VWL AS 125/5	VWL 128/5 IS	188	–	–	–	–	–	249
	VWL AS 125/5	VIH RW 200	193	–	–	–	–	–	255
	VWL AS 125/5	VIH RW 300/3	281	–	–	–	–	–	372
	VWL AS 125/5	VIH RW 400/3	375	–	–	–	–	–	496
	VWL AS 125/5	VIH RW 500/3	460	–	–	–	–	–	608
	VWL AS 125/5	VIH SW 400/3	372	–	–	–	–	–	492
	VWL AS 125/5	VIH SW 500/3	456	–	–	–	–	–	603
geoTHERM Brine/water 2.5 kW	VWS 36/4.1	VIH Q 75 B	68	2.4	–	–	11	60	90
	VWS 36/4.1	VIH QW 190/1	188	2.4	–	–	11	165	249
	VWS 36/4.1	VIH R 120/6	117	2.4	–	–	11	103	155
	VWS 36/4.1	VIH R 150/6	144	2.4	–	–	11	127	190
	VWS 36/4.1	VIH R 200/6	184	2.4	–	–	11	162	243
	VWS 36/4.1	VIH RW 200	193	2.4	–	–	11	170	255

12.9 uniSTOR VIH Q 75 B product description

Fig. 213: uniSTOR VIH QB 75 B

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH Q 75 B	B	68	0010015978
To be ordered separately: VC boiler from the **ecoTEC plus** series, safety group and control system			

Special features

- Wall-mounted, indirectly heated domestic hot water cylinder
- Technology and design configured to the **ecoTEC plus**
- All connections routed downwards and out
- White powder-coated casing
- Matching connection piping available as an accessory

Potential applications

- Indirectly heated cylinder with 68 l capacity for centralised hot water supply to provide a high level of hot water comfort in small spaces
- For the combination with **ecoTEC plus** VC 146/5-5, 206/5-5 and 266/5-5 units;
- Cylinder control system and connection piping are configured accordingly

Equipment

- Domestic hot water cylinder with high-quality enamelling
- Magnesium protection anode
- Powder-coated casing (white)
- Premium-quality PU foam thermal insulation
- Internal pipe heat exchanger
- Circulation connection
- Impressed current anode (order no. 302042) available as an accessory
- Cylinder piping set for horizontal installation (order no. 0020152956) available as an accessory
- Casing element (two pieces, order no. 0020152968) available as an accessory

Technical data

	Unit	VIH Q 75 B
Weight		
Net weight	kg	55
Weight (ready for operation)	kg	123
Hydraulic connection		
Cold/hot water connection	–	R 3/4
Flow and return connection	–	R 3/4
Domestic hot water cylinder output data		
Nominal capacity	l	68
Inner vessel	Steel, enamelled, with magnesium protection anode	
Max. operating pressure (hot water)	MPa (bar)	1 (10)
Max. permitted hot water temperature	°C	85
Continuous hot water output (80 °C flow temperature)	kW (l/h)	30.0 (738)
Continuous hot water output (70 °C flow temperature)	kW (l/h)	23.0 (566)
Continuous hot water output (60 °C flow temperature)	kW (l/h)	16.7 (411)
Standby energy consumption	KWh/24 hrs	0.9
Output characteristic figure NL * (60 °C cylinder temperature)	$N_{L (60 °C)}$	0.7
Output characteristic figure NL * (70 °C cylinder temperature)	$N_{L (70 °C)}$	1.0
Hot water output * (60 °C cylinder temperature)	l/10 min	122
Hot water output * (70 °C cylinder temperature)	l/10 min	143
Specific flow rate (30 K) (60 °C cylinder temperature)	l/min	14.2
Specific flow rate (30 K) (70 °C cylinder temperature)	l/min	16.7
Specific flow rate (45 K) (60 °C cylinder temperature)	l/min	9.5
Specific flow rate (45 K) (70 °C cylinder temperature)	l/min	11.1
Heat-up time from 10 to 60 °C	min	12
Heat-up time from 10 to 70 °C	min	17
Minimum power transmitted by the pipe coil (80 °C flow temperature; 60 °C cylinder temperature)	kW	11
Maximum power transmitted by the pipe coil (80 °C flow temperature; 10 °C cylinder temperature)	kW	37
Heating circuit output data		
Nominal heating medium volume flow	m^3/h	1.3
Pressure loss at nominal heating medium volume flow	MPa (mbar)	0.008 (80)
Maximum operating pressure (heating)	MPa (bar)	1.0 (10)
Maximum hot water flow temperature	°C	110
Heating area of the heat exchanger	m^2	0.85
Heating water of the heat exchanger	l	3.5
* Flow volume flow: 1.3 m^3/h; flow temperature: 80 °C		

Connection dimensions, next to each other

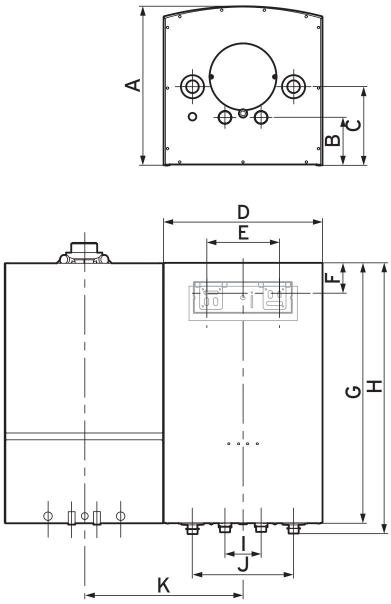


Fig. 214: VIH Q 75 B connection dimensions

A	B	C	D	E	F	G	H	I	J	K
440	132	217	440	200	87	720	746	100	280	440

Connection dimensions, on top of each other

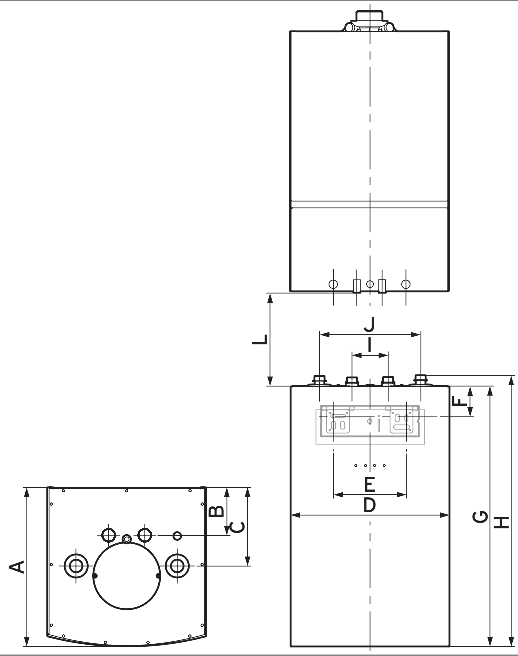


Fig. 215: VIH Q 75 B connection dimensions

A	B	C	D	E	F	G	H	I	J	L
440	132	217	440	200	87	720	746	100	280	350

Continuous output diagram

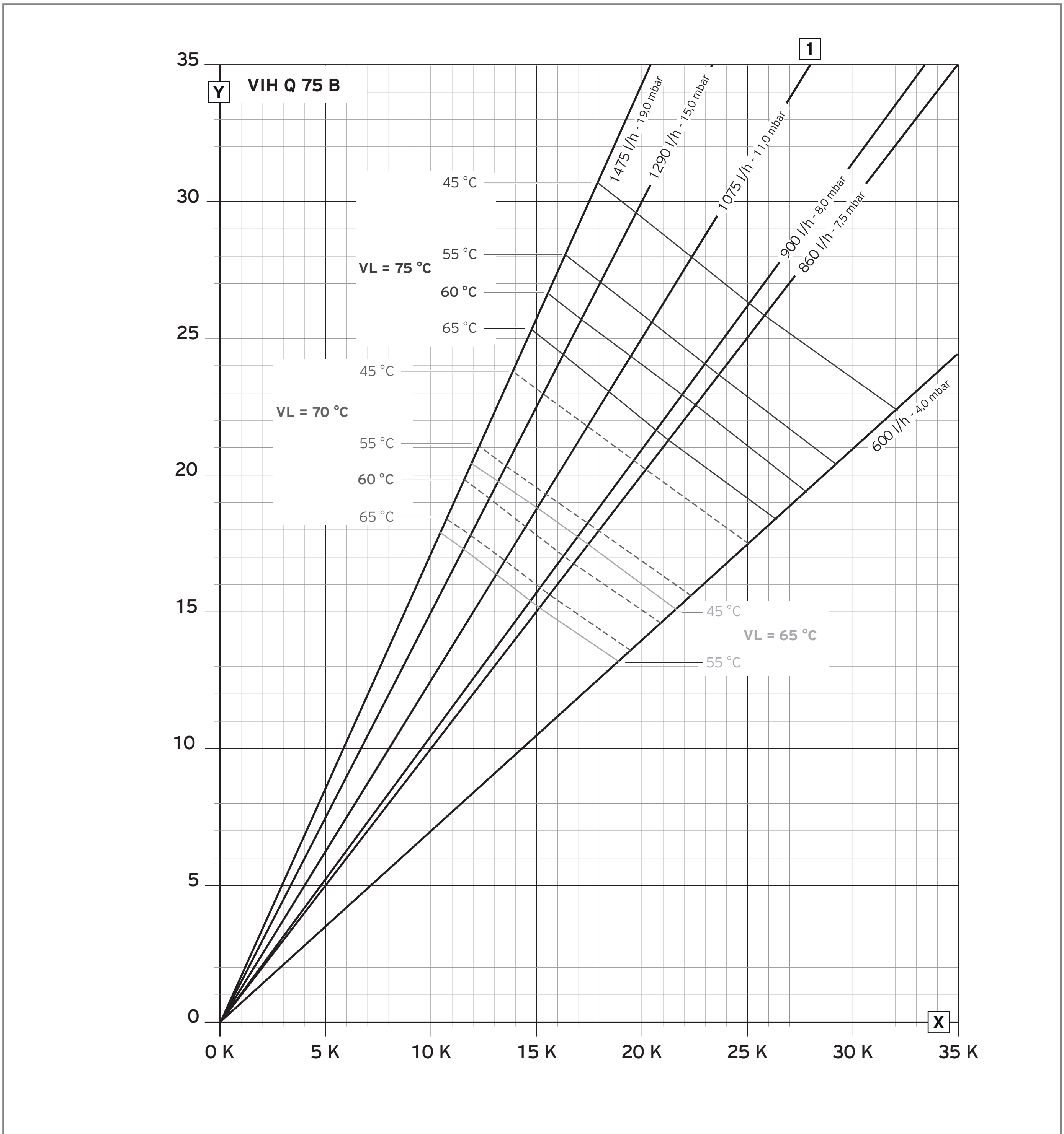


Fig. 216: Continuous output diagram for cylinder dimensioning – VIH Q 75 B

X Δt heating medium flow in K
Y Continuous output in kW
1 Heating medium flow in l/h

12.10 uniSTOR exclusive/plus VIH R 120/6 H/B to VIH R 200/6 H/B product description

uniSTOR exclusive VIH R 120/6 H to VIH R 200/6 H

Fig. 217: uniSTOR exclusive VIH R .../6 H

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH R 120/6 H	A+	117	0010015928
VIH R 150/6 H	A+	144	0010015929
VIH R 200/6 H	A+	184	0010015930

Special features

- Indirectly heated domestic hot water cylinder
- Technology configured to gas-fired wall-hung boilers and floor-standing boilers
- Highly innovative combination of vacuum and thermal insulation minimises energy supply costs
- All connections routed upwards and out
- White casing
- Matching connection piping available as an accessory
- Insulation and casing top for insulating and covering the piping on the cylinder

Potential applications

- Indirectly heated cylinder with 120, 150 or 200 litre capacity for providing a centralised domestic hot water supply in flats, houses and apartment buildings (VIH R 200)
- The VIH R 120 and VIH R 150 can be arranged under VC units.
- Cylinder control system and connection piping are configured accordingly.

Equipment

- Domestic hot water cylinder with high-quality enamelling
- Magnesium protection anode
- Highly innovative combination of vacuum and thermal insulation
- Internal pipe heat exchanger
- Drain valve
- Non-return valve
- Circulation connection
- Impressed current anode (order no. 302 042) available as an accessory
- Adjustable screw-on feet

uniSTOR plus VIH R 120/6 B to VIH R 200/6 B

Fig. 218: uniSTOR plus VIH R .../6 B

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH R 120/6 B	B	117	0010016414
VIH R 150/6 B	B	144	0010015947
VIH R 200/6 B	B	184	0010015948

Special features

- Indirectly heated domestic hot water cylinder
- Technology configured to gas-fired wall-hung boilers and floor-standing boilers
- All connections routed upwards and out
- Matching piping set available

Potential applications

- Indirectly heated cylinder with 120, 150 or 200 litre capacity for providing a centralised domestic hot water supply in flats, houses and apartment buildings (VIH R 200)
- The VIH R 120 and VIH R 150 can be arranged under VC units.
- Cylinder control system and connection piping are configured accordingly.

Equipment

- Domestic hot water cylinder with high-quality enamelling
- Magnesium protection anode
- Premium-quality PU foam thermal insulation
- Internal pipe heat exchanger
- Drain valve
- Non-return valve
- Circulation connection
- Impressed current anode (order no. 302 042) available as an accessory
- Adjustable screw-on feet
- Casing top in accessories (order no. 0020174083)

Pressure loss in the heating coil

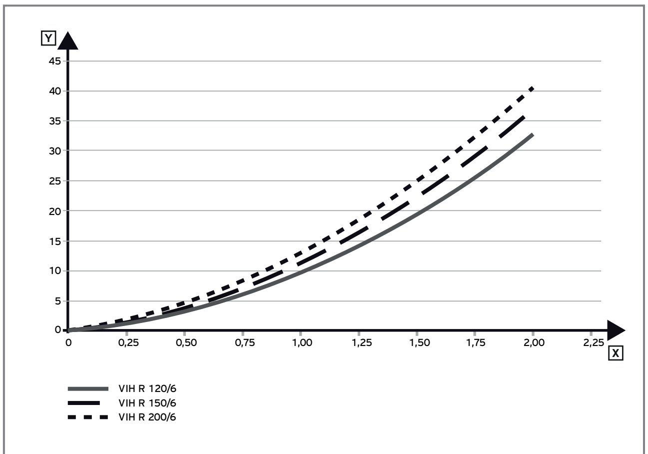


Fig. 219: Pressure loss in the heating coil

X Heating medium flow in m³/h
Y Pressure losses in mbar

uniSTOR exclusive VIH R 120/6 H to VIH R 200/6 H dimension drawing

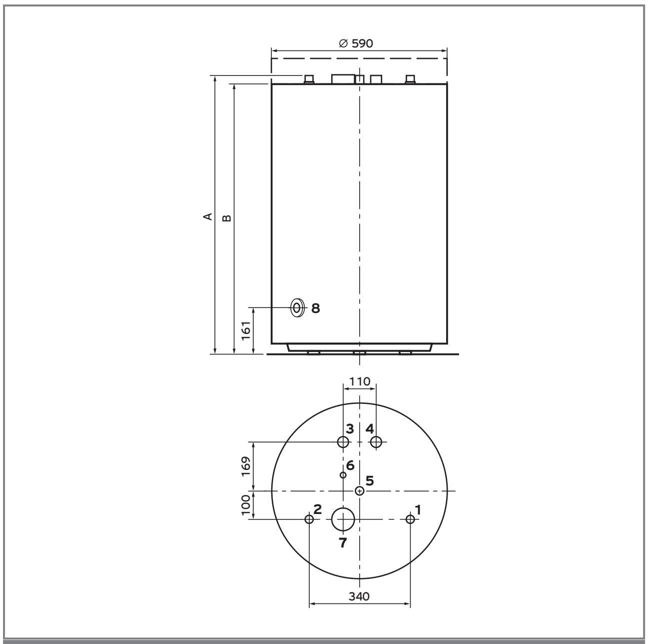


Fig. 220: Dimension drawing

1 R 3/4 cold water connection
2 R 3/4 domestic hot water connection
3 R 3/4 cylinder flow
4 R 3/4 cylinder return
5 R 3/4 circulation connection
6 Temperature sensor cylinder dry pocket
7 Protection anode
8 Drain cock

uniSTOR plus VIH R 120/6 B to VIH R 200/6 B dimension drawing

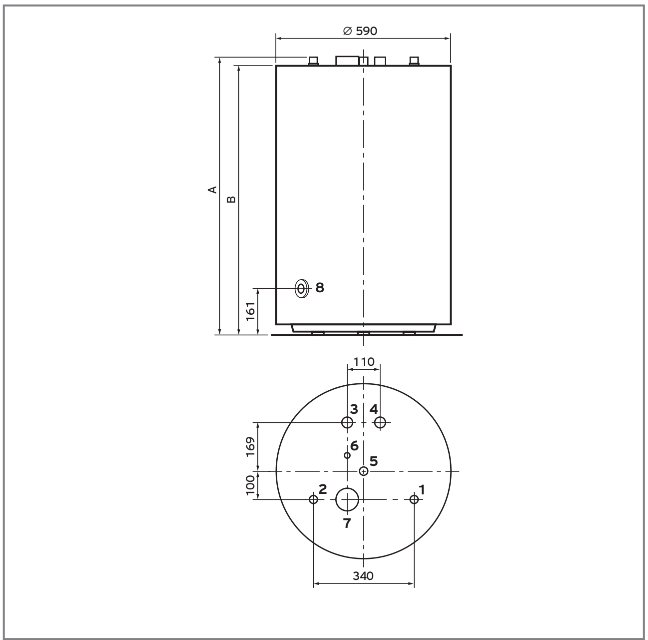


Fig. 221: Dimension drawing

1 R 3/4 cold water connection
2 R 3/4 domestic hot water connection
3 R 3/4 cylinder flow
4 R 3/4 cylinder return
5 R 3/4 circulation connection
6 Temperature sensor cylinder dry pocket
7 Protection anode
8 Drain cock

Technical data

	Unit	VIH R 120/6	VIH R 150/6	VIH R 200/6
Weight				
Net weight	kg	68	79	97
Weight (ready for operation)	kg	185	223	281
Hydraulic connection				
Cold/hot water connection	–	R 3/4		
Flow and return connection	–	R 1		
Circulation connection	–	R 3/4		
Domestic hot water cylinder output data				
Nominal capacity	l	117	144	184
Inner vessel	Enamelled steel with protection anode			
Max. operating pressure (hot water)	MPa (bar)	1 (10)	1 (10)	1 (10)
Max. permitted hot water temperature	°C	85	85	85
Continuous hot water output * (45 °C draw-off temperature)	kW (l/h)	21.4 (527)	27.4 (674)	33.7 (829)
Continuous hot water output * (50 °C draw-off temperature)	kW (l/h)	19.0 (409)	26.7 (575)	33.1 (713)
Continuous hot water output * (55 °C draw-off temperature)	kW (l/h)	17.7 (339)	25.5 (488)	30.2 (578)
Standby energy consumption (VIH R ... H types)	KWh/24 hrs	0.62	0.63	0.69
Standby energy consumption (VIH R ... M types)	KWh/24 hrs	0.74	0.77	0.83
Standby energy consumption (VIH R ... B types)	KWh/24 hrs	0.96	1.13	1.34
Standby energy consumption (VIH R ... BR types)	KWh/24 hrs	1.1	1.3	1.4
Output characteristic figure NL * (50 °C cylinder temperature)	$N_{L (50 °C)}$	0.9	1.4	2.7
Output characteristic figure NL * (55 °C cylinder temperature)	$N_{L (55 °C)}$	1.2	1.8	3.3
Output characteristic figure NL * (60 °C cylinder temperature)	$N_{L (60 °C)}$	1.4	2.2	3.8
Output characteristic figure NL * (65 °C cylinder temperature)	$N_{L (65 °C)}$	1.6	2.5	4.4
Hot water output * (50 °C cylinder temperature)	l/10 min	137	166	222
Hot water output * (55 °C cylinder temperature)	l/10 min	155	186	244
Hot water output * (60 °C cylinder temperature)	l/10 min	163	199	261
Hot water output * (65 °C cylinder temperature)	l/10 min	176	217	279
Specific flow rate (30 K) * (50 °C cylinder temperature)	l/min	16.0	19.4	25.9
Specific flow rate (30 K) * (55 °C cylinder temperature)	l/min	18.1	21.7	28.5
Specific flow rate (30 K) * (60 °C cylinder temperature)	l/min	19.0	23.2	30.5
Specific flow rate (30 K) * (65 °C cylinder temperature)	l/min	20.5	25.3	32.6
Specific flow rate (45 K) * (50 °C cylinder temperature)	l/min	10.7	12.9	17.3
Specific flow rate (45 K) * (55 °C cylinder temperature)	l/min	12.1	14.5	19.0
Specific flow rate (45 K) * (60 °C cylinder temperature)	l/min	12.7	15.5	20.3
Specific flow rate (45 K) * (65 °C cylinder temperature)	l/min	13.7	16.9	21.7
Heat-up time from 10 to 50 °C *	min	15.8	18.8	20.8
Heat-up time from 10 to 55 °C *	min	19.0	22.5	25.0
Heat-up time from 10 to 60 °C *	min	23.3	27.5	30.8
Heat-up time from 10 to 65 °C *	min	28.5	33.8	37.5
Minimum power transmitted by the pipe coil (80 °C flow temperature; 60 °C cylinder temperature)	kW	11.1	12.9	14.8
Minimum power transmitted by the pipe coil (80 °C flow temperature; 10 °C cylinder temperature)	kW	30.9	35.9	41.4
Heating circuit output data				
Nominal heating medium volume flow	m^3/h	1.4	1.4	1.4
Pressure loss at nominal heating medium volume flow	MPa (mbar)	0.0017 (17)	0.002 (20)	0.0022 (22)
Maximum operating pressure (heating)	MPa (bar)	1 (10)	1 (10)	1 (10)
Max. heating water flow temperature **	°C	110	110	110
Heating area of the heat exchanger	m^2	0.7	0.9	1.0
Heating water of the heat exchanger	l	4.8	5.7	6.8

* Flow temperature 80 °C
** The maximum heating water flow temperature is 100 °C in units with a display for the magnesium protection anode.

Continuous output diagram

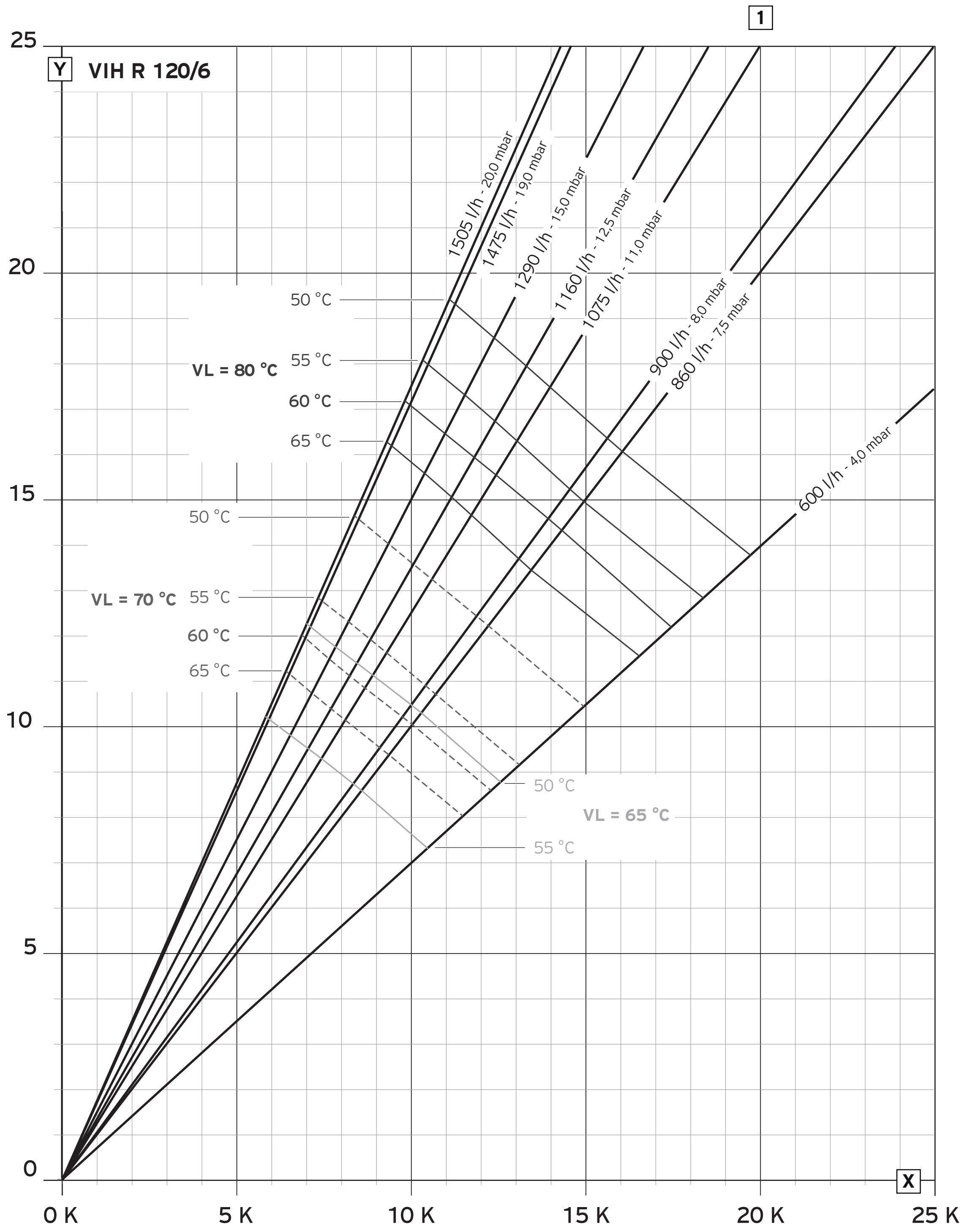


Fig. 222: Continuous output diagram for cylinder dimensioning – uniSTOR VIH R 120/6

X Δt heating medium flow in K
Y Continuous output in kW
1 Heating medium flow in l/h

Continuous output diagram

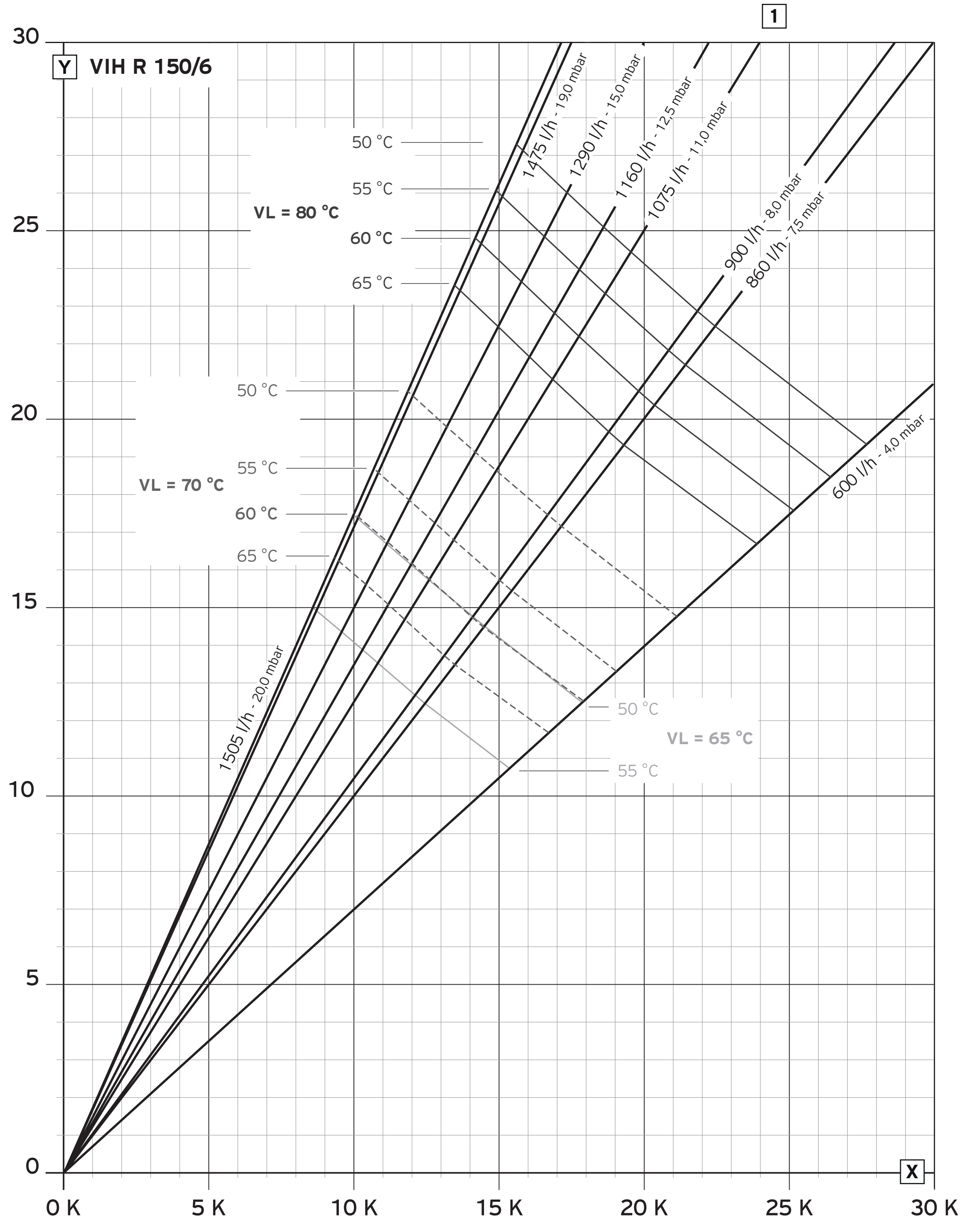


Fig. 223: Continuous output diagram for cylinder dimensioning – uniSTOR VIH R 150/6

X Δt heating medium flow in K
Y Continuous output in kW
1 Heating medium flow in l/h

Continuous output diagram

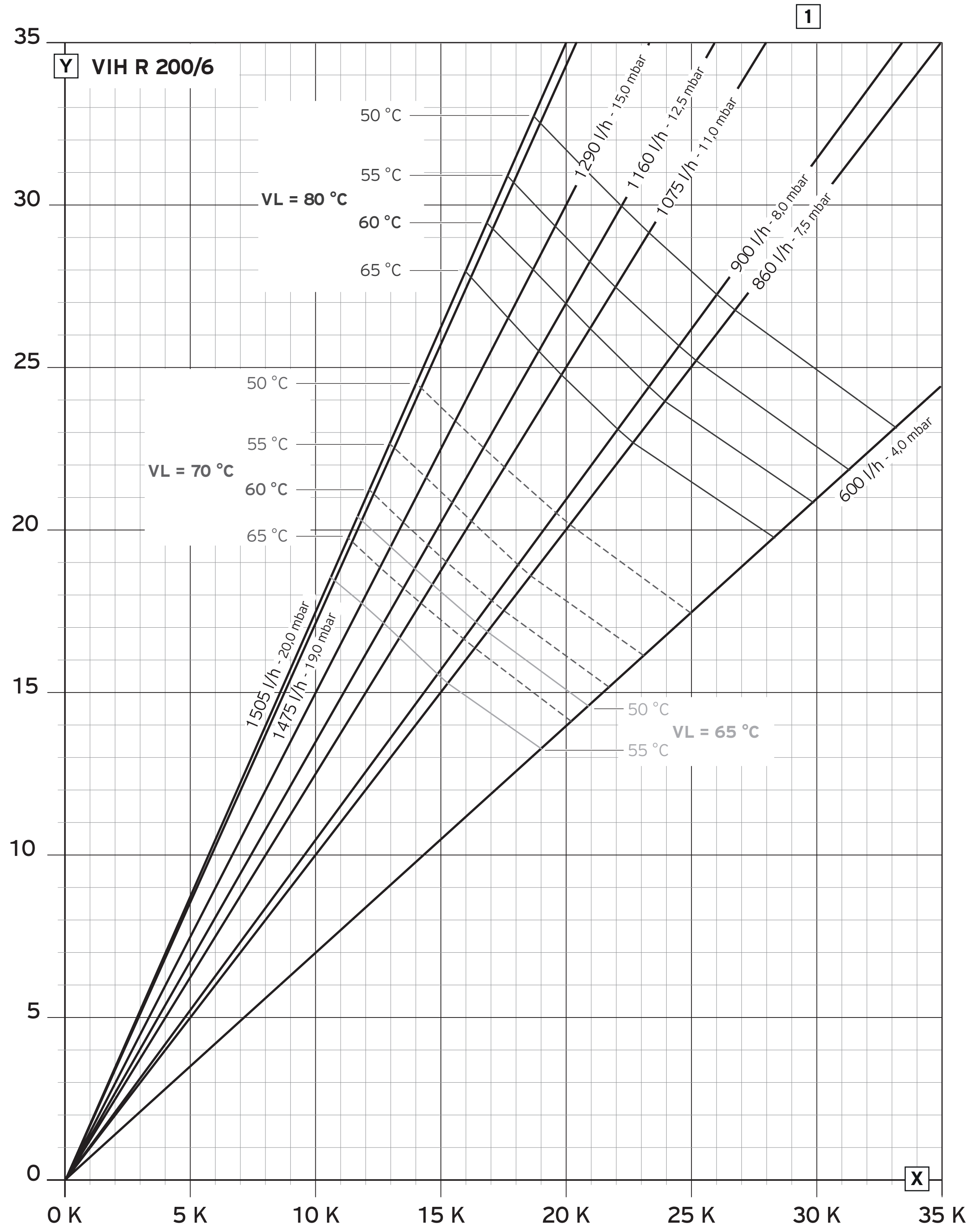


Fig. 224: Continuous output diagram for cylinder dimensioning – uniSTOR VIH R 200/6

X Δt heating medium flow in K
Y Continuous output in kW
1 Heating medium flow in l/h

Product description for uniSTOR VIH RW 200

Fig. 225: uniSTOR VIH RW 200

Equipment

- Enamelled steel tank
- Smooth pipe matrix
- Magnesium protection anode
- Cleaning flange

Special features

- Smooth-pipe matrix with large heat-transfer surface area designed specially for heat pumps
- Low standby losses

Technical data

Technical data	Unit	VIH RW 200
Total contents of cylinder	l	193
Continuous hot water output (at 45 kW)	l/h	1105
Cylinder standby heat loss	KWh/24 hrs	1.8
Heating-side content	l	11.8
Heat exchanger surface for heating	m²	1,81
Max. operating pressure on the hot water side	bar	10
Max. operating pressure on the heating side	bar	10
Hot water temperature (max.)	°C	95
Heating temperature (max.)	°C	110
Weight when ready for operation	kg	296
Tilt measurement	mm	1440
Dimensions excluding packaging (height/width/depth)	mm	1340 / 600 / 600
Weight excluding packaging	kg	103
Heating connection (VL and RL)		G 1
Cold and hot water connection		G 1
Circulation connection		G 3/4

Dimension drawing and connection dimensions

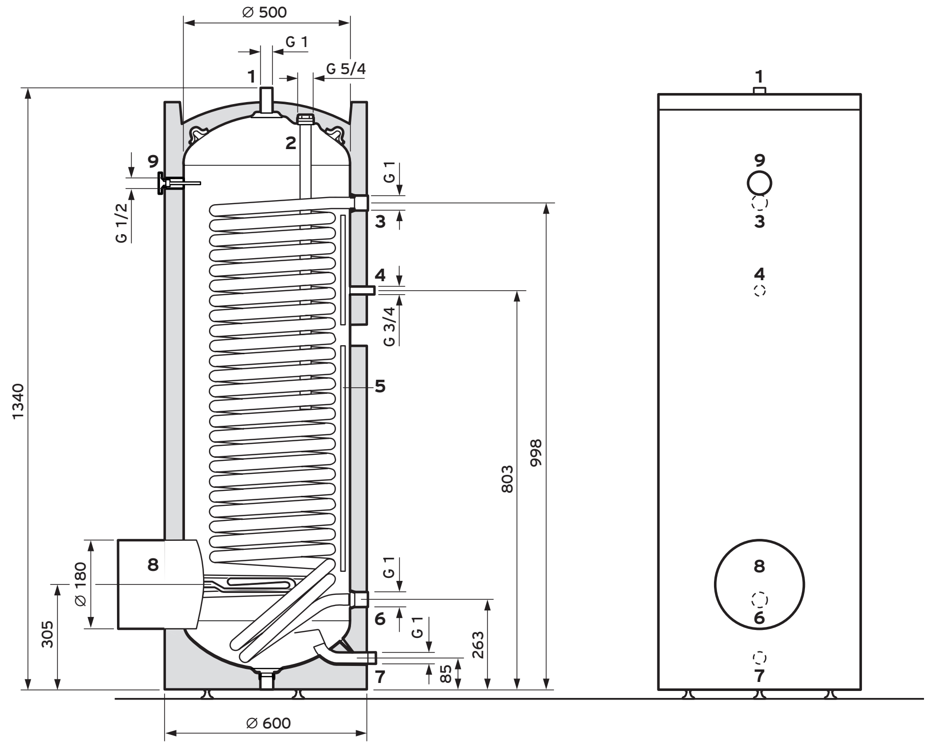


Fig. 226: uniSTOR VIH RW 200 connection dimensions

1 G 1 domestic hot water connection
2 G 5/4 magnesium protection anode
3 G 1 heating flow
4 G 3/4 circulation connection
5 Rail for temperature sensor
6 G 1 heating return
7 G 1 cold water connection
8 G 1/2 thermometer

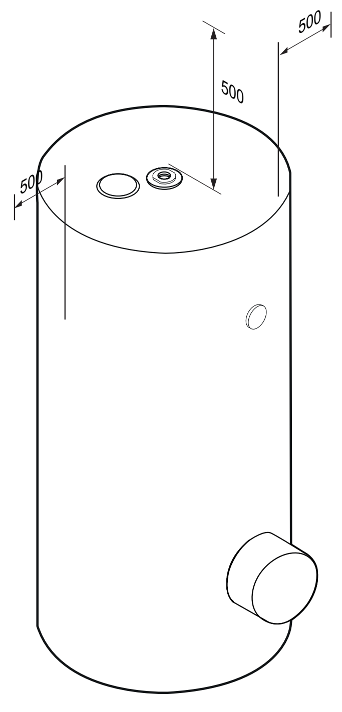


Fig. 227: Minimum clearances

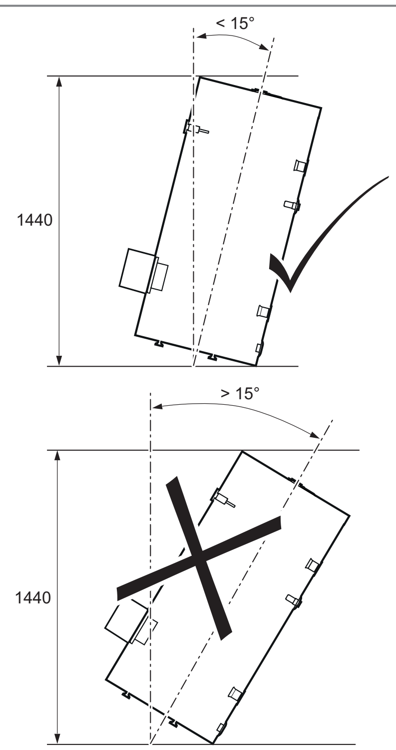


Fig. 228: Tilt dimension

12.1 1 Product description for the uniSTOR exclusive VIH RW 300/3 MR - VIH RW 500/3 MR

Fig. 229: uniSTOR exclusive VIH RW.../3 MR

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH RW 300/3 MR	A	281	0010020667
VIH RW 400/3 MR	A	375	0010020668
VIH RW 500/3 MR	A	460	0010020669

Equipment

- High-quality vacuum heat insulation
- Integrated external current anode
- Pipe coil heat exchanger
- Cleaning eye/flange for electric immersion heater
- Circulation connection
- Transport straps enclosed

Special features

- Bears the Green iQ label
- Indirectly heated domestic hot water cylinder
- Potable water side (cylinder and heat exchanger) with high-quality enamelling
- Digital cylinder display (temperature, cylinder charging and fault messages)
- Smooth-pipe matrix with large heat-transfer surface area designed specially for heat pumps
- Easy to carry to installation site thanks to removable heat insulation

Potential applications

Cylinder that is specially adapted to domestic hot water generation with heat pumps.

Technical data – general

	VIH RW 300/3 MR	VIH RW 400/3 MR	VIH RW 500/3 MR
Nominal capacity	281 l	375 l	460 l
Domestic hot water capacity of the heating coil for the heating circuit	20.4 l	28.9 l	38.6 l
Maximum pressure of the heating coil during operation	1 MPa	1 MPa	1 MPa
Operating pressure	1 MPa	1 MPa	1 MPa
Maximum temperature of the heating circuit	110 °C	110 °C	110 °C
Maximum hot water temperature	85 °C	85 °C	85 °C
Energy efficiency class	A	A	A
Standby energy consumption per 24 hrs	1.05 kWh	1.16 kWh	1.04 kWh
Heating coil pressure loss (heating circuit)	0.00106 MPa	0.0056 MPa	0.00117 MPa
Heating coil surface (heating circuit)	3.1 m²	4.4 m²	5.9 m²
Volume of the mixing water at 40 C (V_{40}) (heating circuit)	423 l	577 l	710 l
Net weight	153 kg	195 kg	251 kg
Weight filled ready for operation	454 kg	599 kg	750 kg

Technical data – Electrics

	VIH RW 300/3 MR	VIH RW 400/3 MR	VIH RW 500/3 MR
Electrical connection for the power supply unit	230 V, 50 Hz	230 V, 50 Hz	230 V, 50 Hz
IP rating	XX	XX	XX

Technical data – Material

	VIH RW 300/3 MR	VIH RW 400/3 MR	VIH RW 500/3 MR
Cylinder material	Black steel (S235JR)		
Corrosion protection	Enamel with external current protection anode		
Insulation material	Polyurethane + vacuum panel		
Insulation thickness	95 mm	100 mm	100 mm
Propellant for insulating material	1233zd(E)	1233zd(E)	1233zd(E)
Ozone depletion potential ODP	WP 1	WP 1	WP 1

Technical data – output

	VIH RW 300/3 MR	VIH RW 400/3 MR	VIH RW 500/3 MR
Output characteristic figure NL (50 °C)	3.3	5.5	8.1
Output characteristic figure NL (55 °C)	3.6	5.9	8.7
Output characteristic figure NL (60 °C)	3.8	6.1	8.9
Output characteristic figure NL (65 °C)	3.8	6.1	8.9
Output characteristic figure NL (70 °C)	3.8	6.1	8.9
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	26.7 kW	38.3 kW	51.0 kW
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	35.5 kW	51.0 kW	68.0 kW
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	43.2 kW	62.2 kW	83.0 kW
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	656 l/h	941 l/h	1,255 l/h
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	872 l/h	1,254 l/h	1,672 l/h
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	1,063 l/h	1,531 l/h	2,041 l/h
Domestic hot water output (50 °C)	302 l/10 min	403 l/10 min	494 l/10 min
Domestic hot water output (55 °C)	340 l/10 min	453 l/10 min	494 l/10 min
Domestic hot water output (60 °C)	377 l/10 min	504 l/10 min	618 l/10 min
Domestic hot water output (65 °C)	415 l/10 min	554 l/10 min	679 l/10 min
Domestic hot water output (70 °C)	453 l/10 min	604 l/10 min	741 l/10 min
Specific flow rate Delta (50 °C 30 K)	35.2 l/min	47.0 l/min	57.7 l/min
Specific flow rate Delta (55 °C 30 K)	39.6 l/min	52.9 l/min	64.9 l/min
Specific flow rate Delta (60 °C 30 K)	44.0 l/min	58.8 l/min	72.1 l/min
Specific flow rate Delta (65 °C 30 K)	48.4 l/min	64.6 l/min	79.3 l/min
Specific flow rate Delta (70 °C 30 K)	52.8 l/min	70.5 l/min	86.5 l/min
Nominal heating medium volume flow for the heating circuit	1.72 m³/h	2.58 m³/h	3.44 m³/h

Dimension drawing and connection dimensions

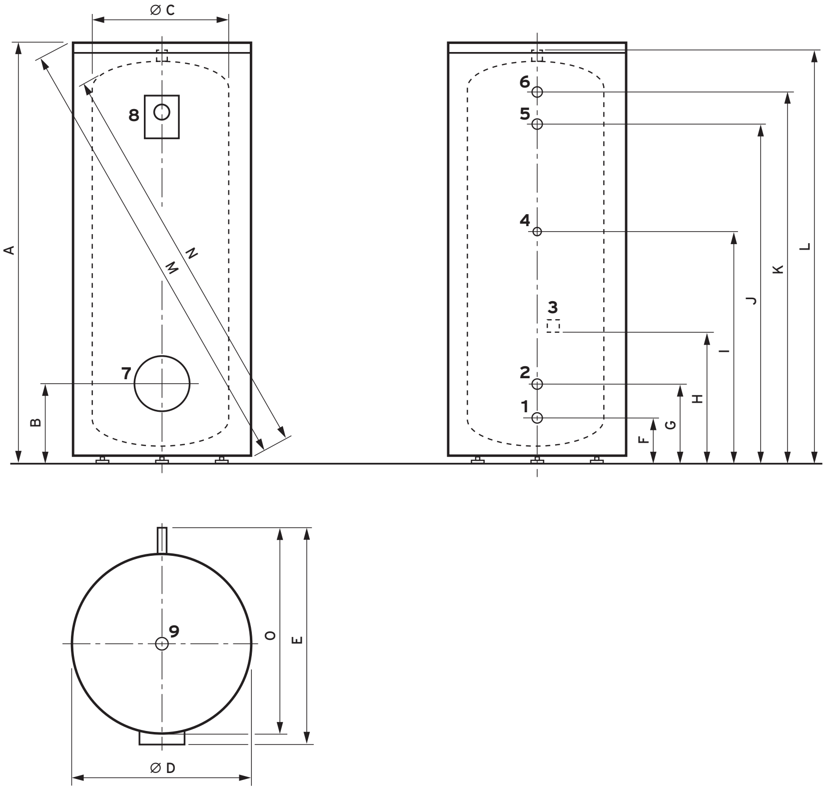


Fig. 230: Dimension drawing

1 Cold water connection
2 Heating return
3 Heating sensor removal tab
4 Circulation
5 Heating flow
6 Domestic hot water
7 Inspection opening
8 Thermometer
9 Protection anode

Dimensions

Unit type	A	B	C (dia.)	D (dia.)	E	F	G	H	I	J	K	L	M	N	O
VIH RW 300/3 MR	1929	313	500	690	775	168	250	522	1059	1555	1636	1773	2049	1850	725
VIH RW 400/3 MR	1633	357	650	850	930	208	294	522	824	1034	1294	1471	1841	1565	880
VIH RW 500/3 MR	1933	357	650	850	930	208	294	522	1124	1259	1594	1771	2112	1850	880

Dimensions in mm

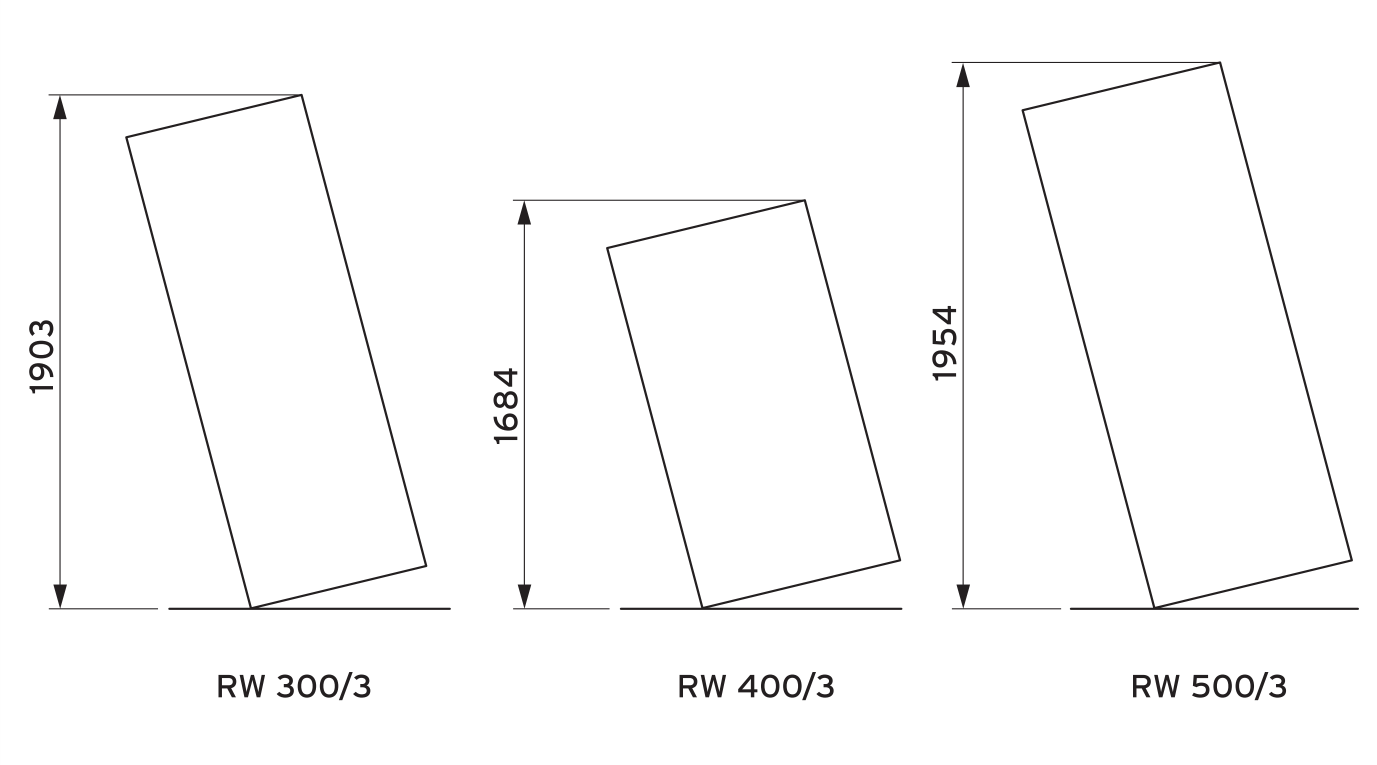


Fig. 231: Tilt dimension

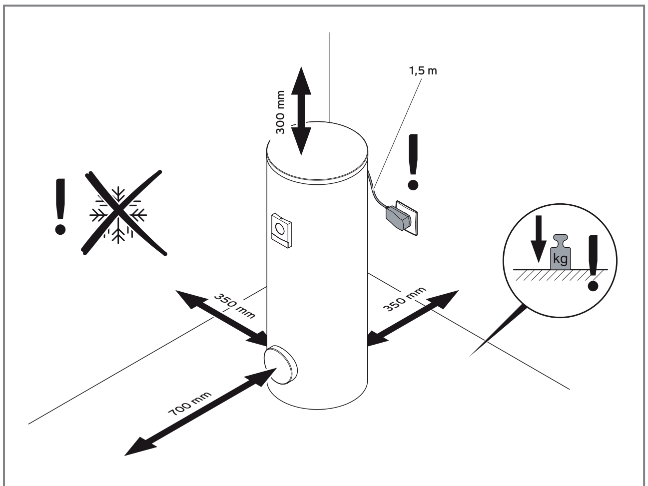


Fig. 232: Minimum clearances

12.12 Product description for the uniSTOR plus VIH RW 300/3 BR - VIH RW 500/3 BR

Fig. 233: uniSTOR plus VIH RW.../3 BR

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH RW 300/3 BR	B	281	0010020645
VIH RW 400/3 BR	B	375	0010020646
VIH RW 500/3 BR	B	460	0010020647

Equipment

- Removable outer casing (not insulation)
- Magnesium protection anode
- Pipe coil heat exchanger
- Cleaning eye/flange for electric immersion heater
- Circulation connection
- Transport straps enclosed
- Cylinder is firmly embedded

Special features

- Indirectly heated domestic hot water cylinder
- Potable water side (cylinder and heat exchanger) with high-quality enamelling
- Analogue cylinder temperature display
- Smooth-pipe matrix with large heat-transfer surface area designed specially for heat pumps
- High-quality heat insulation

Potential applications

Cylinder that is specially adapted to domestic hot water generation with heat pumps.

