

TECHNICAL DOCUMENTATION, INSTALLATION INSTRUCTIONS AND MANUAL



VARICAL

The universal modular buffer store

Application • Use

- Large storage volumes for hot water through fresh water heat exchanger
- Heat generators that need larger buffer volumes
 - Solar heat
 - Biomass boilers
 - Heat pumps
 - Combined heat and power units
 - District heating
 - Power to heat
- Especially suitable for heating system refurbishment
 - Multi family homes
 - Hotels
 - Sun houses

Special benefits

- Can fit through narrow cellar doors and corridors
- Reduced space requirement compared to multiple stores
- Pressurised store: Buffer water can be saved and used directly – no reductions through heat exchangers
- Heat loss reduced by a half compared with storage cascade with same thermal insulation
- Thermal insulation with optional vacuum inserts for extremely low heat loss.
- Very good stratification layering
- Use as a hydraulic separator with minimum mixing at high flow rates

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1 Introduction

1.1 General

This manual applies to the modular buffer store and is part of the scope of supply. The manual covers installation, operation and maintenance. This manual is intended for professional installers who are authorized for the respective areas of responsibility. They must possess the necessary expertise and be informed about the relevant accident prevention measures.

Read this manual with safety information and instructions for the installation and commissioning carefully before installation. Prevent damage to your system caused by improper handling. Non-observance of the safety instructions can lead to danger, damage to property and environmental damage. The indicated instructions and recommendations do not claim to be exhaustive. All relevant guidelines, standards and regulations for assembly and operation of a heating system are to be heeded. Our terms and conditions in its currently valid version apply.

1.2 Intended use

The store can be used in existing or newly built heating systems. They are intended exclusively for the heating and storage of heating water. The improper use, not taking into account of the provisions of this manual as well as unacceptable changes in installation practice, process or the construction lead to the exclusion of any liability and warranty claims.

1.3 Security

The general safety and warning notes are an integral part of this manual and have fundamental importance for the use of the product.

Caution!



This sign warns of property and personal injury.

Caution!

Risk of burns and scalding!
In the store temperatures > 60 °C can occur, therefore there is a risk of burns and scalding by the connectors or the components.
=> Do not touch hot parts

The stores are built to the state of the art and according to all recognised safety standards. Nevertheless, dangers to life and limb of the user or third parties or damage of the product and other material assets deriving from the use.

Operate the store only in technically perfect condition. In case of safety-related dysfunction the product must be stopped immediately and be fixed by a specialist.

1.4 With applicable documents

Follow the planning and operating instructions of all system components, such as fresh water station.

1.5 Installation instructions

The assembly of the product may only be by trained engineers. In addition to specific provincial and municipal regulations and guidelines note also the following standards for the installation.

- EN 806 Specifications for installations inside buildings conveying water for human consumption
- DIN 1988 Codes of practice for drinking water installations
- EN 1717 Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow
- DIN 4708 Central heat-water-installations
- DIN 4753 Water heaters, water heating installations and storage water heaters for drinking water; Requirements, marking, equipment and testing
- DIN 18380 German construction contract procedures (VOB) – Part C: General technical specifications in construction contracts (ATV) – Installation of central heating systems and hot water supply systems
- DIN 18381 VOB – Part C: ATV – Installation of gas, water and drainage pipework inside buildings
- EN 12828 Heating systems in buildings – Design for water-based heating systems
- EN 12897 Water supply – Specification for indirectly heated unvented (closed) storage water heaters
- EN 12975 Thermal solar systems and components
- IEC 60364-5-54:2011 Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors
- VDI 2035 [german guideline for the prevention of damage in water heating installations]
- DVGW Standards and worksheets: requirements and testing for drinking water heating systems, especially DVGW W 551 Drinking water heating and drinking water piping systems

2 Description

This innovative storage system was developed for the market segment of existing multi-family buildings. It was developed by CONSOLAR and the Research and Test Centre for Solar Energy Systems (TZS) of the Institute of Thermodynamics and Thermal Engineering (ITW) at the University of Stuttgart. It was funded by the Federal Ministry for Economic Affairs and Energy (Germany). The modular buffer store allows for storage capacities of up to 11 m³ in particular in existing multi-family buildings due to its modularity.

The buffer store is designed as a pressurised vessel, so that it can be connected by the installer in the usual manner. This also enables an efficient operation without heat exchanger between store, heating circuit and heat generator. The seal-to-seal assembly and the integrated piping ensure good space utilization and minimize heat losses. There is a European patent application for the storage system.

2.1 Special benefits

Modular system fits through any standard door

The individual modules fit through 70 cm doors and can be brought in existing buildings with narrow entrances and assembled on-site.

Pressure tested

The modular store is designed to work up to 3 bar operating pressure, so that the heat generator and heating circuits can be directly connected.

Flexible integration

The 5 connectors on each side of the store allow for a flexible use as a heater buffer or – in conjunction with a fresh water station – as a combined thermal store in a wide variety of applications.

Layered loading and unloading

Running through the entire length of the store, loading and unloading loading tubes allow a clean layered loading and unloading through the outlet slots with flow reversal.

Integrated mixing-free hydraulic diverter

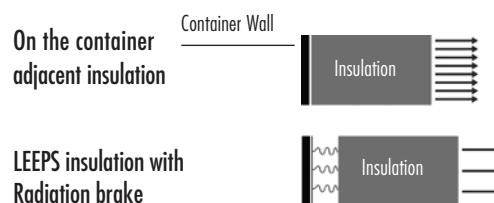
The water from the boiler can flow directly into the heating circuit without any losses due to mixing. This behavior can be achieved if the heat generator is connected on side of the store and the heating circuit on the other side of the same tube. Then only the water the heating circuit is not using flows into the buffer through the slots in the tube. This behaviour is especially important for heat pumps, where any drop in temperature should be avoided.

2.2 Insulation system

Minimized heat loss is achieved by an innovative insulation system optimised in detail

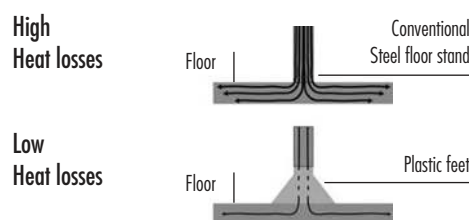
LEEPS insulation

The LEEPS insulation greatly reduces heat loss. Radiant heat losses are reduced by the silver foil lining on the vessel and the fact that the insulation does not contact the vessel. Also the air chambers within the insulation shell reduce heat loss through static air cushions and by reflecting the radiant heat. The inserted LEEPS foam has a very good insulation value.



Plastic feet

Plastic feet reduce the conduction of heat to the floor.



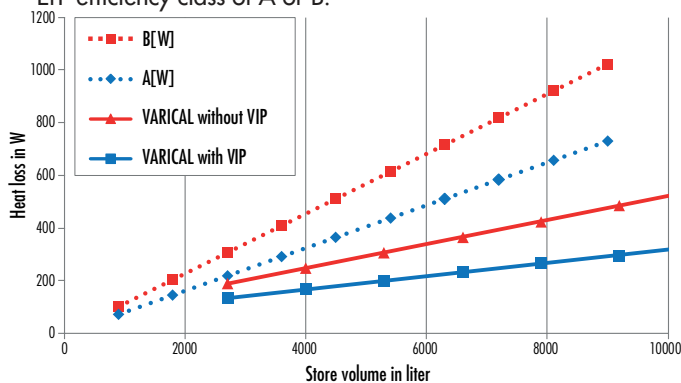
Connections with heat brakes

The thick soft insulation of the front/back enables the (on-site) mounting of anti-thermosyphon connections within the insulation. As a result, the otherwise high conduction heat losses are greatly reduced, without increasing the insulation.