Technical data – general

	VIH RW 300/3 BR	VIH RW 400/3 BR	VIH RW 500/3 BR
Nominal capacity	281 l	375 l	460 l
Domestic hot water capacity of the heating coil for the heating circuit	20.4 l	28.9 l	38.6 l
Maximum pressure of the heating coil during operation	1 MPa	1 MPa	1 MPa
Operating pressure	1 MPa	1 MPa	1 MPa
Maximum temperature of the heating circuit	110 °C	110 °C	110 °C
Maximum hot water temperature	85 °C	85 °C	85 °C
Energy efficiency class	B	B	B
Standby energy consumption per 24 hrs	1.40 kWh	1.54 kWh	1.84 kWh
Heating coil pressure loss (heating circuit)	0.00106 MPa	0.0056 MPa	0.00117 MPa
Heating coil surface (heating circuit)	3.1 m²	4.4 m²	5.9 m²
Volume of the mixing water at 40 C (V_{40}) (heating circuit)	423 l	577 l	710 l
Net weight	141 kg	181 kg	235 kg
Weight filled ready for operation	422 kg	585 kg	734 kg

Technical data – Material

	VIH RW 300/3 BR	VIH RW 400/3 BR	VIH RW 500/3 BR
Cylinder material	Black steel (S235JR)	Black steel (S235JR)	Black steel (S235JR)
Corrosion protection	Enamel with magnesium protection anode	Enamel with magnesium protection anode	Enamel with magnesium protection anode
Insulation material	Polyurethane	Polyurethane	Polyurethane
Insulation thickness	75 mm	70 mm	70 mm
Propellant for insulating material	HFO-1233zd(E)	HFO-1233zd(E)	HFO-1233zd(E)
Ozone depletion potential ODP	WP 1	WP 1	WP 1

Technical data – output

	VIH RW 300/3 BR	VIH RW 400/3 BR	VIH RW 500/3 BR
Output characteristic figure NL (50 °C)	3.3	5.5	8.1
Output characteristic figure NL (55 °C)	3.6	5.9	8.7
Output characteristic figure NL (60 °C)	3.8	6.1	8.9
Output characteristic figure NL (65 °C)	3.8	6.1	8.9
Output characteristic figure NL (70 °C)	3.8	6.1	8.9
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	26.7 kW	38.3 kW	51.0 kW
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	35.5 kW	51.0 kW	68.0 kW
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	43.2 kW	62.2 kW	83.0 kW
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	656 l/h	941 l/h	1,255 l/h
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	872 l/h	1,254 l/h	1,672 l/h
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	1,063 l/h	1,531 l/h	2,041 l/h
Domestic hot water output (50 °C)	302 l/10 min	403 l/10 min	494 l/10 min
Domestic hot water output (55 °C)	340 l/10 min	453 l/10 min	494 l/10 min
Domestic hot water output (60 °C)	377 l/10 min	504 l/10 min	618 l/10 min
Domestic hot water output (65 °C)	415 l/10 min	554 l/10 min	679 l/10 min
Domestic hot water output (70 °C)	453 l/10 min	604 l/10 min	741 l/10 min
Specific flow rate Delta (50 °C 30 K)	35.2 l/min	47.0 l/min	57.7 l/min
Specific flow rate Delta (55 °C 30 K)	39.6 l/min	52.9 l/min	64.9 l/min
Specific flow rate Delta (60 °C 30 K)	44.0 l/min	58.8 l/min	72.1 l/min
Specific flow rate Delta (65 °C 30 K)	48.4 l/min	64.6 l/min	79.3 l/min
Specific flow rate Delta (70 °C 30 K)	52.8 l/min	70.5 l/min	86.5 l/min
Nominal heating medium volume flow for the heating circuit	1.72 m³/h	2.58 m³/h	3.44 m³/h

Dimension drawing and connection dimensions

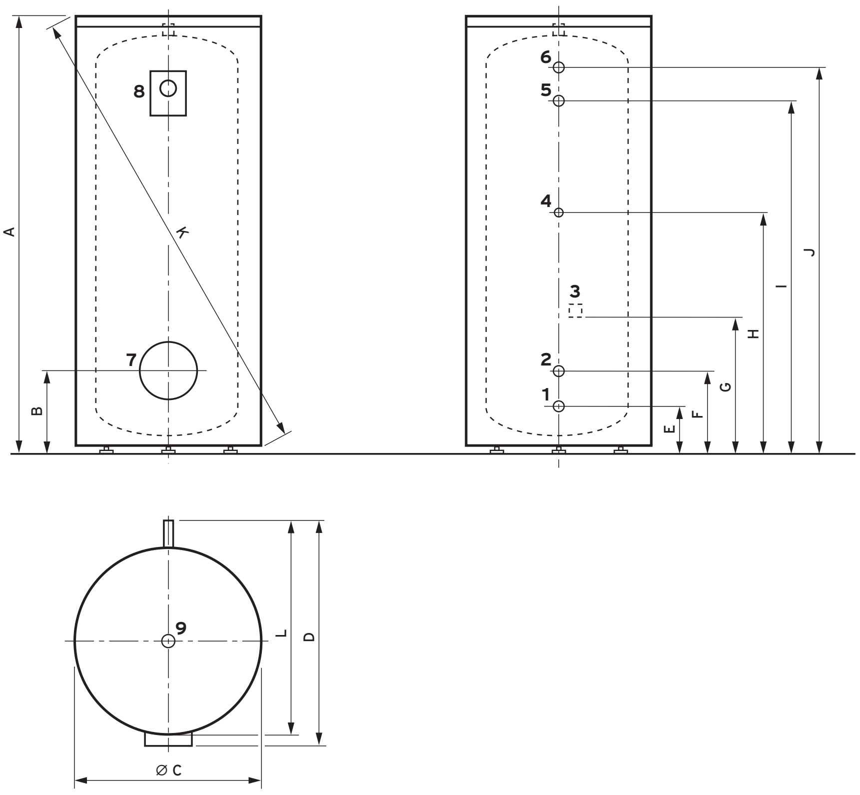


Fig. 234: Dimension drawing

1 Cold water connection
2 Heating return
3 Heating sensor removal tab
4 Circulation
5 Heating flow
6 Domestic hot water
7 Inspection opening
8 Thermometer
9 Protection anode

Dimensions

Unit type	A	B	C (dia.)	D	E	F	G	H	I	J	K	L
VIH RW 300/3 BR	1804	313	650	755	168	250	522	1059	1555	1636	1903	705
VIH RW 400/3 BR	1502	357	790	900	208	294	522	824	1034	1294	1684	850
VIH RW 500/3 BR	1802	357	790	900	208	294	522	1124	1259	1594	1954	850
Dimensions in mm												

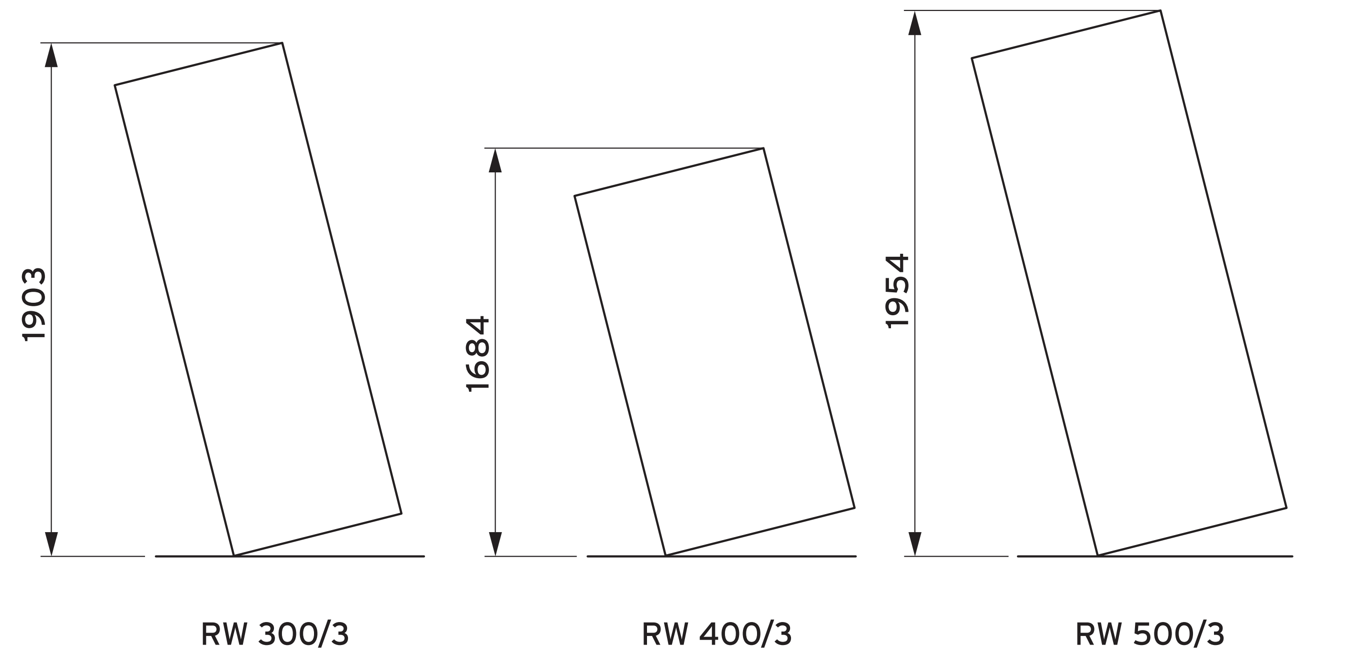


Fig. 235: Tilt dimension

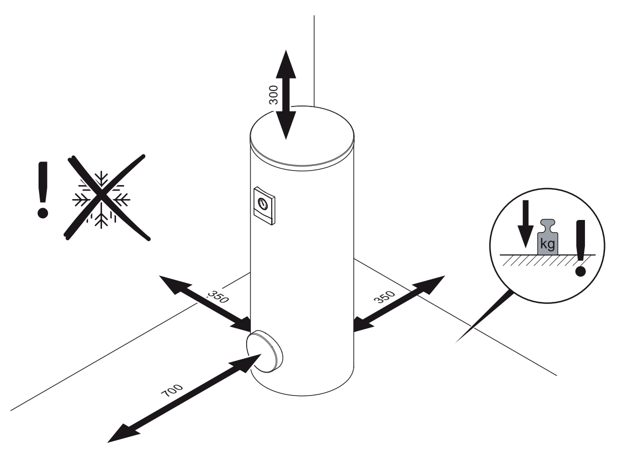


Fig. 236: Minimum clearances

12.13 Product description for the uniSTOR exclusive VIH SW 400/3 MR - VIH SW 500/3 MR

Fig. 237: uniSTOR exclusive VIH SW.../3 MR

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH SW 400/3 MR	A	372	0010020670
VIH SW 500/3 MR	A	456	0010020671

Special features

- Bears the Green iQ label
- Bivalent domestic hot water cylinder, indirectly heated
- Potable water side (cylinder and heat exchanger) with high-quality enamelling
- Digital cylinder display (temperature, cylinder charging and fault messages)
- Easy to carry to installation site thanks to removable heat insulation

Equipment

- High-quality vacuum heat insulation
- Integrated external current anode
- Pipe coil heat exchanger
- Cleaning eye/flange for electric immersion heater
- Circulation connection
- Transport straps enclosed

Potential applications

Indirectly heated solar hot water cylinder for solar-assisted domestic hot water supply, specifically for heat pumps, for group or central supply for system pressures up to 10 bar.

Technical data – VIH S/SW general

	VIH SW 400/3 MR	VIH SW 500/3 MR
Nominal capacity	372 l	456 l
Domestic hot water capacity of the heating coil for the heating circuit	21.2 l	28.9 l
Heat transfer fluid capacity of the heating coil for the solar circuit/environment circuit	9.6 l	13.5 l
Maximum pressure of the heating coil during operation	1 MPa	1 MPa
Operating pressure	1 MPa	1 MPa
Maximum temperature of the heating circuit	110 °C	110 °C
Maximum hot water temperature	85 °C	85 °C
Energy efficiency class	A	A
Standby energy consumption per 24 hrs	1.23 kWh	1.38 kWh
Heating coil pressure loss (heating circuit)	0.0026 MPa	0.0057 MPa
Heating coil surface (heating circuit)	3.2 m²	4.4 m²
Volume of the mixing water at 40 C (V_{40}) (heating circuit)	386 l	471 l
Heating coil pressure loss (solar circuit/environment circuit)	0.0021 MPa	0.0027 MPa
Heating coil surface (solar circuit)	1.5 m²	2.1 m²
Volume of the mixing water at 40 C (V_{40}) (solar circuit)	606 l	771 l
Net weight	203 kg	265 kg
Weight filled ready for operation	606 kg	763 kg

Technical data – Electrics

	VIH SW 400/3 MR	VIH SW 500/3 MR
Electrical connection for the power supply unit	230 V, 50 Hz	230 V, 50 Hz
IP rating	XX	XX

Technical data – Material

	VIH SW 400/3 MR	VIH SW 500/3 MR
Cylinder material	Black steel (S235JR)	Black steel (S235JR)
Corrosion protection	Enamel with external current protection anode	Enamel with external current protection anode
Insulation material	Polyurethane + vacuum panel	Polyurethane + vacuum panel
Insulation thickness	100 mm	100 mm
Propellant for insulating material	1233zd(E)	1233zd(E)
Ozone depletion potential ODP	WP 1	WP 1

Technical data – output

	VIH SW 400/3 MR	VIH SW 500/3 MR
Output characteristic figure NL (50 °C)	1.2	2.2
Output characteristic figure NL (55 °C)	1.4	2.5
Output characteristic figure NL (60 °C)	1.5	2.8
Output characteristic figure NL (65 °C)	2.0	3.0
Output characteristic figure NL (70 °C)	2.0	3.0
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	27.4 kW	38.2 kW
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	36.4 kW	51.0 kW
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	44.3 kW	62.2 kW
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	674 l/h	941 l/h
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	896 l/h	1,253 l/h
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	1,091 l/h	1,530 l/h
Domestic hot water output (50 °C)	213 l/10 min	264 l/10 min
Domestic hot water output (55 °C)	239 l/10 min	297 l/10 min
Domestic hot water output (60 °C)	266 l/10 min	330 l/10 min
Domestic hot water output (65 °C)	292 l/10 min	363 l/10 min
Domestic hot water output (70 °C)	319 l/10 min	396 l/10 min
Specific flow rate Delta (50 °C 30 K)	24.8 l/min	30.8 l/min
Specific flow rate Delta (55 °C 30 K)	27.9 l/min	34.7 l/min
Specific flow rate Delta (60 °C 30 K)	31.0 l/min	38.5 l/min
Specific flow rate Delta (65 °C 30 K)	34.1 l/min	42.4 l/min
Specific flow rate Delta (70 °C 30 K)	37.2 l/min	46.2 l/min
Nominal heating medium volume flow for the heating circuit	1.7 m³/h	2.6 m³/h
Nominal heating medium volume flow for the solar circuit	2.0 m³/h	2.0 m³/h

Dimension drawing and connection dimensions

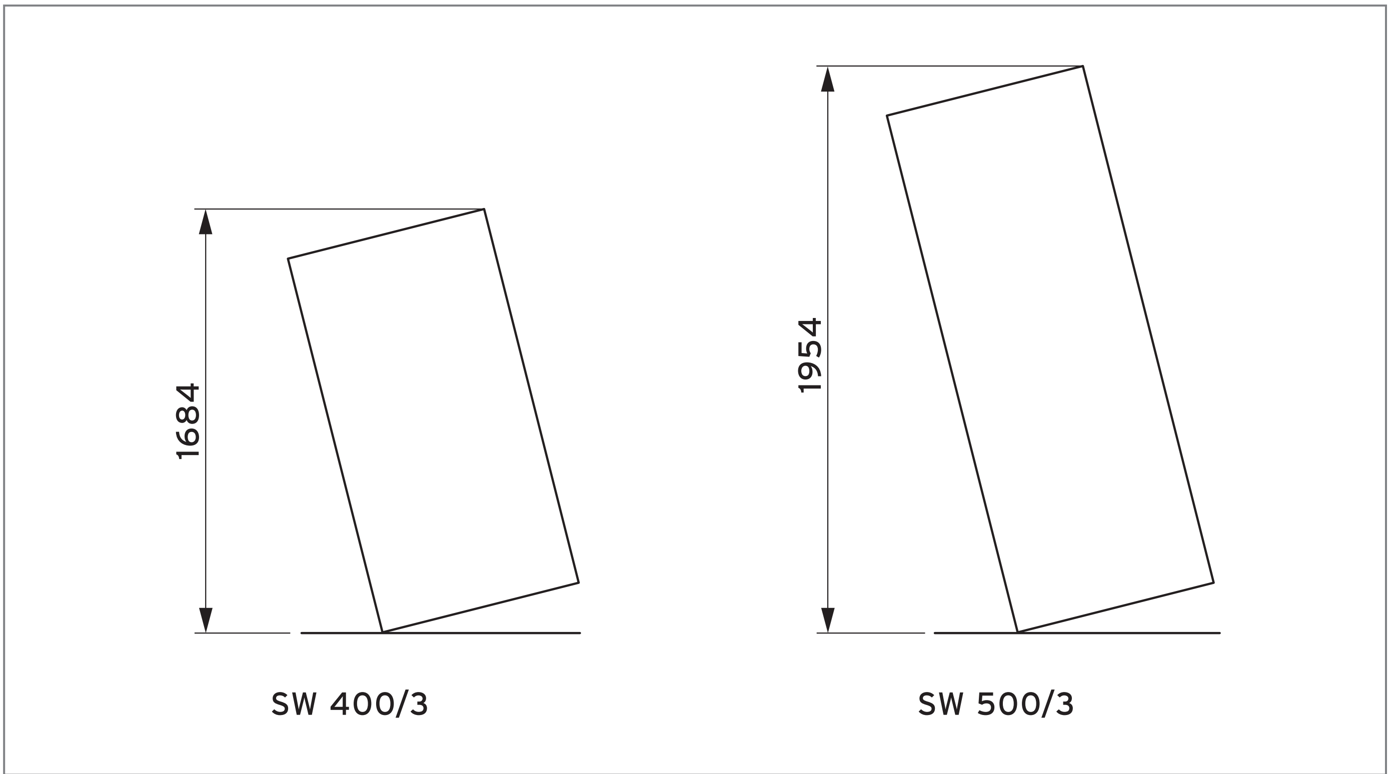


Fig. 238: Tilt dimension

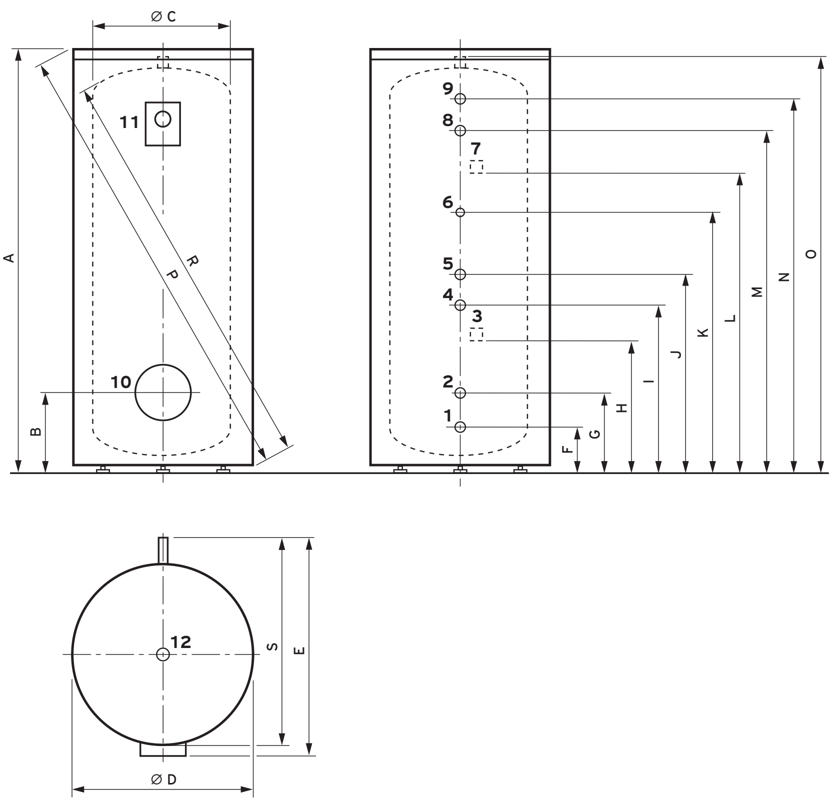


Fig. 239: Dimension drawing

1 Cold water connection
2 Solar return
3 Solar sensor removal tab
4 Solar flow
5 Heating return
6 Circulation
7 Heating sensor removal tab
8 Heating flow
9 Domestic hot water
10 Inspection opening
11 Thermometer
12 Protection anode

Dimensions

Unit type	A	B	C (dia.)	D (dia.)	E	F	G	H	I	J	K	L	M	N	O	P	R	S
VIH SW 400/3 MR	1633	357	650	850	930	208	294	522	584	698	824	996	1208	1294	1471	1841	1565	880
VIH SW 500/3 MR	1933	357	650	850	930	208	294	522	674	818	1124	1275	1508	1594	1771	2112	1850	880
Dimensions in mm																		

12.14 Product description for the uniSTOR plus VIH SW 400/3 BR - VIH SW 500/3 BR

Fig. 240: uniSTOR plus VIH SW.../3 BR

Type overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VIH SW 400/3 BR	B	372	0010020648
VIH SW 500/3 BR	B	456	0010020649

Equipment

- Removable outer casing (not insulation)
- Magnesium protection anode
- Pipe coil heat exchanger
- Cleaning eye/flange for electric immersion heater
- Circulation connection
- Transport straps enclosed
- Cylinder is firmly embedded

Special features

- Bivalent domestic hot water cylinder, indirectly heated
- Potable water side (cylinder and heat exchanger) with high-quality enamelling
- Analogue cylinder temperature display
- Smooth-pipe matrix with large heat-transfer surface area designed specially for heat pumps
- High-quality heat insulation

Potential applications

Indirectly heated solar hot water cylinder for solar-assisted domestic hot water supply, specifically for heat pumps, for group or central supply for system pressures up to 10 bar.

Technical data - general

	VIH SW 400/3 BR	VIH SW 500/3 BR
Nominal capacity	372 l	456 l
Domestic hot water capacity of the heating coil for the heating circuit	21.2 l	28.9 l
Heat transfer fluid capacity of the heating coil for the solar circuit/environment circuit	9.6 l	13.5 l
Maximum pressure of the heating coil during operation	1 MPa	1 MPa
Operating pressure	1 MPa	1 MPa
Maximum temperature of the heating circuit	110 °C	110 °C
Maximum hot water temperature	85 °C	85 °C
Energy efficiency class	B	B
Standby energy consumption per 24 hrs	1.58 kWh	1.85 kWh
Heating coil pressure loss (heating circuit)	0.0026 MPa	0.0057 MPa
Heating coil surface (heating circuit)	3.2 m²	4.4 m²
Volume of the mixing water at 40 C (V_{40}) (heating circuit)	386 l	471 l
Heating coil pressure loss (solar circuit/environment circuit)	0.0021 MPa	0.0027 MPa
Heating coil surface (solar circuit)	1.5 m²	2.1 m²
Volume of the mixing water at 40 C (V_{40}) (solar circuit)	606 l	771 l
Net weight	189 kg	249 kg
Weight filled ready for operation	592 kg	747 kg

Technical data - Material

	VIH SW 400/3 BR	VIH SW 500/3 BR
Cylinder material	Black steel (S235JR)	Black steel (S235JR)
Corrosion protection	Enamel with magnesium protection anode	
Insulation material	Polyurethane	Polyurethane
Insulation thickness	70 mm	70 mm
Propellant for insulating material	HFO-1233zd(E)	HFO-1233zd(E)
Ozone depletion potential ODP	WP 1	WP 1

Technical data - VIH SW output

	VIH SW 400/3 BR	VIH SW 500/3 BR
Output characteristic figure NL (50 °C)	1.2	2.2
Output characteristic figure NL (55 °C)	1.4	2.5
Output characteristic figure NL (60 °C)	1.5	2.8
Output characteristic figure NL (65 °C)	2.0	3.0
Output characteristic figure NL (70 °C)	2.0	3.0
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	27.4 kW	38.2 kW
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	36.4 kW	51.0 kW
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	44.3 kW	62.2 kW
Continuous domestic hot water output (heating circuit) (50 °C 35 K)	674 l/h	941 l/h
Continuous domestic hot water output (heating circuit) (55 °C 35 K)	896 l/h	1,253 l/h
Continuous domestic hot water output (heating circuit) (60 °C 35 K)	1,091 l/h	1,530 l/h
Domestic hot water output (50 °C)	213 l/10 min	264 l/10 min
Domestic hot water output (55 °C)	239 l/10 min	297 l/10 min
Domestic hot water output (60 °C)	266 l/10 min	330 l/10 min
Domestic hot water output (65 °C)	292 l/10 min	363 l/10 min
Domestic hot water output (70 °C)	319 l/10 min	396 l/10 min
Specific flow rate Delta (50 °C 30 K)	24.8 l/min	30.8 l/min
Specific flow rate Delta (55 °C 30 K)	27.9 l/min	34.7 l/min
Specific flow rate Delta (60 °C 30 K)	31.0 l/min	38.5 l/min
Specific flow rate Delta (65 °C 30 K)	34.1 l/min	42.4 l/min
Specific flow rate Delta (70 °C 30 K)	37.2 l/min	46.2 l/min
Nominal heating medium volume flow for the heating circuit	1.7 m³/h	2.6 m³/h
Nominal heating medium volume flow for the solar circuit	2.0 m³/h	2.0 m³/h

Dimension drawing and connection dimensions

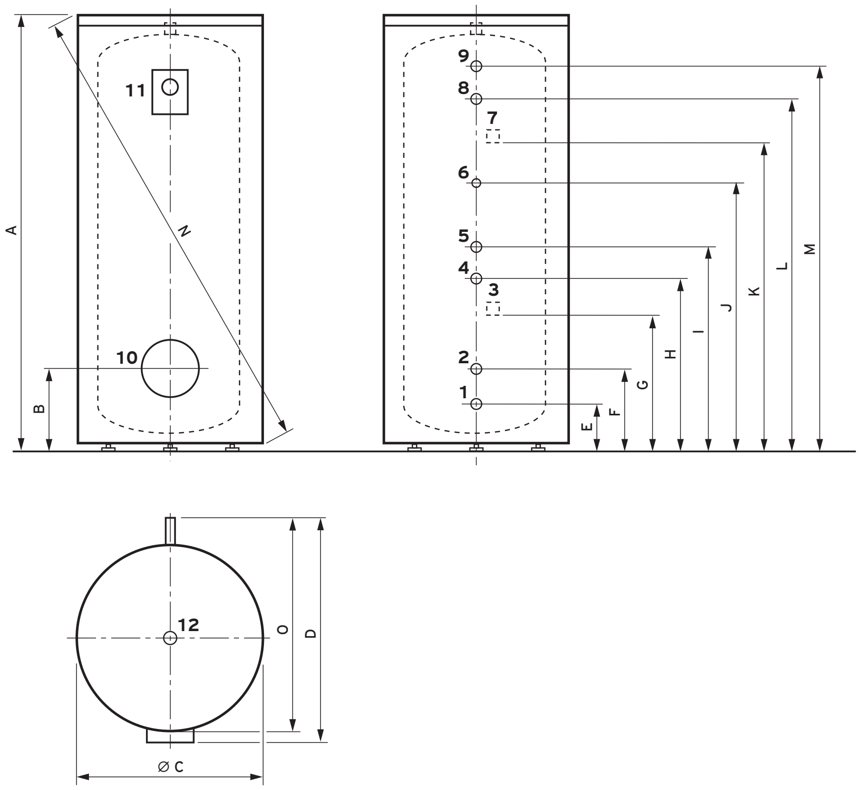


Fig. 241: Dimension drawing

1 Cold water connection
2 Solar return
3 Solar sensor removal tab
4 Solar flow
5 Heating return
6 Circulation
7 Heating sensor removal tab
8 Heating flow
9 Domestic hot water
10 Inspection opening
11 Thermometer
12 Protection anode

Dimensions

Unit type	A	B	C (dia.)	D	E	F	G	H	I	J	K	L	M	N	O
VIH SW 400/3 BR	1502	357	790	900	208	294	522	584	698	824	996	1208	1294	1684	850
VIH SW 500/3 BR	1802	357	790	900	208	294	522	674	818	1124	1275	1508	1594	1954	2112
Dimensions in mm															

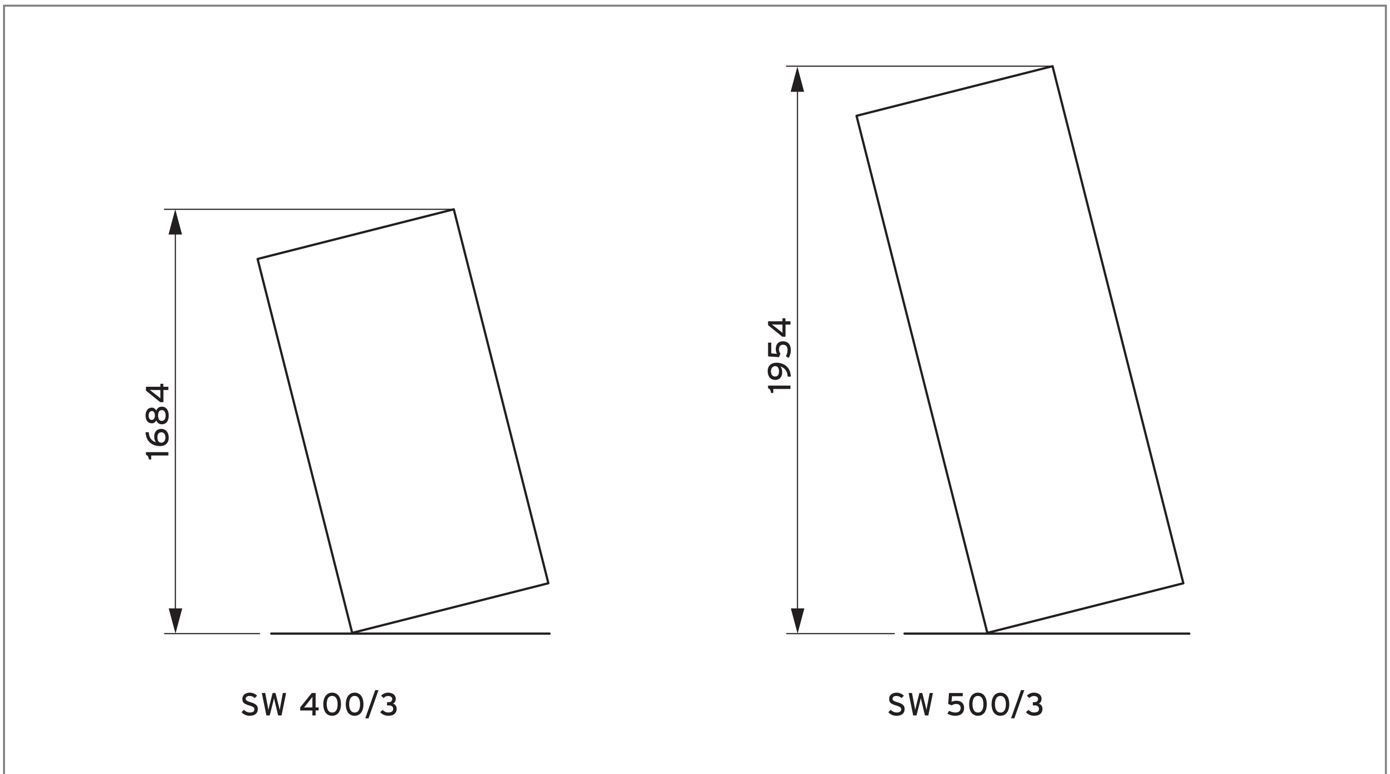


Fig. 242: Tilt dimension

12.15 Product description for the uniTOWER VIH QW 190/1 E


Fig. 243: uniTOWER VIH QW 190/1 E

Product types and article numbers

Unit designation	Art. no.
VIH QW 190/1 E	0010019709
VIH QW 190/1 E	0010019373

Special features

- Extremely short installation times thanks to the compact design
- Can be extended using accessories that can be integrated
- Also available with integrated intermediate heat exchanger
- SplitMountingConcept for easier positioning in two parts

Equipment

- Integrated 190 litre domestic hot water coiled tube cylinder
- High-efficiency pump for the version with an intermediate heat exchanger (22 plates)
- 6 kW electric back-up heater with safety cut-out and electrical connection box
- Purging and draining the back-up heater
- 15 litre diaphragm expansion vessel for heating
- 3-port diverter valve for heating/domestic hot water
- 3 bar expansion relief valve with drain pipework and brine collecting vessel (for the version with intermediate heat exchanger)
- Filling connection
- Brine circuit with manometer

Potential applications

The **uniTOWER** is used only in combination with an **aroTHERM** or **geoTHERM VWS 36/4.1** heat pump and acts as a link between the heat pump and the heating and domestic hot water installation.

Technical data – Heating

	VIH QW 190/1
Filling type	Cartridge immersion heater
Heating output range	2 … 6 kW Δ: 2 kW
Maximum water pressure in heating mode (PMS)	0.3 MPa
Maximum water pressure in domestic hot water mode (PMW) Germany	1 MPa
Maximum heating flow temperature	77 °C
Maximum volume of the system heating circuit	220 l
Maximum volume of the heat pump circuit	30 l
Maximum volume of the heat pump circuit	30 l NoteWith a 2 l expansion vessel.Note With a 2 l expansion vessel.

Technical data – General

	VIH QW 190/1
System type	System with heat pump circuit/complete heating and hot water module disconnected
System type	System without decoupling module
Product dimensions, width	599 mm
Product dimensions, depth	693 mm
Product dimensions, height	1,880 mm
Net weight	170 kg
Weight when filled with water	360 kg

Technical data – Electrics

	VIH QW 190/1
Electric connection	400 V / 50 Hz
Integrated fuse (SMU – eBox)	T4A, 250V
Energy consumption in standby operation	1.2 W
Level of protection	IPX4
Max amperage of the power supply circuit	9 A

Dimension drawing and connection dimensions

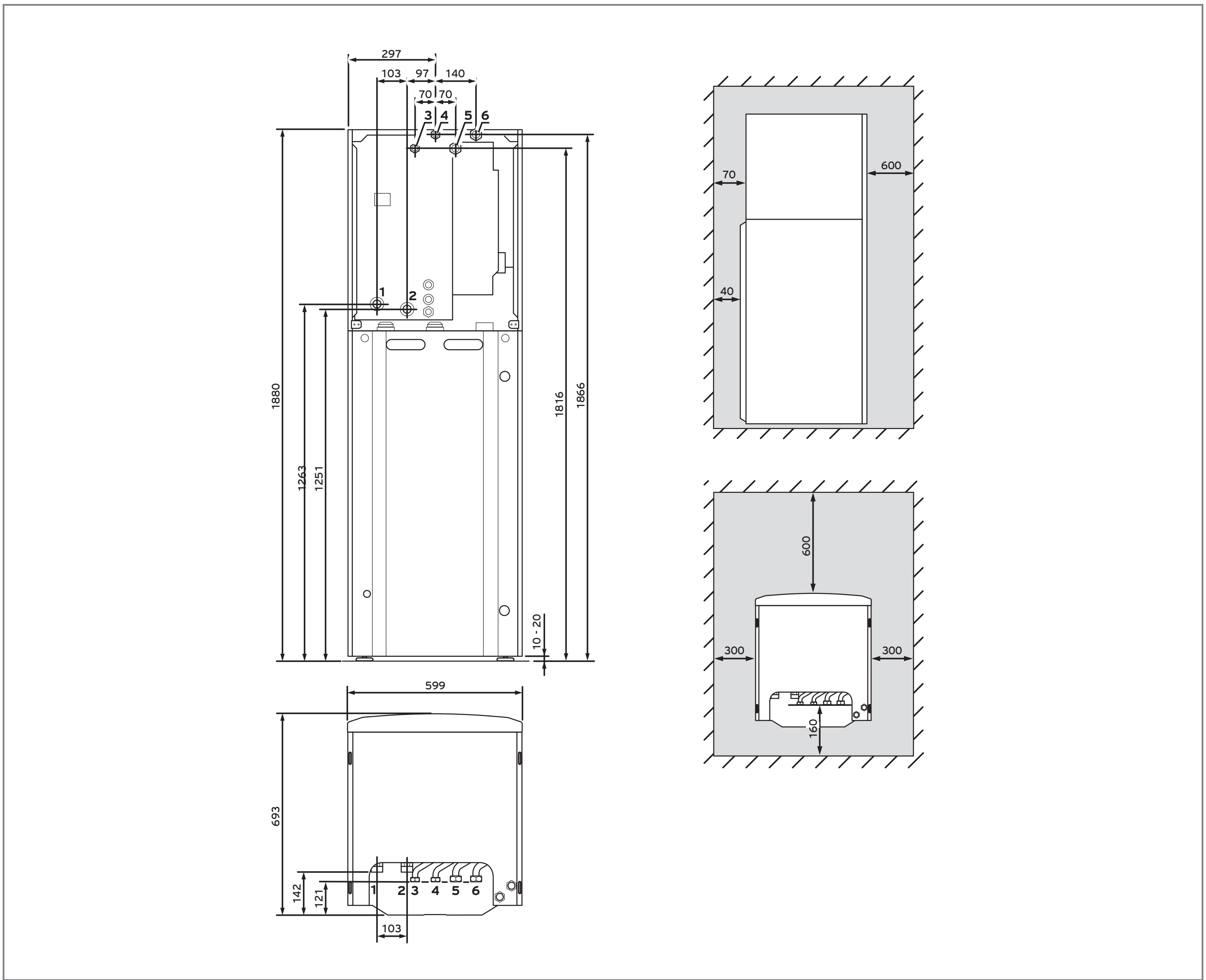


Fig. 244: uniTOWER VIH QW 190/1 E dimension drawing and connection dimensions

1 Flow from heat pump G 1 1/4
2 Return to the heat pump G 1 1/4
3 Cold water connection G 3/4
4 Hot water connection G 3/4
5 G 1 heating flow
6 G 1 heating return

Product dimensions for the transport

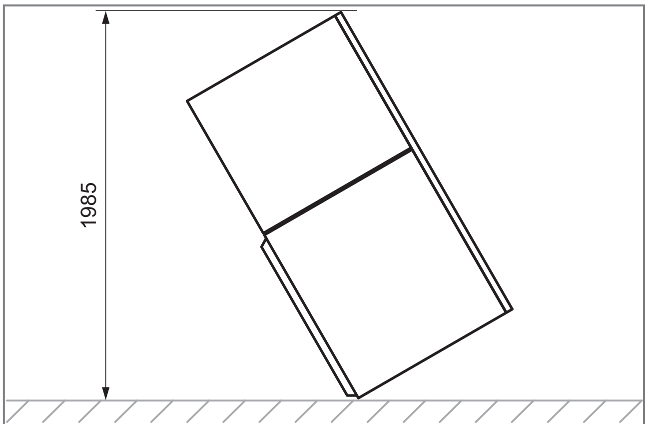


Fig. 245: Dimensions for transport

Pressure losses

Total pressure losses

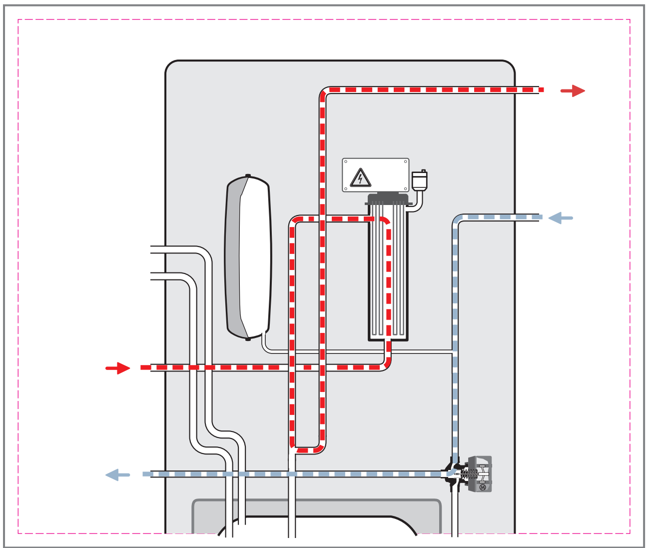


Fig. 246: Total pressure loss basic diagram

Pressure losses in the heat pump circuit

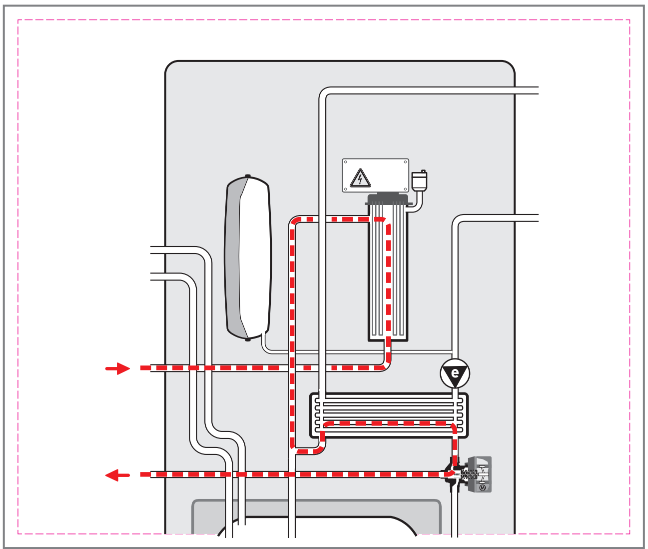


Fig. 248: Basic diagram of the pressure losses in the heat pump circuit

Total pressure loss in the product

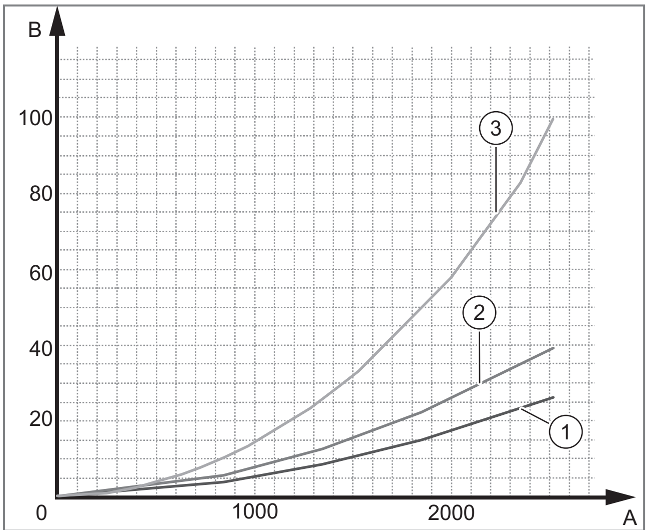


Fig. 247: Pressure loss

1 Product only
2 Product with installation set
3 Product with flexible installation set
A Flow rate in the circuit (l/h)
B Pressure (kPa)

Pressure losses in the unit in the heat pump circuit

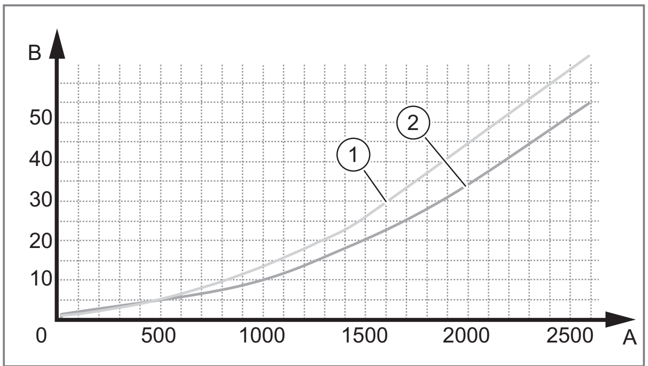


Fig. 249: Pressure losses in the unit in the heat pump circuit

1 Brine 50% (35 °C)
2 Pure water (20 °C)
A Throughput in circuit (l/h)
B Pressure (kPa)

Remaining feed head of the unit for the heating circuit

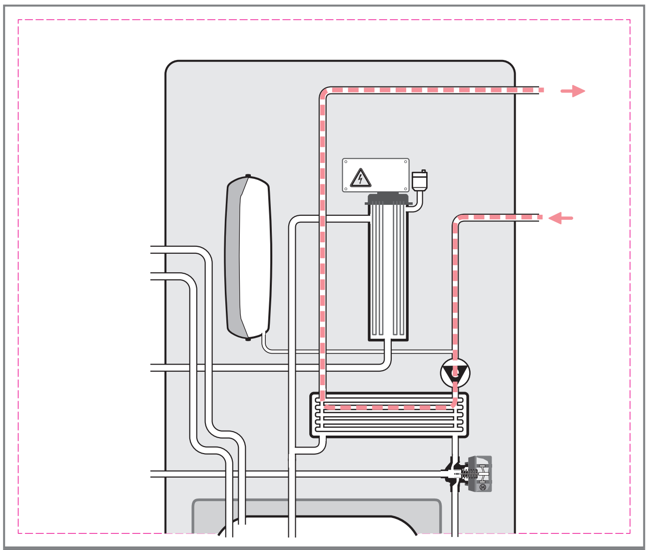


Fig. 250: Remaining feed head basic diagram

Remaining feed head

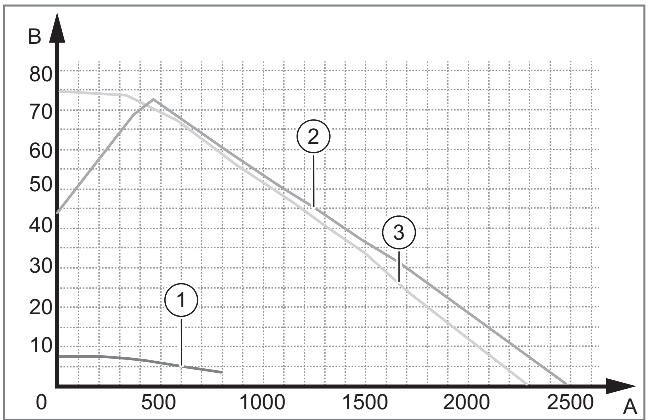


Fig. 251: Remaining feed head

1 PVmin/PCmin product only
2 PVmax/product only
3 PCmax/product only
A Flow rate in the circuit (l/h)
B Available pressure (kPa)

Remaining feed head, constant pressure mode

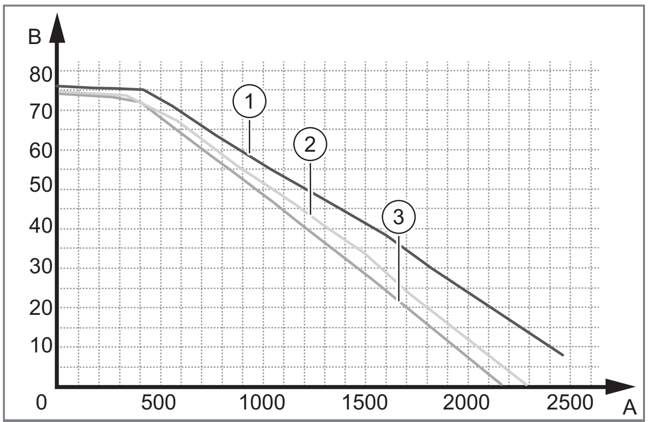


Fig. 252: Remaining feed head, constant pressure mode

1 PCmax/product only
2 PCmax/with installation set
3 PCmax/with flexible installation set
A Flow rate in the circuit (l/h)
B Available pressure (kPa)

Remaining feed head, variable pressure mode

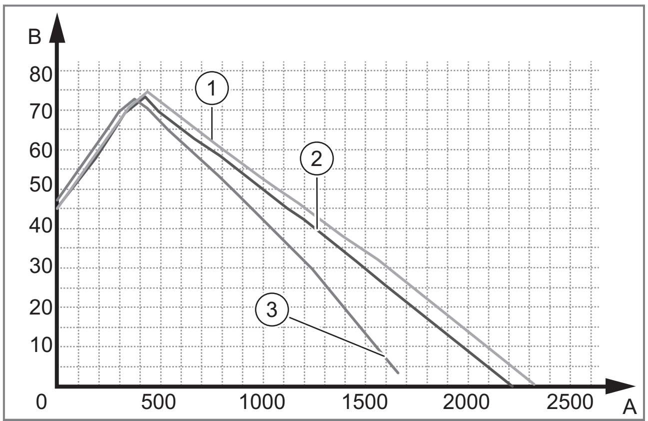


Fig. 253: Remaining feed head, variable pressure mode

1 PVmax/product only
2 PVmax/with installation set
3 PVmax/with flexible installation set
A Flow rate in the circuit (l/h)
B Available pressure (kPa)

12.16 Product description for the uniTOWER VWL ..8/5 IS hydraulic station


Fig. 254: uniTOWER VWL .../5 IS

Product types and article numbers

Unit designation	Art. no.
VWL 58/ 5 IS	0010022070
VWL 78/ 5 IS	0010022071
VWL 128/ 5 IS	0010022072

Special features

- Pre-installed hydraulic tower for **aroTHERM AS**
- Extremely short installation times thanks to the compact design
- Can be extended using accessories that can be integrated
- Also available with integrated intermediate heat exchanger
- SplitMountingConcept for easier positioning in two parts

Equipment

- Integrated 190 litre domestic hot water coiled tube cylinder
- High-efficiency pump for **uniTOWER VWL ..8/5 IS** with intermediate heat exchanger (22 plates)
- 6 kW electric back-up heater with safety cut-out and electrical connection box
- Purging and draining the back-up heater
- 15 litre diaphragm expansion vessel for heating
- 3-port diverter valve for heating/domestic hot water
- 3 bar expansion relief valve with drain pipework and brine collecting vessel
- Filling connection
- Brine circuit with manometer

Potential applications

The **uniTOWER VWL ..8/5 IS** is used only in combination with an **aroTHERM AS** heat pump and acts as a link between the heat pump and the heating and domestic hot water installation.

Technical data

Note
The following performance data is only applicable to new products with clean heat exchangers.

Technical data – General

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Product dimensions, width	595 mm	595 mm	595 mm
Product dimensions, height	1,880 mm	1,880 mm	1,880 mm
Product dimensions, depth	693 mm	693 mm	693 mm
Weight, without packaging	158 kg	158 kg	158 kg
Weight, ready for operation	365 kg	365 kg	365 kg
Rated voltage	230 V (+10%/-15%), 50 Hz, 1~/N/PE	230 V (+10%/-15%), 50 Hz, 1~/N/PE	230 V (+10%/-15%), 50 Hz, 1~/N/PE
Rated voltage	400 V (+10%/-15%), 50 Hz, 3~/N/PE	400 V (+10%/-15%), 50 Hz, 3~/N/PE	400 V (+10%/-15%), 50 Hz, 3~/N/PE
Rated power, maximum	5.4 kW	5.4 kW	0.0 kW
Rated current, maximum	23.50 A (230 V), 14.50 A (400 V)	23.50 A (230 V) 14.50 A (400 V)	0.0
IP rating	IP 10B	IP 10B	IP 10B
Overvoltage category	II	II	II
Fuse type, characteristic C, slow-blow, three-pole switching (disconnection of the three mains connection lines in one switching operation)	Design in accordance with the selected connection diagrams	Design in accordance with the selected connection diagrams	Design in accordance with the selected connection diagrams

Technical data – Heating circuit

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Water content	16.6 l	17.1 l	
Material in the heating circuit	Copper, copper-zinc alloy, stainless steel, ethylene propylene diene monomer rubber, brass, iron		
Permissible water composition	Without frost or corrosion protection. Soften the heating water at water hardnesses from 3.0 mmol/l (16.8° dH) according to Directive VDI 2035 sheet 1.		
Minimum operating pressure	0.05 MPa	0.05 MPa	0.05 MPa
Maximum operating pressure	0.3 MPa	0.3 MPa	0.3 MPa
Min. heating mode flow temperature	20 °C	20 °C	20 °C
Max. heating mode flow temperature with compressor	55 °C	55 °C	55 °C
Max. heating mode flow temperature with back-up heater	70 °C	70 °C	70 °C
Min. cooling mode flow temperature	7 °C	7 °C	7 °C
Max. flow temperature in cooling mode	25 °C	25 °C	25 °C
Min. nominal volume flow with 3 K outdoor unit	0.3 m³/h		
Min. nominal volume flow with 5 K outdoor unit	0.4 m³/h		
Minimum nominal volume flow rate		0.55 m³/h	
Nominal volume flow ΔT 5 K with 3 K outdoor unit	0.54 m³/h		
Nominal volume flow ΔT 5 K with 5 K outdoor unit	0.79 m³/h		
Nominal volume flow ΔT 5 K		1.02 m³/h	
Nominal volume flow ΔT 8 K with 3 K outdoor unit	0.3 m³/h		
Nominal volume flow ΔT 8 K with 5 K outdoor unit	0.4 m³/h		
Nominal volume flow ΔT 8 K		0.55 m³/h	

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Remaining feed head ΔT 5 K with 3 K outdoor unit	71 kPa		
Remaining feed head ΔT 5 K with 5 K outdoor unit	68 kPa		
Remaining feed head ΔT 5 K		66 kPa	
Remaining feed head ΔT 8 K with 3 K outdoor unit	71 kPa		
Remaining feed head ΔT 8 K with 5 K outdoor unit	68 kPa		
Remaining feed head ΔT 8 K		73 kPa	
Min. volume flow during continuous operation at the operating limits with a 3 kW outdoor unit	0.3 m³/h		
Min. volume flow during continuous operation at the operating limits with a 5 kW outdoor unit	0.4 m³/h		
Min. volume flow during continuous operation at the operating limits		0.55 m³/h	
Max. volume flow during continuous operation at the operating limits with a 3 kW outdoor unit	0.54 m³/h		
Max. volume flow during continuous operation at the operating limits with a 5 kW outdoor unit	0.79 m³/h		
Max. volume flow during continuous operation at the operating limits		1.08 m³/h	
Pump type	High-efficiency pump	High-efficiency pump	High-efficiency pump
Energy efficiency index (EEI) of the pump	≤0.2	≤0.2	≤0.2

Technical data – Electrics

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Min. electrical power consumption of the heating pump	2 W	2 W	3 W
Max. electrical power consumption of the heating pump	60 W	60 W	100 W
Electrical power consumption of the heating pump at A7/35 ΔT 5 K with an external pressure loss of 250 mbar in the heating circuit	20 W	20 W	40 W

Technical data – Refrigerant circuit

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Material, refrigerant pipe	Copper	Copper	Copper
Length, refrigerant pipe, maximum	25 m	25 m	25 m
Length, refrigerant pipe, minimum	3 m	3 m	3 m
Connection technology, refrigerant pipe	Flare connection	Flare connection	Flare connection
Outer diameter, hot gas pipe	1/2 " (12.7 mm)	5/8 " (15.875 mm)	5/8 " (15.875 mm)
Outer diameter, liquid pipe	1/4 " (6.35 mm)	3/8 " (9.575 mm)	3/8 " (9.575 mm)
Minimum wall thickness, hot gas pipe	0.8 mm	0.95 mm	0.95 mm
Minimum wall thickness, liquid pipe	0.8 mm	0.8 mm	0.8 mm
Refrigerant, type	R410A	R410A	R410A
Refrigerant, Global Warming Potential (GWP)	2088	2088	2088
Refrigerant, fill quantity	1.50 kg	2.39 kg	3.60 kg
Permissible operating pressure, maximum	41.5 bar	41.5 bar	41.5 bar
Compressor, type	Rotary piston	Rotary piston	Rotary piston
Compressor, oil type	Specific polyvinyl ether (PVE)	Specific polyvinyl ether (PVE)	Specific polyvinyl ether (PVE)
Compressor, control	Electronic	Electronic	Electronic
Permissible height difference between outdoor unit and indoor unit	≤ 10 m	≤ 10 m	≤ 10 m

Dimension drawing and connection dimensions

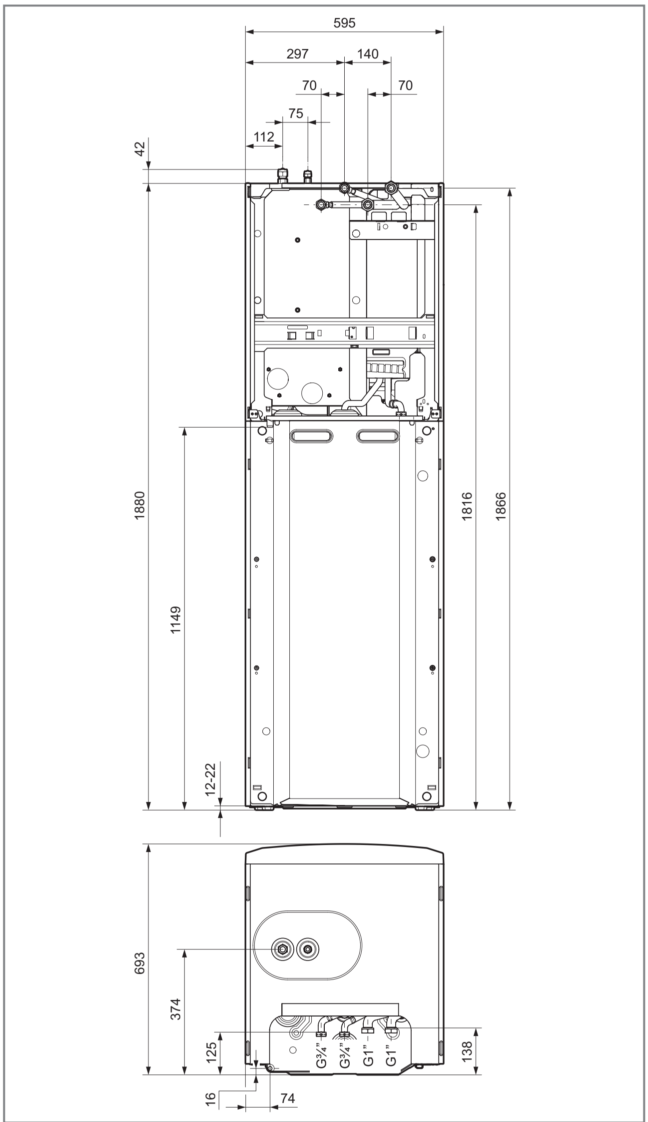


Fig. 255: Dimension drawing and connection dimensions

Product dimensions for the transport

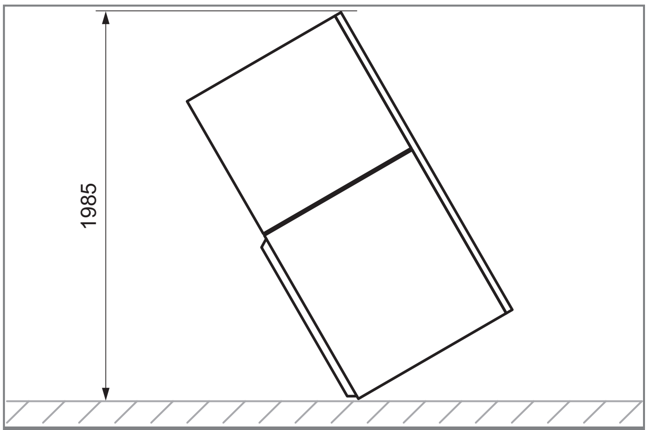


Fig. 256: Dimensions for transport

Remaining feed heads at nominal volume flow

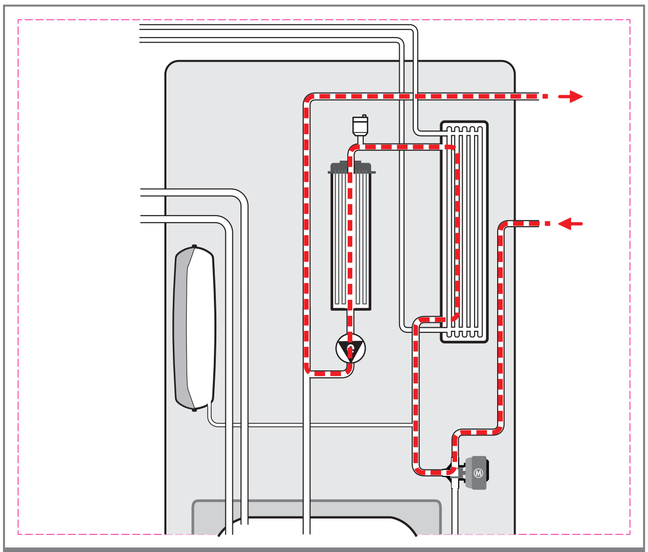


Fig. 257: Remaining feed head basic diagram

VWL 58/5 remaining feed head at nominal volume flow

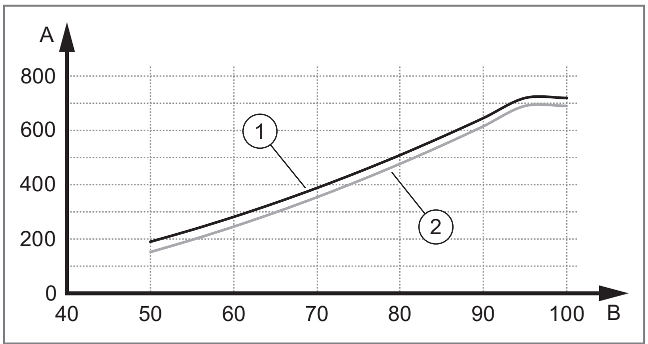


Fig. 258: VWL 58/5 remaining feed head

1 VWL 58/5, 3.5 kW/540 l/h
2 VWL 58/5, 5 kW/790 l/h
A Remaining feed head in hPa (mbar)
B Pump output in %

VWL 78/5 remaining feed head at nominal volume flow

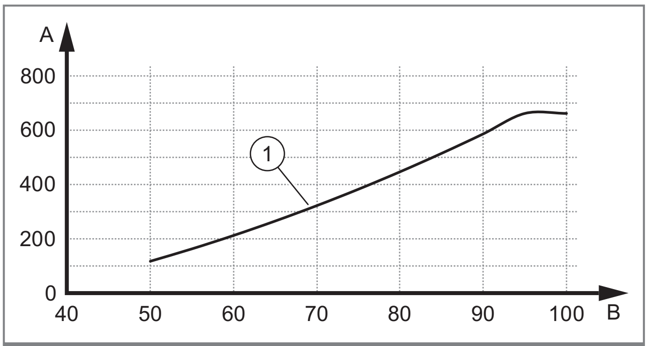


Fig. 259: VWL 78/5 remaining feed head

1 VWL 78/5, 7 kW/1020 l/h
A Remaining feed head in hPa (mbar)
B Pump output in %

VWL 128/5 remaining feed head at nominal volume flow

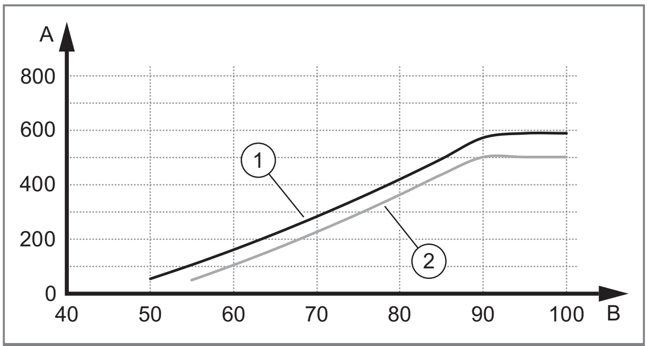


Fig. 260: VWL 128/5 remaining feed head

1 VWL 128/5, 10 kW/1670 l/h
2 VWL 128/5, 12 kW/1850 l/h
A Remaining feed head in hPa (mbar)
B Pump output in %

12.17 Product description for the allSTOR exclusive VPS 300/3-7 to 2000/3-7

Fig. 261: allSTOR VPS 300/3-7 to VPS 2000/3-7

Unit overview for allSTOR VPS 300/3-7 to VPS 2000/3-7

Unit designation	ErP label	Cylinder capacity in l	Order no.
VPS 300/3-7	B	303	0010015112
VPS 500/3-7	B	491	0010015113
VPS 800/3-7	B	778	0010015114
VPS 1000/3-7	B	962	0010015115
VPS 1500/3-7	B	1505	0010015116
VPS 2000/3-7	B	1917	0010015117

Special features

- Compact buffer shift-load cylinder for combining various energy sources, such as solar, heat pump, wood, oil, gas or CHP
- Hygienic potable water preparation via the domestic hot water station that is suitable for flange mounting
- Additional solar pump station that is suitable for flange mounting for solar domestic hot water generation and heating support
- Easy to carry to the installation site; the heat insulation has not been prefit
- Split heat insulation (two-part up to 1000 l, three-part 1500 l and 2000 l)
- Optional thermal insulation caps for unused connections
- Tail lift from 500 l with pallet truck

Possible application

The multi-functional cylinder is supplied via various heat generators and/or a solar charging system. It is used as a buffer cylinder for heating water and provides heat energy to various consumers, such as domestic hot water stations, heating circuits, swimming pools, etc.

Equipment

- Steel buffer shift-load cylinder
- Baffle plates and control units for optimum stratification
- Highly efficient thermal insulation (140 mm for 300 l-1000 l, 200 mm for 1500 l and 2000 l) made from polyester fibre fleece
- Circulation pump as an accessory
- 8 surface mount sensor straps
- 15 charging and discharging connections for individual cylinder zones
- One sleeve for purging

Note
To prevent corrosion and depositions (scale) in the cylinder, you must observe VDI 2035 T1 and T2. This VDI contains, among other things, information about the water hardness level that must be maintained.

Technical data

Description	Unit	Tolerance	VPS 300/3	VPS 500/3	VPS 800/3	VPS 1000/3	VPS 1500/3	VPS 2000/3
Cylinder tank capacity	l	± 2	303	491	778	962	1505	1917
Perm. system overpressure (heating side)	MPa (bar)	–	0.3 (3)					
Heating water temperature	°C	–	95					
Cylinder tank outer diameter (without heat insulation)	mm	± 2	500	650	790	790	1000	1100
Cylinder tank outer diameter (with heat insulation)	mm	± 10	780	930	1070	1070	1400	1500
Cylinder tank depth (incl. heat insulation and connections)	mm	± 10	828	978	1118	1118	1448	1548
Cylinder tank height (incl. purging valve and positioning ring)	mm	± 10	1735	1715	1846	2226	2205	2330
Buffer cylinder height (incl. heat insulation)	mm	± 10	1833	1813	1944	2324	2362	2485
Cylinder tank weight (empty)	kg	± 10	70	90	130	145	210	240
Cylinder tank weight (full)	kg	± 10	373	581	908	1107	1715	2157
Tilt measurement	mm	± 20	1734	1730	1870	2243	2253	2394
Standby energy consumption	KWh/24 hrs	–	< 1.7	< 2.0	< 2.4	< 2.5	< 2.9	< 3.3

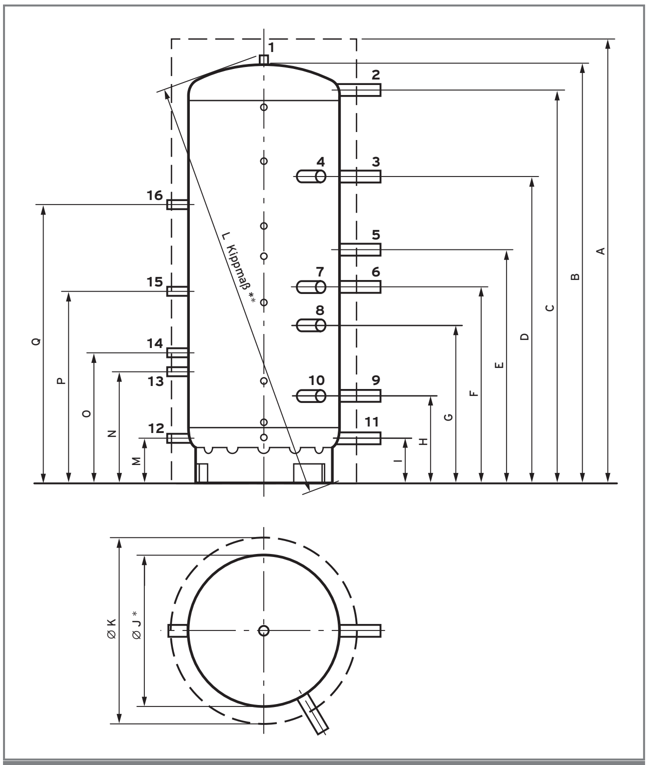


Fig. 262: Dimension drawing

01 Opening for purging valve
02 Heating water flow for domestic hot water station in the case of wall-mounting/flow or return for cascade
03 Boiler flow for hot water demand
04 Boiler flow for hot water demand
05 Boiler return for hot water demand
06 Boiler flow for heating water demand/heating circuit flow
07 Boiler flow for heating water demand/heating circuit flow
08 Boiler return for hot water demand
09 Boiler return for domestic hot water demand/heating circuit return
10 Boiler return for heating water demand/heating circuit return
11 Heating water return for domestic hot water station in the case of wall-mounting/flow or return for cascade
12 Heating water return for the solar charging system (VPS/3-E only)
13 Heating water flow for the solar charging system for low temperatures (VPS/3-E only)
14 Heating water flow for the solar charging system for high temperatures (VPS/3-E only)
15 Heating water return for the domestic hot water station (VPS/3-E only)
16 Heating water flow for the domestic hot water station (VPS/3-E only)

Unit type	A	B	C	D	E	F	G	H	I	J dia.	K dia.	L	M	N	O	P	Q
VPS 300/3	1833	1720	1617	1210	920	744	574	365	130	500	780	1734	130	480	580	900	1350
VPS 500/3	1813	1700	1570	1230	930	750	579	394	190	650	930	1730	190	540	640	960	1410
VPS 800/3	1944	1832	1670	1330	1020	820	636	421	231	790	1070	1870	231	581	681	1001	1451
VPS 1000/3	2324	2215	2051	1598	1220	1020	822	451	231	790	1070	2243	231	581	681	1001	1451
VPS 1500/3	2362	2190	1973	1573	1227	1000	797	521	291	1000	1400	2253	291	641	741	1061	1511
VPS 2000/3	2485	2313	2080	1656	1201	1008	803	551	298	1100	1500	2394	298	648	748	1068	1518
Dimensions in mm, all dimensions ± 10 mm, * ± 2 mm, ** ± 20 mm																	

12.18 Product description for the allSTOR plus VPS 300/3-5 to 2000/3-5

Fig. 263: allSTOR VPS 300/3-5 to VPS 2000/3-5

Unit overview

Unit designation	ErP label	Cylinder capacity in l	Order no.
VPS 300/3-5	B	303	0010015118
VPS 500/3-5	B	491	0010015119
VPS 800/3-5	B	778	0010015120
VPS 1000/3-5	B	962	0010015121
VPS 1500/3-5	B	1505	0010015122
VPS 2000/3-5	B	1917	0010015123

Special features

- Compact buffer shift-load cylinder for combining various energy sources, such as solar, heat pump, wood, oil, gas or CHP
- Cascading up to 6000 l is possible
- Easy to carry to the installation site; the heat insulation has not been prefit
- Split heat insulation (two-part up to 1000 l, three-part 1500 l and 2000 l)
- Optional thermal insulation caps for unused connections

Possible application

The multi-functional cylinder is supplied via various heat generators and/or a solar charging system. It is used as a buffer cylinder for heating water and provides heat energy to various consumers, such as drinking water stations, heating circuits, swimming pools, etc.

Equipment

- Steel buffer shift-load cylinder
- Flow damper for optimum stratification
- Highly efficient thermal insulation (140 mm for 300 l-1000 l, 200 mm for 1500 l and 2000 l) made from polyester fibre fleece
- Circulation pump as an accessory
- 8 surface mount sensor straps
- 10 charging and discharging connections for individual cylinder zones
- One sleeve for purging

Note
To prevent corrosion and depositions (scale) in the cylinder, you must observe VDI 2035 T1 and T2. This VDI contains, among other things, information about the water hardness level that must be maintained.

Technical data

Description	Unit	Tolerance	VPS 300/3	VPS 500/3	VPS 800/3	VPS 1000/3	VPS 1500/3	VPS 2000/3
Cylinder tank capacity	l	± 2	303	491	778	962	1505	1917
Perm. system overpressure (heating side)	MPa (bar)	–	0.3 (3)					
Heating water temperature	°C	–	95					
Cylinder tank outer diameter (without heat insulation)	mm	± 2	500	650	790	790	1000	1100
Cylinder tank outer diameter (with heat insulation)	mm	± 10	780	930	1070	1070	1400	1500
Cylinder tank depth (incl. heat insulation and connections)	mm	± 10	828	978	1118	1118	1448	1548
Cylinder tank height (incl. purging valve and positioning ring)	mm	± 10	1735	1715	1846	2226	2205	2330
Buffer cylinder height (incl. heat insulation)	mm	± 10	1833	1813	1944	2324	2362	2485
Cylinder tank weight (empty)	kg	± 10	70	90	130	145	210	240
Cylinder tank weight (full)	kg	± 10	373	581	908	1107	1715	2157
Tilt measurement	mm	± 20	1734	1730	1870	2243	2253	2394
Standby energy consumption	KWh/24 hrs	–	< 1.7	< 2.0	< 2.4	< 2.5	< 2.9	< 3.3

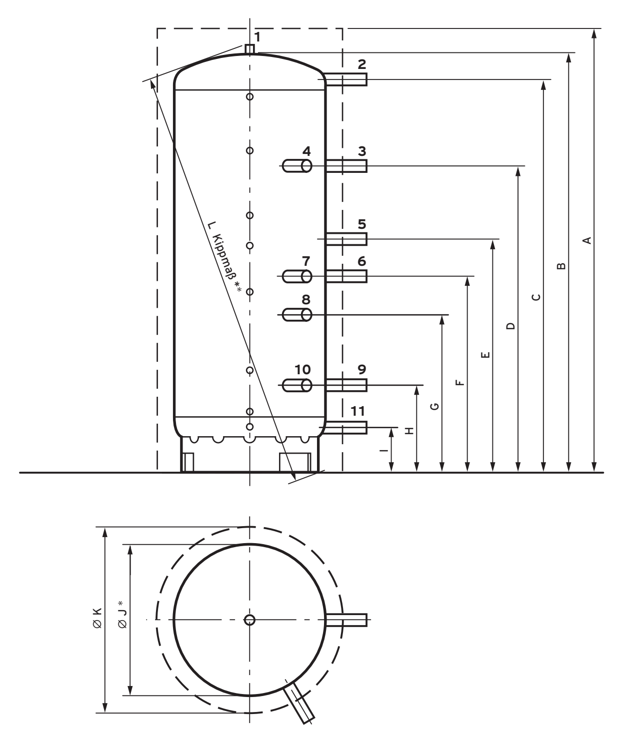


Fig. 264: Dimension drawing

01 Opening for purging valve
02 Heating water flow for domestic hot water station in the case of wall-mounting/flow or return for cascade
03 Boiler flow for hot water demand
04 Boiler flow for hot water demand
05 Boiler return for hot water demand
06 Boiler flow for heating water demand/heating circuit flow
07 Boiler flow for heating water demand/heating circuit flow
08 Boiler return for hot water demand
09 Boiler return for domestic hot water demand/heating circuit return
10 Boiler return for heating water demand/heating circuit return
11 Heating water return for domestic hot water station in the case of wall-mounting/flow or return for cascade

Unit type	A	B	C	D	E	F	G	H	I	J dia.	K dia.	L
VPS 300/3	1833	1720	1617	1210	920	744	574	365	130	500	780	1734
VPS 500/3	1813	1700	1570	1230	930	750	579	394	190	650	930	1730
VPS 800/3	1944	1832	1670	1330	1020	820	636	421	231	790	1070	1870
VPS 1000/3	2324	2215	2051	1598	1220	1020	822	451	231	790	1070	2243
VPS 1500/3	2362	2190	1973	1573	1227	1000	797	521	291	1000	1400	2253
VPS 2000/3	2485	2313	2080	1656	1201	1008	803	551	298	1100	1500	2394

Dimensions in mm, all dimensions ± 10 mm, * ± 2 mm, ** ± 20 mm

12.19 Product description for the aguaFLOW exclusive VPM 20/25/2 W to VPM 40/45/2 W domestic hot water station

Fig. 265: aguaFLOW exclusive domestic hot water station

Type overview

Unit designation	Order no.
VPM 20/25/2 W	0010014311
VPM 30/35/2 W	0010014312
VPM 40/45/2 W	0010014313

Special features

- Hygienic heating of potable water using the counter-flow principle
- A cascade solution of up to four **aguaFLOW exclusive** units is possible
- Various potential applications in combination with the Vaillant buffer cylinders
- Optional anti-legionella function to thermally disinfect domestic hot water and circulation pipe networks in the event of set specifications (time, disinfection temperature and duration) via a suitable system control
- Plate heat exchanger made from stainless steel with large exchanger surface areas and low water content to quickly transfer heat energy to the potable water
- Complete with EPP lining insulation
- Prepared to be easily installed directly on the cylinder. Alternatively, it is possible to mount it on the wall (the wall-mounting bracket is available as an accessory)
- It is also possible to operate it without an additional control

Potential applications

The drinking water station is used to heat drinking water to the exact desired temperature.

Drinking water is guided via a plate heat exchanger using the counter-flow principle. The DHW draw-off point is detected via an integrated flow sensor. The minimum draw-off quantity is:
- VPM 20/25/2 W: 2 l/min,
- VPM 30/35/2 W: 2 l/min and
- VPM 40/45/2 W: 3.5 l/min.

Equipment

- Stainless steel plate heat exchanger
- Specially formed plate structure for preventing scale depositions
- EPP shell thermal insulation
- Integrated volume flow sensor
- High-efficiency pump
- eBUS interface
- Circulation pump as an accessory
- Wall consoles (also for cascade; order no. 0010014300 and/or 0010014301 and/or 0010013303)

Note
To prevent corrosion and depositions (scale) in the station's heat exchanger, you must observe VDI 2035 T1 and T2. This VDI contains, among other things, information about the water hardness level that must be maintained.
Depending on the quality and condition of the potable water, high potable water temperatures may lead to scale depositions on the potable water side of the heat exchanger.
If a max. potable water outlet temperature of 60 °C is set, the potable water hardness may be up to 15 °dH.
From a water hardness of 15 °dH or at a higher selected outlet temperature, we recommend that you use a potable water softener in order to guarantee that the domestic hot water station works correctly and to guarantee the quality of the potable water.

Technical data

Description	Unit	VPM 20/25/2 W	VPM 30/35/2 W	VPM 40/45/2 W
Hot water output				
For hot water at 60 °C	l/min	20	30	40
Max. output characteristic figure *	–	3	5	9.5
Nominal output	kW	49	73	97
For hot water at 65 °C	l/min	25	35	45
Max. output characteristic figure *	–	4 **	7 ***	11.5
Nominal output	kW	60	85	109
Temperatures				
Temperature range	°C	40 ... 60		
Temperature for anti-legionella programme	°C	70		
Electrical connection				
Rated voltage	V, Hz	230, 50		
Station power consumption	W	25 ... 93		
Circulation pump power consumption	W	25		
Pressure				
Remaining feed head on the heating side	MPa (mbar)	0.15 (150)	0.1 (100)	0.15 (150)
Operating pressure on the heating side	MPa (bar)	0.3 (3)		
Operating pressure on the water side	MPa (bar)	1 (10)		
Dimensions				
Height	mm	750		
Width	mm	450		
Depth if installed on the buffer cylinder	mm	275		
Weight	kg	16	16	19
Hydraulic connection				
Cold water, circulation, hot water	DN 20, G 3/4, flat-sealing			
Hot water flow and return	DN 25, G 1, PTFE seal			

* Measured in accordance with DIN 4708-3: At a hot water temperature of 45 °C, a cold water temperature of 10 °C and a cylinder temperature of 65 °C.
The data for systems with heat pumps and pellet boilers can be found in the corresponding planning information.

Dimension drawing

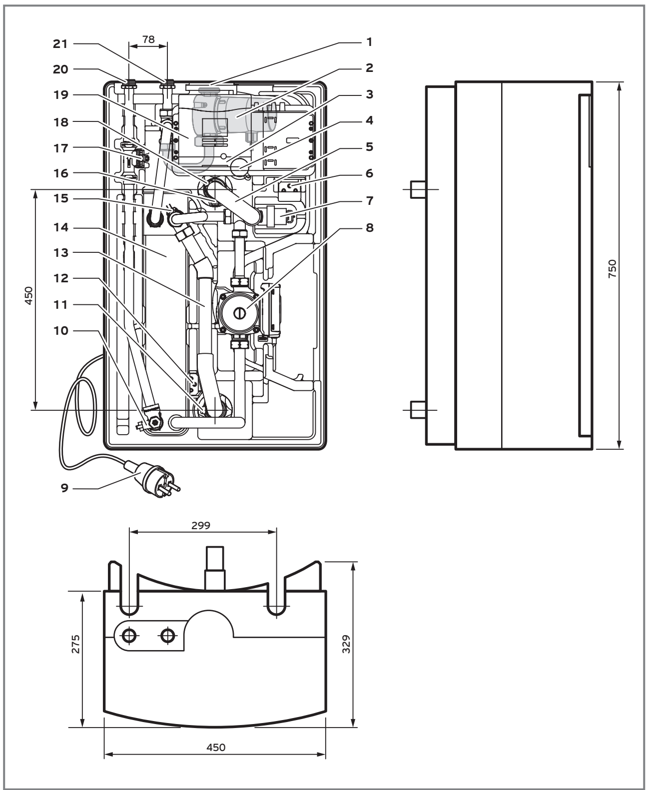


Fig. 266: Dimension drawing

01 Circulation pump connection (optional)
02 Circulation pump
03 Panel
04 Cable duct
05 Buffer circuit flow
06 Bracket for safety screw
07 Mixer
08 Buffer circuit circulation pump
09 Mains plug
10 Hot water temperature sensor
11 Stop valve return
12 Bracket for safety screw
13 Buffer circuit return
14 Plate heat exchanger
15 Buffer circuit return temperature sensor
16 Stop valve flow
17 Flow rate sensor
18 Buffer circuit flow temperature sensor
19 Controller
20 Hot water connection
21 Cold water connection

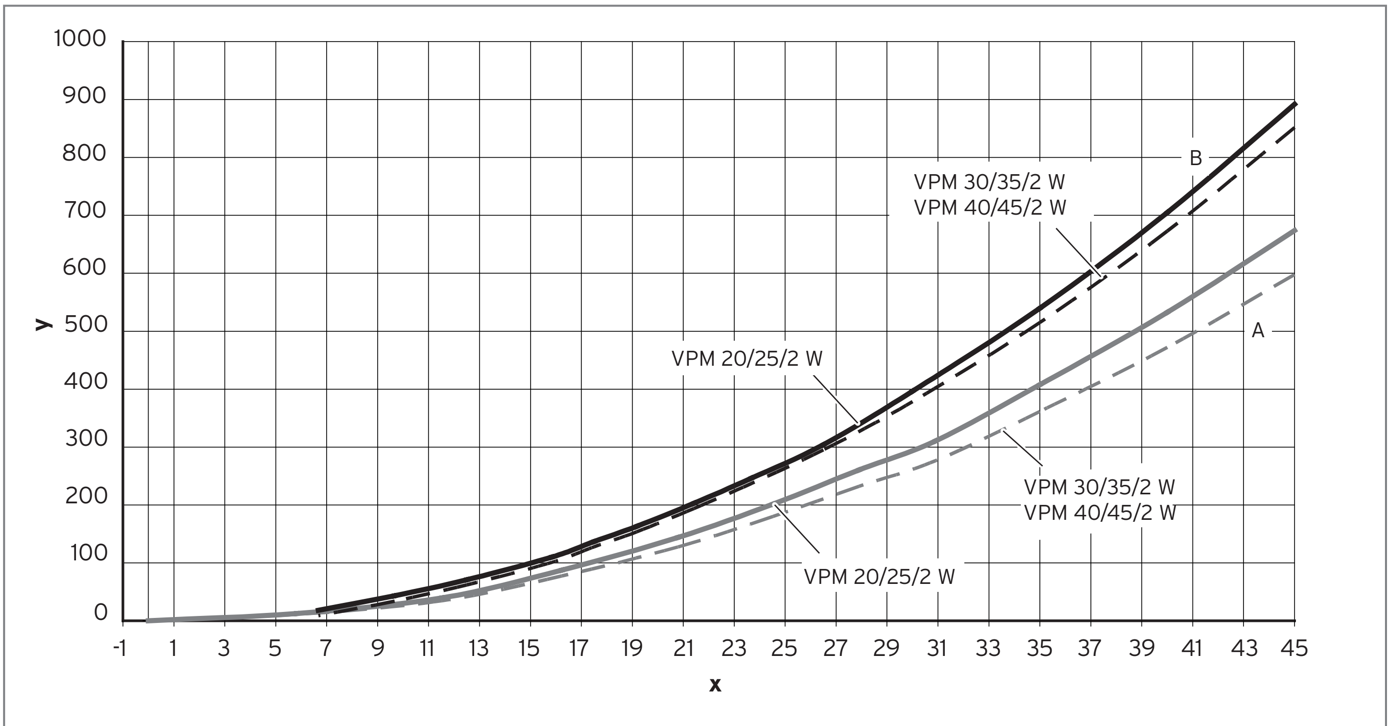


Fig. 267: VPM W pressure loss

x Flow rate [l/min]
y Pressure loss [mbar]

A Drinking water
B Heating

Power levels

VPM 20/25/2 W power levels

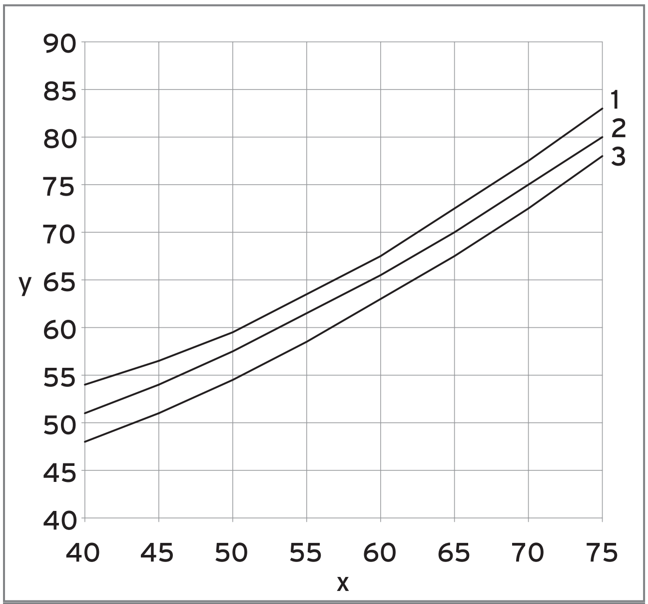


Fig. 268: VPM 20/25/2 W power levels

- x Hot water target value [°C]
- y Buffer cylinder target value [°C]

VPM 30/35/2 W power levels

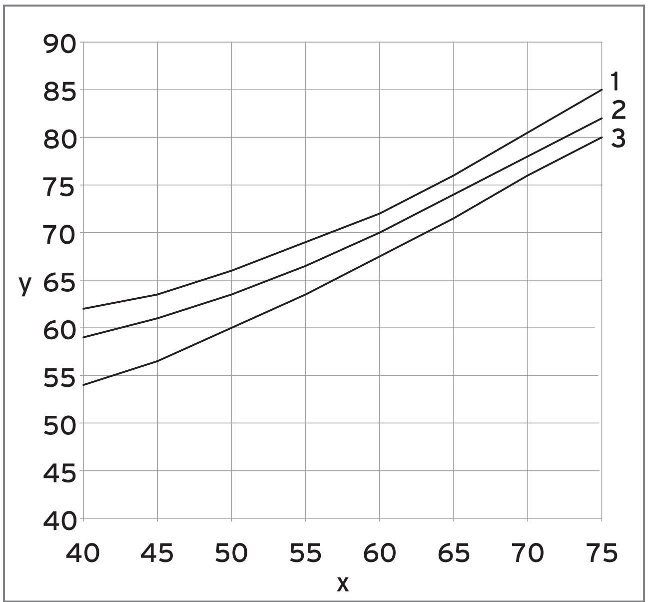


Fig. 269: VPM 30/35/2 W power levels

- x Hot water target value [°C]
- y Buffer cylinder target value [°C]

VPM 40/45/2 W power levels

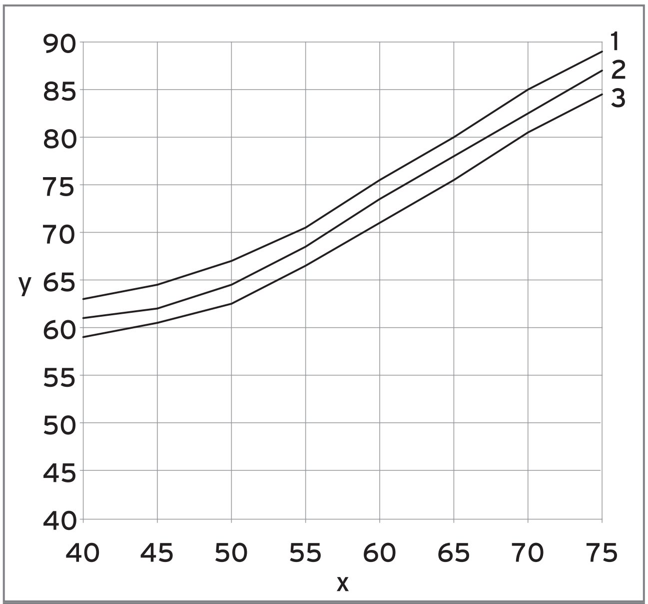


Fig. 270: VPM 40/45/2 W power levels

- x Hot water target value [°C]
- y Buffer cylinder target value [°C]

12.20 Planning buffer cylinders

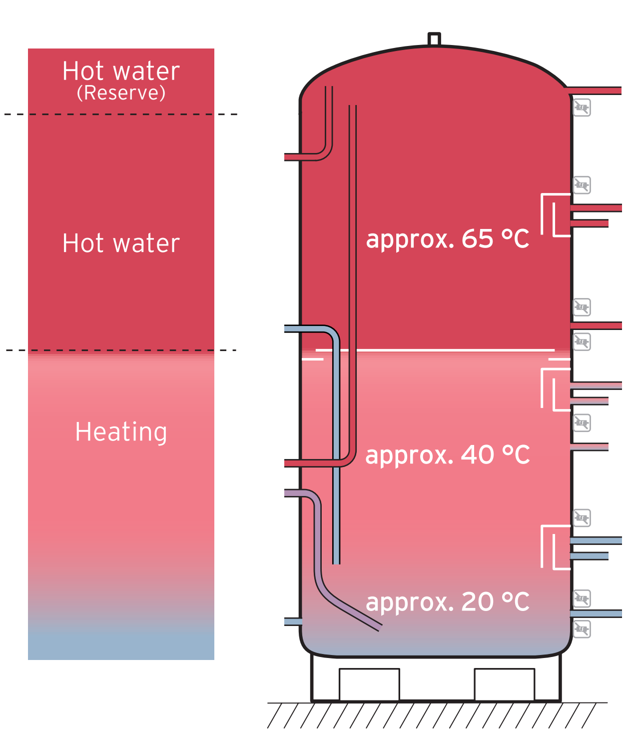


Fig. 271: Controlling cylinder charging

One after the other, starting from the top, three cylinder temperature sensors each trigger a heat requirement if a target value is not reached. The cylinder is divided into three temperature zones by the way in which the sensors are arranged according to the product and the system. If a solar charging system is used, first the **auroFLOW** and then the post-heating installations are triggered, depending on the current solar energy input.

Sensor 1 (hot water, reserve): For the upper 10% of the cylinder volume (hot water).

Sensor 2 (hot water, comfort zone): For the approx. 40% of the cylinder volume that lies below.

Sensor 3 (heating): For the approx. 50% of the cylinder volume that lies below.

The heat generator and the heating circuits are connected as follows:

Overview of the cylinder connections

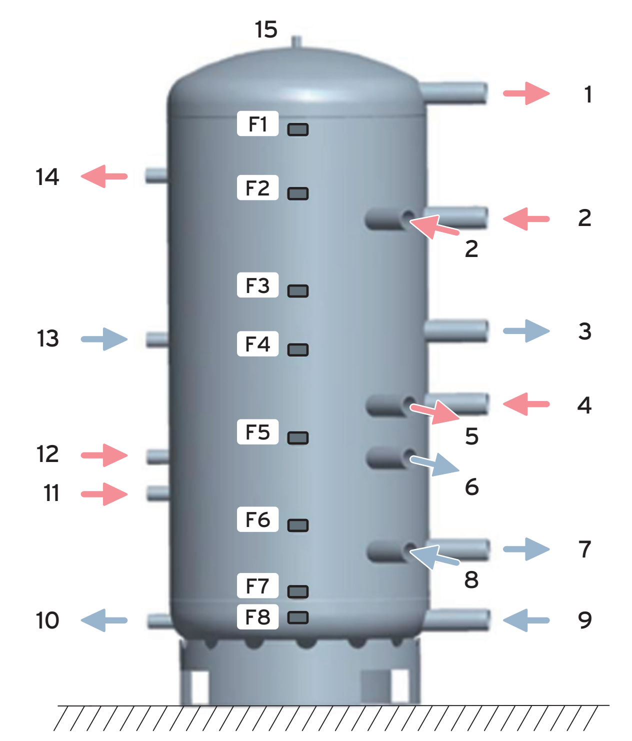


Fig. 272: Cylinder connections - Overview

1	Heating water flow to VPM-W for wall-mounted installations or cylinder cascades
2	Two boiler flow connections for the process water part of the cylinder
3	Boiler return
4	Boiler flow connection for the heating part of the cylinder
5	Heating circuits flow
6	Boiler return
7	Boiler return
8	Heating circuits return
9	Heating water return to VPM-W for wall-mounted installations or cylinder cascades
10	Heating water return to VPM-S
11	VPM-S heating water flow at low temperatures
12	VPM-S heating water flow at high temperatures
13	Heating water return to VPM-W
14	VPM-W heating water flow
15	Connectors for purging valve
F 1-8	Sensor straps for the temperature sensor

There are eight sensor positions in addition to the three-level connection geometry. Positions F1 to F8 indicate the position of the sensor brackets.

Differences between the „exclusive“ and „plus“ equipment variants

The multi-function cylinder are available as an „exclusive“ variant and a „plus“ variant.

While the allSTOR exclusive is a true multi-function cylinder, the allSTOR plus is primarily a buffer cylinder.

Both variants have connections for the heating circuit and boiler pipelines. In addition, the allSTOR exclusive has connections for a solar charging system and a drinking water station.

A baffle plate, various flow dampers and pipes for optimal and efficient stratification from above (hot) to below (cold) are located inside the allSTOR exclusive. The baffle plate is located in the centre of the cylinder so that the areas for heating and hot water are the same size.

There are also flow dampers in the „plus“ variants, but they do not have the same properties. There is no inner chamber. This means that the inflowing heating water is guided downwards, as the kinetic energy cannot be completely eliminated by the „half“ flow dampers.

Fig. 273: allSTOR exclusive profile

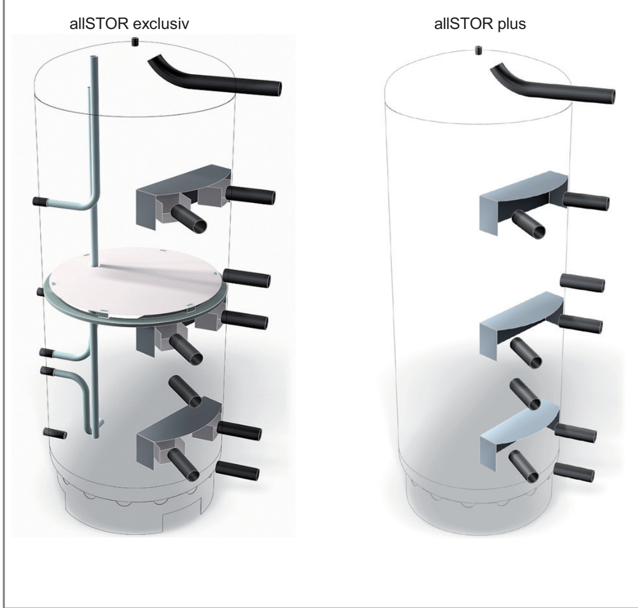


Fig. 274: Differences between „exclusive“ and „plus“

12.21 Dimensioning the system

How efficient the system is and how it functions depend to a large extent on dimensioning the system correctly. All of the following components must be dimensioned according to requirements.

VPS/3 buffer cylinder

- Hot water demand adapted to the VPM /2 W drinking water station
- Heat demand
- Type of boiler (running time, bridging time)
- Solar storage time

The buffer cylinder must be dimensioned carefully to ensure that the system configuration functions correctly and efficiently.

As a rule of thumb, when dimensioning the buffer cylinder, a buffer cylinder with a capacity of at least 30 l should be calculated for each kW of boiler output.

Always observe the maximum system flow rates. These depend on the size of the cylinder and must not exceed the following values:

- VPS 300-500/3: 8 m^3/h
- VPS 800-1000/3: 15 m^3/h
- VPS 1500-2000/3: 30 m^3/h

The following points should also be noted when planning the system:

Heating expansion vessel

- System volume, including buffer cylinder
- System height or expansion-vessel pre-charge pressure
- Water trap

VPM /2 S solar charging system

- Collector surface area
- Collector type

Solar expansion vessel

- Solar system volume
- System height or expansion-vessel pre-charge pressure

VPM /2 W drinking water station

Hot water demand according to:

- Number of people
- Type of application
- Simultaneity
- Buffer cylinder volume

Circulation pump

- Actuation
- Residual head
- Volume flow
- Current consumption

12.22 Selecting the drinking water station

Once the demand index N has been calculated for the hot water demand, the VPM /2 W drinking water station can be selected.

Selecting the drinking water station

Demand index N	VPM .../2 W drinking water station
Up to four (up to two with heat pump)	20/25
Up to seven (up to five with heat pump)	30/35
Up to 11.5 (up to nine with heat pump)	40/45
Greater than 11.5	Cascade (max. four stations can be cascaded)

12.23 Selecting the heat generator

Once the power required for heating and hot water has been calculated, the heat generator (type and output range) can be selected.

12.24 Selecting the system combination from VPS and VPM W

Depending on the type and output range of the heat generator, as well as the calculated output characteristic figure N_L, the required buffer cylinder size can be selected using the following tables.

Selecting the system combination from VPS and VPM W

Power of boilers in kW	VPS 300/3	VPS 500/3	VPS 800/3	VPS 1000/3	VPS 1500/3	VPS 2000/3
10.2	2.0	3.5	–	–	–	–
14.4	2.5	4.0	5.0	–	–	–
19.6	2.5	4.5	6.0	6.5	–	–
20.4	2.5	5.0	6.0	6.5	–	–
21.6	2.5	5.0	6.5	7.0	–	–
24.4	3.0	5.0	6.5	7.5	9.0	–
25.8	3.0	5.0	7.0	8.0	9.5	–
30.9	–	5.0	8.0	9.0	10.5	–
35.4	–	5.5	8.0	9.5	11.5	17.0
45.5	–	5.5	9.0	10.0	18.0	18.0
65.7	–	–	9.6	10.5	22.0	20.5
75.0	–	–	10.0	11.0	23.5	26.0
105.0	–	–	17.0	19.5	26.0	30.0
115.0	–	–	–	20.0	29.0	31.5
130.0	–	–	–	–	32.0	34.0
150.0	–	–	–	–	34.0	37.5
165.0	–	–	–	–	37.0	40.5
201.0	–	–	–	–	43.0	48.0
241.0	–	–	–	–	45.0	49.0
281.0	–	–	–	–	49.5	51.0

General parameters:
In combination with auroMATIC 620/3
Buffer cylinder temperature 80 °C
Process water outlet temperature from drinking water station 60 °C
Process water mixer temperature at the draw-off point 45 °C

12.25 Checking the selected buffer cylinder when using renewable heat generators

If the additional heat generator chosen is a **geoTHERM** heat pump or a **renerVIT** pellet boiler, the minimum volume for the heating share and the total volume of the buffer cylinder must be checked using additional conditions. The values calculated must then be compared with the volume shares that were calculated previously.

The result either confirms that the selected buffer cylinder is correct or specifies a different size for the buffer cylinder.

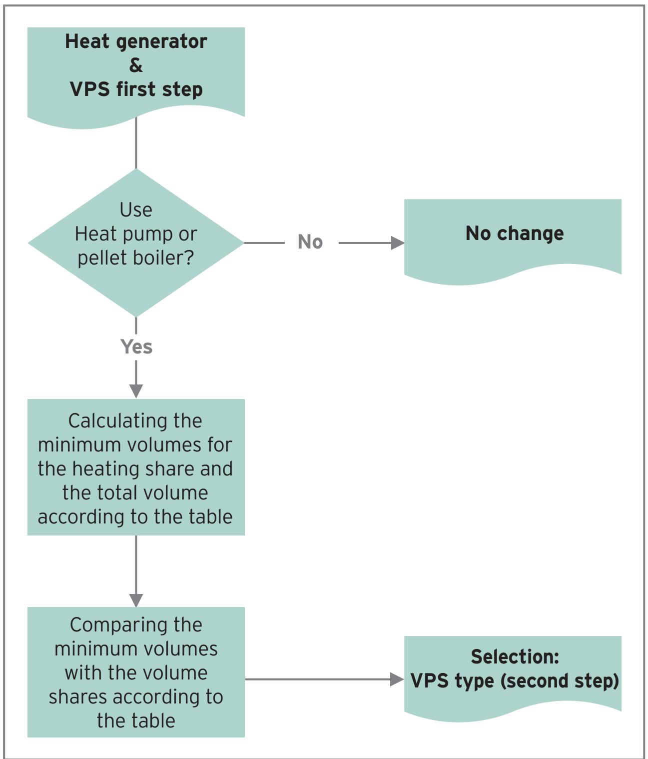


Fig. 275: Changing the selected cylinder

Minimum volume for the heating share and total volume for renerVIT pellet boilers

	Volume of the heating share in litres	Total volume of the buffer cylinder in litres
Output in kW	**Volumes for minimum running time (15 min)**	**Minimum volume for promotion programme (30 l/kW) ***
13	62	390
21	100	630
28	134	840

* For promoting a recently installed buffer cylinder in combination with a pellet boiler, a cylinder volume of at least 30 l/kW must be installed. Observe the applicable promotion programmes in each case!

There are different volume shares available in the buffer cylinder for heating or hot water generation depending on the application type (only hot water/only heating).

12.26 Dimensioning the water pipes

When wall-mounting the drinking water station, note that the pipes between the buffer cylinder and the drinking water station must be dimensioned in accordance with the following specifications.

12.27 Planning cascade systems

The allSTOR buffer cylinder system can be used in almost any heating system. The individual system components (VPS, VPM W and VPM S) can be cascaded to create larger systems.

This means that a buffer cylinder system can consist of up to three allSTOR VPS /3 units, four aguaFLOW exclusive VPM /2 W units and a maximum of two auroFLOW exclusive VPM /2 S units.

Vaillant offers a wide range of accessories for all these units to set up cascade systems.

The customised range of accessories makes it possible to set up a cascade system that has the following advantages:

- Simple installation of the system
- High level of operational reliability in the event of faults or maintenance work
- Compact, space-saving solutions

Fig. 276: Installation example: Four-unit VPM W cascade

Advantages of a cascade system

The use of several buffer cylinders basically means that a cascade solution offers increased flexibility when supplying heat to a building according to requirements.