Optional: With or without vacuum insulation

The LEEPS insulation shell allows the incorporation of vacuum insulation panels (VIP). If desired, they are inserted into the air chambers within the insulation shell. They significantly reduce the heat losses further.

The following graphic shows that the heat loss of the VARICAL system is significantly lower when compared to a cascade of common stores that fit through a standard door and have an ErP efficiency class of A or B.



Heat loss of VARICAL in comparison with a cascade consisting of 900 l stores with the same total volume. Calculated on the basis of readings for 3 modules, see section 4. Graphics: ITW

3 Planning aids

3.1 Transport

The store modules must be transported upright. The individual modules are delivered on a pallet and can be easily transported with a forklift truck.

3.2 Notes on buffer water

Water quality

The water quality of the store should at least conform to the guideline VDI 2035 for heating water. Further requirements of the manufacturer are to be observed! We recommend the use of de-ionised water to reduce the risk of corrosion and calcification in store / heating system. In case of the addition of substances such as antifreeze to the water circuit, ask your supplier of the substance whether it is compatible with steel and EPDM.

NOTE: It is to ensure that no other materials or substances (such as sludge, sealants, anticorrosive, etc.) can get in the store, e.g. from existing components of the heating system. Do this through appropriate measures such as flushing of the system, filters, etc.

Expansion tank safety

A volume expansion tank to compensate the thermal expansion has to be sized and installed accordingly. A suitable safety valve without shut-off facility must be connected to the buffer.

Minimum room sizes for the module installation see 4.3

3.3 Connection to boiler and heating circuit

Boiler

The modular buffer store allows the connection of different heating circuits and heat generators at the positions corresponding to their temperature. Boiler and heating circuits are connected directly to the store. This means up to approx. 200 kw can be transferred depending on the temperature difference. Larger capacities and flow rates (see below) are possible by connecting to both sides of the store. The modular buffer store is designed for low return temperatures. With boilers which are sensitive to low return temperatures precautions must be taken, especially if the bottom connection is used.

Connections: The connections of the modular buffer are located in a vertical line on each end. They are connected via pipes for low turbulence loading up to approx. 13 m³/h.

Heating circuit and fresh water station

All the connected heating circuits and transfer stations are required to be diffusion proof. If this is not guaranteed, a system separation has to be planned. Diffusion tightness according to DIN 4726 (0.1 g/m³ and day) is not sufficient.

NOTE: In the case of heating circuits where sludge formation is likely we recommend the installation of a sludge filter or separator (supplier such as Spiro).

It is recommended to use an heating circuit mixer, to ensure the flow temperature depending on the outside temperature. This will significantly reduce the energy consumption. Condensate formation in the lower store area must be prevented by control engineering and hydraulic measures to avoid temperatures below room temperature.

Connection pipes: Generally, siphoned connections are to be used, see section 5.1. Otherwise it is imperative to install U shaped pipe runs with appropriate offset in proximity to the store. This is required to prevent inadmissible tension on the store connection during thermal expansion.

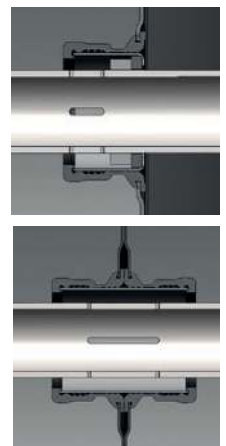
NOTE: After assembly the store must undergo a pressure test with at least 1.2 times the maximum of the operating pressure, i.e. 3 bar. For this purpose shut-off facilities to the connected heating system should be provided.

3.4 Modular design of buffer store

The modular design of the buffer allows an easy increase of the storage capacity.