- The system has a modular design and, as the heat demand in the building increases, it can be extended. This means that partial refurbishments of existing heating installations are also possible.
- Simple transport and installation of units and cascade accessories – even in the case of renovations – thanks to these being delivered in individual packaging units. It is easier to install parts of the system in narrow stairways or by doors, for example, which in turn minimises personnel costs.

- High level of maintenance flexibility because maintenance work can be carried out on individual units without having to switch off the entire system.

12.28 Calculating the pressure loss in cylinder cascades

The planSOFT software tool is available on our Expert Partner network to help you calculate the system pressure loss.

The pressure losses in the pipe sections and cylinder tanks can also be determined using the corresponding diagrams.

To calculate the pressure loss in the cylinder cascade, proceed as follows:

- Determine the required pipe length and the number of 90° pipe elbows
- For each 90° elbow, add 0.45 m to the pipe length determined
- Select the pipe diameter
- Determine the pressure loss in the connection pipes (dependent on the volume flow). See diagram.
- Add the pressure losses in the cylinder tanks (dependent on the volume flow). See diagram.

Pressure loss per metre of pipeline

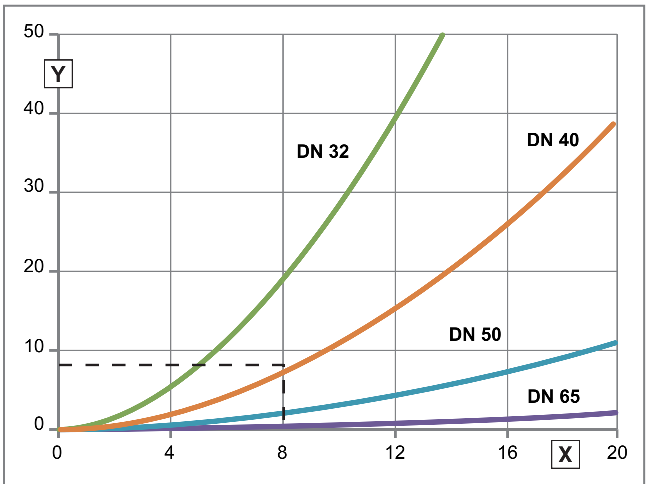


Fig. 277: Pressure loss per metre of pipeline

X Flow rate in m³/h
Y Pressure loss in mbar

For each elbow, an additional equivalent pipe length of 0.45 m must be added.

Pressure loss in the cylinder tanks within a cascade

Pressure loss per metre of pipeline

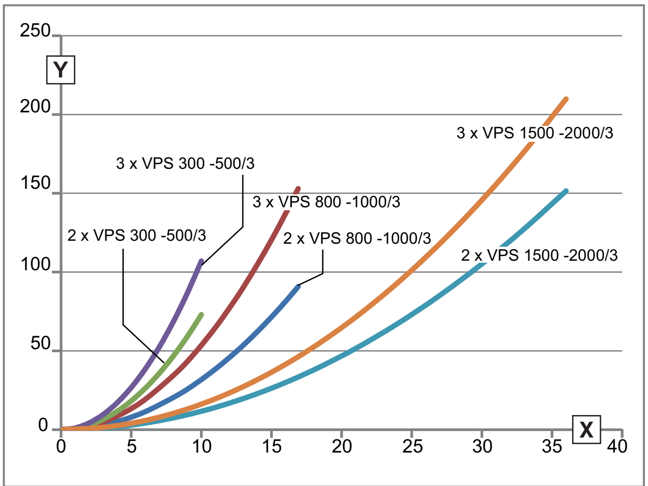


Fig. 278: Pressure loss in the cylinder tanks within the cascade

X Flow rate in m³/h
Y Pressure loss in mbar

A three-unit cascade that consists of allSTOR VPS 500/3 is calculated below:

Sample calculation:

- Required pipe length per cylinder connection: 3.4 m
- Number of 90° elbows per cylinder connection: 4
- Chosen pipe diameter: DN 40
- Maximum flow rate for VPS 500/3: 8 m³/h

Calculation of the pipe length: 2 x 3.4 m + 8 x 0.45 m = **10.4 m**

Pressure loss per metre of pipeline: Approx. **8 mbar** (taken from the diagram)

Pressure loss in the three cylinder tanks: Approx. **75 mbar** (taken from the diagram)

Total pressure loss in the cylinder cascade:

10.4 m x 10 mbar/m + 75 mbar = 179 mbar

12.29 Cascading the drinking water station

Fig. 279: Two-unit cascade

Up to four **aquaFLOW exclusive** units can be combined in a cascade. This enables up to 105 standard accommodation units to be supplied.

The drinking water stations can be connected to the left or the right of the buffer cylinders.

Brackets for wall-mounting are available as accessories in different sizes.

The following combinations are possible:

Possible combinations for the drinking water stations

VPM 20/25/2 W	VPM 30/35/2 W	VPM 40/45/2 W	Litres per minute	N_L
2	–	–	40/50	9/14
1	1	–	50/60	14/19
–	–	2	80/90	32/39
3	–	–	60/75	14/29
2	1	–	70/85	25/35
1	2	–	80/95	32/42
–	–	3	110/125	54/65
4	–	–	70/90	25/39
3	1	–	80/100	32/46
2	2	–	90/110	39/54
1	3	–	110/120	46/52
–	–	4	150/170	87/105

Note:

Cascade valves (KV) are required on each aquaFLOW unit. Each valve is actuated by the station it belongs to and can be switched to „open" and „closed" using a limit switch.

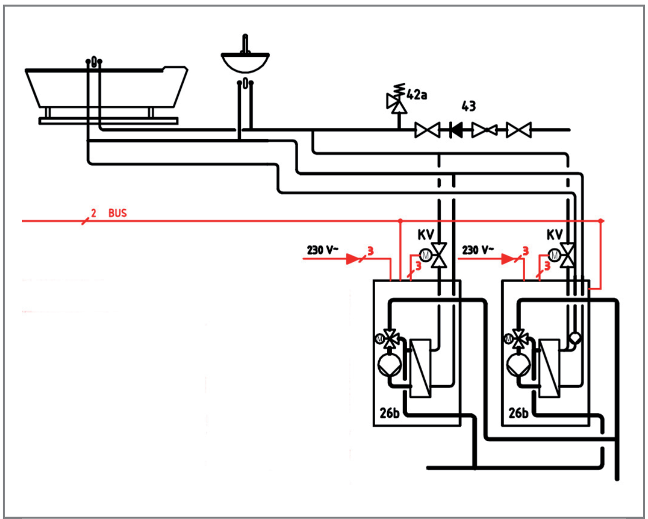


Fig. 280: VPM .../2 W hydraulics cascade connection

12.30 Planning the installation location

When setting up, installing and operating the buffer cylinder system, proceed in accordance with the local regulations, rules, directives and guidelines on electrical connection issued by the utility company of the water supply company regarding the use of geothermal energy to connect heat source systems and heating installations.

The system components must be installed in dry and permanently frost-free rooms.

The ambient temperature must not exceed 40 °C.

The installation site must be selected such that, in the event of damage, relatively large volumes of water can be drained effectively (e.g. via a floor drain).

The weight of the buffer cylinder when it is full must be compared with the load-bearing capacity of the floor.

When planning the installation site, the weight of the buffer cylinder, including all water when filled to capacity, MUST be taken into account, and this weight must then be compared with the load-bearing capacity of the floor.

Take the tilt measurement of the buffer cylinder into account.

Type designation	Unit	Tolerance	Tilt measurement A
VPS 300/3	mm	± 20	1734
VPS 500/3	mm	± 20	1730
VPS 800/3	mm	± 20	1870
VPS 1000/3	mm	± 20	2243
VPS 1500/3	mm	± 20	2253
VPS 2000/3	mm	± 20	2394

The buffer cylinder requires sufficient clearance from the walls and the ceiling. If the auroFLOW and aguaFLOW are to be installed, their dimensions must be taken into account when calculating the amount of clearance required.

Side clearance of the cylinder to the wall

Type designation	Side clearance A [mm]	Ceiling clearance B [mm]
VPS 300/3	350	350
VPS 500/3	450	
VPS 800/3	500	
VPS 1000/3	500	
VPS 1500/3	600	
VPS 2000/3	650	

13 Intelligent system combinations from Vaillant

13.1 Efficient in every detail

The new **flexoTHERM** range of heat pumps is part of Vaillant's new Green iQ concept which stands for efficient, intelligent and sustainable heating technology of an outstanding standard of quality.

The heat pump range is composed of a standardised heat pump for all energy sources and modules for the various heat sources. This means that all heat pumps are installed and controlled in exactly the same way.

The heat pumps from the flexoTHERM series are flexible, quiet and have the A++ efficiency label. The particularly quiet outdoor unit in the air-to-water heat pump can even be installed in rows of terraced houses.

Energy is transported from the outdoor unit to the indoor unit of this air-to-water heat pump highly efficiently, as the heat is only „produced" in the house.

13.2 Systematic integration of renewable energies

Since Vaillant traditionally focuses on pioneering and efficient technology, the combination of high-efficiency condensing boilers with solar thermal energy installations or domestic ventilation systems that have integrated heat recovery is a logical step that not only offers potentially high savings and comfort but may also help the owner to receive attractive subsidies. As you would expect, Vaillant systems meet the requirements of the German Renewable Energies Heat Act (EEWärmeG) – meaning that, with Vaillant, you can always look to the future with confidence.

Vaillant also offers other systems and combination options that meet the requirements of the EEWärmeG (Renewable Energies Heat Act):

- The Vaillant **flexoTHERM** heat pump – used as a single unit in a house (up to 150 m²) or with additional solar assistance in an apartment building (up to 400 m²) – makes heating especially eco-friendly and eliminates the need to use gas or oil.
- The Vaillant **renerVIT** system consists of a pellet boiler and a buffer cylinder in which heating water and potable water are heated at the same time.
- It is advisable to add efficient **auroTHERM** solar thermal collectors for potable water heating and/or heating support when used in an apartment building.
- Vaillant is focusing on the **zeoTHERM** system as the next logical step in the further development of gas condensing technology: The control system connects the solar collectors, the gas condensing cell and the zeolite unit together with heat exchangers, hydraulic components and controls in one perfectly functioning unit.

Note
All heating systems – with the exception of renerVIT, zeoTHERM and geoTHERM systems – can be combined with the Vaillant VRC 700 system control in an intelligent and energy-efficient way.

Domestic ventilation with heat recovery

In addition to the heating technology, controlled domestic ventilation has been established as an essential component in modern building technology. It increases living comfort, protects the building fabric and consistently reduces your heat load by preventing ventilation heat losses. Vaillant offers you complete system solutions for heating, domestic hot water and ventilation.

Although neither the EnEV nor the EEWärmeG (Renewable Energies Heat Act) require a ventilation system to be installed, it is nevertheless advisable to do so in order to comply with the strict limits on energy consumption in new builds and to ensure that humidity is evaporated adequately.

The centralised solutions with air-duct systems offer maximum comfort, e.g. thanks to the rehumidification. The flow-optimised air outlets can be unobtrusively integrated into any living situation. The units are perfect for new-build single- and dual-occupancy houses and apartment buildings, but can also be integrated into renovation work if this is planned accordingly.

Thanks to how easy they are to install, the non-centralised solutions are the first choice for renovation – especially in apartment buildings. However, they can also be used in new builds, for example if there is insufficient available space in the installation room.

13.3 From planning to operation

Vaillant will not only help you to select and plan the right heating system for your needs, but also offer you considerable assistance with system start-up and maintenance.

The Vaillant 5Plus Worry-free Promise

The 5Plus Worry-free Promise ensures that you can enjoy your product for longer. Your Vaillant boiler will always be set up according to your needs, maintained at regular intervals and optimised to be as energy-efficient as possible. You also reap the long-term benefits of a five-year guarantee, optimum system reliability and the ability to plan your costs with certainty. Close collaboration between your specialist and Vaillant's Customer Services team will ensure that your system is easy to operate and that your queries are answered quickly at all times.

13.4 geoTHERM VWS 36/4.1 heating heat pump with uniTOWER

The **geoTHERM VWS 36/4.1** is a small, easy-to-install wall-hung boiler unit. You can connect a heating installation to a heating circuit without any other accessories. The use of this space-saving solution is recommended for new builds and for retrofitting existing heating installations with an underfloor circuit.

In this system configuration, mono-energy mode operation of the heat pump is possible.

The heat pump charges the cylinder, if necessary with the support of the electric back-up heater that is integrated in the **uniTOWER**. The **VRC 700** system control (wall-hung) controls the heat pump system.

The recoVAIR domestic ventilation unit for controlled ventilation with heat recovery can be combined with all heating systems.

Key system components:

- **geoTHERM VWS 36/4.1** heating heat pump
- **recoVAIR** domestic ventilation unit
- **uniTOWER VIH QW 190**
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation

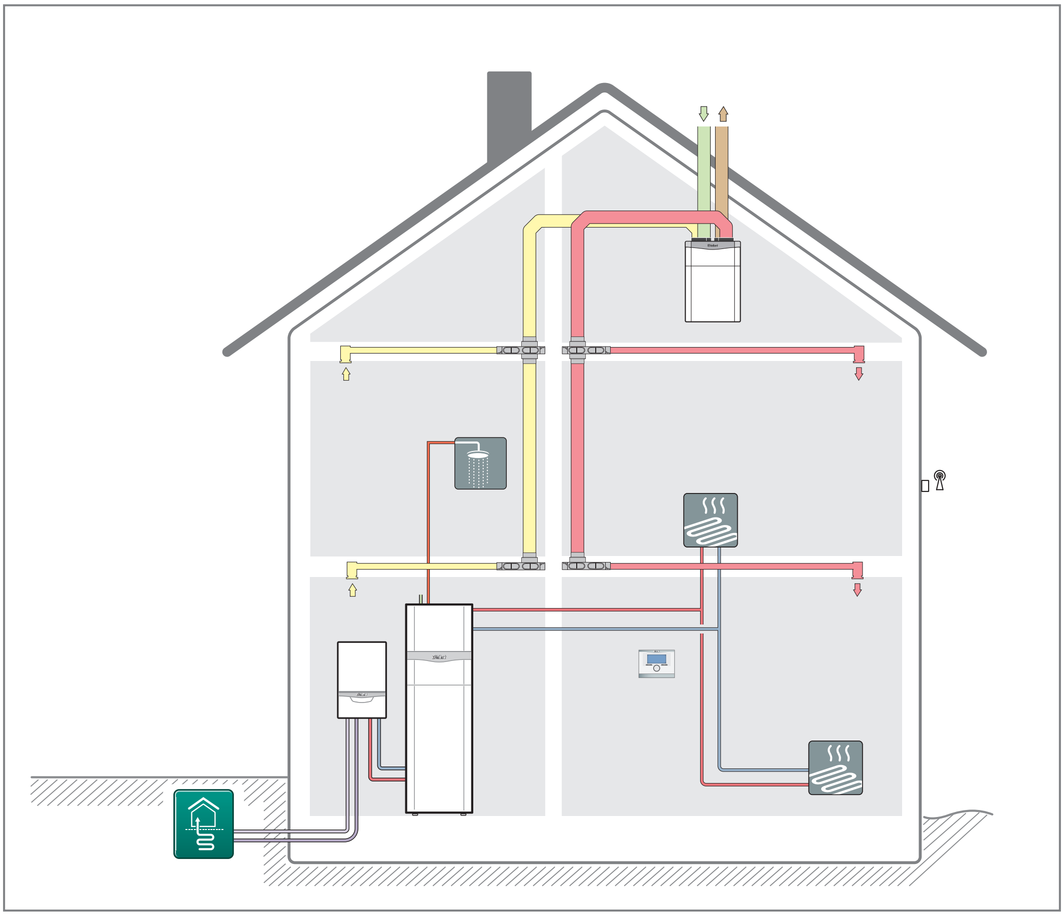


Fig. 282: geoTHERM VWS 36/4.1 heating heat pump with uniTOWER

The **VRC 700** weather-compensated heating control is used to control and adjust the heat pump system. Optional: Passive cooling function.

13.5 geoTHERM VWS 36/4.1 heating heat pump with VWZ MEH 61 hydraulic station

The **geoTHERM VWS 36/4.1** is a small, easy-to-install wall-hung boiler unit. You can connect a heating installation to a heating circuit without any other accessories. The use of this space-saving solution is recommended for new builds and for retrofitting existing heating installations with an underfloor circuit.

In this system configuration, mono-energy mode operation of the heat pump is possible.

Key system components:

- **geoTHERM VWS 36/4.1** heating heat pump
- Electric post-heating via the **VWZ MEH 61** hydraulic station
- **uniSTOR VIH RW 200** domestic hot water cylinder
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation

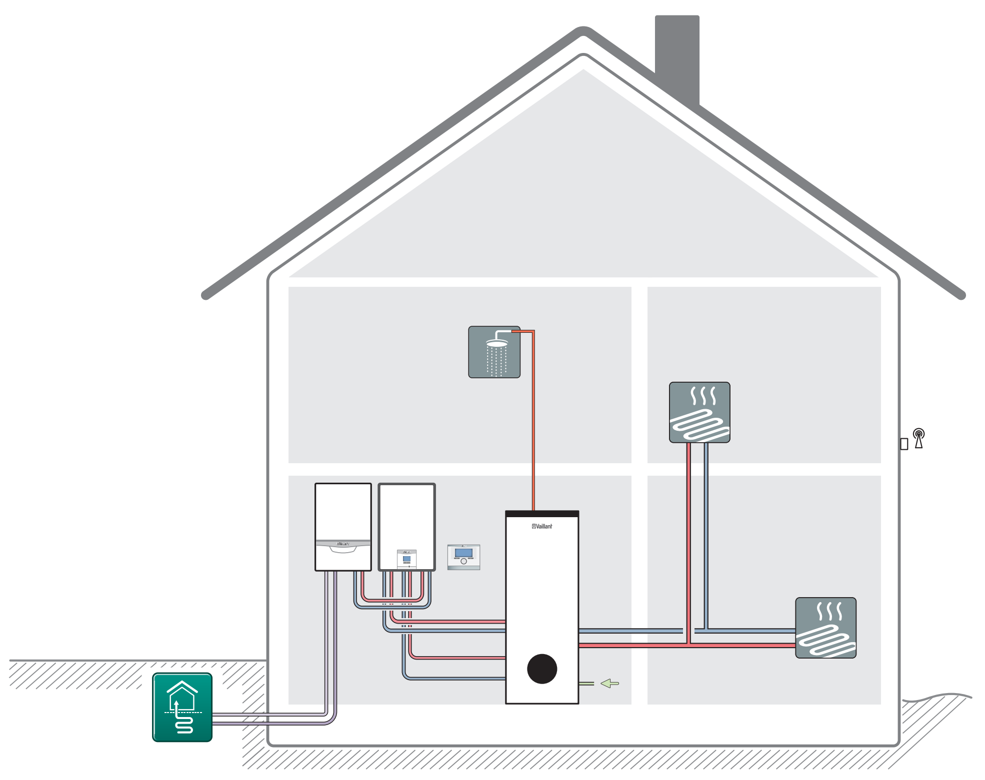


Fig. 283: geoTHERM VWS 36/4.1 heating heat pump with VWZ MEH 61 hydraulic station

The **VRC 700** weather-compensated heating control is used to control and adjust the heat pump system. Optional: Passive cooling function.

The electric back-up heater in the **VWZ MEH 61** hydraulic station provides additional heat for the heating mode and domestic hot water generation when required. The interface for heat pump diagnostics is integrated in the hydraulic station.

13.6 flexoCOMPACT heat pump installation with buffer cylinder

The **flexoCOMPACT exclusive** heat pumps are easy to install. The hot water comfort is determined by the integrated 185 l domestic hot water cylinder. It is therefore very important to carefully calibrate this with the required domestic hot water demand in advance. This space-saving solution can be used particularly in new builds without a cellar.

The **recoVAIR** domestic ventilation unit can be combined with all heat pump systems for controlled ventilation with heat recovery.

Key system components:

- Boiler: **flexoCOMPACT** heat pump
- **VPS R 100/1 M** buffer cylinder
- **recoVAIR** domestic ventilation unit
- **eloPACK** battery storage system
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- **VR 70**
- **comDIALOG VR 920** communication module
- App control for Android and iOS
- Photovoltaic installation
- Hydraulic assemblies

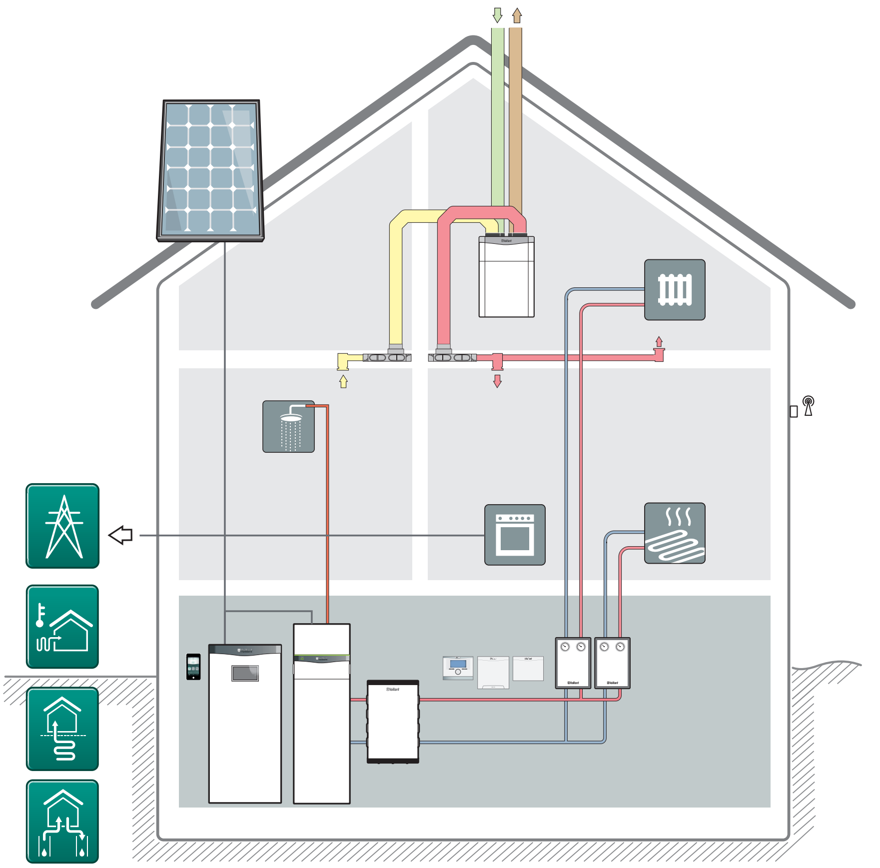


Fig. 284: flexoCOMPACT heat pump installation with buffer cylinder, eloPACK battery storage system and recoVAIR domestic ventilation

The solution shown above is compatible with all heat sources. The passive cooling function is available when using brine or water as the heat source (with the VWZ NC 11/19 additional module). Information on the different heat sources, their advantages and disadvantages, and the corresponding application limits are summarised in the heat pump's planning module.

13.7 aroTHERM – in combination with uniTOWER

Use of the **aroTHERM** heat pump ensures economical exploitation of air as a heat source through simple and easy installation of the heat pump outdoors. In this system configuration, mono-energy mode operation of the heat pump is possible.

In the system configuration below, the heat pump is combined with the **uniTOWER**.

The heat pump charges the cylinder, if necessary with the support of the electric back-up heater that is integrated in the **uniTOWER**. The **VRC 700** system control (wall-hung) controls the heat pump system.

The **recoVAIR** domestic ventilation unit can be combined with all heating systems for controlled ventilation with heat recovery.

Key system components:

- Boiler: **aroTHERM** heat pump
- **recoVAIR** domestic ventilation unit
- **uniTOWER** compact unit with domestic hot water cylinder and components for heat distribution
- **eloPACK** battery storage system
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- App control for Android and iOS
- Optional with VR 920
- Photovoltaic installation

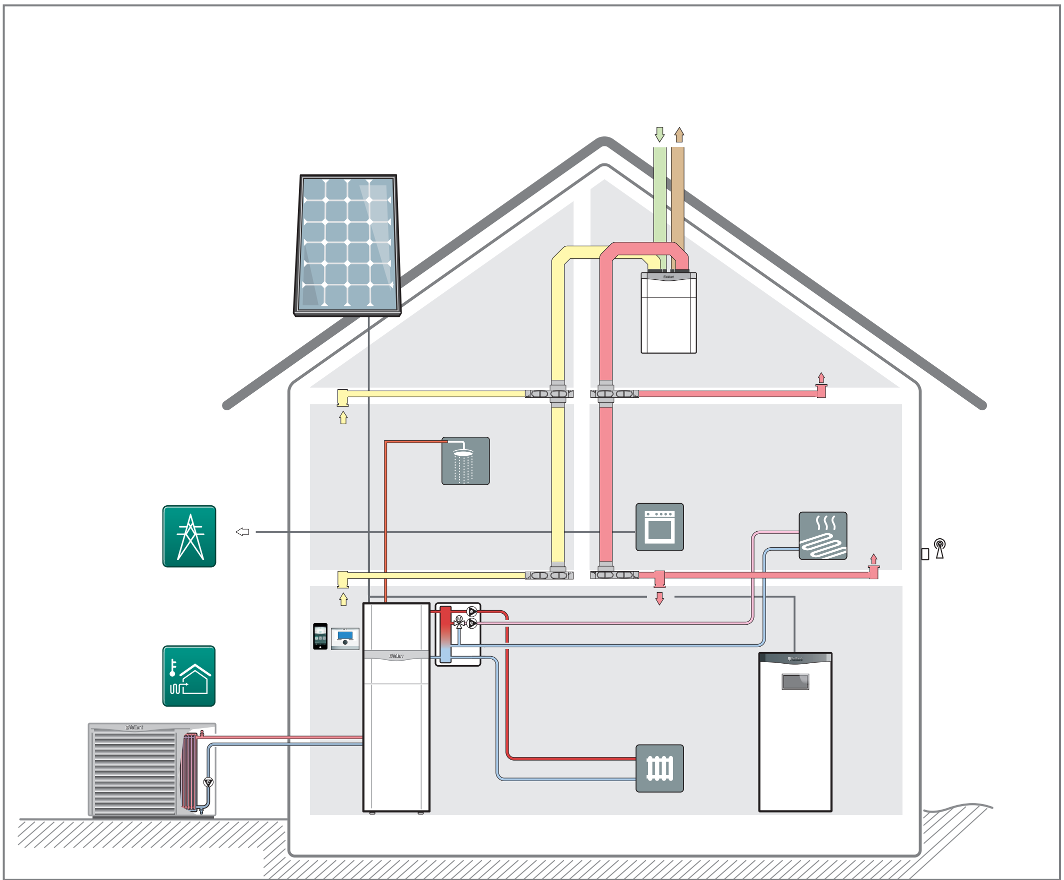


Fig. 285: aroTHERM – in combination with uniTOWER, eloPACK battery bank and recoVAIR

The VRC 700 weather-compensated heating control is used to control and adjust the heat pump system.

13.8 flexoTHERM heat pump installation

An increased domestic hot water demand can be flexibly covered using an additional cylinder. Solar-thermal integration is possible when a suitable cylinder is selected. This basic installation diagram can be implemented using any heat source.

A photovoltaic installation can be combined with all heat pump installations

Key system components:

- Boiler: **flexoTHERM** heat pump
- Photovoltaic installation
- **geoSTOR VIH RW 300** or **uniSTOR VIH RW 200** domestic hot water cylinder
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- **VR 920** communication module
- App control for Android and iOS

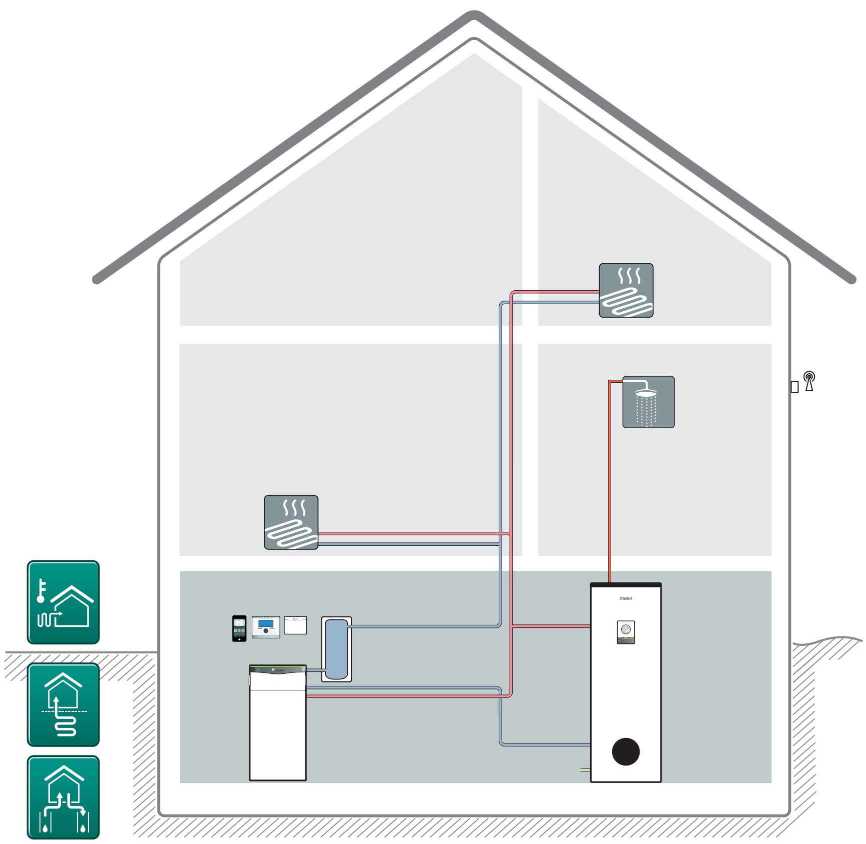


Fig. 286: flexoTHERM heat pump installation with domestic hot water cylinder – basic system diagram

The solution shown above is compatible with all heat sources. The passive cooling function is available when using brine or water as the heat source (with the VWZ NC 11/19 additional module). Information on the different heat sources, their advantages and disadvantages, and the corresponding application limits are summarised in the previous sections.

In the case of active cooling, a buffer cylinder that is suitable for the cold must be used.

13.9 Hot water heat pumps in existing systems

The **aroSTOR** hot water heat pump can supply an entire single-occupancy house with hot water from a central location.

The installation room is primarily located where heat accumulates. This may be in a utility room, boiler room or in cellar spaces where waste heat from washing machines or cooling appliances is available. The heat pump extracts the air, cools it and releases it into the room again. The room air is also dehumidified.

The **recoVAIR** domestic ventilation unit can be combined with all heat pump systems for controlled domestic ventilation with heat recovery.

Key system components:

- **aroSTOR** domestic hot water heat pump
- **ecoTEC** gas-fired condensing boiler
- Photovoltaic system
- **recoVAIR** domestic ventilation unit

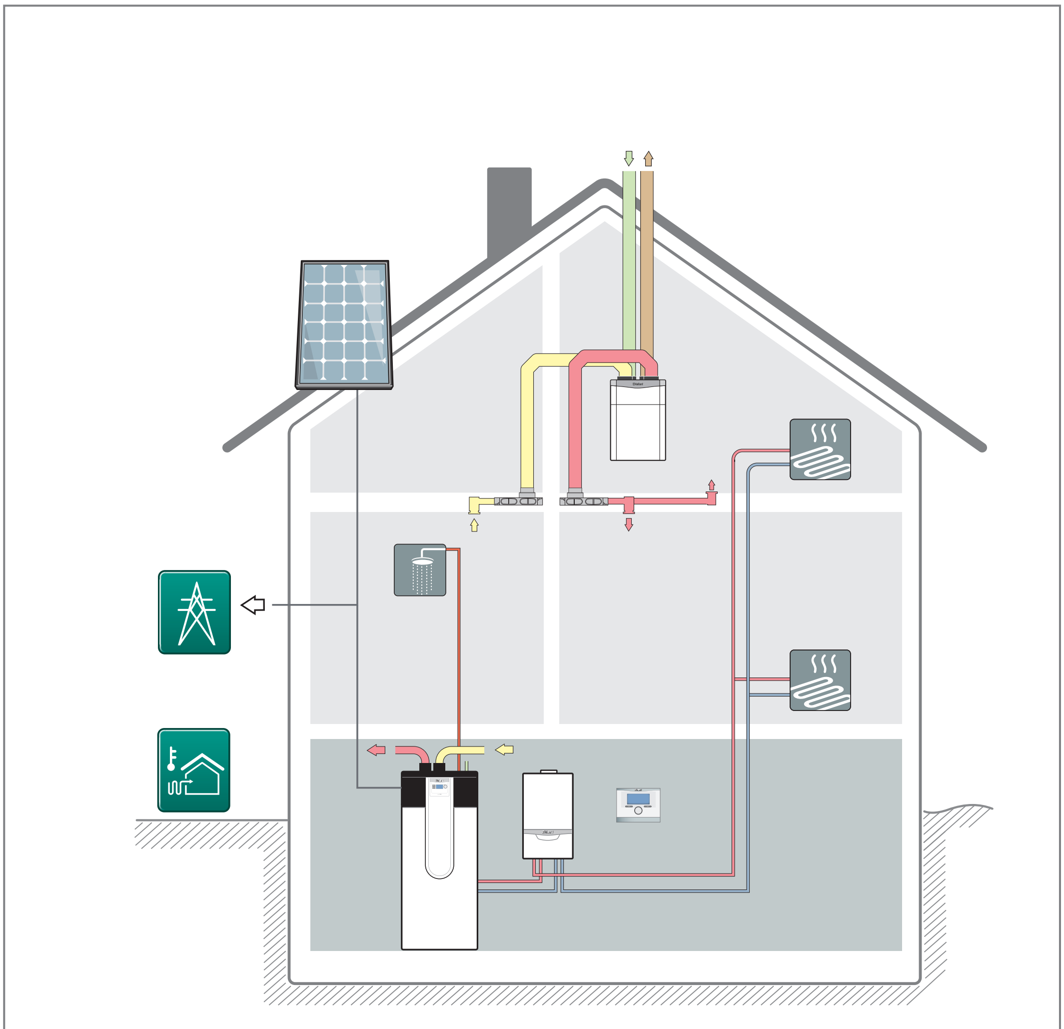


Fig. 287: aroSTOR hot water heat pump for expanding existing systems

The **aroSTOR** VWL B 290/4 and VWL BM 290/4 are designed as standard in such a way that both the supply air and the exhaust air are extracted from or released into the installation room.

This cools the air in the installation room. If this is not required, the exhaust air can be guided outdoors via an exhaust air duct or into another room to be cooled.

13.10 aroTHERM – mono-energy mode

Use of the **aroTHERM** heat pump ensures economical exploitation of air as a heat source through simple and easy installation of the heat pump outdoors.

In this system configuration, mono-energy mode operation of the heat pump is possible.

Key system components:

- Boiler: **aroTHERM** heat pump
- Electric post-heating via the **VWZ MEH 61** hydraulic station
- **uniSTOR plus VIH RW 300/3 BR** domestic hot water cylinder
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- Active cooling function (optional)

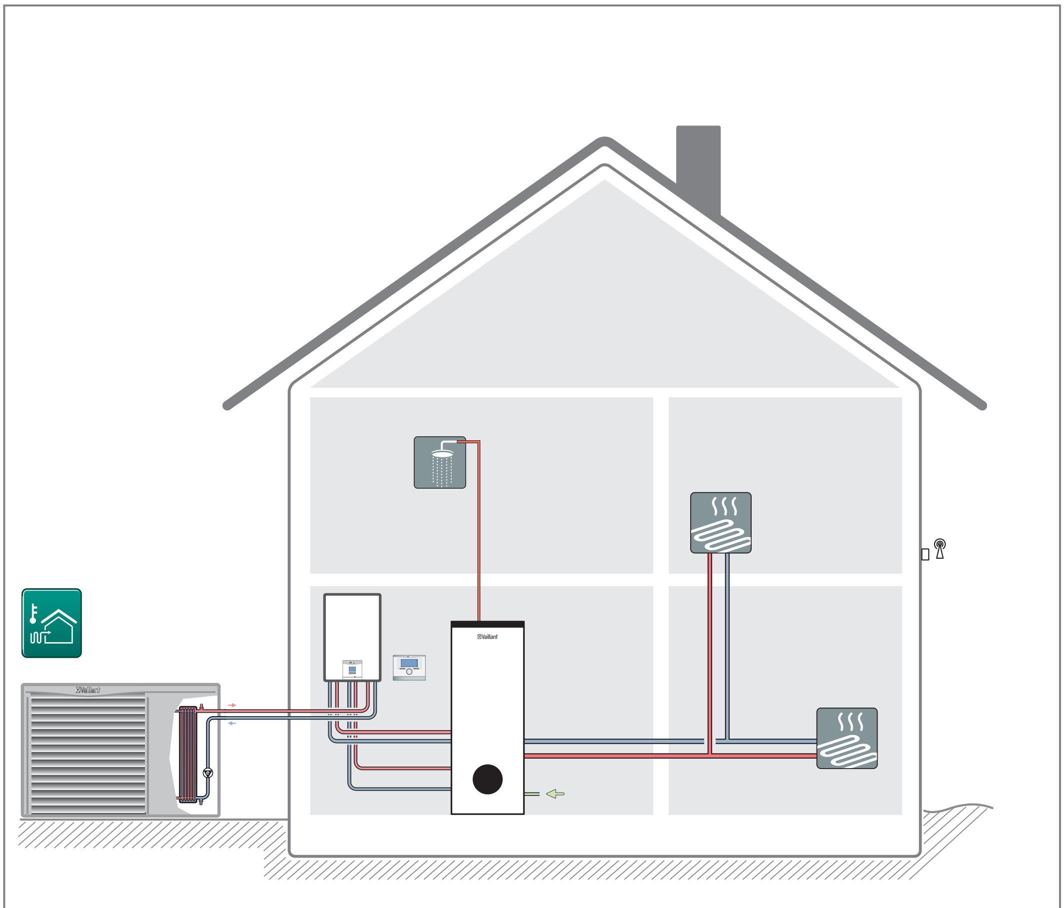


Fig. 288: aroTHERM – mono-energy mode

The electric back-up heater in the VWZ MEH 61 hydraulic station provides additional heat for the heating mode and domestic hot water generation when required.

The VRC 700 weather-compensated heating control is used to control and adjust the heat pump system.

The interface for heat pump diagnostics is integrated in the VWZ MEH 61 hydraulic station.

13.11 aroTHERM – hydraulic isolation through heat exchanger module

Use of the **aroTHERM** heat pump ensures economical exploitation of air as a heat source through simple and easy installation of the heat pump outdoors.

In this system configuration, mono-energy mode operation of the heat pump is possible. Hydraulic isolation of heat pump and heat source installation through a heat exchanger module.

Electric post-heating via electrical immersion heater.

The integrated active cooling function increases living comfort in the summer.

Key system components:

- Boiler: **aroTHERM** heat pump
- **geoSTOR VIH RW 300** or **uniSTOR VIH RW 200** domestic hot water cylinder
- **VWZ MWT 150** heat exchanger module
- **VWZ MEH 60** electrical immersion heater
- **VWZ AI** heat pump control interface module
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- Active cooling function (optional)

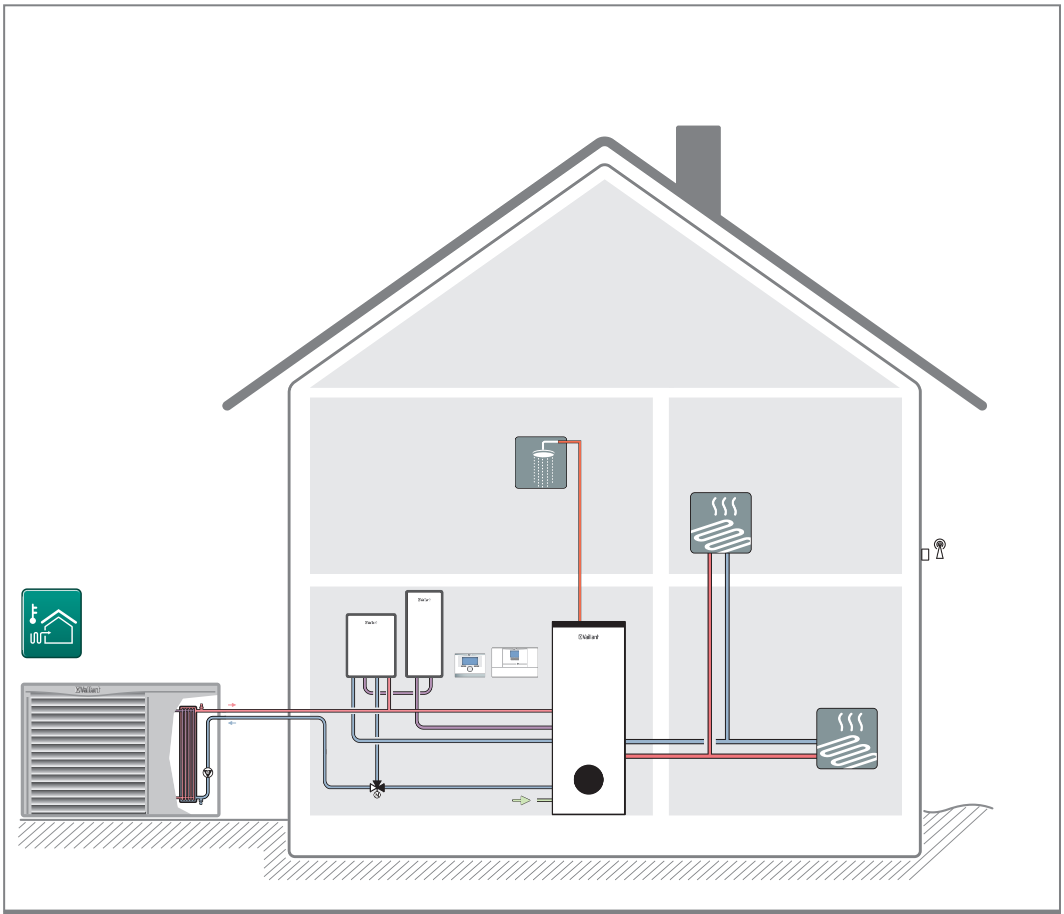


Fig. 289: aroTHERM with heat exchanger module

The VRC 700 weather-compensated heating control is used to control and adjust the heat pump system.

Diagnostics is carried out on the heat pump by means of the VWZ AI heat pump control interface module.

13.12 aroTHERM – bivalent mode

Use of the **aroTHERM** heat pump ensures economical exploitation of air as a heat source through simple and easy installation of the heat pump outdoors.

In this system configuration, bivalent mode operation of the heat pump is possible.

The use of this space-saving solution is recommended for retrofitting existing heating installations with an existing gas-fired wall-hung boiler.

Key system components:

- Boiler: **aroTHERM** heat pump
- **VWZ MPS 40** decoupler module
- **ecoTEC** gas-fired wall-hung boiler
- **VWZ AI** heat pump control interface module
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- App control for Android and iOS (optional with VR 920)
- Active cooling function (optional)

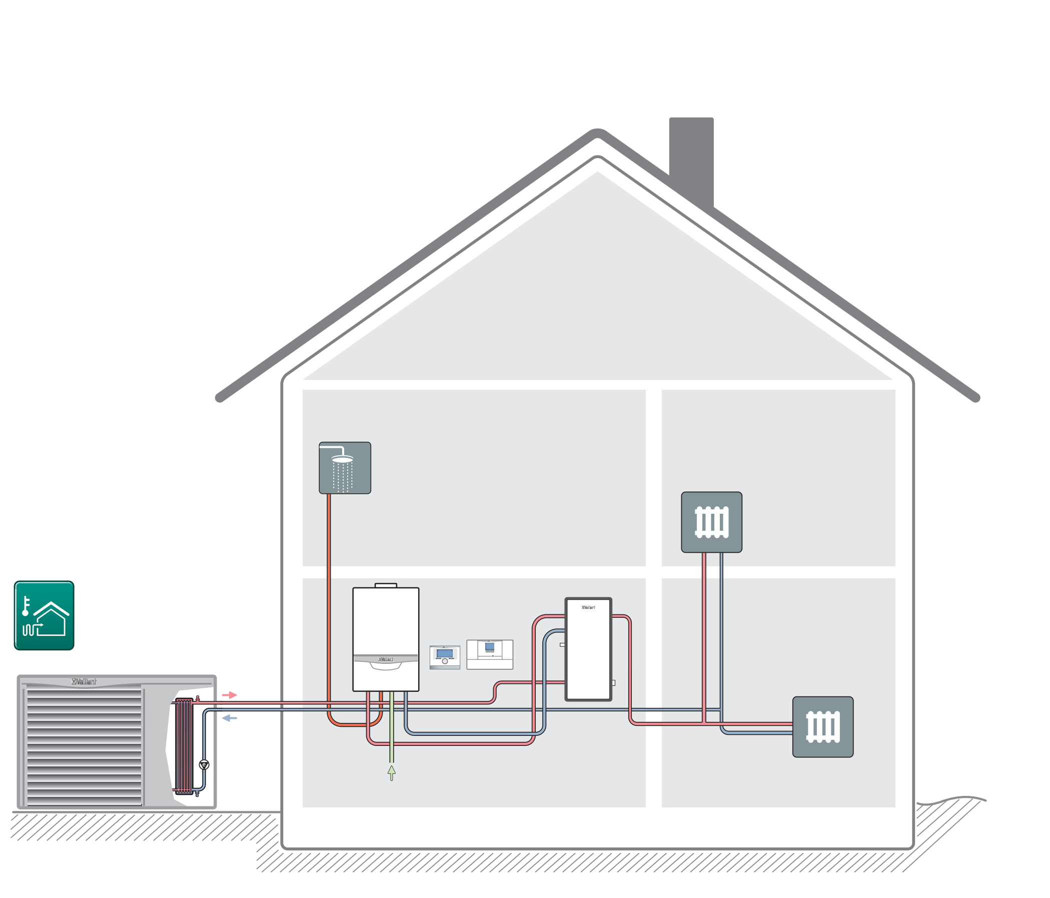


Fig. 290: aroTHERM heat pump in bivalent mode – basic system diagram

The VRC 700 weather-compensated heating control is used to control and adjust the heat pump system.

Diagnostics is carried out on the heat pump by means of the VWZ AI heat pump control interface module.

13.13 Heat pump installation in large systems

The **allSTOR** multi-functional cylinder stores the heat that is generated and passes it onto the heating water or the domestic hot water when required. The effective combination of condensing boilers and renewable energy sources can be used at the same time.

An **allSTOR** buffer cylinder system is the core component in an effective, energy-saving heating system and improves (lowers) the primary energy requirement and the system's expenditure factor. In this type of cylinder system, the heat that is generated is stored and passed on as heating water or domestic hot water when required.

Key system components:

- Boiler: **geoTHERM** heat pump
- **auroTHERM** solar thermal collectors
- **allSTOR exclusive** multi-functional cylinder
- **ecoTEC** gas-fired condensing boiler
- **auroFLOW exclusive** solar loading module
- **aguaFLOW exclusive** domestic hot water station
- **recoVAIR** domestic ventilation unit
- Hydraulic assemblies

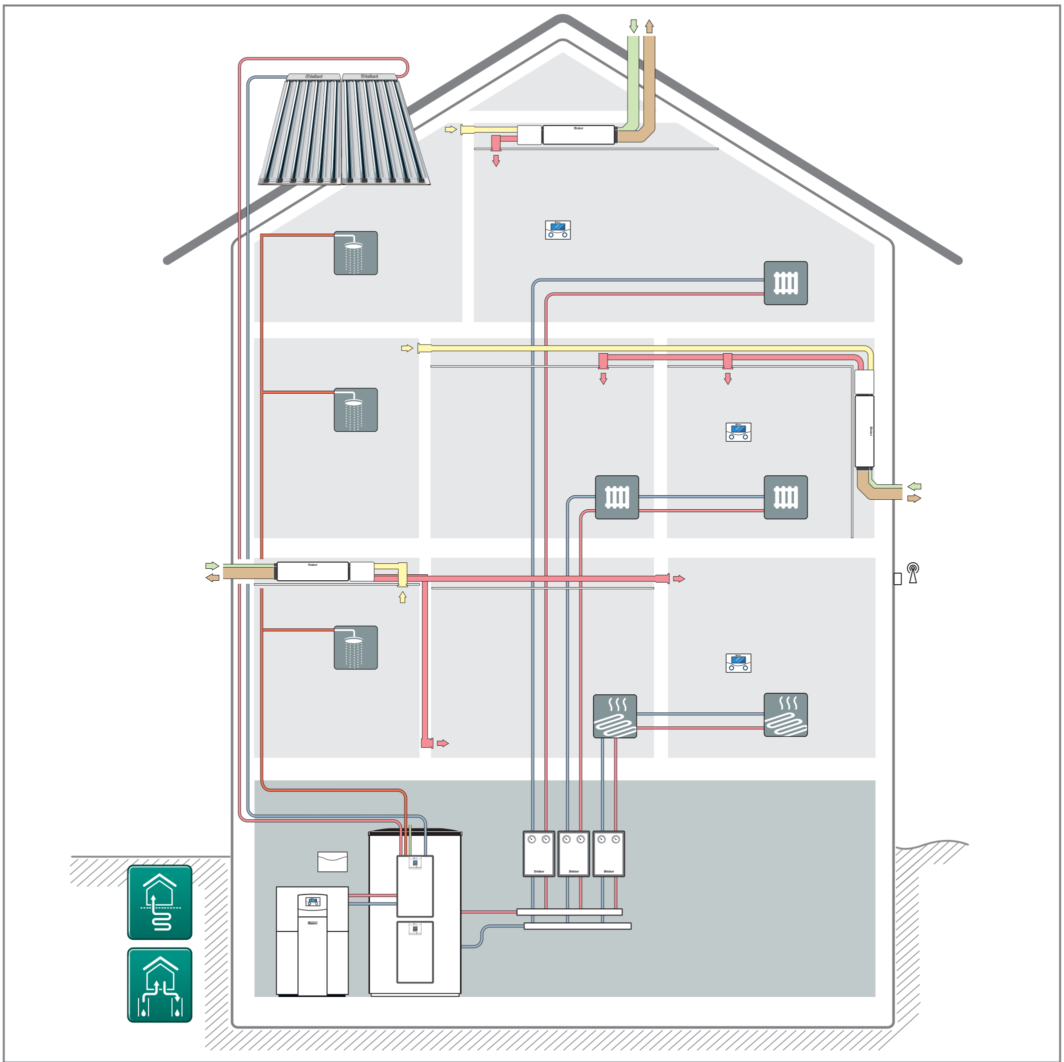


Fig. 291: geoTHERM heat pump with allSTOR multi-functional cylinder

The allSTOR multi-functional cylinder can be used with all types of heat generators, including solar thermal systems, heat pumps, gas-fired or oil-fired condensing boilers, pellet boilers, hearths and CHP systems.

A cascade comprising up to three cylinders provides a total cylinder volume of up to 6000 litres. The **auroFLOW exclusive** solar loading module can be combined as a two-cascade configuration and incorporate a solar collector surface of up to 120 m². The **aquaFLOW exclusive** domestic hot water station can be cascaded with up to four stations to provide enough domestic hot water for as many as 350 people.

The **recoVAIR** domestic ventilation units guarantee individual ventilation comfort for each accommodation unit. Thanks to the **recoVAIR** units being installed in the centre of the apartment, additional riser ducts are no longer required and additional fire-protection measures are not usually required.

13.14 geoTHERM VWS 36/4.1 heating heat pump in an apartment building with small residential units

This system with a **geoTHERM VWS 36/4.1** has been specially designed for apartment buildings with small residential units (approx. 60 m²) and a maximum number of people of two per unit. It is suitable for new builds and existing installations. A common heat source is used in the system in order to supply the residential units with heat and domestic hot water.