Seal of the pipe penetrations

For the permanent sealing of pipe penetrations, a special seal system was developed and carefully tested. It seals the individual modules at the pipe penetrations against each other through flat and lamellar seals. It is based on proven long-lasting elastomers in conjunction with stainless steel sleeves. The seals act immediately without pressure during filling and emptying. With increasing pressure, the sealing function increases. The sealing system was successfully tested in a pressure change test facility at the ITW of the University of Stuttgart with 20000 cycles from 0 to 6 bar at 20 °C and with 15000 cycles at 90-60 °C.



3.5 Venting

For quick venting during filling and commissioning the intermediate modules have 1/2"-fittings with caps and the end modules have manual air vents. The manual air vents are accessible when the store is insulated. In operation, the venting of the store takes place preferably through it's top connections: For permanent trouble-free operation of the system—in particular in connection with a fresh water station—it is highly recommended to fit an air separator at the top outlet of the store.

NOTE: Install pipe of a large size and height to ensure good flow calming for ventilation. It is effective to have an additional air separator in the flow line between boiler and store because in this area gases—dissolved by the temperatures—increasingly emerge as bubbles. Alternatively or in addition a temporary vacuum degassing with a mobile device can be performed during commissioning to degas the entire system. The recommended procedure is described in the guideline VDI 4708 sheet 2 'pressure maintenance, ventilation, degassing; ventilation and degassing'. After the ventilation phase (approx. 2 weeks), the system pressure should be re-examined and water refilled if necessary.

3.6 Temperature sensor

Sensor terminal positions are on the end modules. Here the heated volume can be set by the varying height of the sensor, and temperatures measured.

3.7 Electric auxiliary heating

An external heating group preferably with a speed-controlled pump and electric heating element is used for the electric auxiliary heating of the buffer water, such as in the context of power to heat. => See Hydraulic schematic. Heating elements must be equipped with a safety limiter according to EN 60335 part 1 and 2.

3.8 Materials

The buffer range is free of PVC, CFC, HFC and fiber insulating materials. Materials used and their weightings in a store with three modules (4000 l):

Steel	709,6 kg	91,1%
EPS	22,5 kg	2.9%
EPS-EPE copolymer	2,9 kg	0,4%

PET fleece	18,1 kg	2.3%
PS	12 kg	1,5%
PA	4,7 kg	0,6%
Stainless steel	4,7 kg	0,6%
EPDM	4 kg	0.5%

3.9 Installation location

Prior to installation of the store, the static load bearing capacity of the ground must be checked. The weight of the filled store including the attached accessories must not exceed the maximum permissible floor or ceiling load! The required, permitted minimum loading of the floor is 0.35 N/mm².

The area where the store will be sited must be level and ensure a permanently vertical installation. Some unevenness can be compensated for by means of the supplied floor rails and levelling compound (see assembly instructions). The store should be placed in a room with water drainage or with some other consideration.

The unit must be installed in a frost-proof room. Pipes should be as short as possible and frost-proofed. Also the outlet of the pressure blow-off pipe must be in a frost-proofed area.

The spacing must be chosen to walls, ceilings, and immovable obstructions, so that ease of Assembly and disassembly, inspection, and maintenance are possible. Applicable standards and technical rules must be observed!

3.10 Standards

The buffer class contains vertical stores of S 235 and S 355 according to DIN 17100 with quality certification. The containers comply with DIN 4753 for heating water storage in heating systems with flow temperatures up to 90 °C, according to DIN 4751 part 1.

3.11 Notice of withdrawal

The store can be returned to the manufacturer at the end of life. It is also possible to recycle locally. A final decommissioning or disposal is permitted only by authorized personnel. The materials must be disposed of according to current national and the relevant locally applicable environmental laws and regulations.