Key system components:

- **geoTHERM VWS 36/4.1** heating heat pump
- **uniSTOR VIH RW 120** domestic hot water cylinder
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation
- **VWZ AI** heat pump control interface module

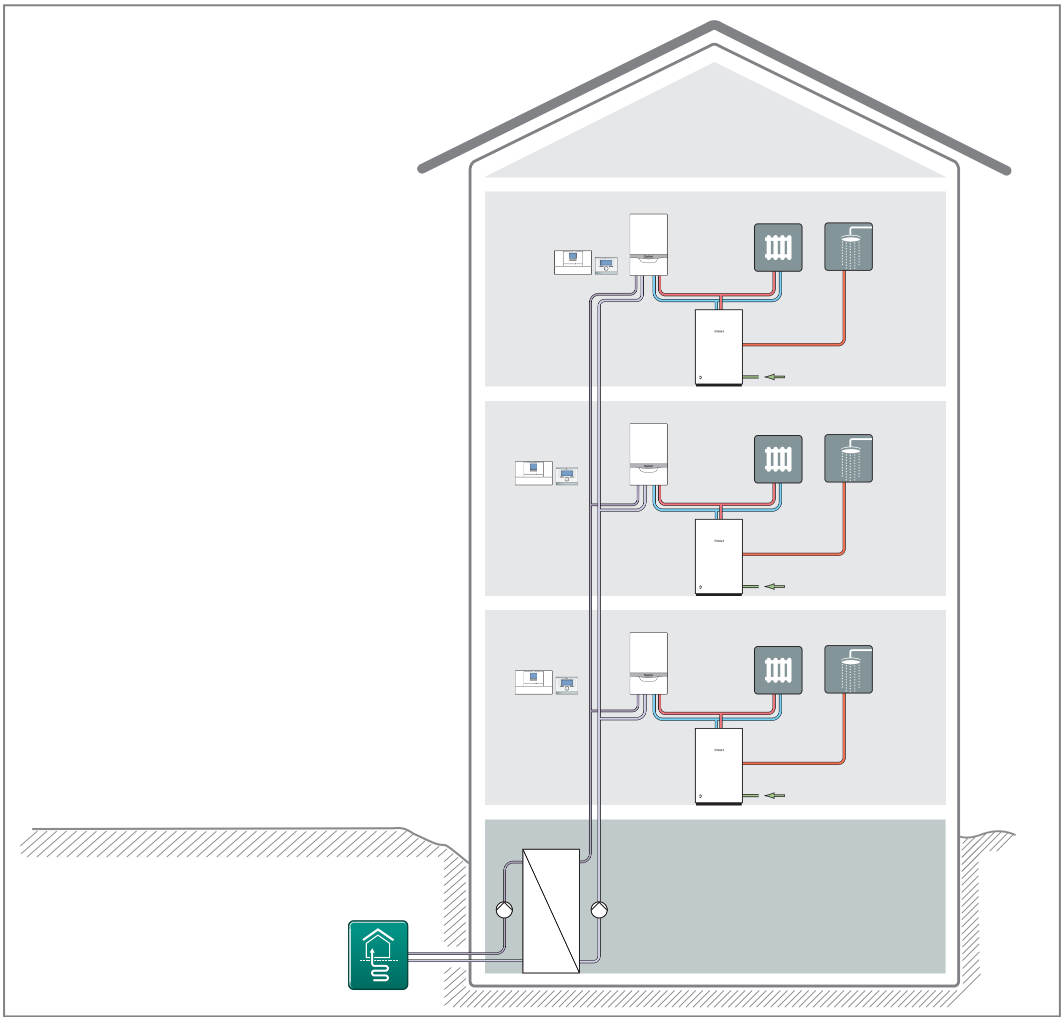


Fig. 292: geoTHERM VWS 36/4.1 heating heat pump in an apartment building with small residential units

The **VRC 700** weather-compensated heating control is used to control and adjust the heat pump system.

13.15 aroTHERM split heat pump combined with a hydraulic station

Use of the **aroTHERM split** heat pump ensures economical exploitation of air as a heat source through simple and easy installation of the heat pump outdoors. In this system configuration, mono-energy mode operation of the heat pump is possible.

Key system components:

- Boiler: **aroTHERM split** heat pump
- Electric post-heating via the **VWL .7/5 IS hydraulic station**
- **uniSTOR plus VIH RW 300/3 BR** domestic hot water cylinder
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation.
- Active cooling function (optional)

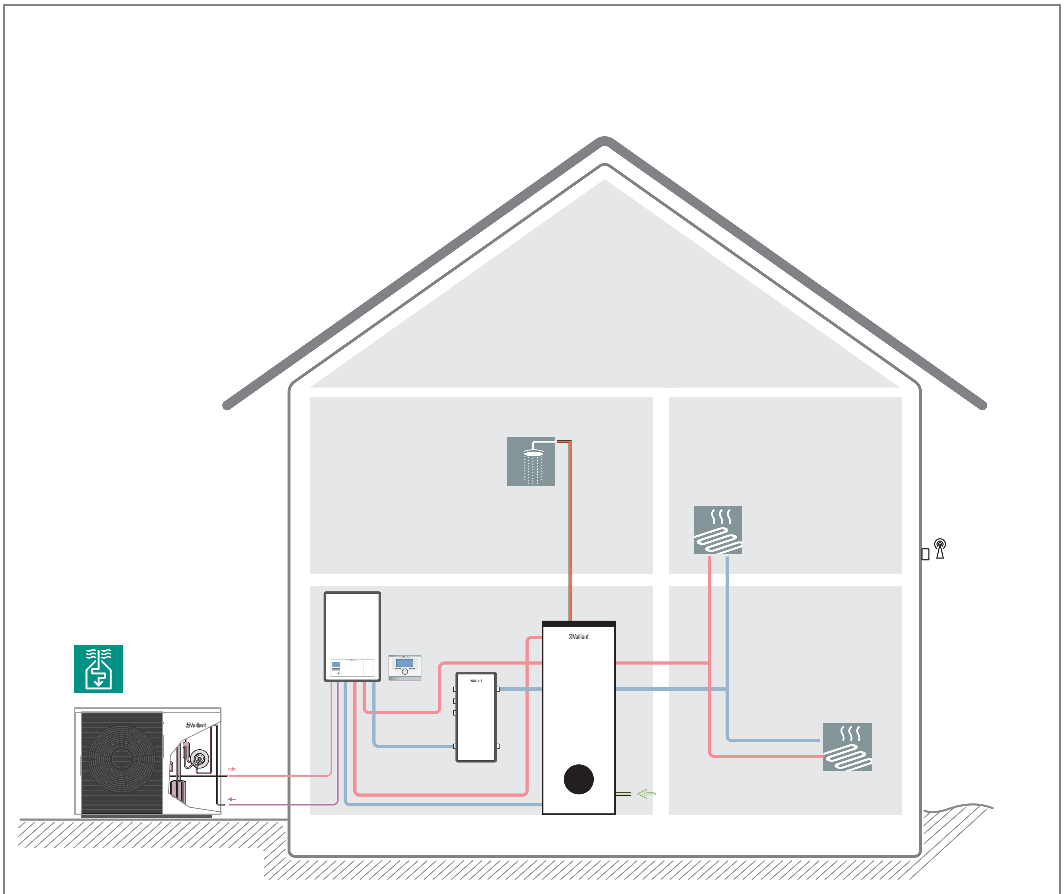


Fig. 293: aroTHERM split heat pump with hydraulic station

13.16 aroTHERM split heat pump combined with a uniTOWER split

Use of the **aroTHERM split** heat pump ensures economical exploitation of air as a heat source through simple and easy installation of the heat pump outdoors. In this system configuration, mono-energy mode operation of the heat pump is possible.

In the system configuration below, the heat pump is combined with a **uniTOWER VWL .8/5 IS**. The heat pump charges the cylinder, if necessary with the support of the electric back-up heater that is integrated in the uniTOWER. The **VRC 700** system control (wall-mounted) controls the heat pump system. The **recoVAIR** domestic ventilation unit can be combined with all heating systems for controlled ventilation with heat recovery.

Key system components:

- Boiler: **aroTHERM split** heat pump
- **uniTOWER VWL .8/5 IS** compact unit with domestic hot water cylinder and components for heat distribution
- **recoVAIR** domestic ventilation unit
- **eloPACK** battery storage system
- **uniSTOR plus VIH RW 300/3 BR** domestic hot water cylinder
- **VRC 700** weather-compensated control for heating, cooling, ventilation and domestic hot water generation.
- App control for Android and iOS
- **VR 920** Internet communication module (optional)
- Photovoltaic installation

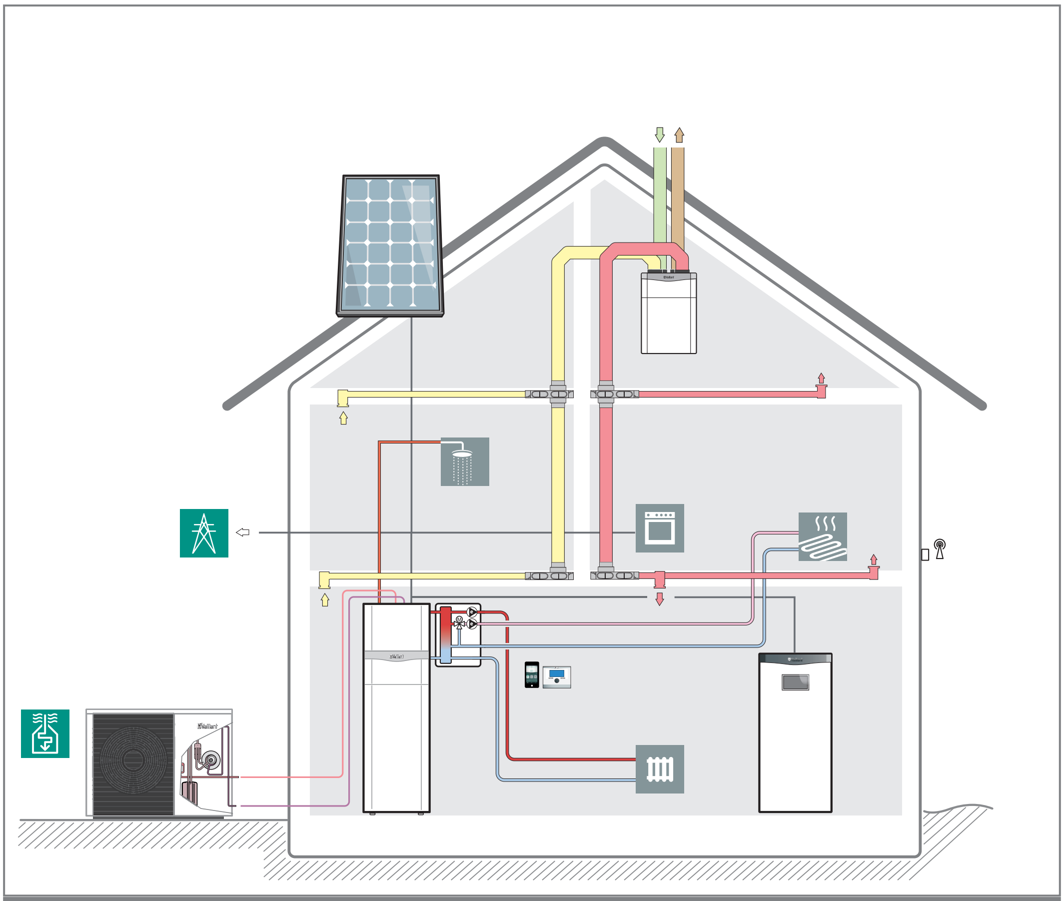


Fig. 294: aroTHERM split heat pump with uniTOWER split

14 System accessories

Vaillant offers an extensive range of accessories for every kind of installation.

This section describes the Vaillant accessories that may be required when using a Vaillant system with heat pumps.

The accessories are categorised by:

Accessories for the flexoTHERM heat pump system

Accessories for the aroTHERM heat pump system

Accessory for the geoTHERM heat pump system

Accessories for the aroTHERM split heat pump system

Accessories for heat distribution

Accessories for system separation

Accessories for the heat source

Accessories for domestic hot water generation

Accessories for unit installation

All accessories are clearly explained.

Accessories relevant to planning are described (if required) with their dimensions and technical data.

You can find further accessories in the current price list.

14.1 Accessories for the flexoTHERM/flexoCOMPACT heat pump system

aroCOLLECT VWL 11/4 SA air/brine collector

Order no. 0010016715

Fig. 295: aroCOLLECT air/brine collector

For connection to flexoCOMPACT exclusive or flexo-THERM exclusive.

The air/brine collector is used to exchange heat between the brine circuit and the outdoor air.

Note
The entire purging/filling process should last at least 30 minutes. During this time, the purging valves for the air/brine collectors must be opened and closed every five minutes.

We recommend the brine purging support set for the air/brine collector as this makes the purging process significantly easier if it is to be carried out by one person. Observe the aroCOLLECT installation instructions (0020196699).

Pre-(installation) base

Order no. 0020213871


Fig. 296: Base for aroCOLLECT

For simple pre-installation of the aroCOLLECT VWL 11/4 SA air/brine collector.

The base is only required if the outdoor unit is ordered separately.

Note
A maximum of two bases must be installed on top of each other.

Installation set with Tichelmann

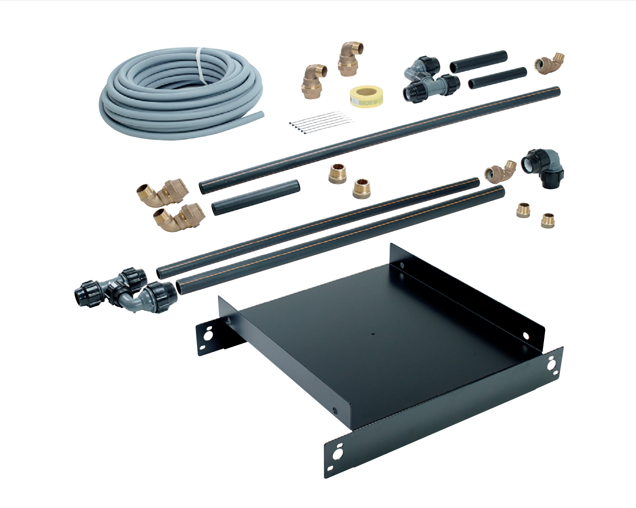


Fig. 297: Installation set with Tichelmann

System for the simple installation of two aroCOLLECTs.

Can be used for VWF 157/4, VWF 197/4.

Note
50 x 4.6 mm pipes must be used in the Tichelmann system.

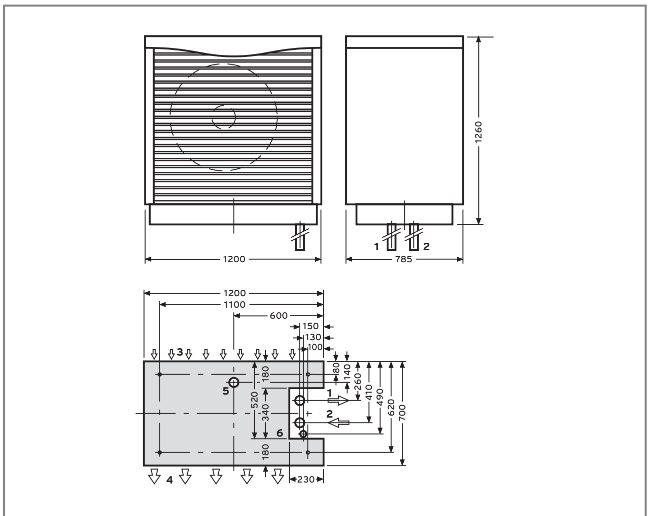


Fig. 298: aroCOLLECT dimension drawing

1 70 mm diameter empty pipe for hot brine from the heat source to the heat pump (hot brine)
2 70 mm diameter empty pipe for cold brine from the heat source to the heat pump (cold brine)
3 Air inlet side
4 Air outlet side
5 Empty pipe for condensate discharge, 120 mm diameter
6 Empty pipe for cable channel, 50 mm diameter

fluoCOLLECT VWW 11/4 SI and VWW 19/4 SI groundwater module

Order no. 0010016719, 0010016720

Fig. 299: fluoCOLLECT groundwater module

For connection to flexoCOMPACT exclusive or flexoTHERM exclusive.

The groundwater module is used to transfer heat between the brine circuit and the groundwater.

VWW 11/4 SI for 5-11 kW heat pumps.

VWW 19/4 SI 15-19 kW heat pumps.

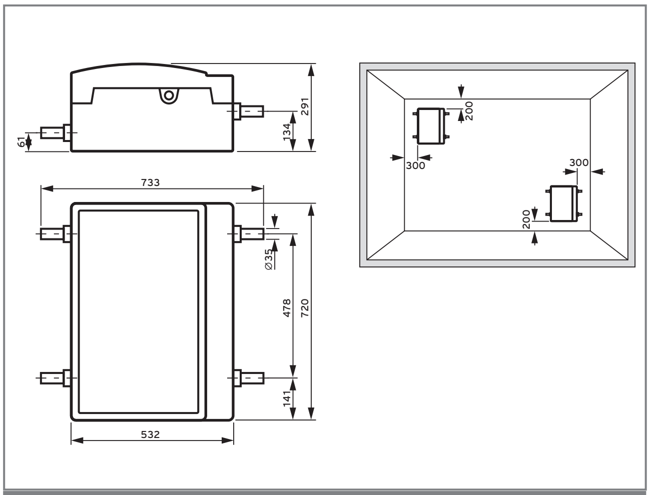


Fig. 300: fluoCOLLECT dimension drawing

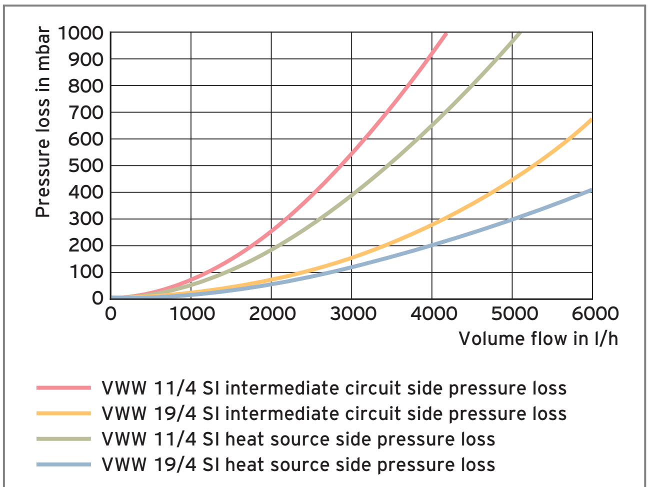


Fig. 301: VWW 11/4 SI and 19/4 SI pressure loss diagram

VWZ NC 11 /4 and 19/4 passive cooling module

Order no. 0010016721, 0010016722

For connection to flexoCOMPACT exclusive or flexo-THERM exclusive.

Accessories for passive cooling with sensor (borehole) or collector.

VWZ NC 11/4 for 5-11 kW heat pumps.

VWZ NC 19/4 15-19 kW heat pumps.

Fig. 302: VWZ NC passive cooling module

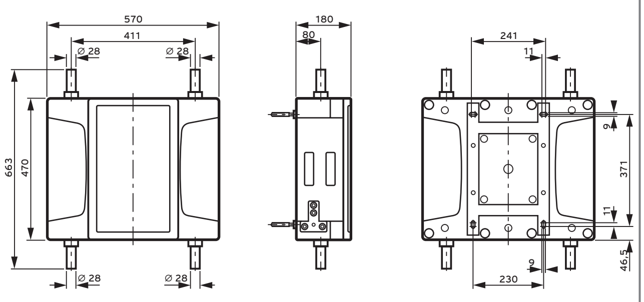


Fig. 303: VWZ NC dimension drawing

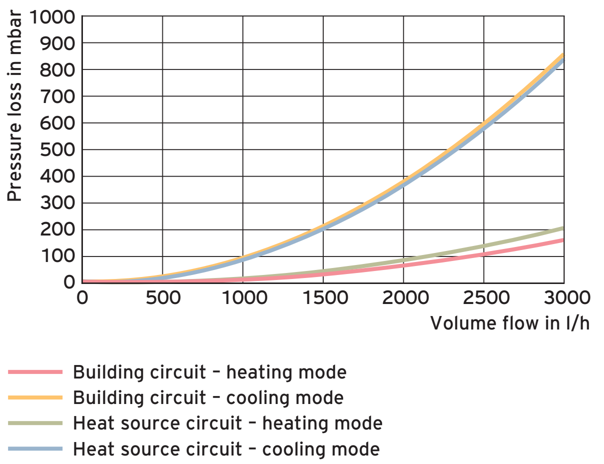


Fig. 304: VWZ NC 11/4 pressure loss diagram

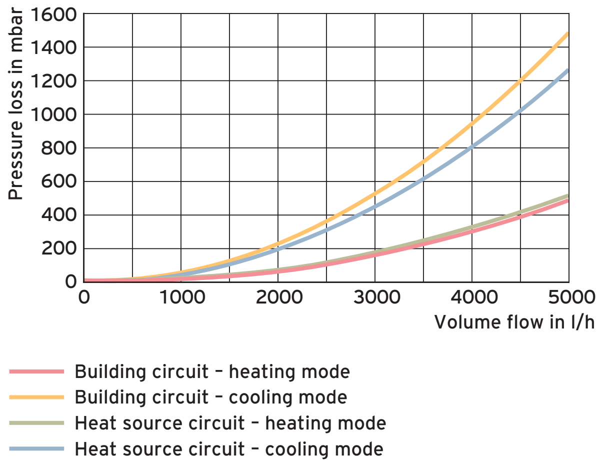


Fig. 305: VWZ NC 19/4 pressure loss diagram

flexoCOMPACT pre-installation jig

Order no. 0020205412

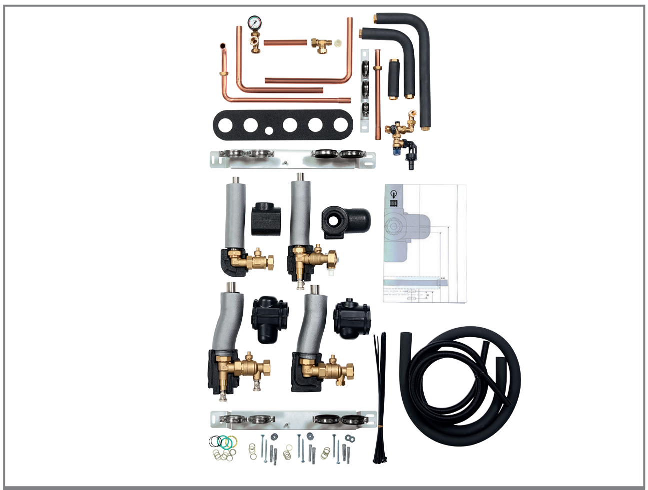


Fig. 306: flexoCOMPACT pre-installation jig

Pre-installation jig with flexible connection pipes for piping upwards and downwards with plain stainless steel pipes to facilitate routing (pressing) and ensure short set-up times, easy installation, and a high level of flexibility.

Compact combination option close to the wall guaranteed with the VWZ NC 11/4 and NC 19/4 natural cooling module.

flexoTHERM pre-installation jig

Order no. 0020205413

Fig. 307: flexoTHERM pre-installation jig

Pre-installation jig with flexible connection pipes for piping upwards and downwards with plain stainless steel pipes to facilitate routing (pressing) and ensure short set-up times, easy installation, and a high level of flexibility.

Compact combination option close to the wall guaranteed with the VWZ NC 11/4 and NC 19/4 natural cooling module.

Circulation set with pump for the flexoCOMPACT pre-installation jig

Order no. 0020229714

Fig. 308: Circulation set with pump for the flexoCOMPACT

High-efficiency circulation pump with non-return valve, connection pipe and connection fittings.

14.2 Accessories for the aroTHERM and 3 kW heat pump systems

Product description for the uniTOWER VIH QW 190/1 E

Fig. 309: uniTOWER VIH QW 190/1 E

Product types and article numbers

Unit designation	Art. no.
VIH QW 190/1 E	0010019709
VIH QW 190/1 E	0010019373

Special features

- Extremely short installation times thanks to the compact design
- Can be extended using accessories that can be integrated
- Also available with integrated intermediate heat exchanger
- SplitMountingConcept for easier positioning in two parts

Equipment

- Integrated 190 litre domestic hot water coiled tube cylinder
- High-efficiency pump for the version with an intermediate heat exchanger (22 plates)
- 6 kW electric back-up heater with safety cut-out and electrical connection box
- Purging and draining the back-up heater
- 15 litre diaphragm expansion vessel for heating
- 3-port diverter valve for heating/domestic hot water
- 3 bar expansion relief valve with drain pipework and brine collecting vessel (for the version with intermediate heat exchanger)
- Filling connection
- Brine circuit with manometer

Potential applications

The **uniTOWER** is used only in combination with an **aroTHERM** or **geoTHERM VWS 36/4.1** heat pump and acts as a link between the heat pump and the heating and domestic hot water installation.

Technical data – General

	VIH QW 190/1
System type	System with heat pump circuit/complete heating and hot water module disconnected
System type	System without decoupling module
Product dimensions, width	599 mm
Product dimensions, depth	693 mm
Product dimensions, height	1,880 mm
Net weight	170 kg
Weight when filled with water	360 kg

Technical data – Heating

		VIH QW 190/1
Filling type		Cartridge immersion heater
Heating output range		2 ... 6 kW Δ: 2 kW
Maximum water pressure in heating mode (PMS)		0.3 MPa
Maximum water pressure in domestic hot water mode (PMW)	Germany	1 MPa
Maximum heating flow temperature		77 °C
Maximum volume of the system heating circuit		220 l
Maximum volume of the heat pump circuit		30 l
Maximum volume of the heat pump circuit		30 l NoteWith a 2 l expansion vesse

Technical data – Electrics

	VIH QW 190/1
Electric connection	400 V / 50 Hz
Integrated fuse (SMU – eBox)	T4A, 250V
Energy consumption in standby operation	1.2 W
Level of protection	IPX4
Max amperage of the power supply circuit	9 A

Dimension drawing and connection dimensions

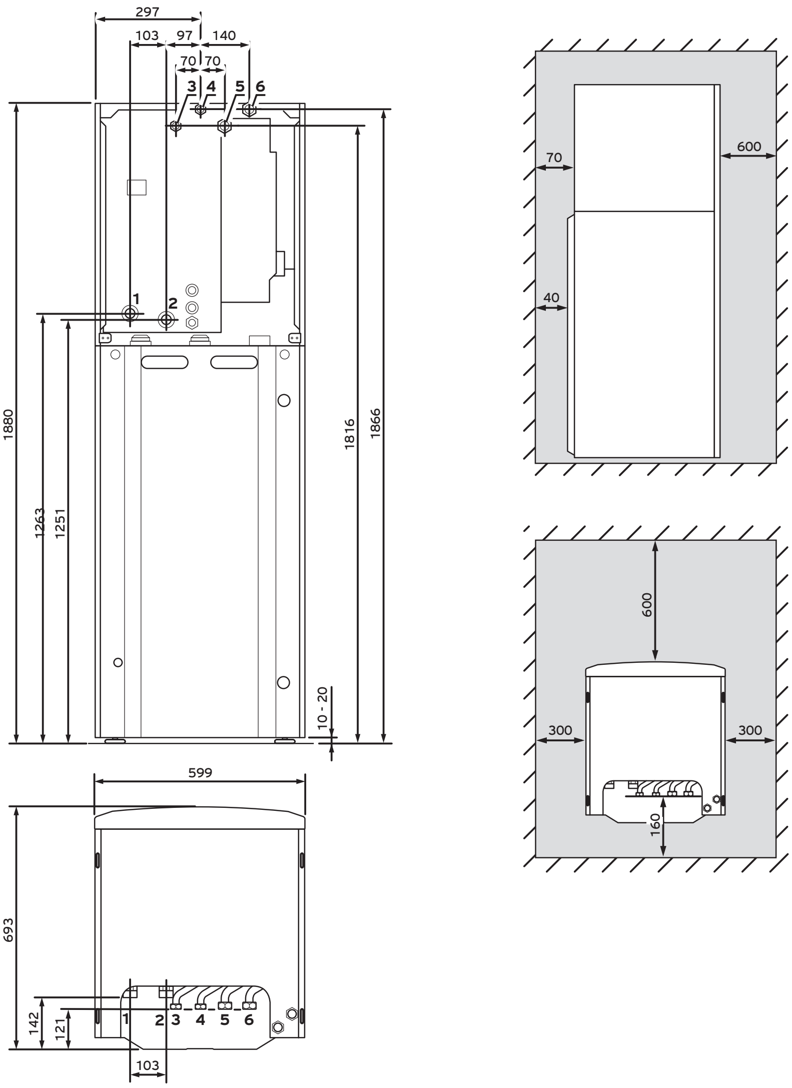


Fig. 310: uniTOWER VIH QW 190/1 E dimension drawing and connection dimensions

1 Flow from heat pump G 1 1/4
2 Return to the heat pump G 1 1/4
3 Cold water connection G 3/4
4 Hot water connection G 3/4
5 G 1 heating flow
6 G 1 heating return

Product dimensions for the transport

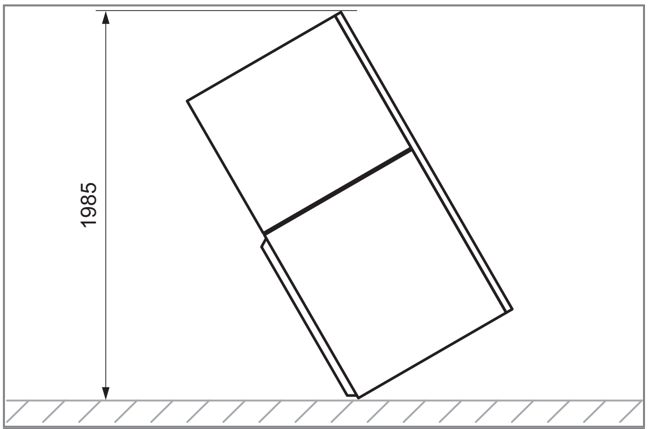


Fig. 311: Dimensions for transport

Pressure losses

Total pressure losses

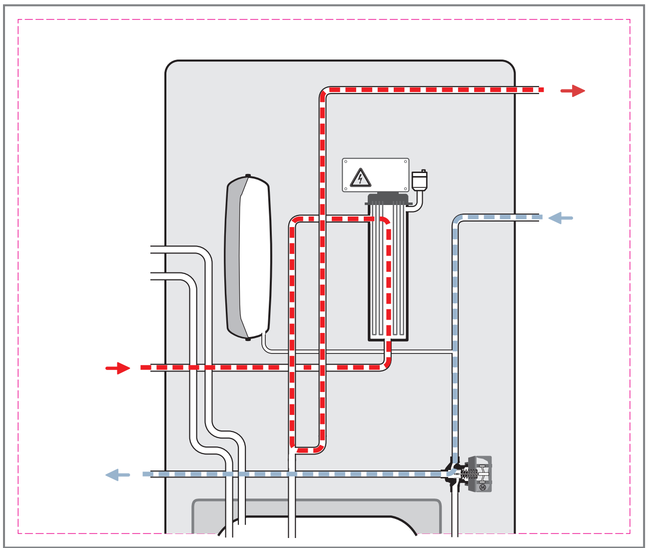


Fig. 312: Total pressure loss basic diagram

Pressure losses in the heat pump circuit

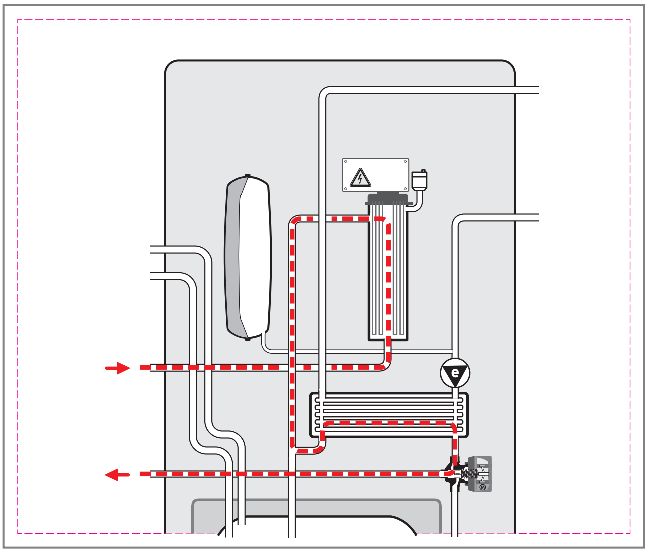


Fig. 314: Basic diagram of the pressure losses in the heat pump circuit

Total pressure loss in the product

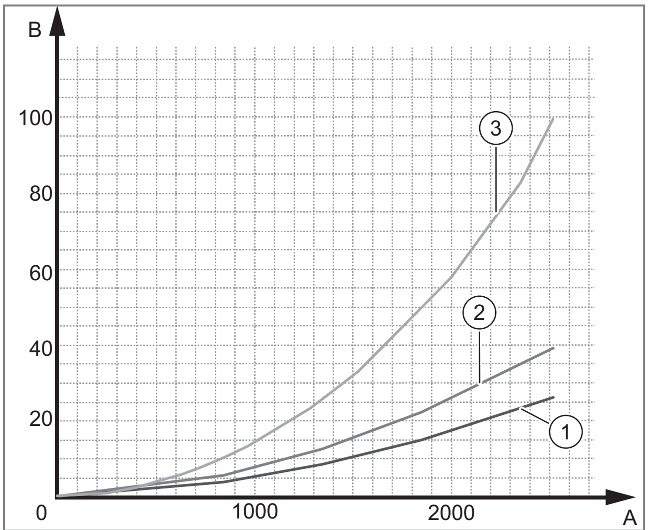


Fig. 313: Pressure loss

1 Product only
2 Product with installation set
3 Product with flexible installation set
A Flow rate in the circuit (l/h)
B Pressure (kPa)

Pressure losses in the unit in the heat pump circuit

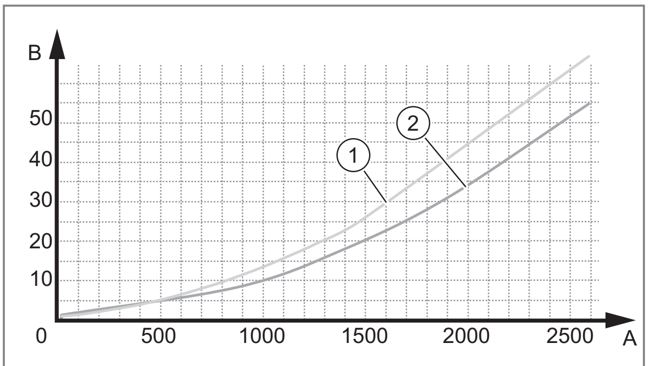


Fig. 315: Pressure losses in the unit in the heat pump circuit

1 Brine 50% (35 °C)
2 Pure water (20 °C)
A Throughput in circuit (l/h)
B Pressure (kPa)

Remaining feed head of the unit for the heating circuit

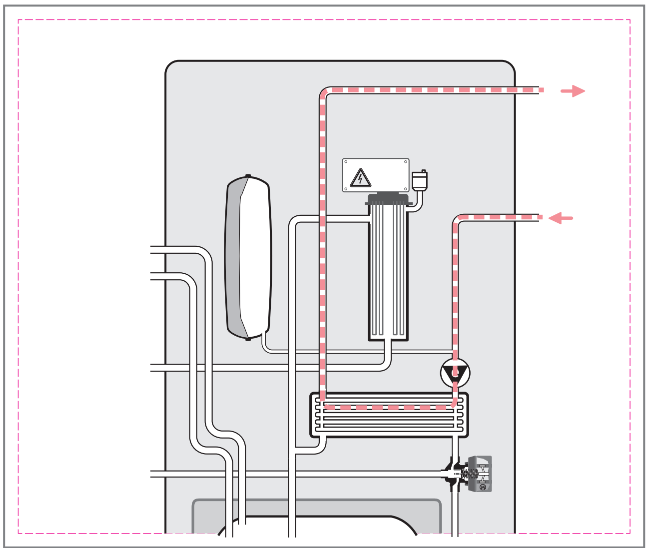


Fig. 316: Remaining feed head basic diagram

Remaining feed head

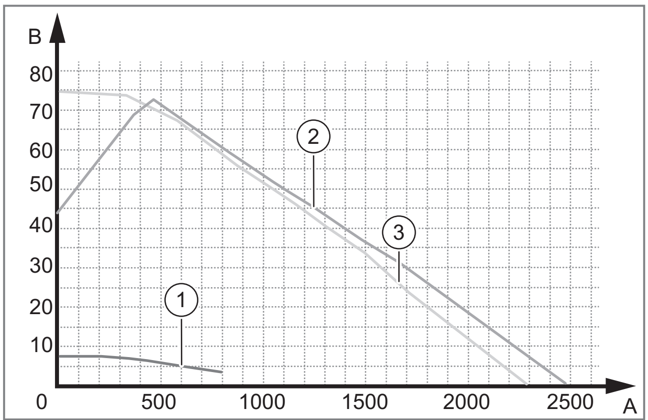


Fig. 317: Remaining feed head

1 PVmin/PCmin product only
2 PVmax/product only
3 PCmax/product only
A Flow rate in the circuit (l/h)
B Available pressure (kPa)

Remaining feed head, constant pressure mode

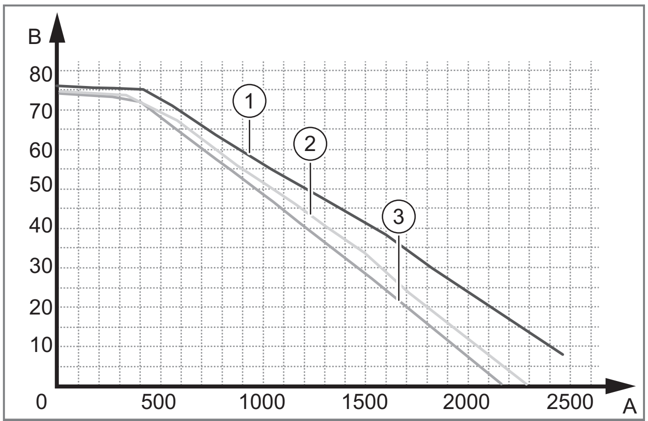


Fig. 318: Remaining feed head, constant pressure mode

1 PCmax/product only
2 PCmax/with installation set
3 PCmax/with flexible installation set
A Flow rate in the circuit (l/h)
B Available pressure (kPa)

Remaining feed head, variable pressure mode

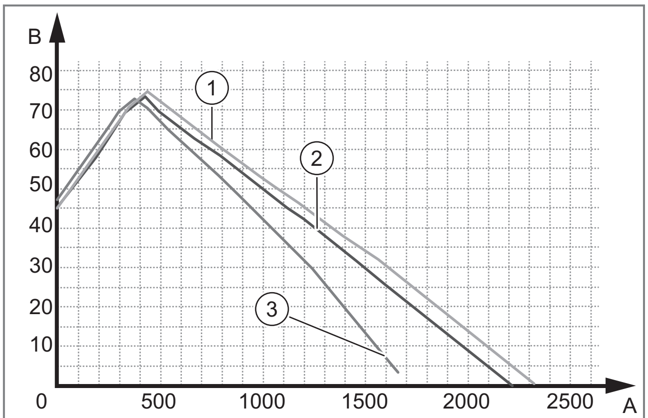


Fig. 319: Remaining feed head, variable pressure mode

1 PVmax/product only
2 PVmax/with installation set
3 PVmax/with flexible installation set
A Flow rate in the circuit (l/h)
B Available pressure (kPa)

VWZ MEH 61 hydraulic station – Product description

Order no. 0020143590

Fig. 320: VWZ MEH 61 hydraulic station

Technical data

	VWZ MEH 61
Operating voltage U_{max}	400 V
Heating	Up to 70 °C
Cooling	Up to 7 °C
Level of protection	IP 20
Protection class	II
Internal temperature	Max. 70 °C
Maximum ambient temperature	40 °C
Height	720 mm
Width	440 mm
Depth	350 mm

Potential applications

The VWZ MEH 61 hydraulic station is an electric reheater module with integrated heat pump control interface module and diverter valve for the **geoTHERM VWS 36/4.1** or **aroTHERM** heating system. Depending on the system design and configuration, it can supplement the heat supply from the heat pump.

The heat output of the electrical heating rod can be set as required to either 2, 4 or 6 kW. The module can be connected to a 230 V or 400 V power supply.

Equipment

The hydraulic station consists of:

- eBUS interface
- Appliance interface with display and control buttons
- Electrical immersion heater with safety cut-out
- 10 l expansion vessel for heating
- 3-port diverter valve
- Water pressure sensor
- Expansion relief valve for heating
- VF1 temperature sensor
- Connection cable

Dimension drawing

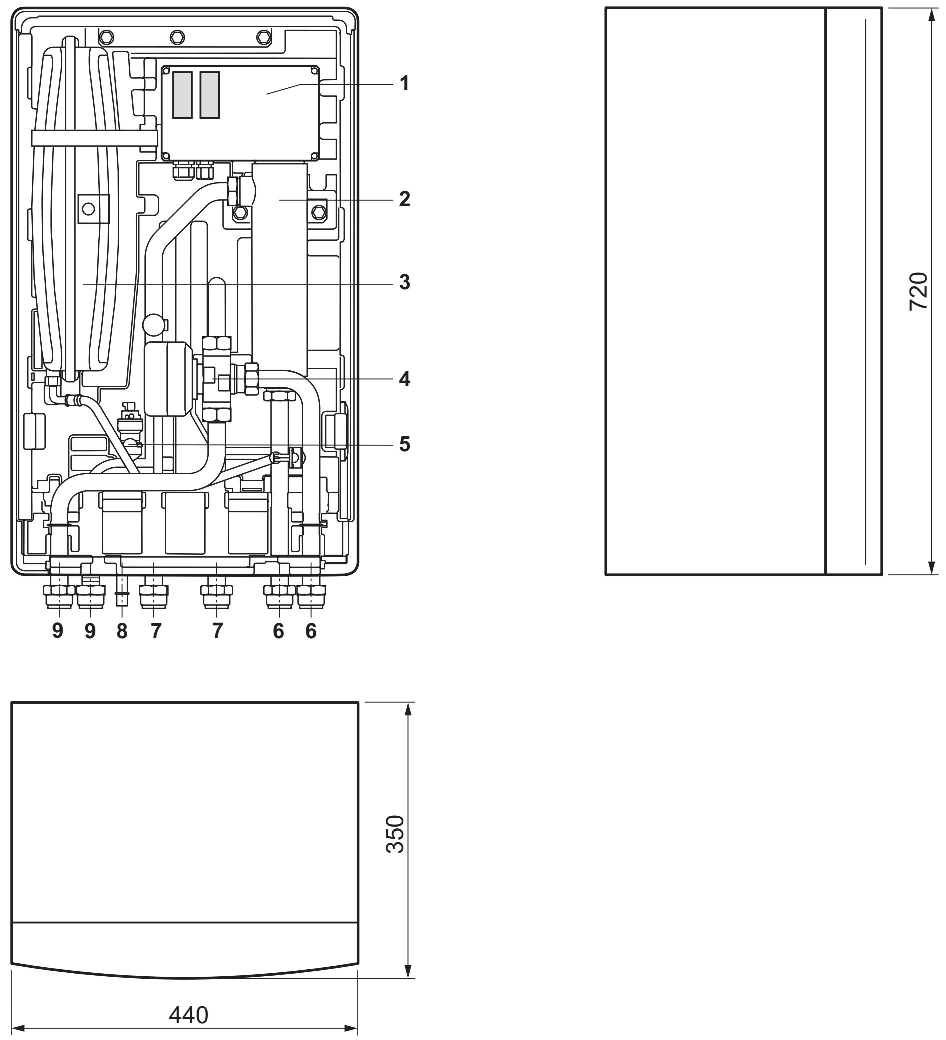


Fig. 321: VWZ MEH 61 – Design and dimensions

1 Terminal box
2 Electrical heating rod
3 Expansion vessel (10 l)
4 Diverter valve
5 Expansion relief valve
6 Flow/return to heat pump (R 1")
7 DHW cylinder flow/return (R 1")
8 Drain for expansion relief valve
9 Heating circuit flow/return (R 1")

Pressure loss diagram

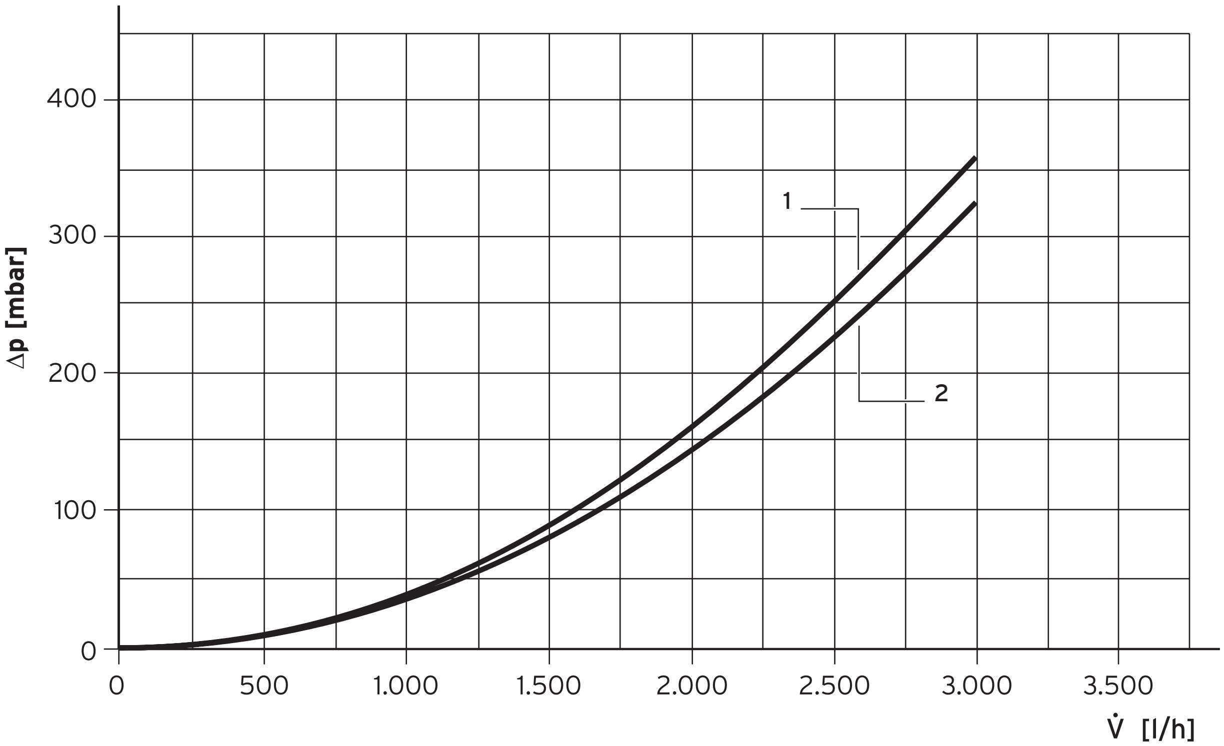


Fig. 322: VWZ MEH 61 pressure loss graph for heating and hot water handling

1 Heating mode
2 DHW mode

VWZ MEH 60 electrical immersion heater – Product description

Order no. 0020145030

Fig. 323: 6 kW electrical immersion heater

Dimension drawing

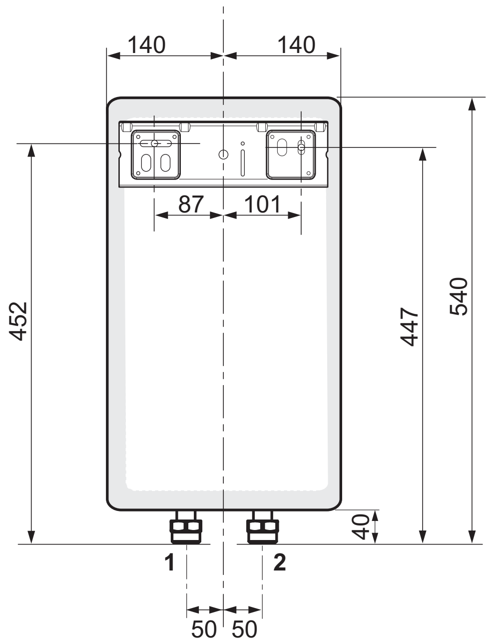


Fig. 324: VWZ MEH 60 – Connections and dimensions

1 Connection to heating circuit (R 1")
2 Connection to heat pump (R 1")

Equipment

The electric reheater module consists of:

- Safety cut-out for the back-up heater
- Electrical connection box
- Purging valve
- Drain valve

Potential applications

The electrical immersion heater in the reheater module supplements the heat pump when operating in mono-energy mode. The module can be connected to a 230 V or 400 V supply. Depending on the electrical wiring mode, the heat output can be set to 2, 4 or 6 kW as required. The electric module is connected to the heat pump control interface module via a control cable.

Technical data

	VWZ MEH 60		
Operating voltage U_{max}	230 V/ 50 Hz	230 V/ 50 Hz	400 V/ 50 Hz
Maximum power consumption (P_{max})	6.0 kW	4.0 kW	6.0 kW
Built-in fuse rating (I_{max})	30 A	20 A	10 A
IP rating	IP X4		
Maximum operating pressure	3.0 bar		
Minimum operating pressure	0.5 bar		
Weight	4 kg		
Height	500 mm		
Width	280 mm		
Depth	250 mm		

Pressure loss diagram

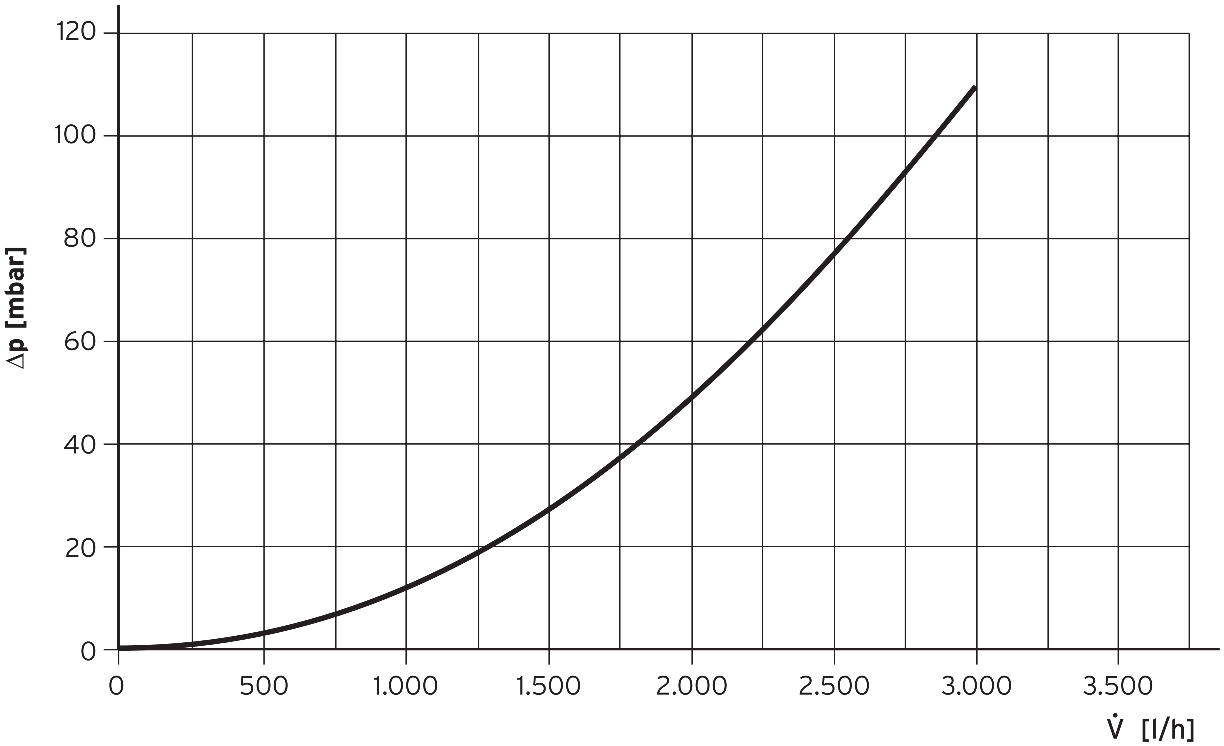


Fig. 325: Pressure loss curve for VWZ MEH 60

VWZ MPS 40 decoupler module – product description

Order no. 0020145020

Fig. 326: VWZ MPS 40 decoupler module

Equipment

The decoupler module is provided with several connection options for the heat generator circuit flow and return. On the secondary side, there are flow and return connectors for the heating circuits. In the upper and lower areas of the decoupler module, guide plates ensure optimum heat transfer within the module. This prevents intermixing of the different volume flows and/or temperature zones. A temperature sensor can be fitted in the decoupler module.