4 Technical data

4.1 Individual containers and thermal insulation

- 1) Optional accessories
- 2) at 40 °C average temperature
- 3) Calculated values of ITW, measurement according to DIN EN 12977-4:2012 (valid up to 3000 l capacity) in Preparation

Individual containers:	Unit		
Material container n. DIN 17100	-	S 235 JR / S 355 JR	
Empty weight (approx.)	kg	150 (intermediate module)	190 (end module)
Content	l	1 350 (intermediate module)	1 380 (end module)
Maximum allowable store pressure	bar	3	
Maximum allowable temperature	°C	95	
Thermal insulation:	Unit		
Material jacket	-	LEEPS (low emission EPS, Neopor®)	
Material of vacuum insulation panels 1)	-	welded v. a. colloidal silica in a Metallised plastic laminated under vacuum	
Front insulation material	-	PET fleece	
Insulation thickness coat	cm	13 (LEEPS) + 3 (air cushion)	
Front insulation thickness	cm	25	
Base (EPS) insulation thickness	cm	5	
Thermal conductivity LEEPS sqm)	W/mK	0.032	
Thermal conductivity PET fleece	W/mK	0.035	
Reaction to fire class	-	Sheath insulation: B1, front insulation: B2	

		No. Modules						
	Unit	2	3	4	5	6	7	8
Heat loss - standard 3)	W	189	248	307	367	426	485	544
Heat loss with vacuum accessories 3)	W	136	168	201	233	266	298	331

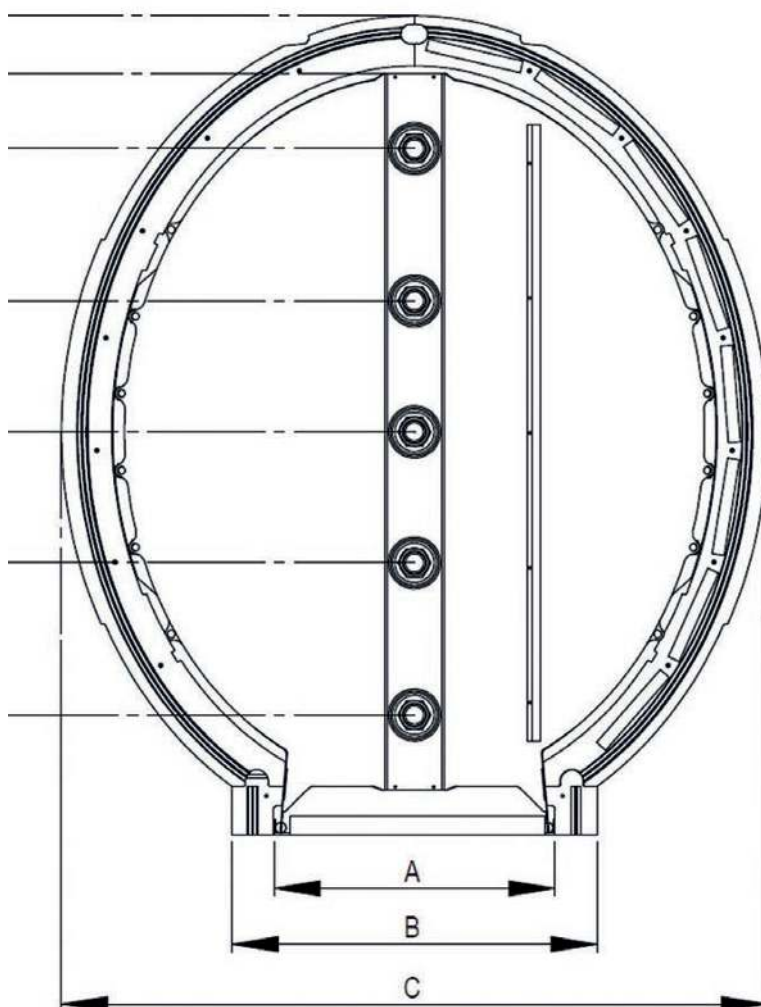
4.2 Dimensions, weight and pressure loss

	Unit	No. Modules						
		2	3	4	5	6	7	8
Length without insulation	mm	1 386	2 016	2 646	3 276	3 906	4 536	5 166
Length incl. insulation	mm	1 905	2 535	3 165	3 795	4 425	5 055	5 685
Total weight empty *	kg	591	799	1 007	1 216	1 429	1 620	1 828
Filled weight *	kg	3 351	4 909	6 467	8 026	9 589	11 130	12 688
Content	l	2 760	4 110	5 460	6 810	8 160	9 510	10 860

* Weight incl. pressure profile, pipes and insulation

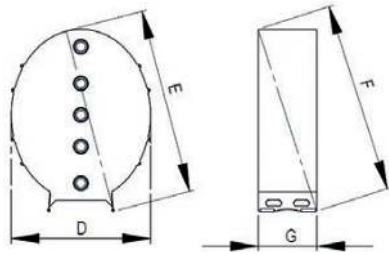
Dimension (mm) Volume fraction Description

2 130		Height with insulation
1 980	100%	Height without insulation
1 781	95%	Connection 1 2" male thread
1 386	73%	Connection 2 2" male thread
1 046	50%	Connection 3 2" male thread
706	27%	Connection 4 2" male thread
311	5%	Connection 5 2" male thread
728		Wide rail A
948		Width insulation. below B
1 850		Width insulation C



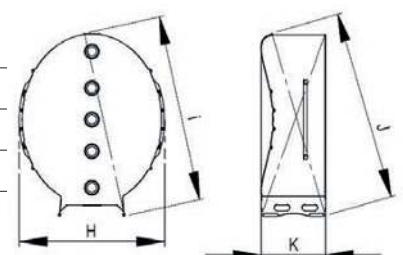
Intermediate module

Dimension (mm)	Description
1500	D
2007	E
2060	F
630	G



End module

Dimension (mm)	Description
1565	H
2020	I
2050	J
693	K

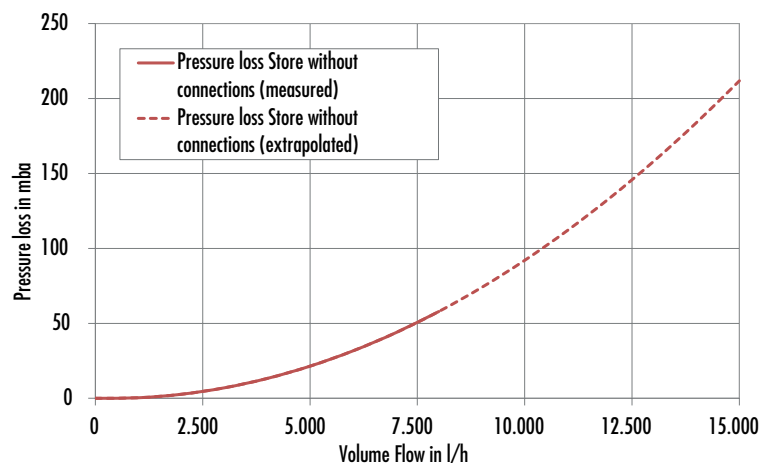


Pressure loss		No. Modules				
Flow	Unit	2	3	4	5	6
5m³/h	mbar	33	22	21	21	21
10 m³/h	mbar	130	92	82	82	82
15m³/h	mbar	292	212	183	180	180

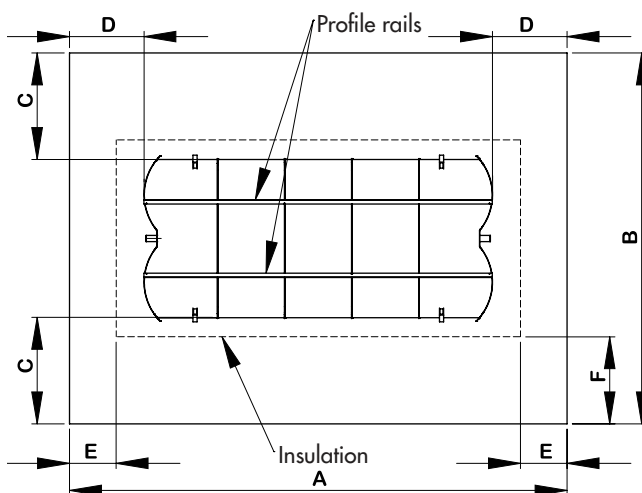
Values calculated on the basis of measured values for 3 modules and up to approx. 6 m³/h.