The cylinder volume is 35 litres.

Potential applications

The decoupler module can be used to hydraulically separate the heat pump and heating installation. This ensures that a minimum circulation rate is always maintained even with sealed underfloor circuits.

In a heating system that operates in bivalent mode, the auxiliary boiler can be hydraulically connected to the decoupler module. It can also be used as a return flow sequence cylinder. As such, it serves to increase the water volume in the heating installation and thus extend the running time of the heat pump.

Technical data

Technical data

	Decoupler module
Nominal cylinder capacity	35 l
Weight	18 kg
Maximum operating pressure	3.0 bar
Minimum operating pressure	0.5 bar
Height	720 mm
Width	360 mm
Depth	350 mm

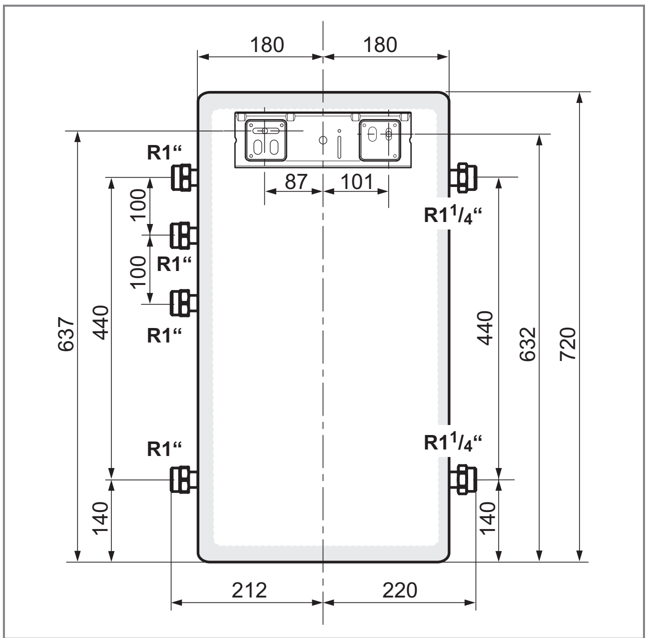


Fig. 327: Dimension drawing

Connection options

The decoupler module can also be used to hydraulically decouple the heat pump and the heat source installation, or to hydraulically incorporate back-up boilers into the heat pump installation.

Hydraulic disconnection

The following illustration shows the possible connections to the decoupler module if the heat source installation is to be hydraulically decoupled in order to guarantee the minimum circulation water volume. Take account of the different pressure losses, depending on the installation site requirements.

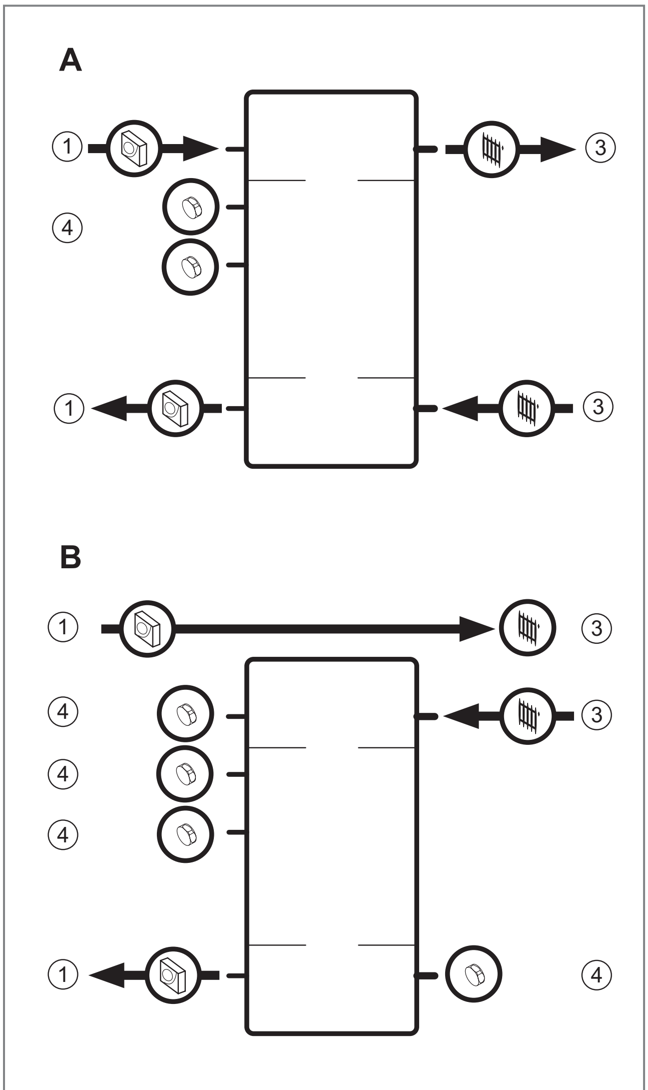


Fig. 328: Hydraulic connection for hydraulic disconnection

1 Heat pump flow/return
3 Heat recovery plant flow/return
4 Plug (connection not used)

Integration of a back-up heater

A back-up heater can be incorporated into the heat pump installation according to the following illustration.

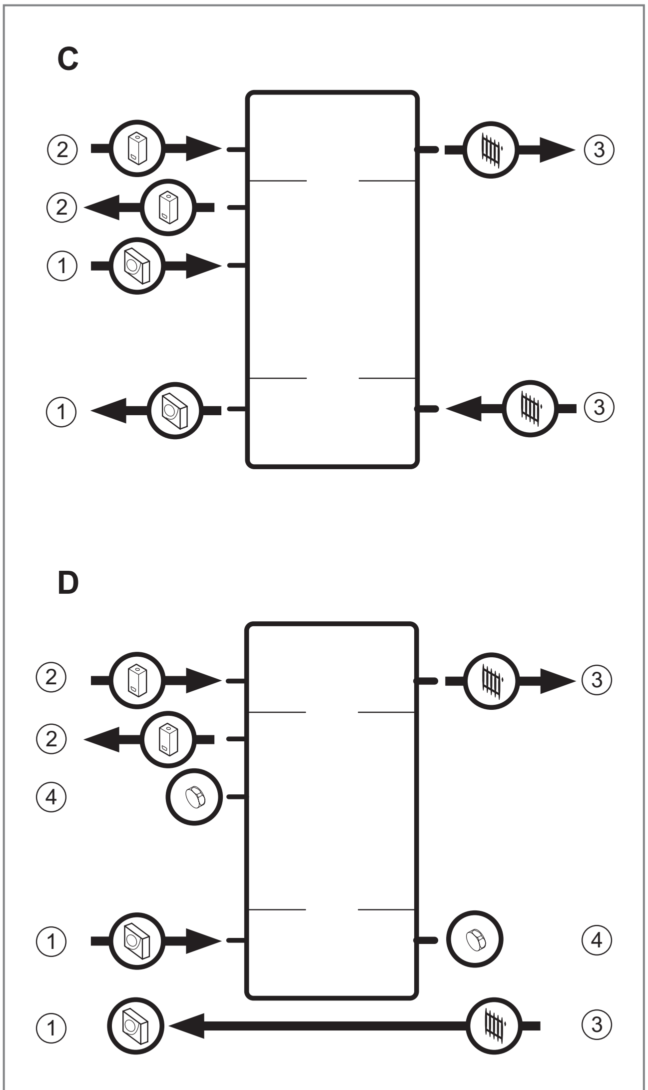


Fig. 329: Hydraulic connection for integrating an auxiliary boiler

1 Heat pump flow/return
2 Auxiliary boiler flow/return
3 Heat recovery plant flow/return
4 Plug (connection not used)

Pressure losses for different installation site requirements

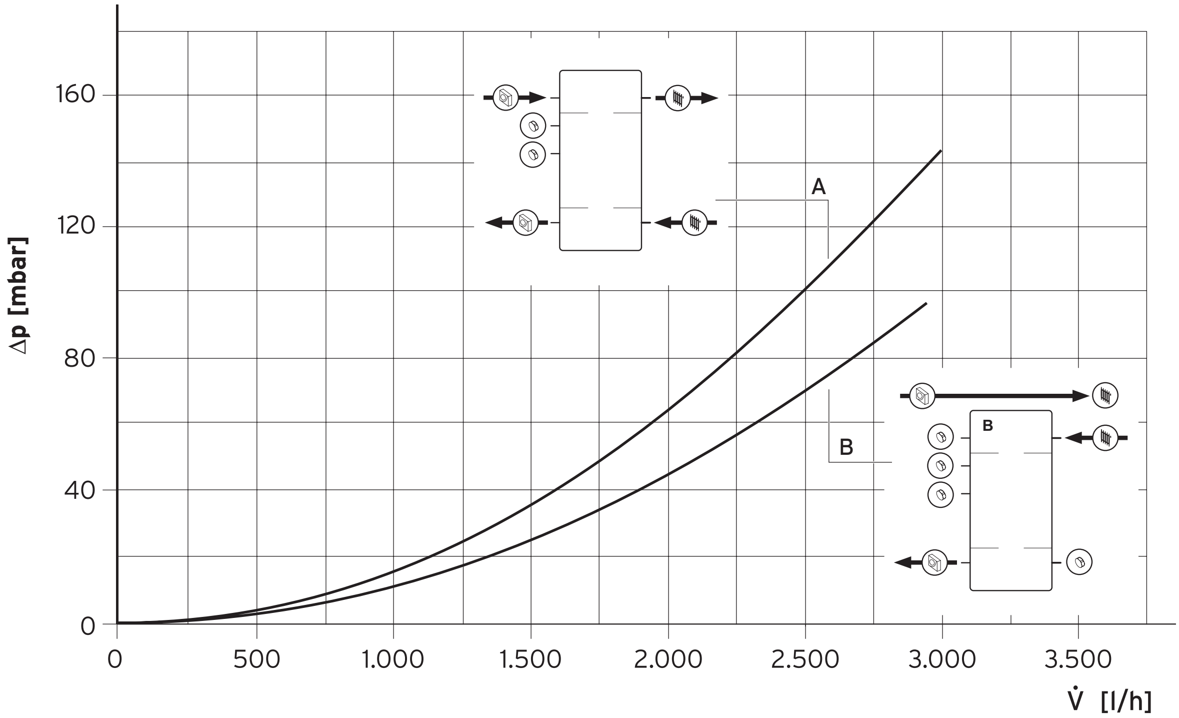


Fig. 330: Pressure losses for different installation site requirements

VWZ MWT 150 heat exchanger module – Product description

Order no. 0020143800

Fig. 331: VWZ MWT 150 heat exchanger module

Equipment

The heat exchanger module consists of:

- High-efficiency pump
- Plate heat exchanger
- Filling device for the brine circuit
- Expansion relief valve for heating

Potential applications

The **VWZ MWT 150** heat exchanger module is an additional module for the **aroTHERM** heating system. Thanks to its built-in heat exchanger, it can be used as a hydraulic system separation between the heat pump and heating installation. This means that the heat pump can be protected against frost without having to fill the entire installation with antifreeze.

Note
Ready-mixed brine fluid (article number 0020147182) should be used as the antifreeze.

Technical data

	VWZ MWT 150
Operating voltage U_{max}	230 V
Maximum electrical power consumption (pump)	45 W
Maximum operating pressure	3.0 bar
Minimum operating pressure	0.5 bar
IP rating	IP 20
Protection class	II
Maximum environmental temperature	40 °C
Height	500 mm
Width	360 mm
Depth	250 mm

Dimension drawing

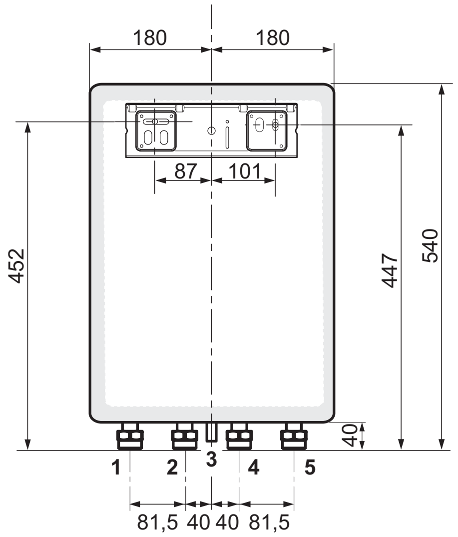


Fig. 332: VWZ WMT 150 - Connections and dimensions

1 Return from heating circuit (R 1")
2 Flow to heating circuit (R 1")
3 Drain for expansion relief valve
4 Return to heat pump (R 1")
5 Flow from heat pump (R 1")

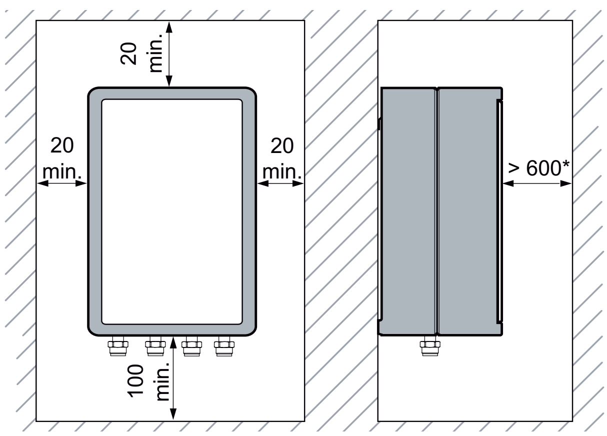


Fig. 333: Installation clearance

* Free space required for installing or maintaining the unit.

Available feed head for the heating circuit

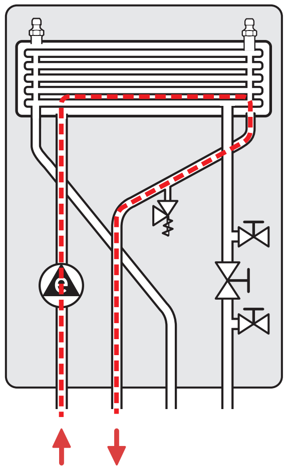


Abb. 334: Basic diagram of the available feed head for the heating circuit

Available feed head for the heating circuit

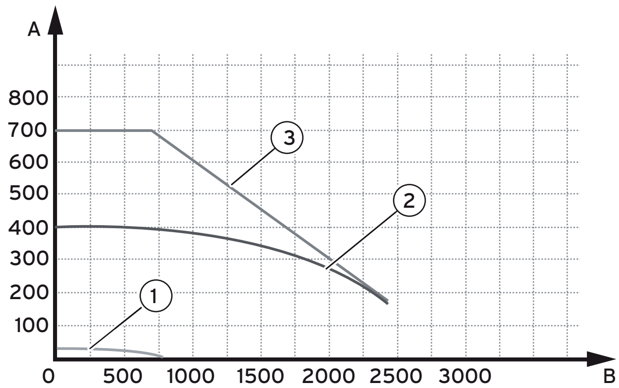


Fig. 335: Available feed head for the heating circuit

A Pressure (mbar)
B Flow rate (l/hr)
01 "I" position
02 "II" position
03 "III" position

Heating circuits connection

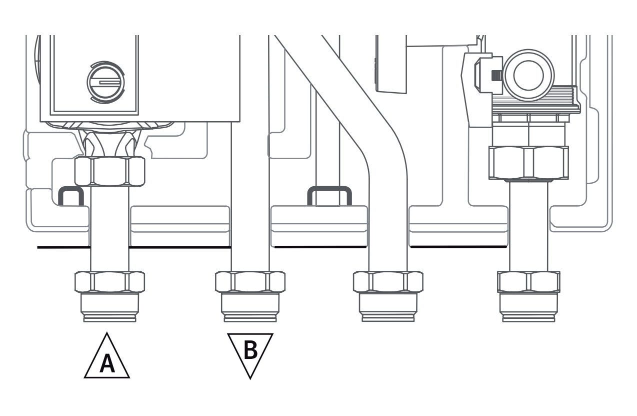


Fig. 336: Heating circuit flow/return connection

A Heating circuit return
B Heating circuit flow

Pressure loss

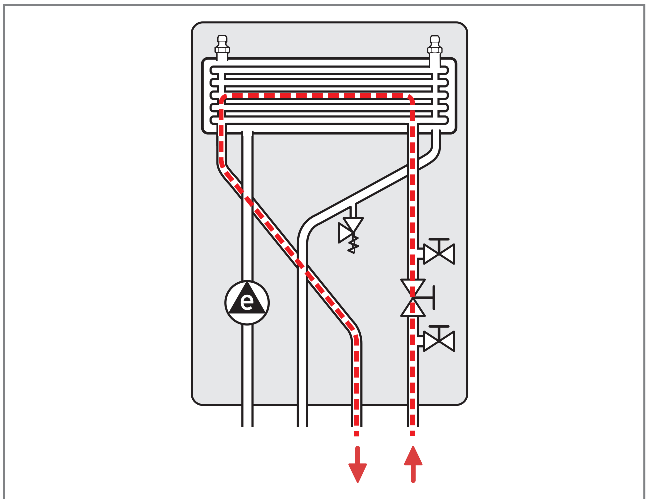


Fig. 337: Pressure loss basic diagram

Pressure loss in the heat pump's circuit

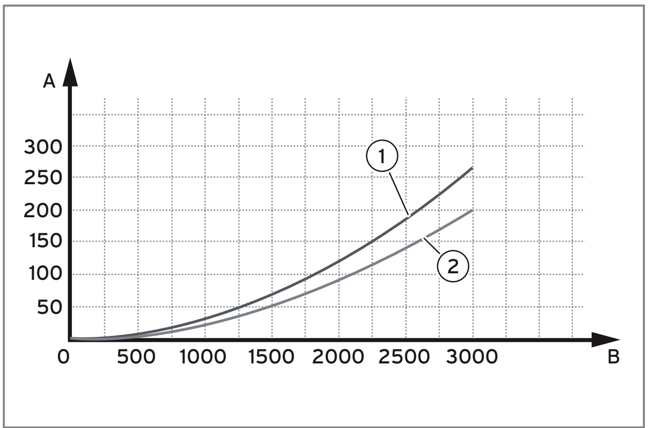


Fig. 338: Pressure loss in the heat pump's circuit

A Pressure (mbar)
B Flow rate (l/hr)
01 Flow rate in the circuit with 50% glycol
02 Flow rate in the water circuit

Heat pump connection

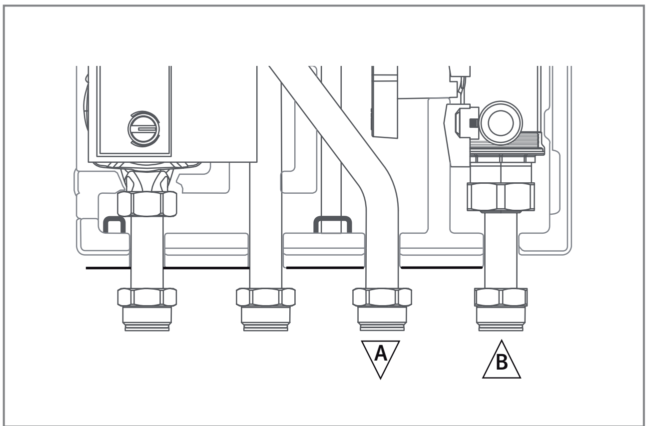


Fig. 339: Heat pump connection

A Glycol/water circuit flow to the heat pump
B Glycol/water circuit return from the heat pump

Wall bracket

Order no. 0020173401

Fig. 340: Wall bracket

For hanging the heat pump on the wall.

Ensure that the wall structure is stable enough.

Can be used for the **aroTHERM VWL**.

Cannot be used with aroTHERM VWL 155/2.

Elevated base

Order no. 0020173403

Fig. 341: Elevated base

For an installation that is raised by 40 cm.

Can be used for the **aroTHERM VWL**.

Cannot be used with aroTHERM VWL 155/2.

VWZ AI

Order no. 0020117049

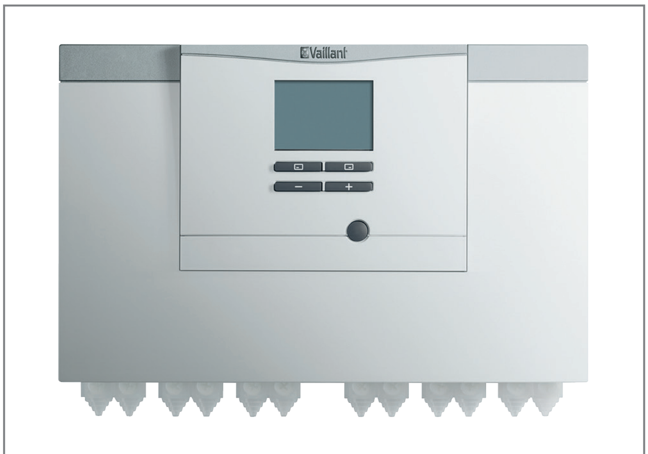


Fig. 342: VWZ AI

DIA system heat pump control interface module with illuminated plain text display, consisting of:

- 2x VR 10 sensors
- 1x set of installation accessories (bolts, rawl plugs)
- 1x installation instructions

Can be used for **aroTHERM VWL** and **geoTHERM VWS 36/4.1**.

For expanding an existing heating system to create a hybrid system; not needed when using the VWZ MEH 61.

14.3 Accessories for the geoTHERM hybrid heat pump system

2-zone kit for actuating two heating circuits with different temperatures

Order no. 0020219775

Fig. 343: 2-zone kit

The optional 2-zone kit makes bivalent-parallel operation with triVAI parameters possible and, in particular, means that a geoTHERM and gas heating hybrid system can be retrofitted in an existing building.

- VR 70
- 3-way mixer and zone valve
- Temperature sensor
- Stable EPP casing with wall bracket and front panel
- Increasing the heat pump‘s percentage of cover by distributing to two heating circuits

14.4 Accessories for the aroTHERM split heat pump system

Product description for the uniTOWER VWL ..8/5 IS hydraulic station

Fig. 344: uniTOWER VWL .../5 IS

Product types and article numbers

Unit designation	Art. no.
VWL 58/ 5 IS	0010022070
VWL 78/ 5 IS	0010022071
VWL 128/ 5 IS	0010022072

Special features

- Pre-installed hydraulic tower for **aroTHERM AS**
- Extremely short installation times thanks to the compact design
- Can be extended using accessories that can be integrated
- Also available with integrated intermediate heat exchanger
- SplitMountingConcept for easier positioning in two parts

Equipment

- Integrated 190 litre domestic hot water coiled tube cylinder
- High-efficiency pump for **uniTOWER VWL ..8/5 IS** with intermediate heat exchanger (22 plates)
- 6 kW electric back-up heater with safety cut-out and electrical connection box
- Purging and draining the back-up heater
- 15 litre diaphragm expansion vessel for heating
- 3-port diverter valve for heating/domestic hot water
- 3 bar expansion relief valve with drain pipework and brine collecting vessel
- Filling connection
- Brine circuit with manometer

Potential applications

The **uniTOWER VWL ..8/5 IS** is used only in combination with an **aroTHERM AS** heat pump and acts as a link between the heat pump and the heating and domestic hot water installation.

Technical data

Note
The following performance data is only applicable to new products with clean heat exchangers.

Technical data – General

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Product dimensions, width	595 mm	595 mm	595 mm
Product dimensions, height	1,880 mm	1,880 mm	1,880 mm
Product dimensions, depth	693 mm	693 mm	693 mm
Weight, without packaging	158 kg	158 kg	158 kg
Weight, ready for operation	365 kg	365 kg	365 kg
Rated voltage	230 V (+10%/-15%), 50 Hz, 1~/N/PE	230 V (+10%/-15%), 50 Hz, 1~/N/PE	230 V (+10%/-15%), 50 Hz, 1~/N/PE
Rated voltage	400 V (+10%/-15%), 50 Hz, 3~/N/PE	400 V (+10%/-15%), 50 Hz, 3~/N/PE	400 V (+10%/-15%), 50 Hz, 3~/N/PE
Rated power, maximum	5.4 kW	5.4 kW	0.0 kW
Rated current, maximum	23.50 A (230 V), 14.50 A (400 V)	23.50 A (230 V) 14.50 A (400 V)	0.0
IP rating	IP 10B	IP 10B	IP 10B
Overvoltage category	II	II	II
Fuse type, characteristic C, slow-blow, three-pole switching (disconnection of the three mains connection lines in one switching operation)	Design in accordance with the selected connection diagrams		

Technical data – Heating circuit

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Water content	16.6 l	17.1 l	
Material in the heating circuit	Copper, copper-zinc alloy, stainless steel, ethylene propylene diene monomer rubber, brass, iron		
Permissible water composition	Without frost or corrosion protection. Soften the heating water at water hardnesses from 3.0 mmol/l (16.8° dH) according to Directive VDI 2035 sheet 1.		
Minimum operating pressure	0.05 MPa	0.05 MPa	0.05 MPa
Maximum operating pressure	0.3 MPa	0.3 MPa	0.3 MPa
Min. heating mode flow temperature	20 °C	20 °C	20 °C
Max. heating mode flow temperature with compressor	55 °C	55 °C	55 °C
Max. heating mode flow temperature with back-up heater	70 °C	70 °C	70 °C
Min. cooling mode flow temperature	7 °C	7 °C	7 °C
Max. flow temperature in cooling mode	25 °C	25 °C	25 °C
Min. nominal volume flow with 3 K outdoor unit	0.3 m³/h		
Min. nominal volume flow with 5 K outdoor unit	0.4 m³/h		
Minimum nominal volume flow rate		0.55 m³/h	
Nominal volume flow ΔT 5 K with 3 K outdoor unit	0.54 m³/h		
Nominal volume flow ΔT 5 K with 5 K outdoor unit	0.79 m³/h		
Nominal volume flow ΔT 5 K		1.02 m³/h	
Nominal volume flow ΔT 8 K with 3 K outdoor unit	0.3 m³/h		
Nominal volume flow ΔT 8 K with 5 K outdoor unit	0.4 m³/h		
Nominal volume flow ΔT 8 K		0.55 m³/h	
Remaining feed head ΔT 5 K with 3 K outdoor unit	71 kPa		

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Remaining feed head ΔT 5 K with 5 K outdoor unit	68 kPa		
Remaining feed head ΔT 5 K		66 kPa	
Remaining feed head ΔT 8 K with 3 K outdoor unit	71 kPa		
Remaining feed head ΔT 8 K with 5 K outdoor unit	68 kPa		
Remaining feed head ΔT 8 K		73 kPa	
Min. volume flow during continuous operation at the operating limits with a 3 kW outdoor unit	0.3 m³/h		
Min. volume flow during continuous operation at the operating limits with a 5 kW outdoor unit	0.4 m³/h		
Min. volume flow during continuous operation at the operating limits		0.55 m³/h	
Max. volume flow during continuous operation at the operating limits with a 3 kW outdoor unit	0.54 m³/h		
Max. volume flow during continuous operation at the operating limits with a 5 kW outdoor unit	0.79 m³/h		
Max. volume flow during continuous operation at the operating limits		1.08 m³/h	
Pump type	High-efficiency pump	High-efficiency pump	High-efficiency pump
Energy efficiency index (EEI) of the pump	≤0.2	≤0.2	≤0.2

Technical data – Electrics

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Min. electrical power consumption of the heating pump	2 W	2 W	3 W
Max. electrical power consumption of the heating pump	60 W	60 W	100 W
Electrical power consumption of the heating pump at A7/35 ΔT 5 K with an external pressure loss of 250 mbar in the heating circuit	20 W	20 W	40 W

Technical data – Refrigerant circuit

	VWL 58/5 IS	VWL 78/5 IS	VWL 128/5 IS
Material, refrigerant pipe	Copper	Copper	Copper
Length, refrigerant pipe, maximum	25 m	25 m	25 m
Length, refrigerant pipe, minimum	3 m	3 m	3 m
Connection technology, refrigerant pipe	Flare connection	Flare connection	Flare connection
Outer diameter, hot gas pipe	1/2 " (12.7 mm)	5/8 " (15.875 mm)	5/8 " (15.875 mm)
Outer diameter, liquid pipe	1/4 " (6.35 mm)	3/8 " (9.575 mm)	3/8 " (9.575 mm)
Minimum wall thickness, hot gas pipe	0.8 mm	0.95 mm	0.95 mm
Minimum wall thickness, liquid pipe	0.8 mm	0.8 mm	0.8 mm
Refrigerant, type	R410A	R410A	R410A
Refrigerant, Global Warming Potential (GWP)	2088	2088	2088
Refrigerant, fill quantity	1.50 kg	2.39 kg	3.60 kg
Permissible operating pressure, maximum	41.5 bar	41.5 bar	41.5 bar
Compressor, type	Rotary piston	Rotary piston	Rotary piston
Compressor, oil type	Specific polyvinyl ether (PVE)	Specific polyvinyl ether (PVE)	Specific polyvinyl ether (PVE)
Compressor, control	Electronic	Electronic	Electronic
Permissible height difference between outdoor unit and indoor unit	≤ 10 m	≤ 10 m	≤ 10 m

Dimension drawing and connection dimensions

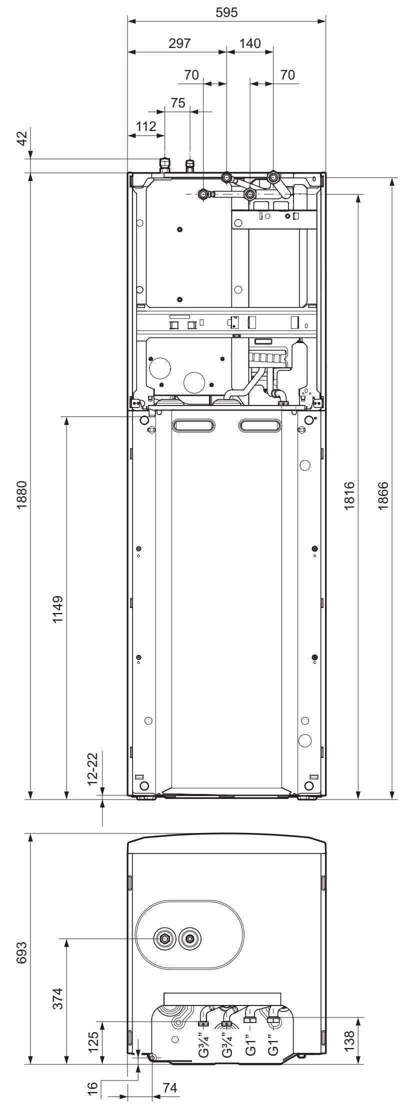


Fig. 345: Dimension drawing and connection dimensions

Product dimensions for the transport

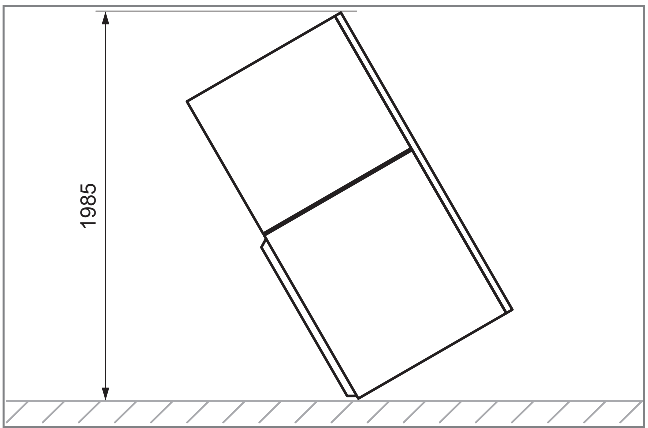


Fig. 346: Dimensions for transport

Remaining feed heads at nominal volume flow

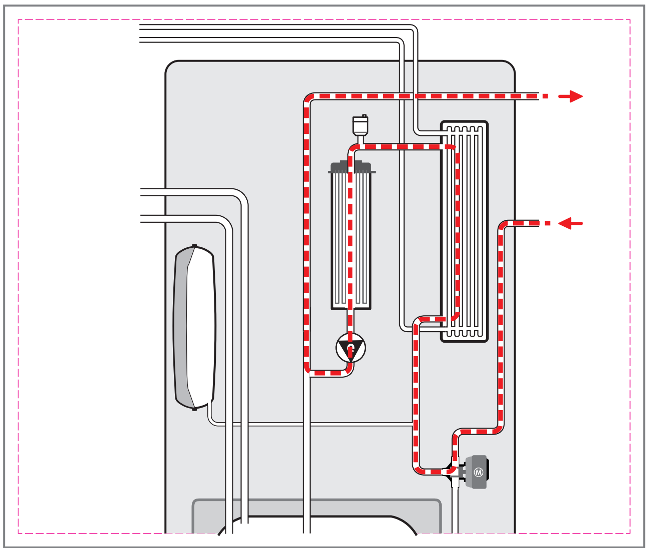


Fig. 347: Remaining feed head basic diagram

VWL 58/5 remaining feed head at nominal volume flow

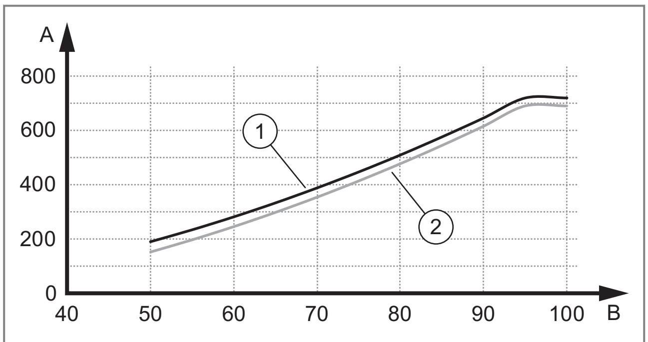


Fig. 348: VWL 58/5 remaining feed head

1 VWL 58/5, 3.5 kW/540 l/h
2 VWL 58/5, 5 kW/790 l/h
A Remaining feed head in hPa (mbar)
B Pump output in %

VWL 78/5 remaining feed head at nominal volume flow

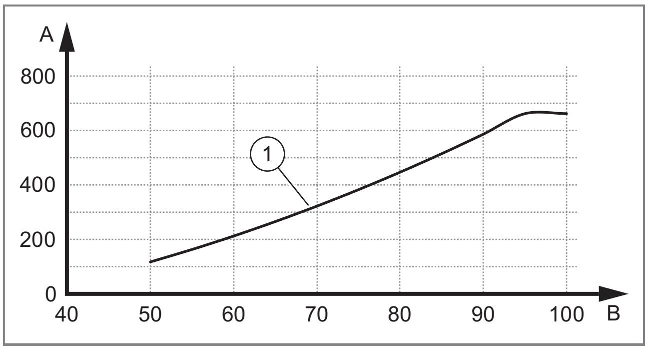


Fig. 349: VWL 78/5 remaining feed head

1 VWL 78/5, 7 kW/1020 l/h
A Remaining feed head in hPa (mbar)
B Pump output in %

VWL 128/5 remaining feed head at nominal volume flow

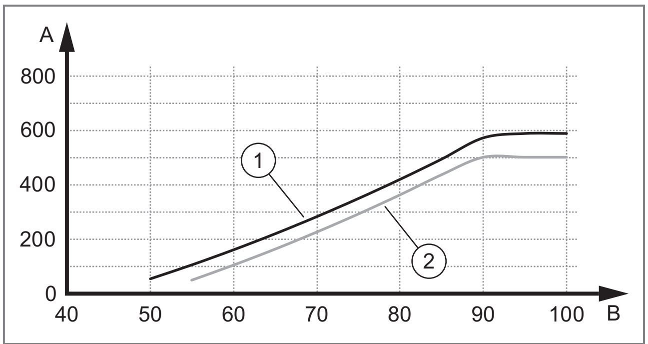


Fig. 350: VWL 128/5 remaining feed head

1 VWL 128/5, 10 kW/1670 l/h
2 VWL 128/5, 12 kW/1850 l/h
A Remaining feed head in hPa (mbar)
B Pump output in %

Product description for the VWL ..7/5 IS hydraulic station


Fig. 351: VWL ..7/5 IS hydraulic station

Equipment
- eBUS interface
- Appliance interface with display and control buttons
- Electrical immersion heater with safety cut-out
- 10 l expansion vessel for heating
- 3-port diverter valve
- Water pressure sensor
- Expansion relief valve for heating
- VF1 temperature sensor
- Connection cable

Potential applications

The **VWL ..7/5 IS hydraulic station** is an electric reheater module with integrated heat pump control interface module and diverter valve for the aroTHERM heating system. Depending on the system design and configuration, it can supplement the heat supply from the heat pump.

The heat output of the electrical heating rod can be set as required to either 2, 4 or 6 kW. The module can be connected to a 230 V or 400 V power supply.

Product types and article numbers

Unit designation	Art. no.
VWL 57/ 5 IS	0010023494
VWL 77/ 5 IS	0010023498
VWL 127/ 5 IS	0010023523

Technical data – General

	VWL 57/5 IS	VWL 77/5 IS	VWL 127/5 IS
Product dimensions, width	440 mm	440 mm	440 mm
Product dimensions, height	720 mm	720 mm	720 mm
Product dimensions, depth	350 mm	350 mm	350 mm
Weight, without packaging	23 kg	24 kg	26.5 kg
Rated voltage	230 V (+10%/-15%), 50 Hz, 1~/N/PE	230 V (+10%/-15%), 50 Hz, 1~/N/PE	230 V (+10%/-15%), 50 Hz, 1~/N/PE
Rated voltage	400 V (+10%/-15%), 50 Hz, 3~/N/PE	400 V (+10%/-15%), 50 Hz, 3~/N/PE	400 V (+10%/-15%), 50 Hz, 3~/N/PE
Rated power, maximum	5.4 kW	5.4 kW	0.0 kW
Rated current, maximum	23.50 A (230 V), 14.50 A (400 V)	23.50 A (230 V) 14.50 A (400 V)	0.0
IP rating	IP 10B	IP 10B	IP 10B
Overvoltage category	II	II	II
Fuse type, characteristic C, slow-blow, three-pole switching (disconnection of the three mains connection lines in one switching operation)	Design in accordance with the selected connection diagrams	Design in accordance with the selected connection diagrams	Design in accordance with the selected connection diagrams

Dimension drawing and connection dimensions

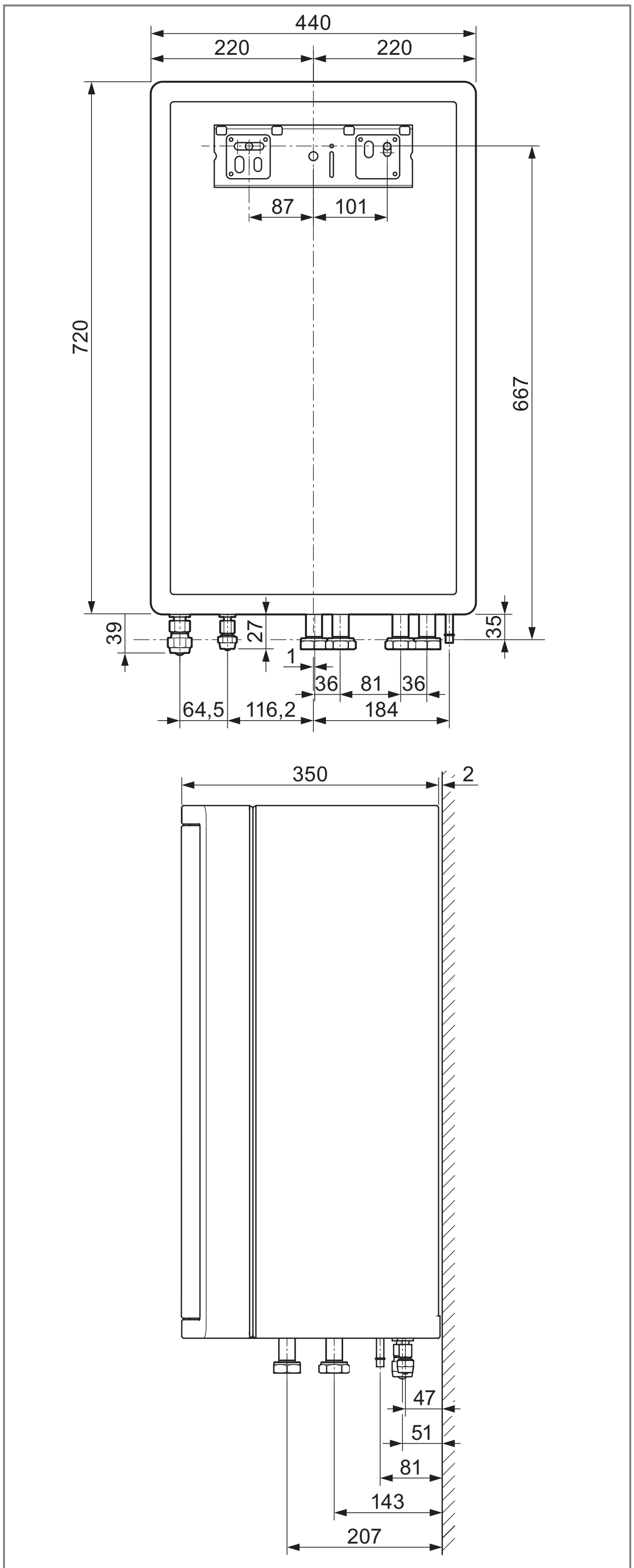


Fig. 352: VWL ..7/5 IS – dimensions

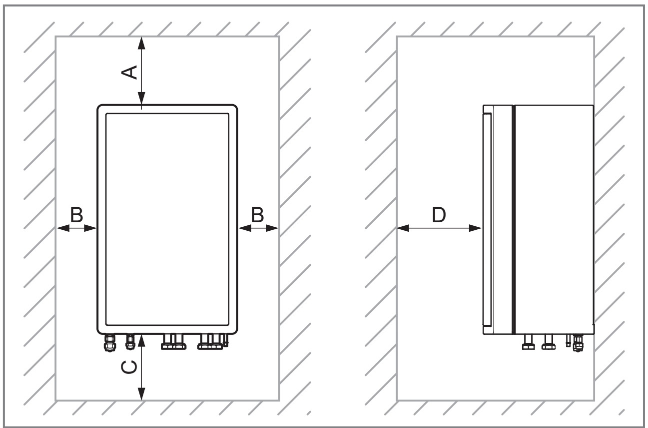


Fig. 353: Recommended minimum clearances and installation

Remaining feed heads at nominal volume flow

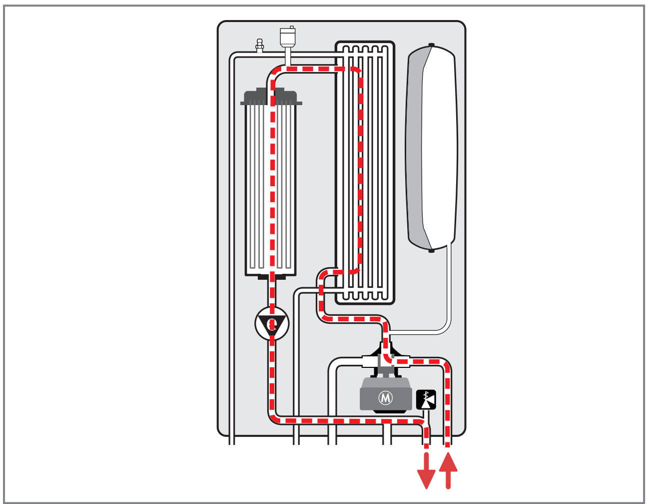


Fig. 354: Remaining feed head basic diagram

VWL 77/5 IS remaining feed head at nominal volume flow

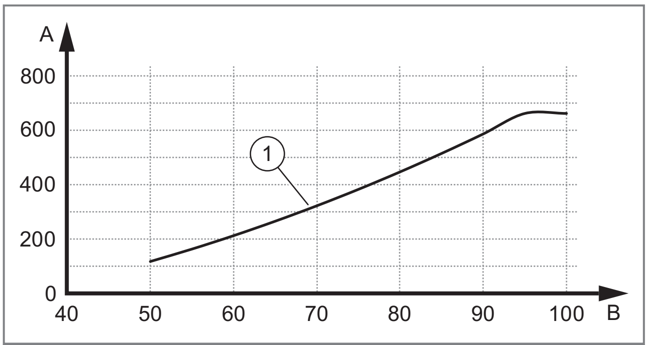


Fig. 356: VWL 77/5 IS remaining feed head

1 Air heat source
A Remaining feed head in hPa (mbar)
B Pump output in %

VWL 57/5 IS remaining feed head at nominal volume flow

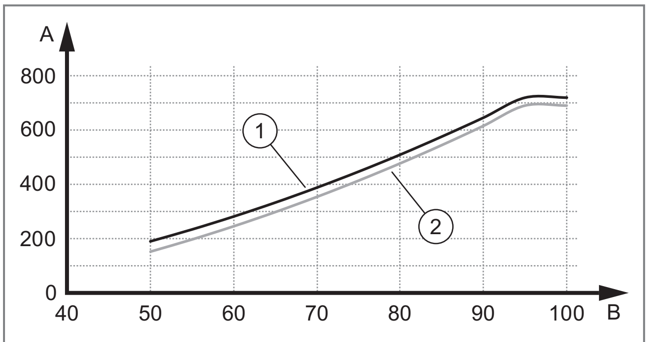


Fig. 355: VWL 57/5 IS remaining feed head

1 Air heat source
A Remaining feed head in hPa (mbar)
B Pump output in %

VWL 127/5 IS remaining feed head at nominal volume flow

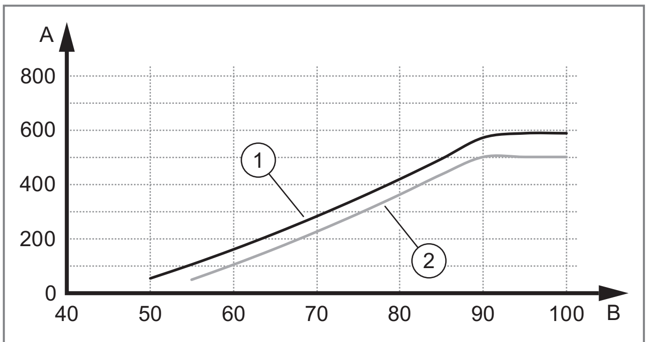


Fig. 357: VWL 127/5 IS remaining feed head

1 Air heat source
A Remaining feed head in hPa (mbar)
B Pump output in %

Coolant hoses

Order number xxx

Fig. 358: Coolant hoses

Dimensions of the coolant hoses

Dimensions	Outer diameter [mm]	Inner diameter [mm]
1/4"	6,32	5,08
3/8"	9,53	8
1/2"	12.7	10,92
5/8"	15,88	13,84

Refrigerant pipe connection

	VWL 35/5 AS 230 V	VWL 55/5 AS 230 V	VWL 75/5 AS 230 V	VWL 105/5 AS 230 V	VWL 105/5 AS	VWL 125/5 AS 230 V	VWL 125/5 AS
Material	Copper						
Maximum length	25 m						
Minimum length	3 m						
Outer diameter of the hot gas pipe	1/2"	1/2"	5/8"	5/8"	5/8"	5/8"	5/8"
Outer diameter, liquid pipe	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
Coolant type	R410A						
Coolant volumetric capacity (incl. 15 m hose length)	1.5 kg	1.5 kg	2.4 kg	3.6 kg	3.6 kg	3.6 kg	3.6 kg
Maximum operating pressure	xxx bar/xxx PSI						
Additional refrigerant volume	30 g/m	30 g/m	70 g/m	70 g/m	70 g/m	70 g/m	70 g/m
Maximum height difference between the outdoor unit and the indoor unit	10 m						

Rubber feet

Fig. 359: Vibration protection

Order number xxx

ation protection for all aroTHERM split units

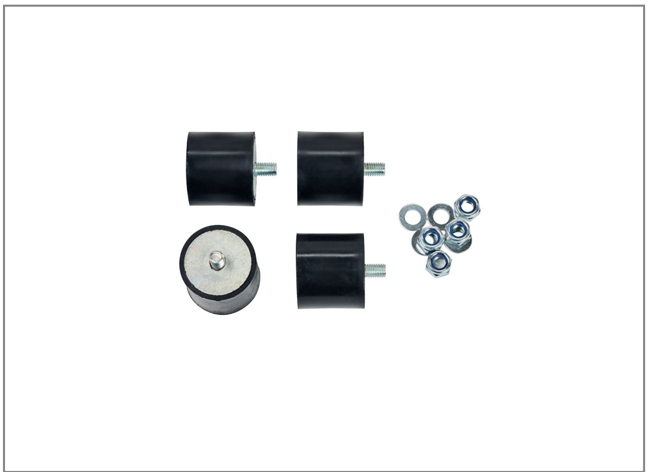


Fig. 360: Vibration protection

Order number xxx

Small rubber feet for the concrete base

Wall bracket

Fig. 361: Wall bracket

Order number xxx

For hanging the heat pump on the wall.

Ensure that the wall structure is stable enough.

Can be used for **aroTHERM split**.

Cannot be used with aroTHERM xxx

Elevated base

Fig. 362: Elevated base

Order number xxx

For an installation that is raised by 40 cm.

Can be used for **aroTHERM split**.

Cannot be used with aroTHERM xxx

14.5 Accessories for heat distribution

Pipe group with high-efficiency pump, without mixer

Order no. 0020191817

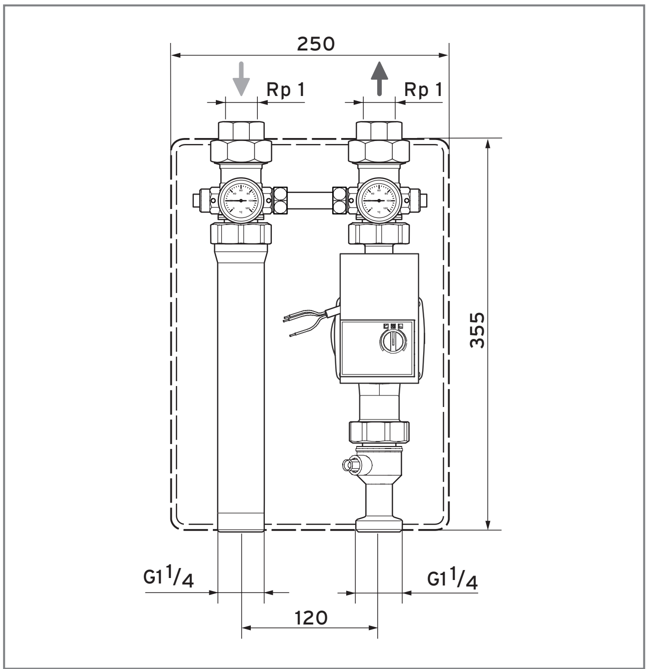


Fig. 363: Pipe group dimension drawing

Pump diagrams

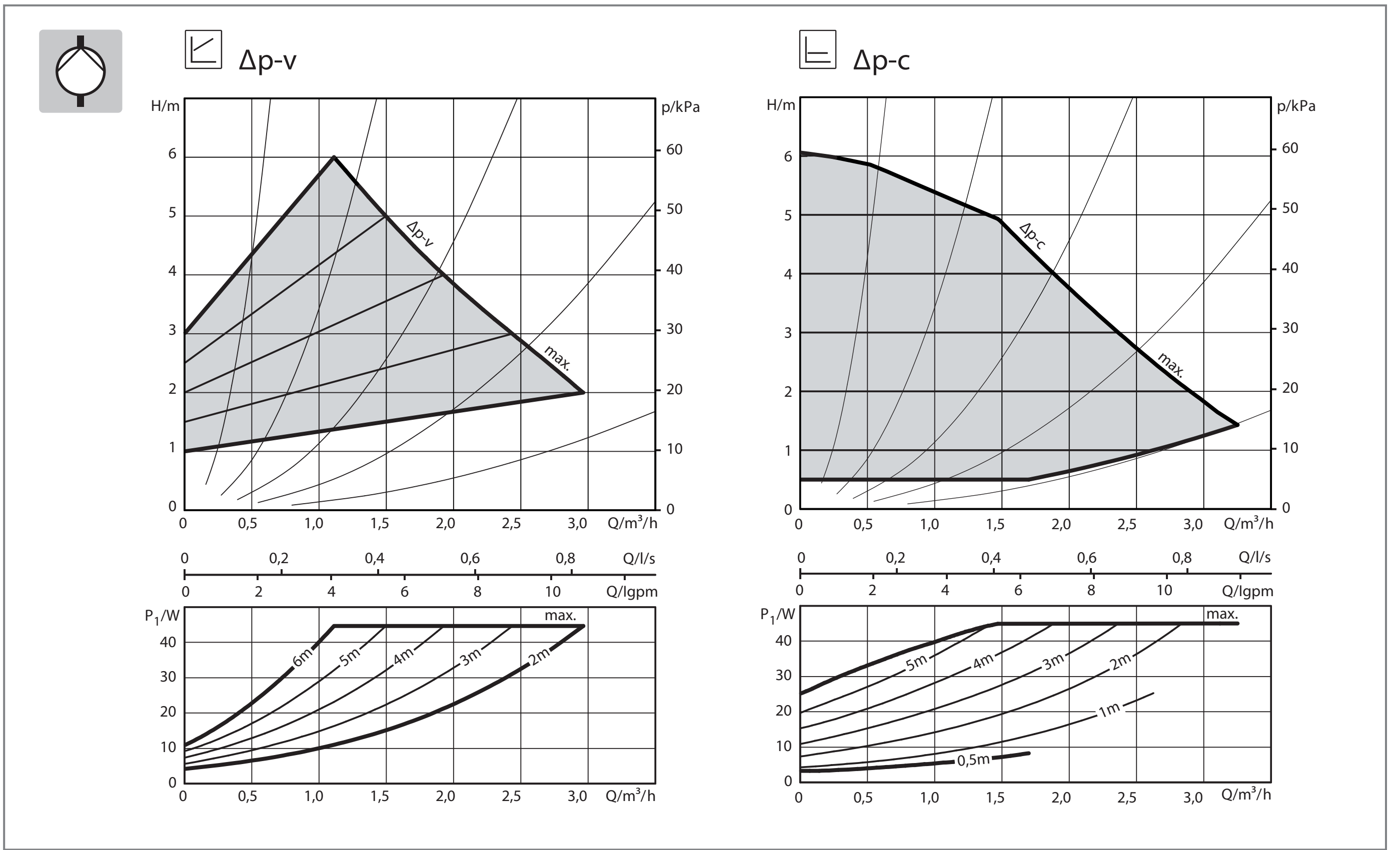


Fig. 364: Pump diagrams, order no. 0020191817

Pipe group with high-efficiency pump and 3-port mixing valve

Order no. 0020191813, 0020191814, 0020191788

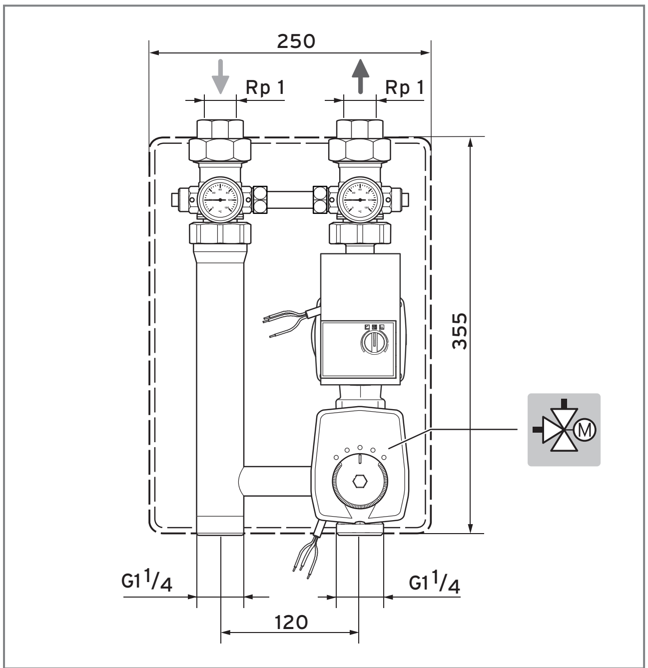


Fig. 365: Pipe group dimension drawing

Technical data

	Mixer	K_{vs}
0020191814	Rp 1/2	2.5
0020191813	Rp 3/4	6.3
0020191788	Rp 1	8.0

Pressure loss diagrams

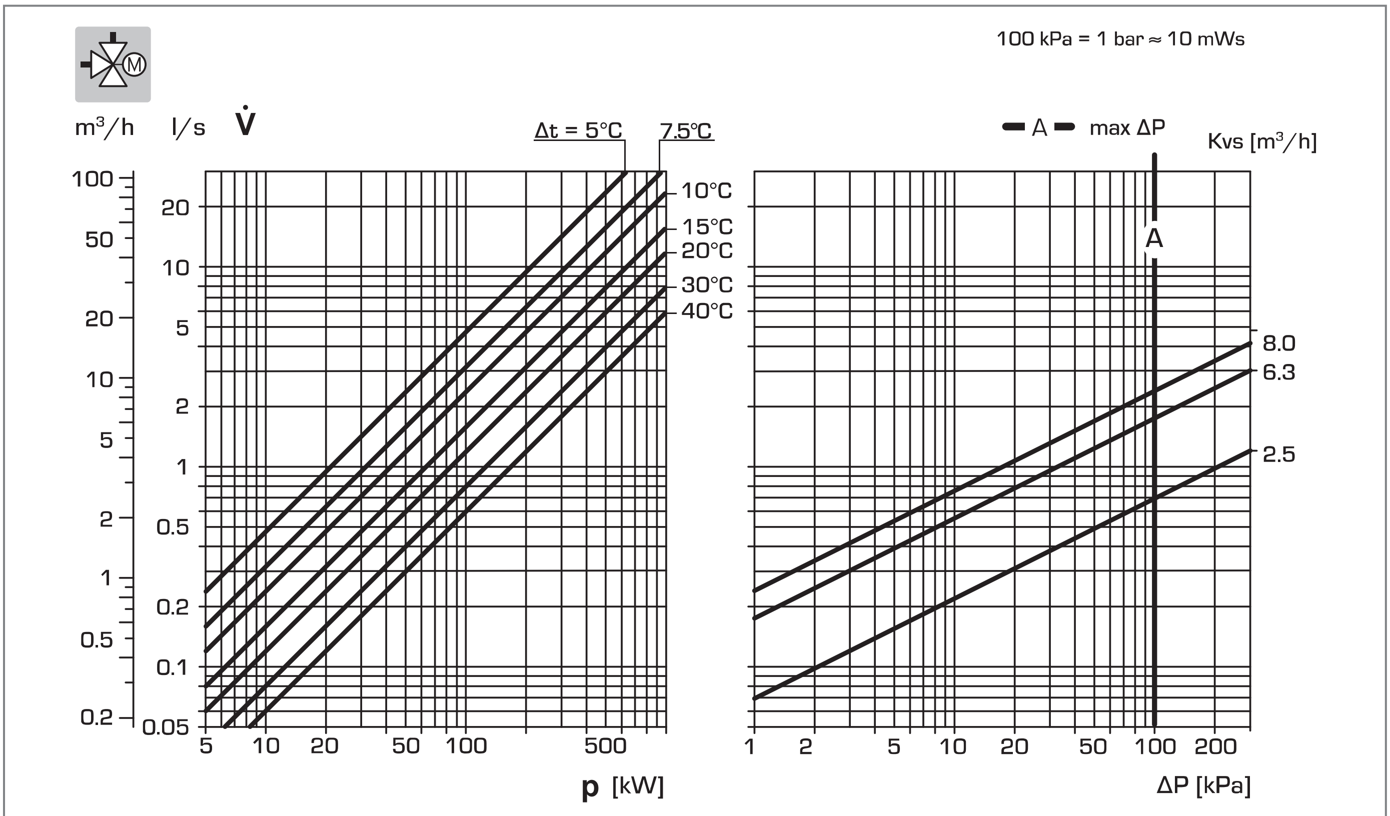


Fig. 366: Pressure loss diagrams, order no. 0020191813, 0020191814, 0020191788

3-port diverter valve

Order no. 0020036743

Choice of R 1 or G 1 1/4 connection, 230 V, K_{vs}=7.7

Fig. 367: 3-port diverter valve

1 x 3-port diverter valve with motor, 1 x connection cable with Molex connector, 3 x 28 mm connection pipes with support sleeves, 3 x G 1 1/4 union nuts with flat seals.

Can be used for **allSTOR exclusive**, **allSTOR plus**, **flexo-THERM exclusive**.

Pressure loss diagram

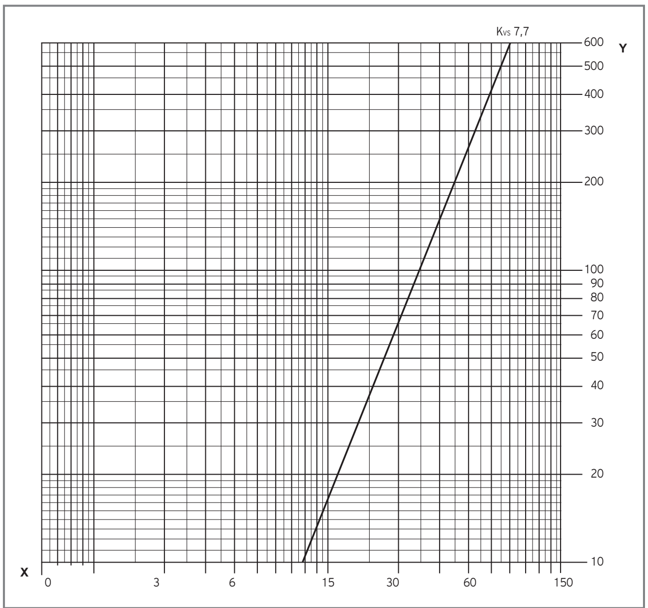


Fig. 368: 3-port valve pressure loss diagram

Y Pressure loss [mbar]
X Flow rate [l/min]

geoTHERM brine pumps

Order no. 0020227825, 0020227826, 0020227827, 0020227828

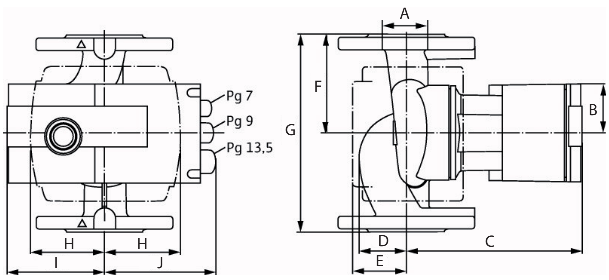


Fig. 369: Dimension drawing for the brine pump

Table of dimensions

Order no.	A	B	C	D	E	F	G	H	I	J
0020227825	DN 32	55	204	48	65	110	220	82	106	120
0020227826	DN 40	66	252	62	84	125	250	96	120	136
0020227827	DN 50	66	256	62	83	140	280	96	120	136
0020227828	DN 40	78	311	62	85	125	250	120	156	164

Pump diagrams

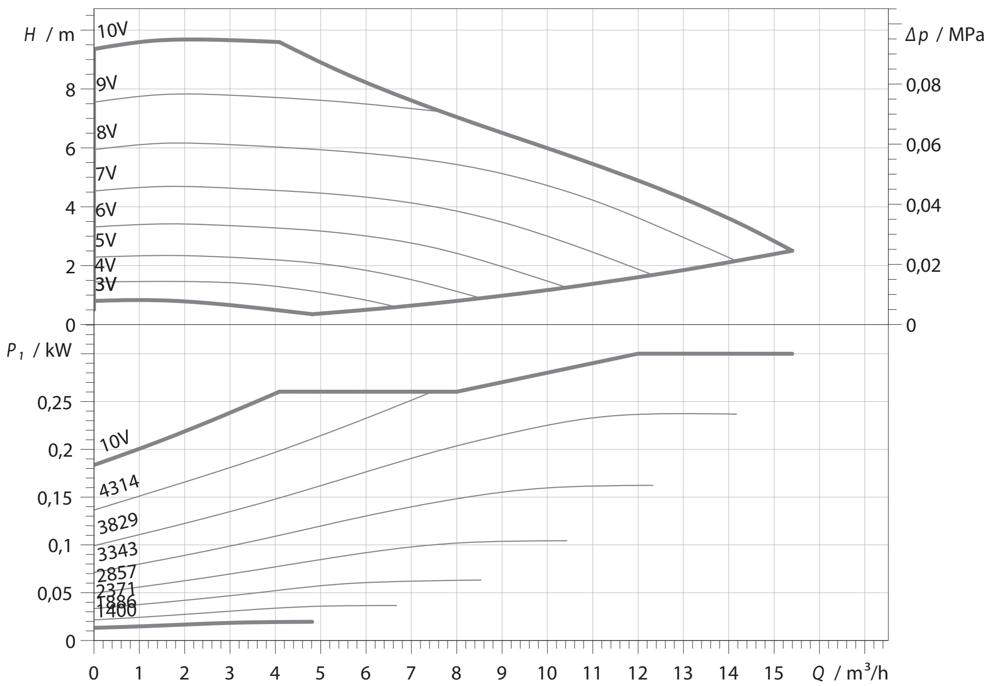


Fig. 370: Power output graph for the DN 32 brine pump, order no. 0020227825

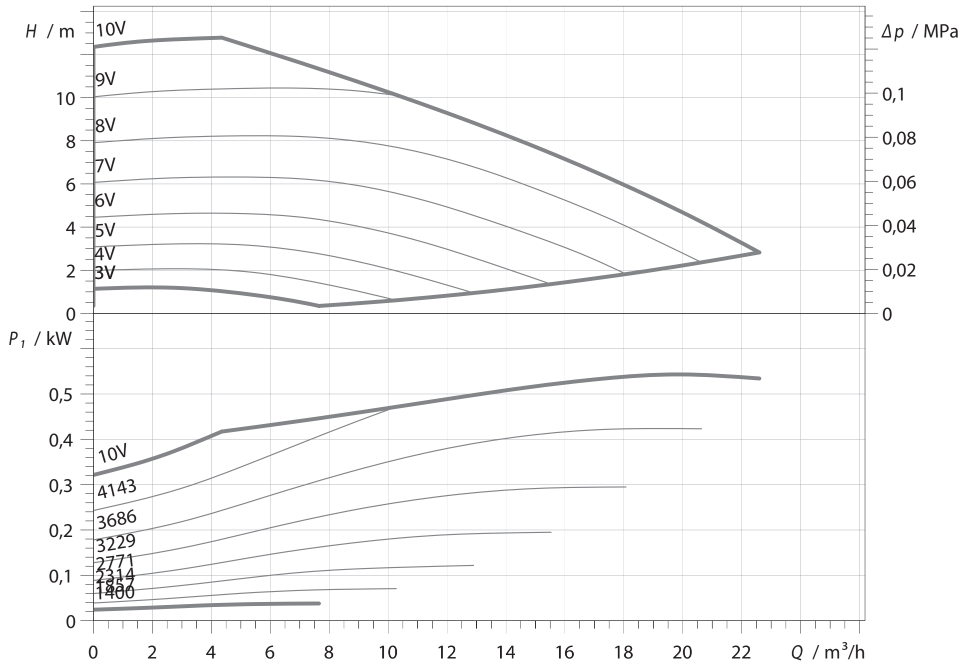


Fig. 371: Power output graph for the DN 40 brine pump, order no. 0020227826

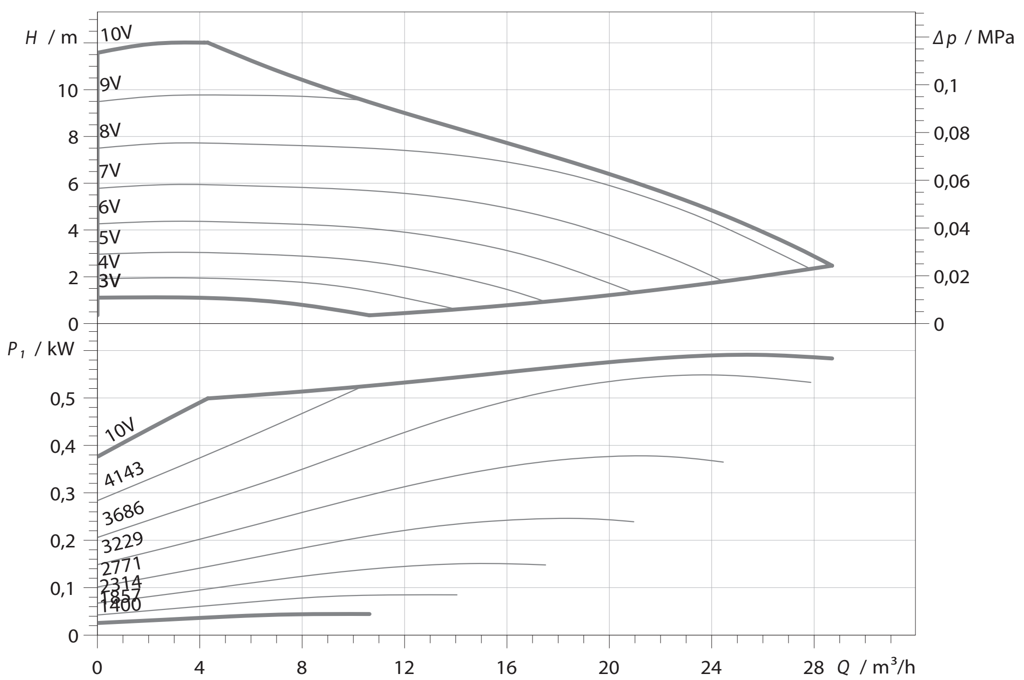


Fig. 372: Power output graph for the DN 50 brine pump, order no. 00202278257

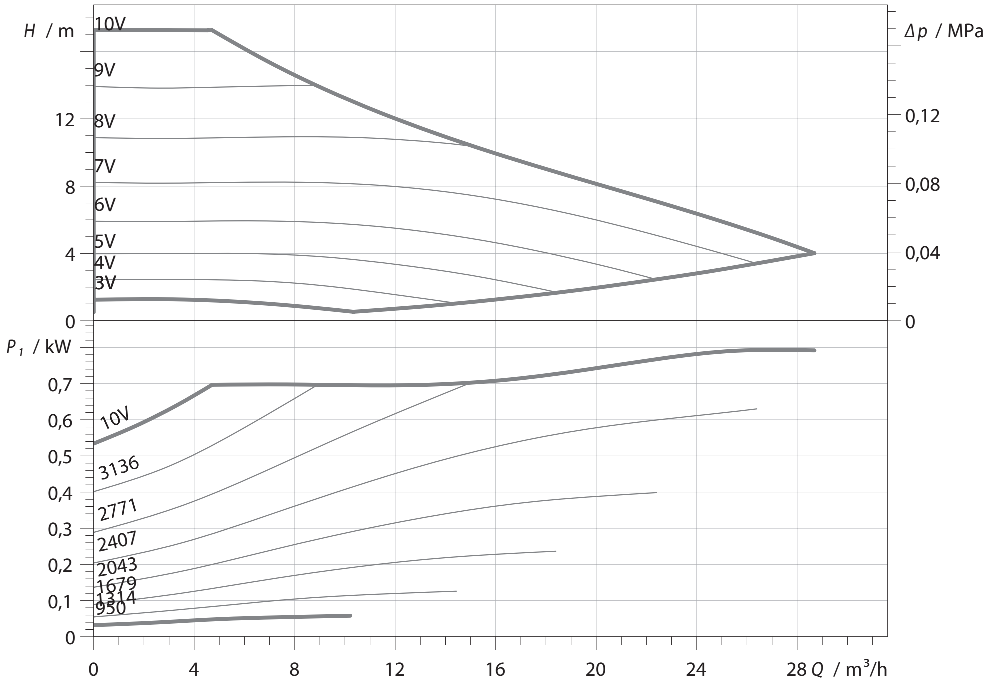


Fig. 373: Power output graph for the DN 40 brine pump, order no. 0020227828

Distribution manifold for two pipe groups

Order no. 307556

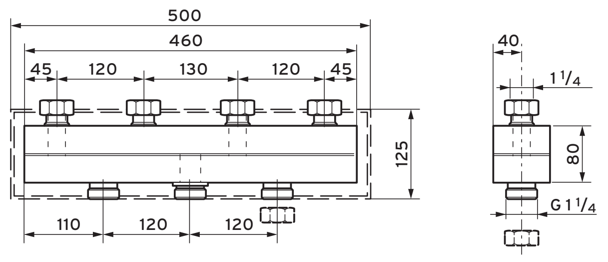


Fig. 374: Distribution manifold for two pipe groups

Fully preconfigured to connect two pipe groups (with or without a 3-port mixing valve), with heat insulation.

Technical data

Technical data, order no. 307556

	Unit	307556
Thermal insulation cover		EPP
Permissible operating temperature	°C	-20 to 110
Max. permissible operating pressure	bar	6
Weight	kg	6.3

Pressure loss

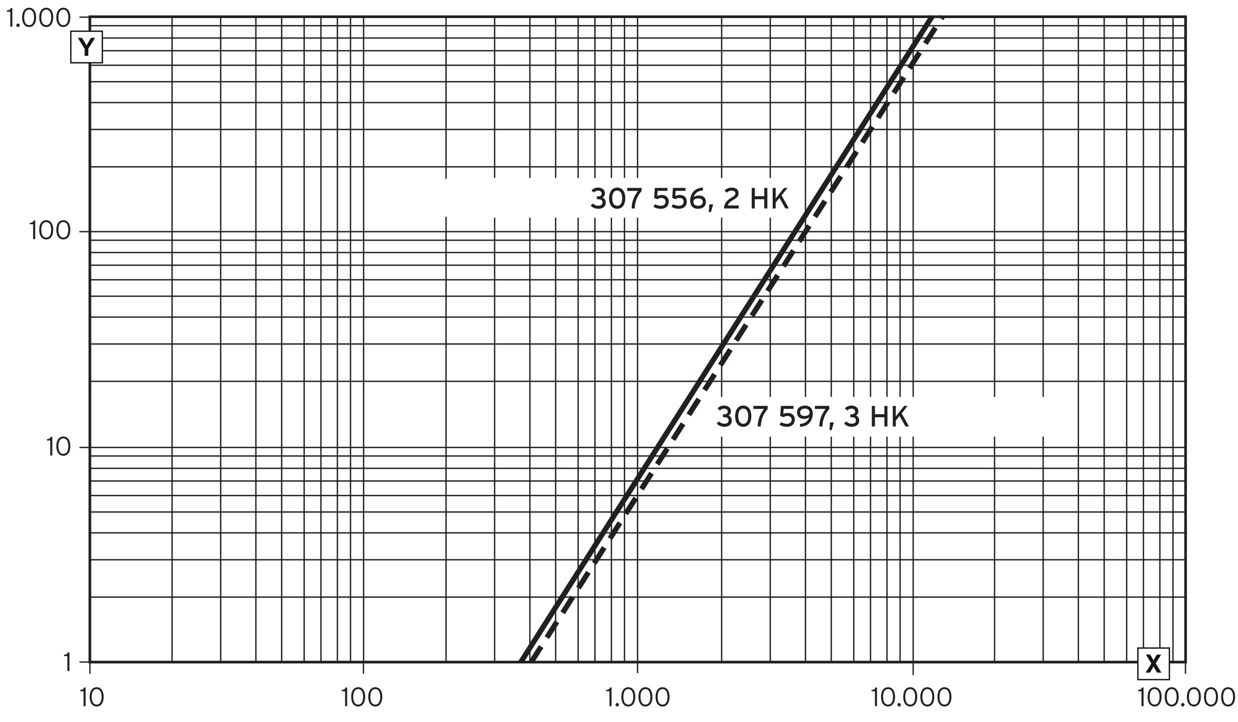


Fig. 375: Pressure loss

Y Pressure loss in mbar
X Volume flow l/h

Distribution manifold for three pipe groups

Order no. 307597

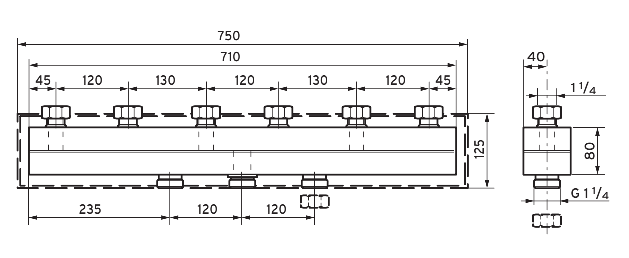


Fig. 376: Distribution manifold for three pipe groups

Fully preconfigured to connect three pipe groups (with or without a 3-port mixing valve), with heat insulation.

Technical data

Technical data, order no. 307597

	Unit	307597
Thermal insulation cover		EPP
Permissible operating temperature	°C	-20 to 110
Max. permissible operating pressure	bar	6
Weight	kg	9.2

Pressure loss

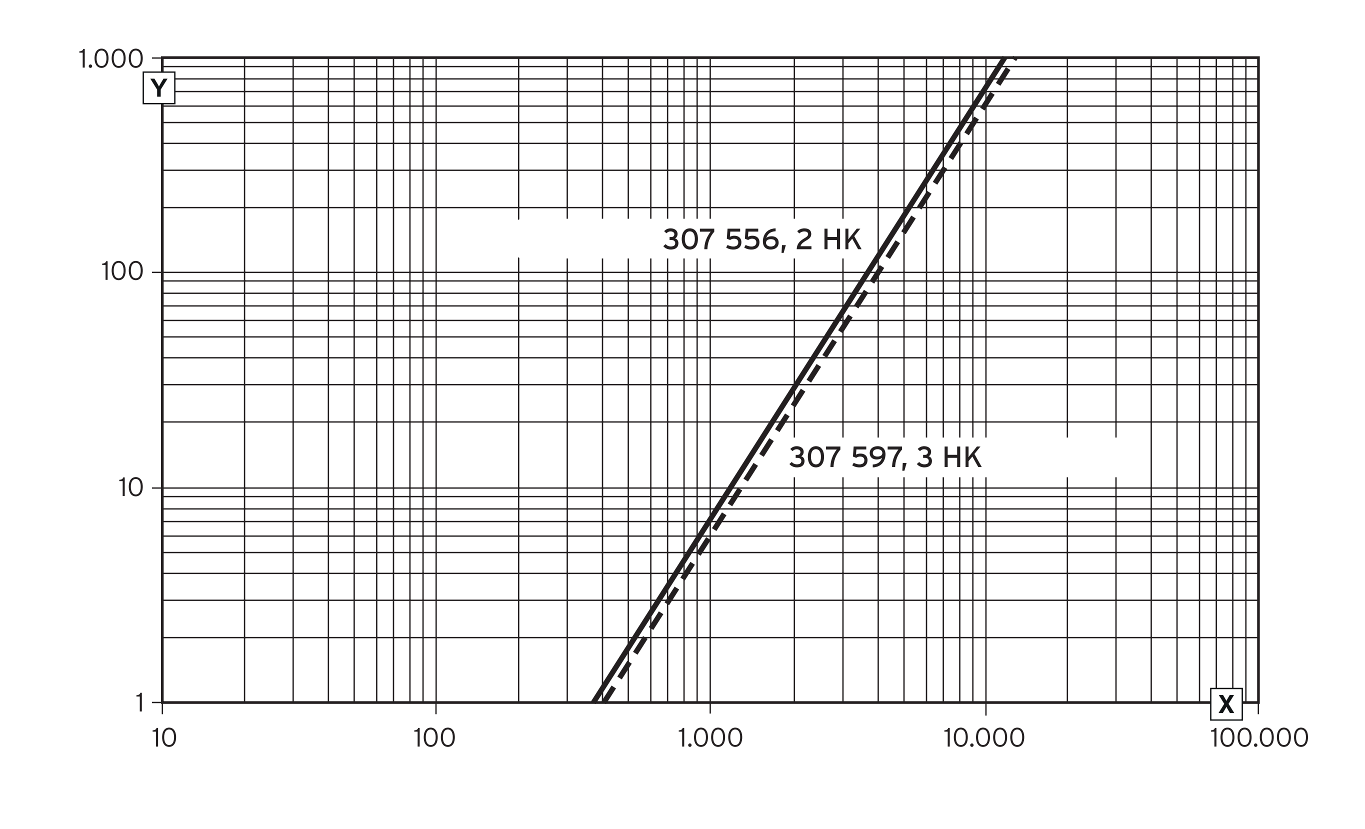


Fig. 377: Pressure loss

Y Pressure loss in mbar
X Volume flow l/h

14.6 Accessories for system separation

PHE S plate heat exchanger

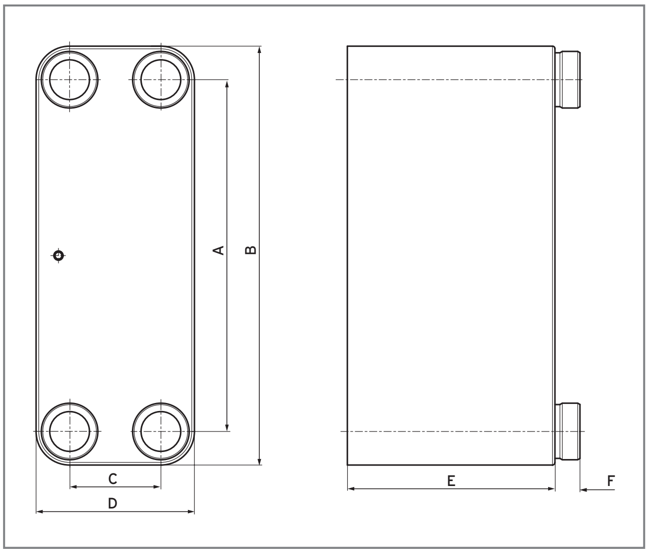


Fig. 378: PHE S heat exchanger

Transferable power: 120 kW (not available in Germany).

Dimensions

Dimension	Unit	PHE S 120-70
A	mm	281
B	mm	335
C	mm	73
D	mm	124
E	mm	166
F	mm	20

Primary side pressure loss

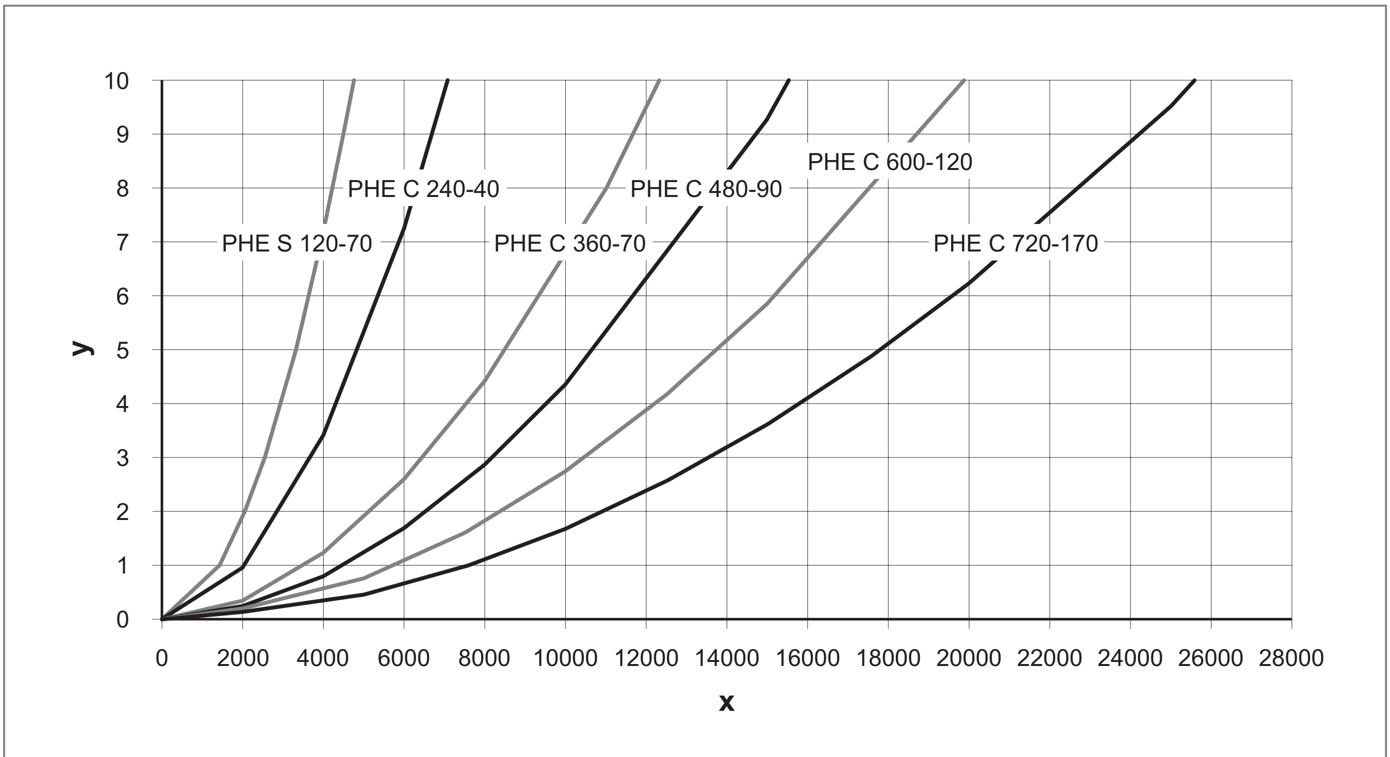


Fig. 379: Primary side pressure loss

Y Pressure loss in kPa
X Mass flow in kg/h

PHE C plate heat exchanger

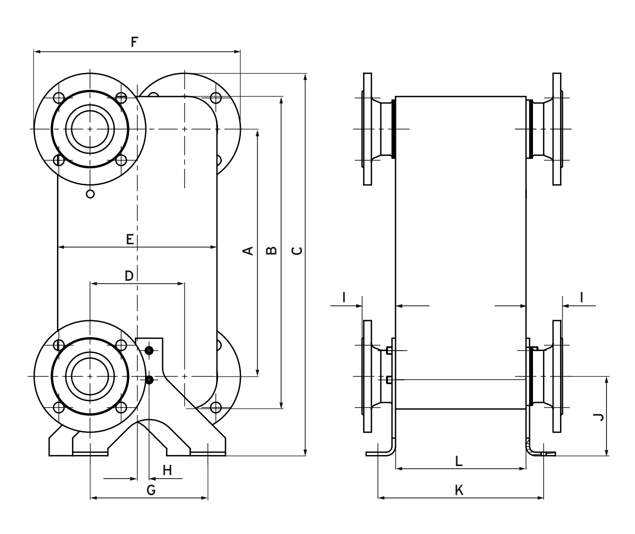


Fig. 380: PHE C heat exchanger

Transferable power: 240-720 kW (not available in Germany).

Unit	Unit	A	B	C	D	E	F	G	H	I	J	K	L
PHE C 240-40	mm	421	532	636	161	271	321	200	20	86	135	175	105
PHE C 360-70	mm											246	176
PHE C 480-90	mm			651			351			62		292	222
PHE C 600-120	mm											362	292
PHE C 700-170	mm											479	409

Secondary side pressure loss

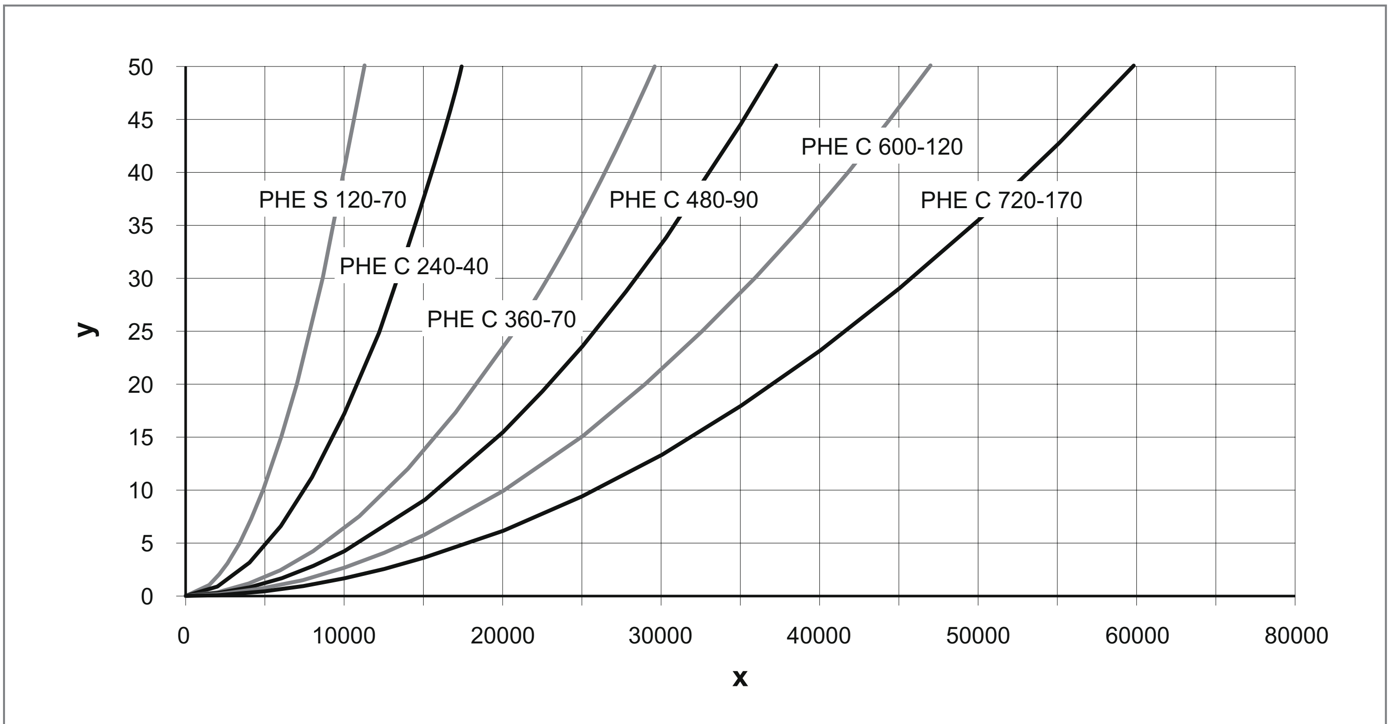
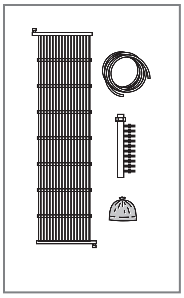
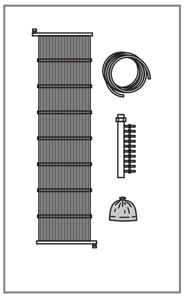


Fig. 381: Secondary side pressure loss

Y Pressure loss in kPa

X Mass flow in kg/h

14.7 Heat source accessories

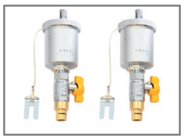
Accessories	Description	Order no.
Heat source exploitation		
	VWZ KK 8 compact collector as a heat source for brine-to-water heat pumps, consisting of: 8 x 6 m x 1 m collector mats, 2 x DA 20 mm 100 m PP pipe, 8-outflow manifold incl. flow rate limiter, ball valve and manometer, 8-inflow collecting unit incl. ball valve, 16 x DA 20 45° PP angle, 2 x 8 pcs holding clips for positioning the manifold/collecting unit inflows/outflows and installation instructions Ground collector system that requires little space, is easy and quick to install, can be used for VWF 58/4, VWF 57/4 **Note:** Before installation, observe the installation instructions and planning information. Unsuitable for the following applications: Heating the screed flooring to a high temperature/dry-heating the screed flooring Cooling function	0020022301
	VWZ KK 10 compact collector as a heat source for brine-to-water heat pumps, consisting of: 12 x 6 m x 1 m collector mats, 4 x DA 20 mm 100 m PP pipe, 12-outflow manifold incl. flow rate limiter, ball valve and manometer, 12-inflow collecting unit incl. ball valve, 24 x DA 20 45° PP angle, 2 x 12 pcs holding clips for positioning the manifold/collecting unit inflows/outflows and installation instructions Ground collector system that requires little space, is easy and quick to install, can be used for VWF 88/4, VWF 87/4 **Note:** Before installation, observe the installation instructions and planning information. Unsuitable for the following applications: Heating the screed flooring to a high temperature/dry-heating the screed flooring Cooling function	0020022302
	40 mm installation set, consisting of: 4 x 40 x R 1 1/4 brass connector for 40 x 3.7 PE pipe, 2 x 90° brass threaded elbow joint, 40 x R 1 1/4 for connection to 40 x 3.7 PE pipe, 4 x 90° angular coupling for 40 x 3.7 PE pipe, 2 x T-piece for 40 x 3.7 PE pipe, 2 x empty pipe for routing the eBUS cable in the ground, 1 x pipe marking tape and cable ties for indicating the PE pipes. Can be used for VWF 157/4 with **aroCOLLECT**, VWF 197/4 with **aroCOLLECT** **Note:** For clearances between the outdoor unit and indoor unit of up to 10 m.	0020115490
	50 mm installation set, consisting of: 4 x 50 x R 1 1/4 brass connector for 50 x 4.6 PE pipe, 2 x 90° brass threaded elbow joint, 50 x R 1 1/2 for connection to 50 x 4.6 PE pipe, 4 x 90° angular coupling for 50 x 4.6 PE pipe, 2 x T-piece for 50 x 4.6 PE pipe, 2 x empty pipe for routing the eBUS cable in the ground, 1 x pipe marking tape and cable ties for indicating the PE pipes. Can be used for VWF 157/4 with **aroCOLLECT**, VWF 197/4 with **aroCOLLECT** **Note:** For clearances between the outdoor unit and indoor unit of 10 to 30 m. Not required when using the installation set with Tichelmann.	0020115491

Accessories	Description	Order no.
	40 mm installation set between the indoor and outdoor unit, consisting of: 2 x 40 x R 1 1/4 brass connector for 40 x 3.7 PE pipe, 2 x 90° brass threaded elbow joint, 40 x R 1 1/4 for connection to 40 x 3.7 PE pipe, 2 x 90° angular coupling for 40 x 3.7 PE pipe. 1 x empty pipe for routing the eBUS cable in the ground. 1 x pipe marking tape and cable ties for indicating the PE pipes. Can be used for **flexoCOMPACT exclusive** air/water, VWF 57/4 with **aroCOLLECT**, VWF 87/4 with **aroCOLLECT**, VWF 117/4 with **aroCOLLECT**. **Note:** For clearances between the outdoor unit and indoor unit of up to 10 m.	0020087227
	50 mm installation set between the indoor and outdoor unit, consisting of: 2 x 50 x R 1 1/4 brass connector for 50 x 4.6 PE pipe, 2 x 90°brass threaded elbow joint, 50 x R 1 1/2 for connection to 50 x 4.6 PE pipe, 2 x 90° angular coupling for 50 x 4.6 PE pipe, 1 x empty pipe for routing the eBUS cable in the ground, 1 x pipe marking tape and cable ties for indicating the PE pipes. Can be used for **flexoCOMPACT exclusive** air/water, VWF 57/4 with **aroCOLLECT**, VWF 87/4 with **aroCOLLECT**, VWF 117/4 with **aroCOLLECT**. **Note:** For clearances between the outdoor unit and indoor unit of 10 to 30 m.	0020087831
	90° angular coupling (2 pcs) for diverting the PE connection pipe for 40 x 3.7 PE pipe	0020112792
	90° angular coupling (2 pcs) for diverting the PE connection pipe for 50 x 4.6 PE pipe	0020112793

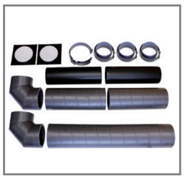
Accessories	Description	Order no.
	Installation set for installing the outdoor unit on a flat roof, consisting of: 2 x gravel tray; 2 x 28 mm dia. x 1.5 mm flat roof connection pipes, G 1 1/4; 1 x base panel for flat-roof installation; 1 x heat insulation for connection pipes; 4 x connecting elements for securing the gravel tray to the outdoor unit; 2 x brass threaded joints, R 5/4. Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020087826
	Installation set for laying a PE pipe at ground level, consisting of: 2 x 28 dia. x 1.5 mm G 1 1/4 connection pipes, 1 x base panel with cut-outs, 2 x R 1 1/4 brass threaded joint. Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020112803
	PE connection pipe between the indoor and outdoor unit 2 x 10 m, 40 x 3.7 mm Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020087224
	PE connection pipe between the indoor and outdoor unit 2 x 20 m, 50 x 4.6 mm Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020087225
	PE connection pipe between the indoor and outdoor unit 2 x 30 m, 50 x 4.6 mm Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020087226

Accessories	Description	Order no.
	Key for PE pipe connecting elements 40/50 mm Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020115870
	Elevating base for installing the outdoor unit at a higher position (20 cm): Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water **Note:** A maximum of two elevating bases may be used per outdoor unit.	0020093781

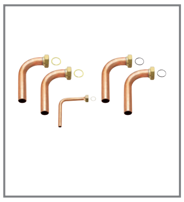
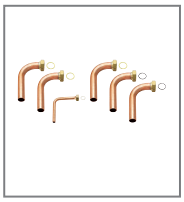
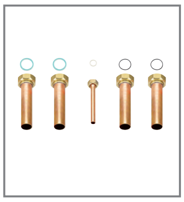
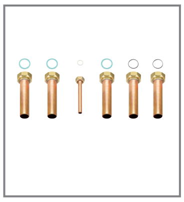
Accessories	Description	Order no.
Brine circuit accessories		
	Solar/brine expansion vessel, 18 litres, wall-hung; resistant to solar fluids for installations up to 10 bar Suitable for **flexoTHERM** and **flexoCOMPACT** heat pumps Pre-charge pressure of 2.5 bar (to be reduced to 1.0 bar when used with heat pumps)	302097
	Solar/brine expansion vessel, 25 litres, wall-hung; resistant to solar fluids for installations up to 10 bar Suitable for **flexoTHERM** and **flexoCOMPACT** heat pumps Pre-charge pressure of 2.5 bar (to be reduced to 1.0 bar when used with heat pumps)	302098
	Heat pump brine filling unit for simple filling and rinsing of the brine circuit, consisting of: Brine flow/return connections for 35 mm diameter plain-end pipe, connection for brine expansion tank, connection for filling pump, diffusion-tight insulation, manometer. Can be used for **flexoCOMPACT exclusive** air/water, **flexoCOMPACT exclusive** brine/water, **flexoTHERM exclusive** air/water, **flexoTHERM exclusive** brine/water, VWS 220/3, VWS 300/3, VWS 380/3.	0020106265
	Solar/brine collecting container with a collection volume of 9 litres: (W x H x D): 300 mm x 270 mm x 140 mm. Incl. Installation accessories and combined filling/draining cock valve for draining, plastic vessel for absorbing discharged solar/brine fluid. Can be used for **auroTHERM exclusive**, **auroTHERM plus**, VFK 145 H, VFK 145 V, **flexoCOMPACT exclusive**, **flexoTHERM exclusive**, **geoTHERM** VWS > 20 kW, VWS 36/4.	0020145563

Accessories	Description	Order no.
	20 l ready-mixed brine fluid with frost protection for temperatures down to -30 °C: 44 vol.% ethylene glycol/water mixture. Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water.	0020096232
	30 l ready-mixed brine fluid with frost protection for temperatures down to -16 °C: 30 vol.% ethylene glycol/water mixture. Can be used for **flexoCOMPACT exclusive** brine/water, **flexoTHERM exclusive** brine/water, **geoTHERM** VWS > 20 kW, VWS 36/4. **Note:** Not for **flexoTHERM** with **aroCOLLECT**.	0020147182
	VWZ AV automatic air vent set for **aroCOLLECT** outdoor unit Can be used for **flexoCOMPACT exclusive** air/water, **flexoTHERM exclusive** air/water	0020129148

14.8 Accessories for hot water generation

Accessories	Description	Order no.
Domestic hot water heat pump connection		
	Air connection set for **aroSTOR** VWL Can be used for **aroSTOR**.	0020205775
Domestic hot water station accessories		
	1 1/4" circulation pump set Electrical connection: 230 volt/50 Hz, IP 44 **Note:** Observe the pressure loss of the drinking water installation. If it is too high, the minimum volume flow of the domestic hot water station will not be reached.	0010015144
Safety groups		
	Cylinder safety group for a content of up to 200 l For cold water connection and mains overpressure of up to 10 bar, R 1/2 expansion relief valve, non-return valve, isolation valve, R 3/4 connections.	0020060434
	Cylinder safety group for a content of more than 200 l For cold water connection and mains overpressure of up to 10 bar, R 1 connections	305827
	R 3/4 safety group: Passage with stopcock, measuring stub pipes, non-return valve, R 3/4 expansion relief valve and two threaded connections with R 1 outside thread for mains overpressure below 6 bar and a cylinder capacity of more than 200 l, can be used for **eloSTOR** VEH 200 - 400	000473
	Safety group with R 3/4 pressure reducer Passage with stopcock, measuring stub pipes, non-return valve, R 3/4 expansion relief valve, pressure reducer and two threaded connections with R 1 outside thread for mains overpressure below 16 bar and a cylinder capacity of more than 200 l, can be used for **eloSTOR** VEH 200 - 400	000474

14.9 Accessories for unit installation

Accessories	Description	Order no.
Heat generator connection accessories		
	90° installation set for **flexoCOMPACT**, consisting of: 4 x 35 mm dia. 90° pipe for heating and brine with G 1 1/2 union nut; 2 x 1 1/2" rectangular seal; 2 x O-ring seal (for brine line), 1 x 15 mm dia. 90° pipe for expansion vessel with G 3/4 union nut and seal. Can be used for **flexoCOMPACT exclusive**.	0020212718
	90° installation set for **flexoTHERM**, consisting of: 5 x 35 mm dia. 90° pipe for heating and brine with G 1 1/2 union nut, 3 x 1 1/2" rectangular seal, 2 x O-ring seal (for brine line), 1 x 15 mm dia. 90° pipe for expansion vessel with G 3/4 union nut and seal. Can be used for **flexoTHERM exclusive**.	0020212716
	Straight installation set for **flexoCOMPACT**, consisting of: 4 x 35 mm dia. 20 cm long pipe for heating and brine with G 1 1/2 union nut, 2 x 1 1/2" rectangular seal, 2 x O-ring seal (for brine line), 1 x 15 mm dia. 20 cm long pipe for expansion vessel with G 3/4 union nut and seal. Can be used for **flexoCOMPACT exclusive**.	0020212717
	Straight installation set for **flexoTHERM**, consisting of: 5 x 35 mm dia. 20 cm long pipe for heating and brine with G 1 1/2 union nut, 3 x 1 1/2" rectangular seal, 2 x O-ring seal (for brine line), 1 x 15 mm dia. 20 cm long pipe for expansion vessel with G 3/4 union nut and seal. Can be used for **flexoTHERM exclusive**.	0020212715

Accessories	Description	Order no.
Safety equipment		
	Rp 1/2 boiler safety group for **ecoVIT** up to 50 kW, fully preassembled, consisting of: Boiler safety group (≤ 65 kW), 3 bar to 50 kW expansion relief valve (Rp 1/2), removable EPP insulation jacket, manometer, automatic air vent, filling device, 3/4" sealing ring, connection pipe with insulation and 3/4" and 1" union nuts, 1" sealing ring (2 pcs), brass connection bracket with 1" union nut, G1 x R 3/4 adapter nipple with O-ring (enclosure).	307591
Other		
	Tundish to connect to the overflow line: R 1 tundish with siphon and collar.	000376

15 SG Ready and PV Ready

15.1 SG Ready

The SG Ready label (SG = Smart Grid) is given to heat pump series that feature control technology that enables the individual heat pump to be incorporated into an intelligent power grid. Heat pump manufacturers and operating companies can apply for this label.

The label is awarded in Germany only and is not valid elsewhere.

The following Vaillant heat pumps come with the SG Ready label:

- flexoTHERM exclusive
- flexoCOMPACT exclusive
- aroTHERM
- aroSTOR

Installation-relevant units and accessories

- Vaillant **flexoTHERM** VWF 57/4, VWF 87/4, VWF 117/4, VWF 157/4, VWF 197/4 heat pump

and/or

- Vaillant **flexoCOMPACT** VWF 58/4, VWF 88/4, VWF 118/4 heat pump

and/or

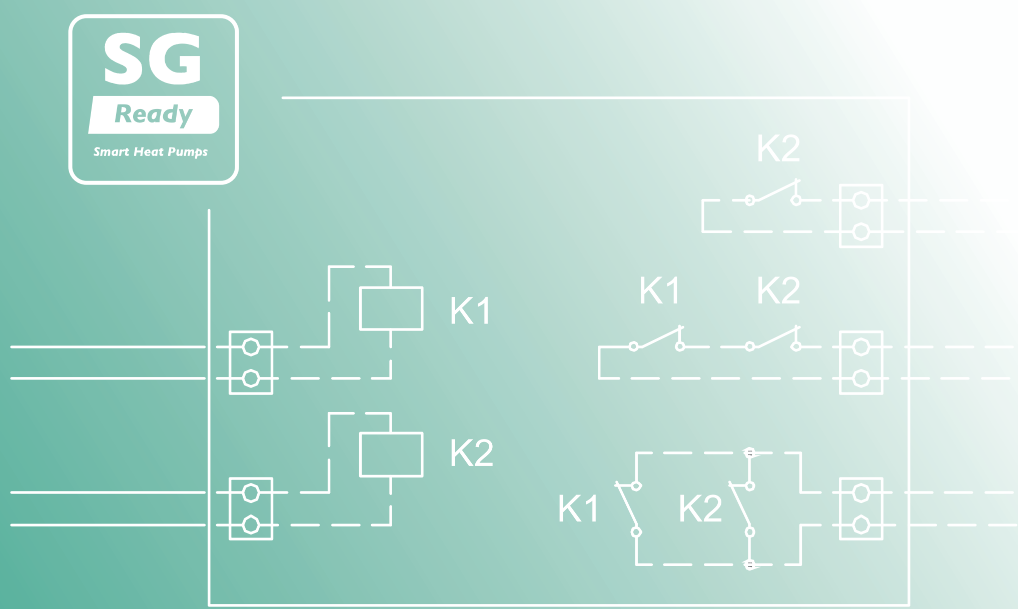
- Vaillant **aroTHERM** VWL 55/3, VWL 85/3, VWL 115/2, VWL 155/2 heat pump and the additional VWZ MEH 61 decoupler module

with

- Vaillant **VRC 700** system control
- Vaillant VR 70/ VR 71 system expansion module
- Two external relays each with one N/C contact and one N/O contact with gold contacts for 24 V/20 mA
- System connection no. 0020212759 for **flexoTHERM**
- System connection no. 0020212760 for **aroTHERM**

OR

- Vaillant **aroSTOR** VWL B 290/4 and VWL BM 290/4 domestic hot water heat pump



Functionality

The smart grid switching statuses 0:0, 0:1, 1:0, 1:1 are passed to the Vaillant system by an on-site transfer point. This must consist of two relays.

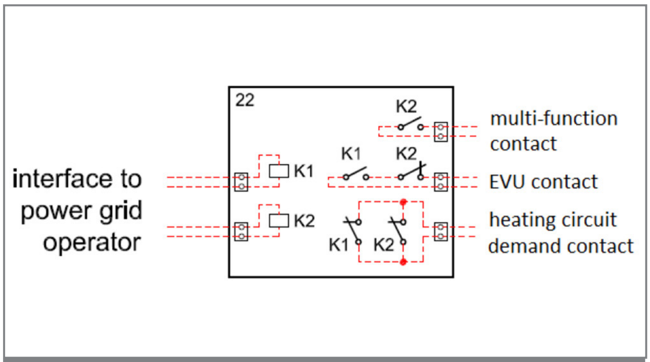


Fig. 382: On-site signal transmission point / processing of energy suppliers

Key for signal processing for the flexoTHERM and flexoCOMPACT

flexoTHERM/flexoCOMPACT	Terminal
Multi-function contact	FB/OT "neutral ground" from the HMU terminal block X 41
Energy supply company contact	S 21 from the HMU
Heating circuit demand contact	S 2 of VR 70 module

Key for signal processing for the aroTHERM

aroTHERM	Terminal
Multi-function contact	ME VWZ AI or MEH 61
Energy supply company contact	VWZ AI or MEH 61
Heating circuit demand contact	S 2 of VR 70 module

Switching status 1 or 1:0 (K1 = 1; K2 = 0) Forced switch-off

Operation: The heat pump and the electric back-up heater are off.

Switching status 2 or 0:0 (K1 = 0; K2 = 0) Normal operation

Operation: No restriction on heat pump operation.

Switching status 3 or 0:1 (K1 = 0; K2 = 1) Switch-on recommendation

Operation: The system stores energy in the domestic hot water cylinder by triggering cylinder boost until the target temperature that is set in the **VRC 700** is reached. The system then stores energy in the buffer cylinder (if available) by increasing the temperature to the target value set in the **VRC 700** control.

In the case of domestic hot water generation, the forced charging prevails over the time programmes for hot water. Cylinder charging is carried out outside of the set time periods.

If there is no heat requirement and switching status 3 is present, no cylinder charging takes place in heating mode.

Switching status 4 or 1:1 (K1 = 1; K2 = 1) Forced switch-on

Operation: The system stores energy in the domestic hot water cylinder by triggering cylinder charging. The system then stores energy in the buffer cylinder by increasing the temperature to the target value set in the **VRC 700** and a variably adjustable offset. The temperature value is above the value set for switching status 3.

For domestic hot water, see switching status 3.

Heating mode deviation: Due to an additional virtual heating circuit (with variably adjustable separate target value (from x-y)), an artificial heat requirement is generated in any case, which leads to the buffer cylinder being charged to the target value and the variably adjustable offset (0 20 K). (Offset status 3 = Offset status 4).

A normal heating circuit is not affected by the cylinder charging.

Note
When using several real heating circuits, a usable heating circuit is no longer necessary if you want to use status 4. A non-mixed or mixed heating circuit can be used for this.

Connecting to the flexoTHERM/ flexoCOMPACT exclusive

1. Connecting the transfer point to the Vaillant system as can be seen from the system wiring 0020212759
2. The series circuit of the N/O contact of K1 and the N/C contact of K2 must be connected to the **S21** ESC contact of the flexoTHERM/flexoCOMPACT heat pump. The N/O contact of K2 must be connected to the **FB** „multi-function input“ and **OT** „neutral ground“ of terminal block X41.
3. The parallel switching of the N/C contact of K1 and the N/C contact of K2 must be connected to the **S2** contact of the external VR 70 module. The VR 70 module is installed next to the heat pump and is integrated into the eBUS system.

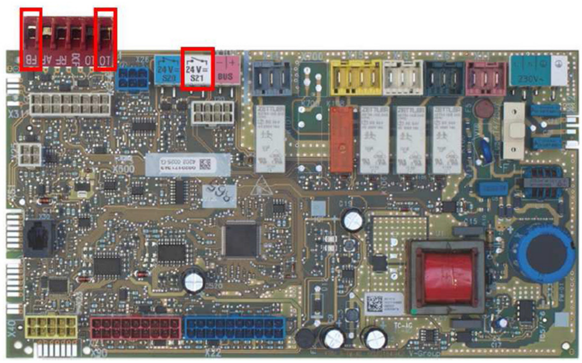


Fig. 383: Control PCB with highlighted energy supply company (ESC) input (S21) and multi-function input (FB and neutral/earth)

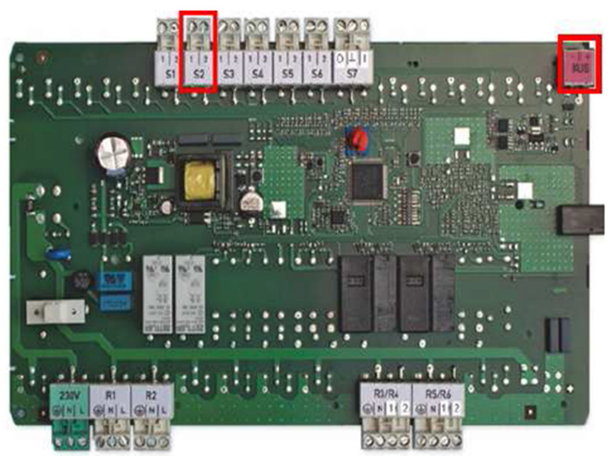


Fig. 384: VR 70 PCB with highlighted S2 input and eBUS connection

Connecting to aroTHERM

1. Connecting the transfer point to the Vaillant system as can be seen from the system wiring 0020212760
2. Connect the N/O contact of K1 and the N/C contact of K2 to the ESC input so that they are connected in series.
3. Connect the N/O contact of K2 to the ME input.
4. The parallel switching of the N/C contact of K1 and the N/C contact of K2 must be connected to the **S2** contact of the external VR 70 module. The VR 70 module is installed next to the heat pump and is integrated into the eBUS system.

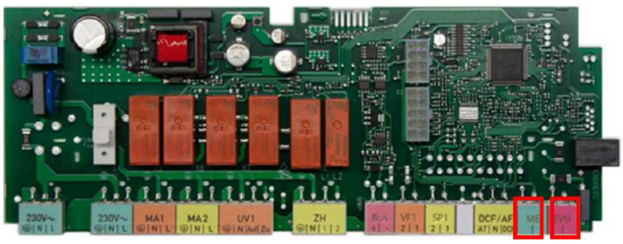


Fig. 385: Decoupler module PCB with selected multi-functional input and ESC input

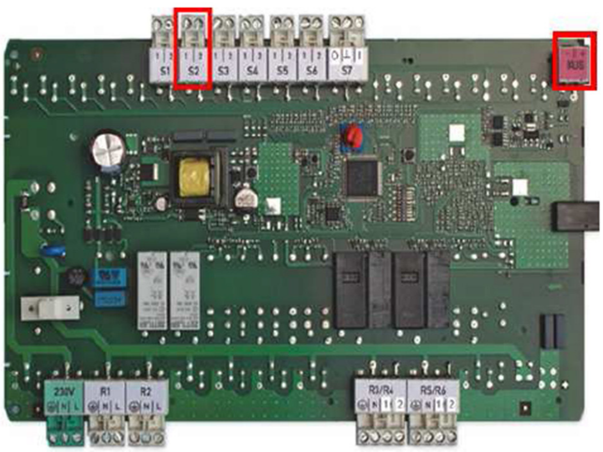


Fig. 386: VR 70 PCB with highlighted S2 input and eBUS connection

Settings in the VRC 700 system control for flexoTHERM, flexoCOMPACT and aroTHERM

- VRC700_1-5576 – Basic system diagram = 8
- VRC700_1-5512 – Configuration: VR 70, addr. 1 = 1
- VRC700_1-7697 – Energy supplier = HP&BH off
- VRC700_1-9784 – Multi-function input = Smart PV
- VRC700_1-9920 – PV buffer cylinder offset = e.g. 10 K
- VRC700_1-7923 – Zone activated = Yes (for zone/HK B)
- VRC700_1-5391 – Type of circuit = Fixed value (for HK A)
- VRC700_1-5391 – Type of circuit = Heating (for HK B)
- VRC700_1-4508 – Outs. temp. switch-off threshold = e.g. 21 °C (identical for both HK A and HK B)
- VRC700_1-5401 – Day target flow temperature = e.g. 50 °C (for HK A)
- VRC700_1-5402 – Night target flow temperature = 0 °C (for HK A)
- VRC700_1-4504 – Operating mode/heating = Day (for zone/HK A)

Further functions are described in the **VRC 700** installation instructions.

Setting in the flexoTHERM/flexoCOMPACT heat pump

Cooling: **Cooling OFF**

Connection to aroSTOR domestic hot water heat pump

Low tariff/high tariff

A low-tariff plug (LT plug) designed as a potential-free switching contact is located on the relay printed circuit board. If the power supply network operator opens this contact, it is possible to set the components which take over cylinder charging in the heat pump menu under the „AUX.SETT." parameter during high-tariff periods (heat pump, back-up heater, none). If a photovoltaic installation is integrated into the system, this function is not available.

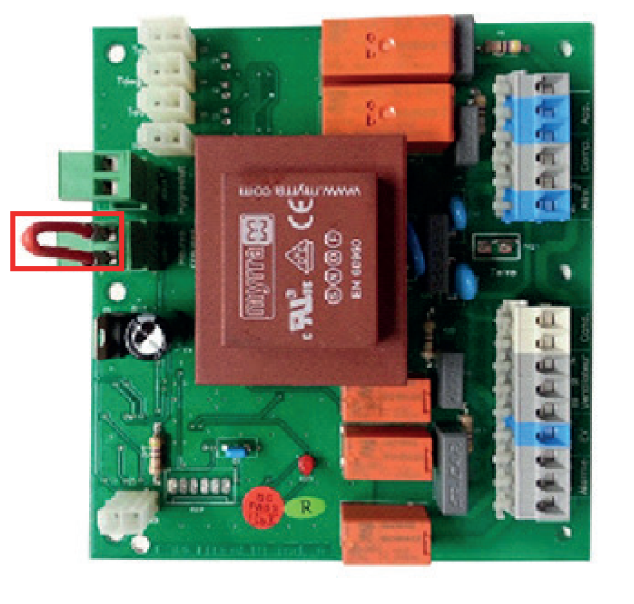


Fig. 387: aroSTOR relay printed circuit board with low-tariff plug

System plans

flexoTHERM and flexoCOMPACT

flexoTHERM VWF 57/4, VWF 87/4, VWF 117/4, VWF 157/4 and VWF 197/4.

flexoCOMPACT VWF 58/4, VWF 88/4 and VWF 118/4.

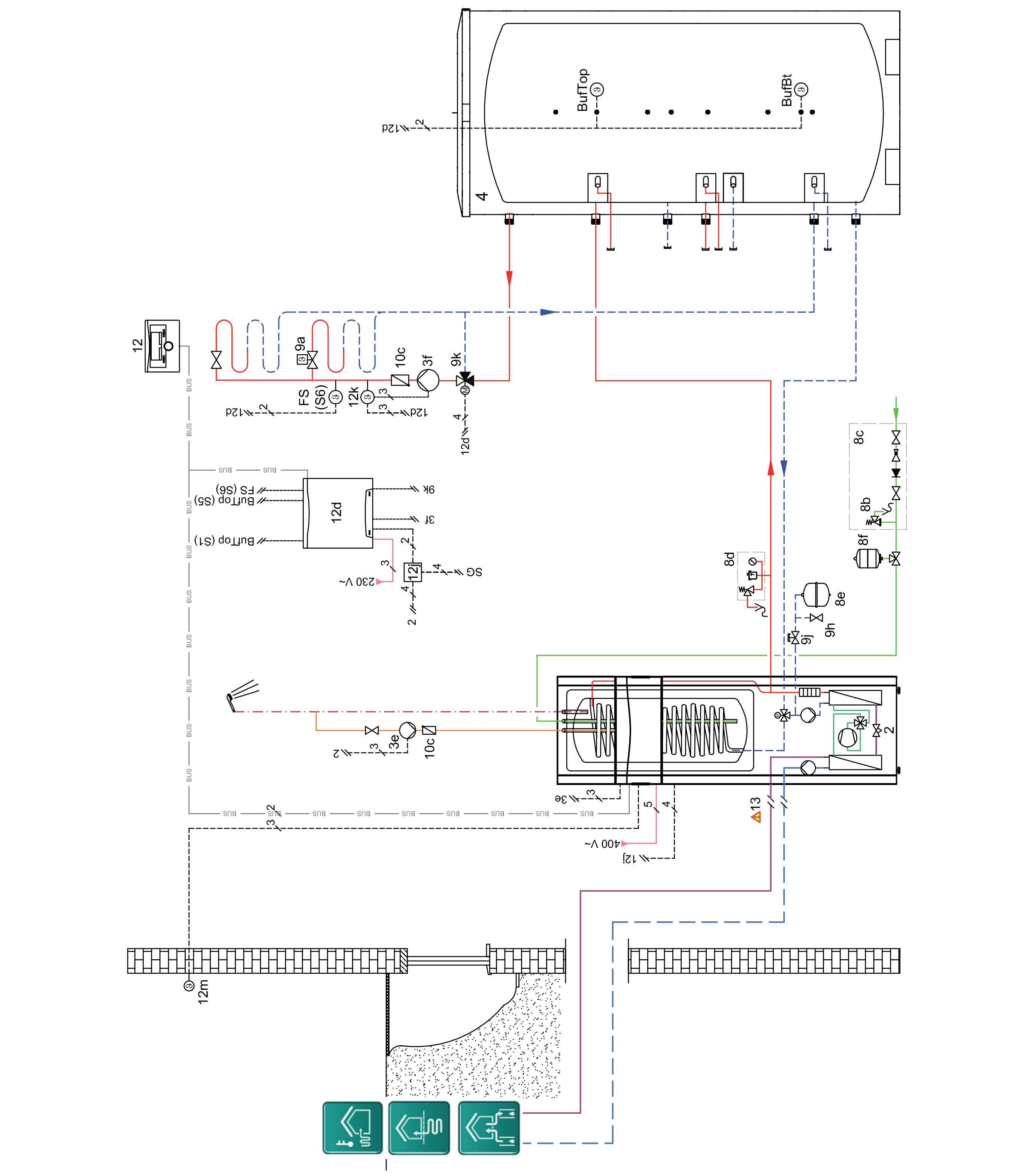
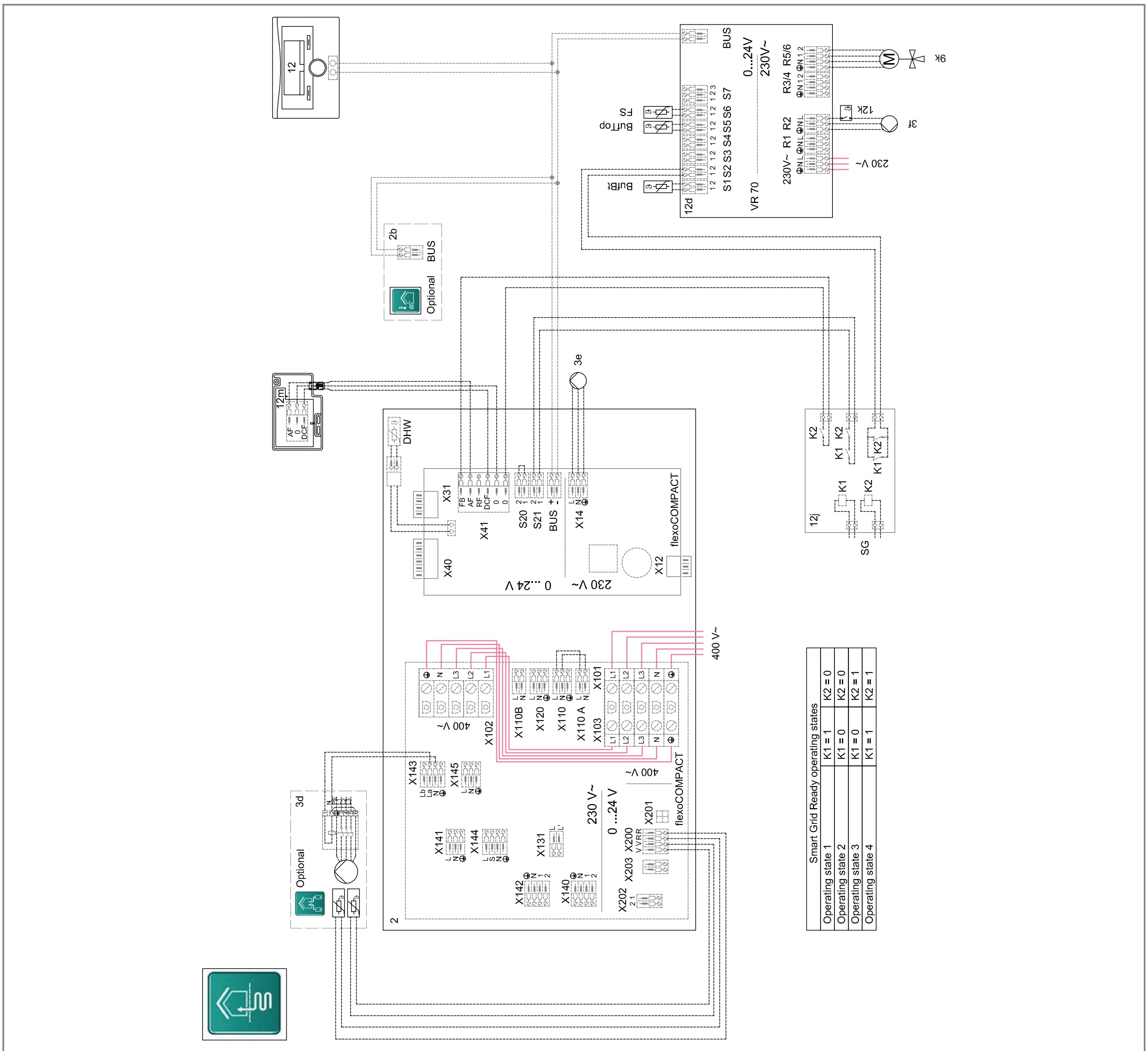


Fig. 388: Hydraulic plan flexoTHERM/ flexoCOMPACT



Smart Grid Ready operating states		
Operating state 1	K1 = 1	K2 = 0
Operating state 2	K1 = 0	K2 = 0
Operating state 3	K1 = 0	K2 = 1
Operating state 4	K1 = 1	K2 = 1

Fig. 389: Wiring diagram flexoTHERM/ flexoCOMPACT

aroTHERM

VWL 55/3, VWL 85/3, VWL 115/2 and VWL 155/2.

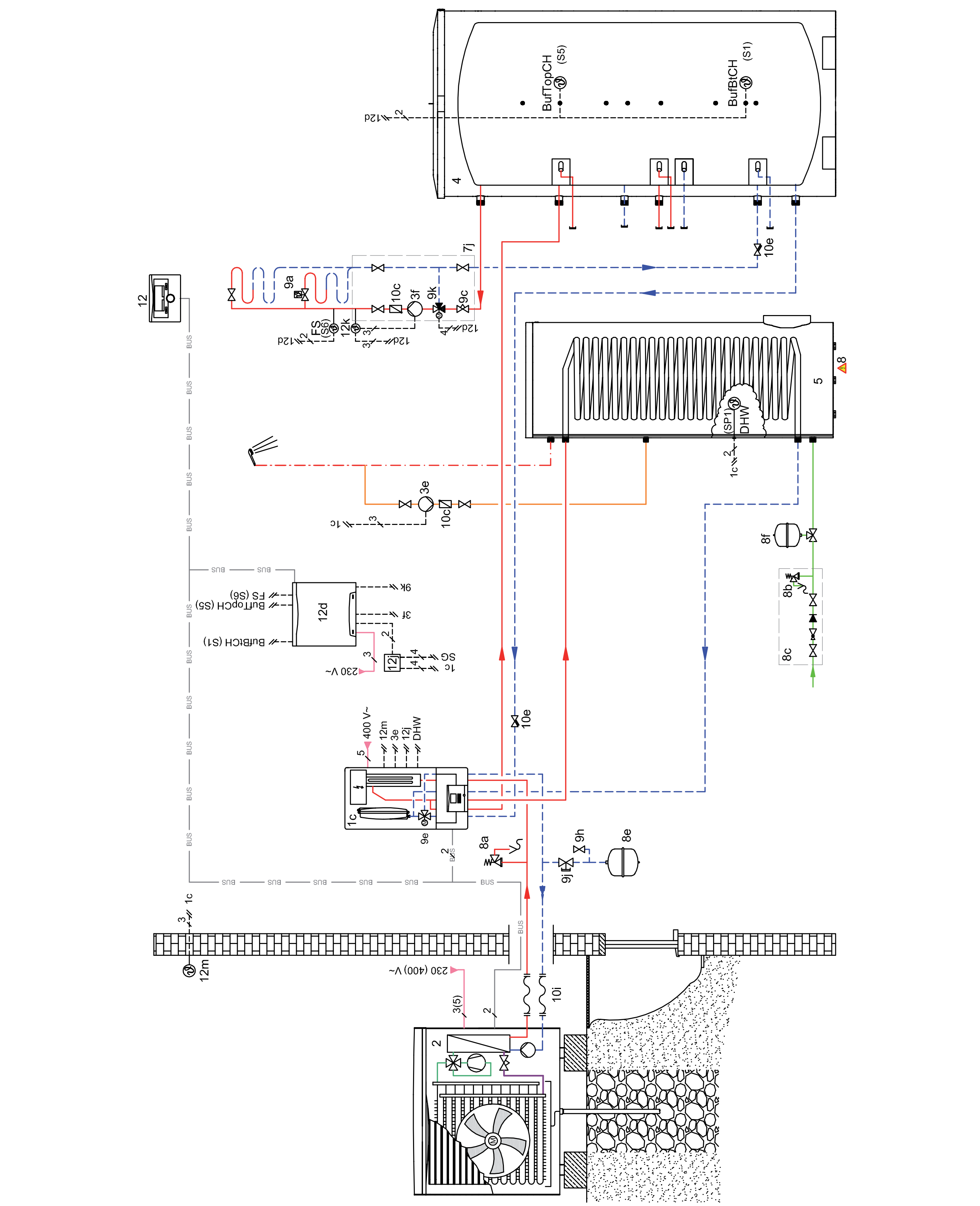
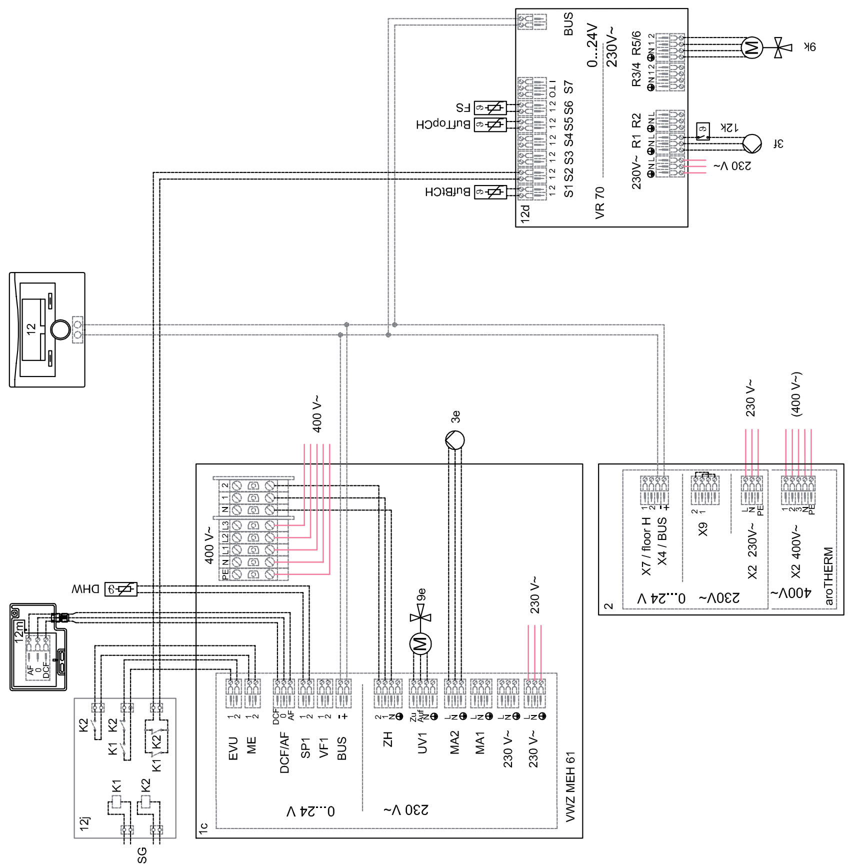


Fig. 390: Hydraulic plan aroTHERM



Smart Grid Ready operating states		
Operating state 1	K1 = 1	K2 = 0
Operating state 2	K1 = 0	K2 = 0
Operating state 3	K1 = 0	K2 = 1
Operating state 4	K1 = 1	K2 = 1

Fig. 391: Wiring diagram aroTHERM

15.2 PV Ready

Excess electricity that is generated by the photovoltaic installation can be used for a heat pump. As a result, the solar current is not only used in your own household but, thanks to heat pump technology, it is also simultaneously efficiently converted into heat and stored.

This means that the energy production of the photovoltaic installation is used optimally, and you can use more of the energy you produce yourself.

To actuate the heat pump specifically when there is excess PV energy, the switching statuses 1 and 2 of the PV Ready are used.

Functionality

The switching states 1 and 2 are transmitted to the heating system by an on-site transfer point.

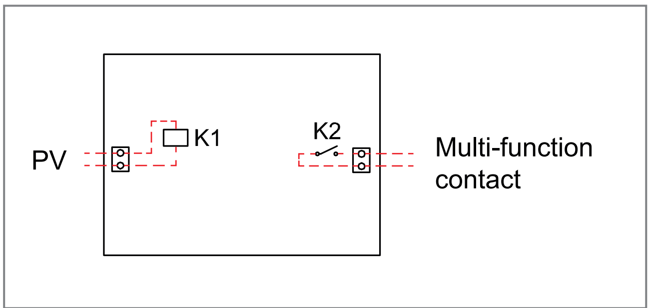


Fig. 392: On-site signal transfer point

Switching status 1 (K1 = 0) normal mode

Operation: No restriction on heat pump operation.

Switching status 2 (K1 = 1) switch-on recommendation

Operation: The system stores energy in the domestic hot water cylinder by triggering one-time cylinder charging until the target temperature that is set in the control is reached. The system then stores energy in the buffer cylinder (if available) by increasing the temperature by the target value set in the control. In the case of domestic hot water generation, the forced charging prevails over the time programmes for hot water. Cylinder charging is carried out outside of the set time periods.

If there is no heat requirement and switching status 2 is present, no cylinder charging takes place in heating mode.

Connecting to the flexoTHERM/ flexoCOMPACT exclusive

For the **flexoTHERM**/**flexoCOMPACT**, the „FB and OT“ contact on plug X 41 is closed by an energy manager in the photovoltaic installation, for example (as of software version 304.03.00). In advance of this, the competent person must set the „multi-function input“ on the VRC 700 to „PV“.

The PV function has been provided since the VRC 700/2. If a VR 70 wiring centre is available in the system, a bridge must be installed at sensor input S2.

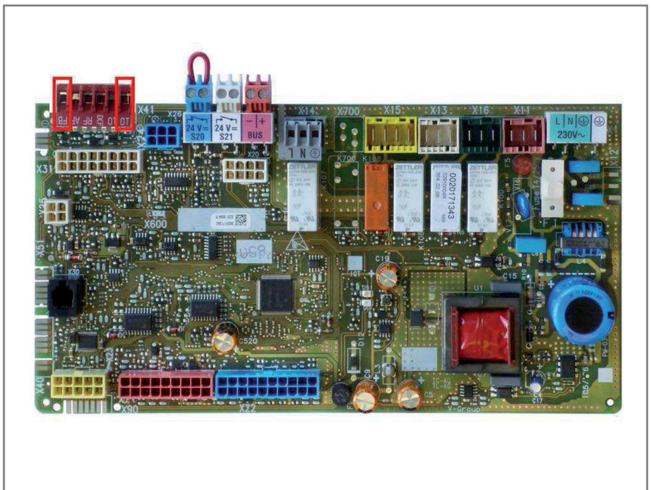


Fig. 393: FB and OT contacts on the PCB

1. Connecting the transfer point to the system as can be seen from the system wiring 0020177918.
2. **Switch-on recommendation:** Connect the N/O contact of K2 to plug X 41 on the FB and OT contacts.
3. **Optional:** If a VR 70 wiring centre is available, install a bridge at sensor input S2.

Connecting to the aroTHERM or geoTHERM

With the **aroTHERM** or **geoTHERM VWS 36/4.1,** the ME multi-functional input with the potential-free contact of the Energy Manager must be connected to the connection PCB of the VWZ MEH 61, the VWZ AI or the VIH QW 190.

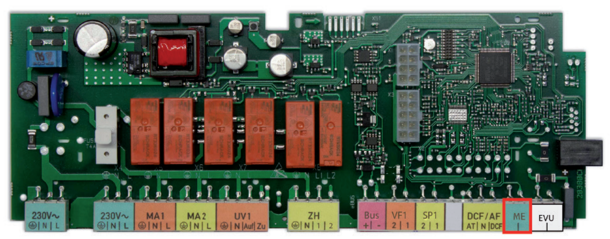


Fig. 394: VWZ MEH 61 – with multi-functional input and energy supply company input

1. Connecting the transfer point to the system as can be seen from the system wiring 0020223729.
2. **Switch-on recommendation:** Connect the N/O contact of K2 to the ME input.

Connection to aroSTOR domestic hot water heat pump

A plug for an external fan control (1) and a low-tariff plug (LT plug) designed as a potential-free switching contact are located on the relay printed circuit board. If these contacts are connected to the photovoltaic installation, two different switching statuses arise.

In doing so, note that only one of the two switching statuses may be used. You cannot connect both statuses to one system.

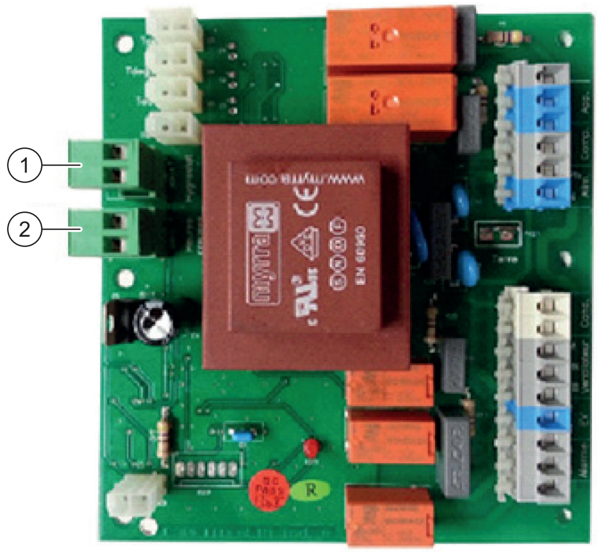


Fig. 395: Relay PCB with external fan control and low-tariff plug

1 External fan control system (compressor and electrical immersion heater)
2 Low-tariff plug (compressor only)

This function can make use of the self-sufficiency optimised by the photovoltaic installation to supply the heat pump and the electrical immersion heater and to heat up the water in the cylinder.

System plans

flexoTHERM and flexoCOMPACT

flexoTHERM VWF 57/4, VWF 87/4, VWF 117/4, VWF 157/4 and VWF 197/4.

flexoCOMPACT VWF 58/4, VWF 88/4 and VWF 118/4.

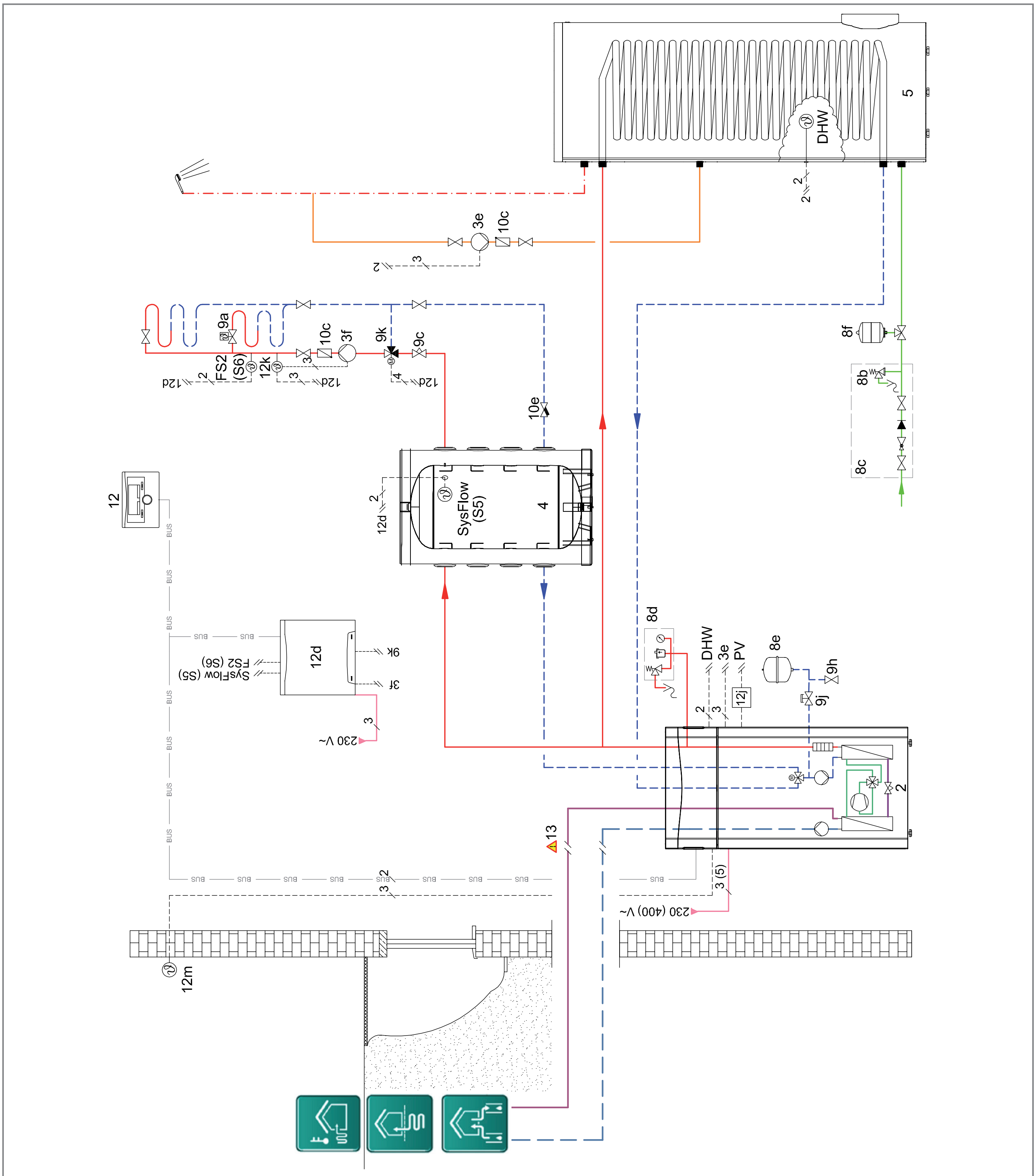
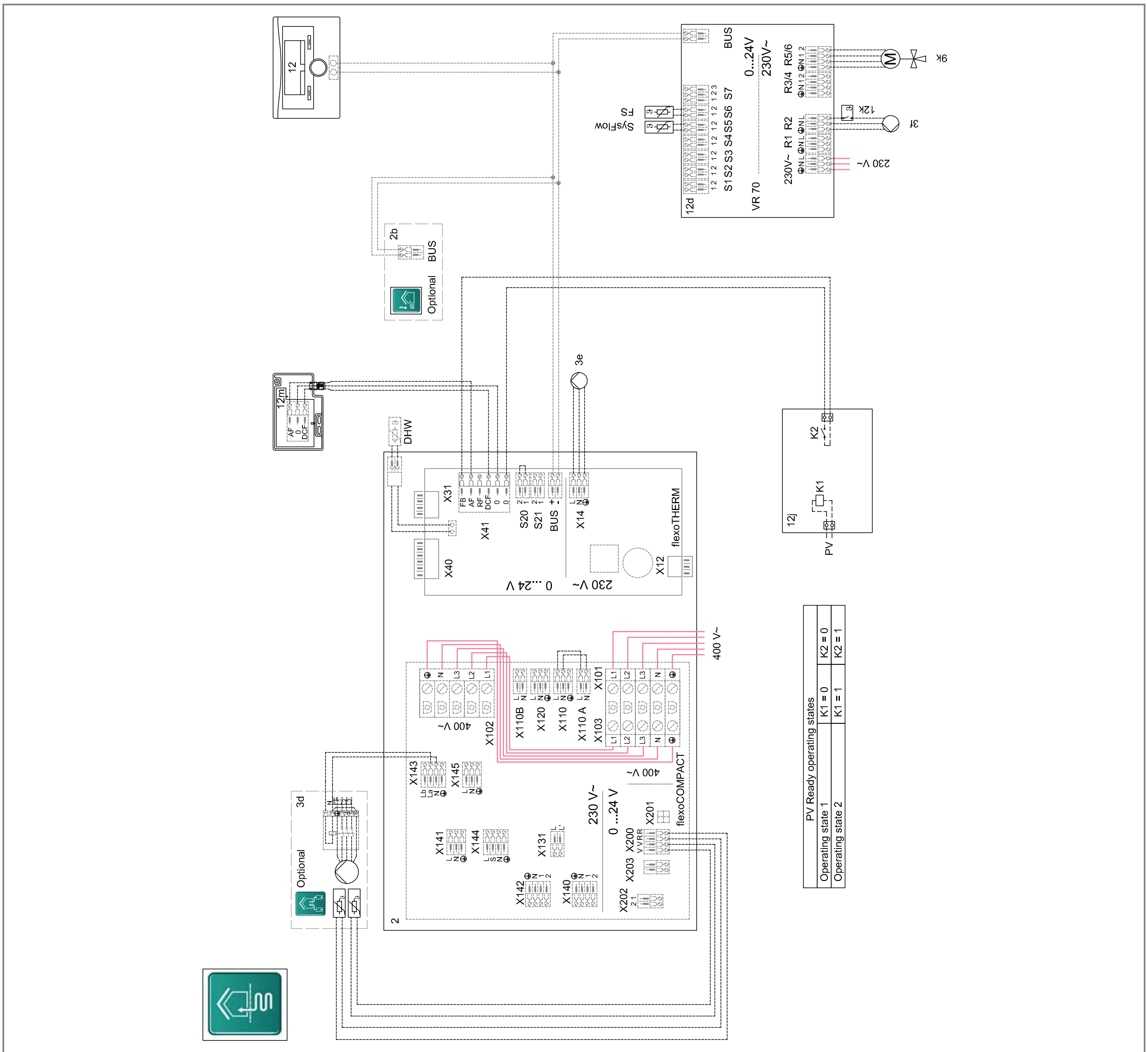


Fig. 396: Hydraulic plan flexoTHERM/ flexoCOMPACT



PV Ready operating states		
Operating state 1	K1 = 0	K2 = 0
Operating state 2	K1 = 1	K2 = 1

Fig. 397: Wiring diagram flexoTHERM/ flexoCOMPACT

aroTHERM

VWL 55/3, VWL 85/3, VWL 115/2 and VWL 155/2.

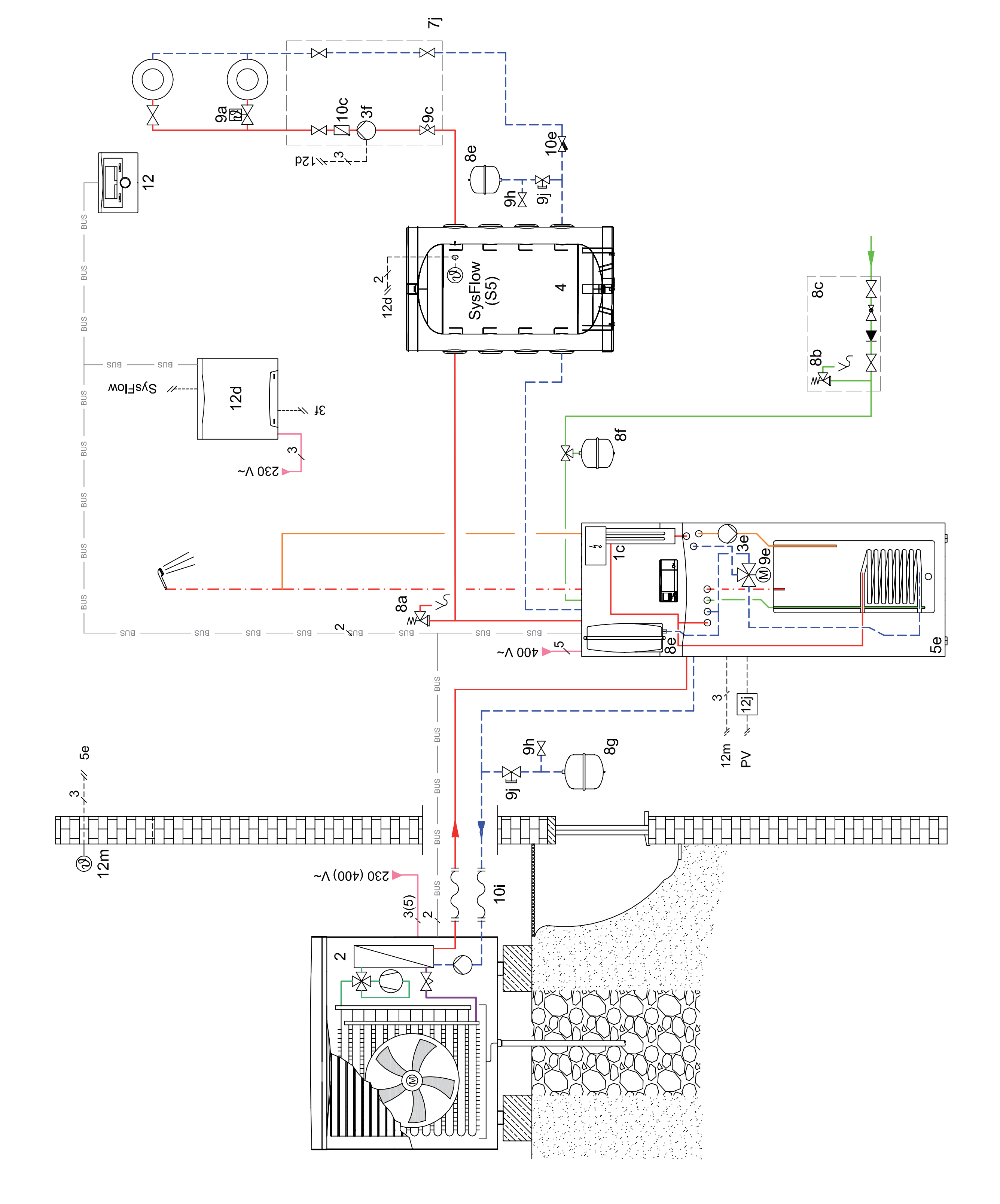
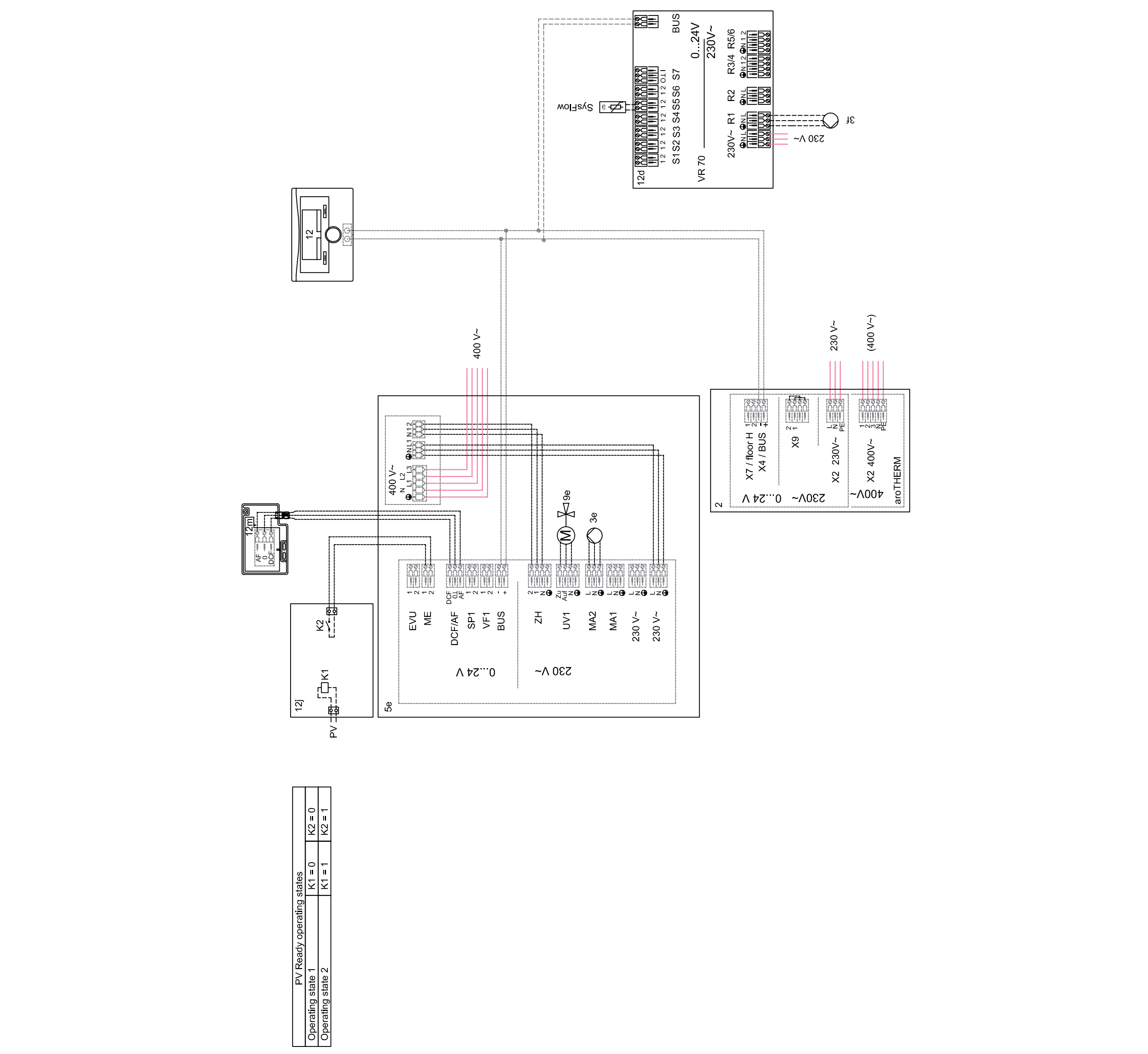


Fig. 398: Hydraulic plan aroTHERM



PV Ready operating states		
Operating state 1	K1 = 0	K2 = 0
Operating state 2	K1 = 1	K2 = 1

Fig. 399: Wiring diagram aroTHERM

Change history

Update 05, March 2018

Chapter		Topic	Comments
3	**Planning the building**		
3.5	Planning in new buildings	Note screed drying	Addition Extension
7	**Buffer cylinder**		
7.1	Dimensioning buffer cylinders	Calculation EnEV data	Calculation adjusted
7.3	Vaillant heating buffer cylinder – Overview	uniTOWER	Adjustment and update
8	**Planning the heat source**		
8.4	Heat sources for air/water heat pumps	Schematic drawing aroTHERM split	Drawing adjusted
9	**Planning the installation of the heat generator**		
9.2	Planning the installation site – installing the heat pump/ outdoor unit outside	Updating aroCOLLECT	Drawing adjusted
9.2	Planning the installation site for aroTHERM and aroTHERM split	Updating aroTHERM split	Drawing adjusted
9.4	Noise emissions		Additions and adjustments
12	**Hot water generation**		
12.8	Heat-up times for the domestic hot water cylinder and heat generator – Overview	Extension at aroTHERM split	Additions
12.16	Product description for uniTOWER VIH QW 190/1 E	Tilt height and pressure loss	Drawings additioned
12.17	Product description for uniTOWER VWL	Tilt height and pressure loss	Drawings additioned
13	**Intelligent system combinations from Vaillant**		
13.15	recoCOMPACT exclusive VWL 39/5 heat pump in a house		Drawing adjusted
13.17	versoTHERM VWL 37/5 heat pump with versoVAIR in a house		Drawing additioned
14	**System accessories**		
14.2	Accessories for the aroTHERM and 3 kW heat pump systems	Pressure loss diagrams	Drawings additioned
14.3	Accessories for the aroTHERM split heat pump system	Pressure loss diagrams	Drawings additioned
PI1-PI11	**Product information**	NEW: Product combinations	Drawing additioned
PI8	**aroTHERM split product information**	Technical data	Update

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0020222099_05 • Produktinformationen Wärmepumpen • 03/18 • Technische und inhaltliche Änderungen vorbehalten • Angaben ohne Gewähr