Pressure drop when flowing through of 3 modules (measurement: ITW)

NOTE: When connecting both sides of the store and more than 3 modules larger flow rates at the same pressure loss are possible. In parallel use of two Connections on different heights a higher flow rate is also possible



4.3 Minimum room sizes for module installation



Minimum depth	A (cm)	Length of loading and discharge tube (cm)
2 modules	278	134
3 modules	340	197
4 modules	403	260
5 modules	466	323
6 modules	529	197
7 modules	592	260
8 modules	655	323

When assessing access note the lengths of pipe.

	Recommended value	Min. value for assembly*
B: Room width	ca. 350 cm	ca. 290 cm
C: Recommended clearance lateral wall to store without insulation	ca. 100 cm	ca. 50 cm
D: Minimum longitudinal wall to store distance without insulation	ca. 70 cm	s. l.
E: Minimum longitudinal wall to store distance with insulation	ca. 44 cm	s. l.
F: Lateral distance to wall from store with insulation (at C = 100 cm)	ca. 82 cm	ca. 52 cm (bei C = 290 cm)
Minimum room height for insulated modules	ca. 217 cm	s. l.

* Accessibility for connections, maintenance, etc. not included.

5 Hydraulic plans

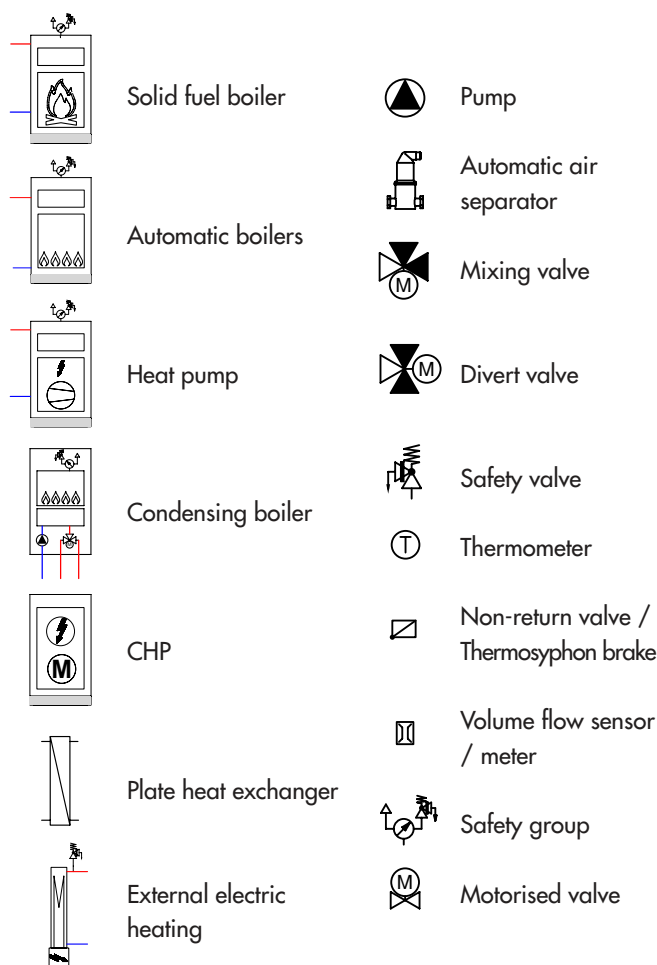
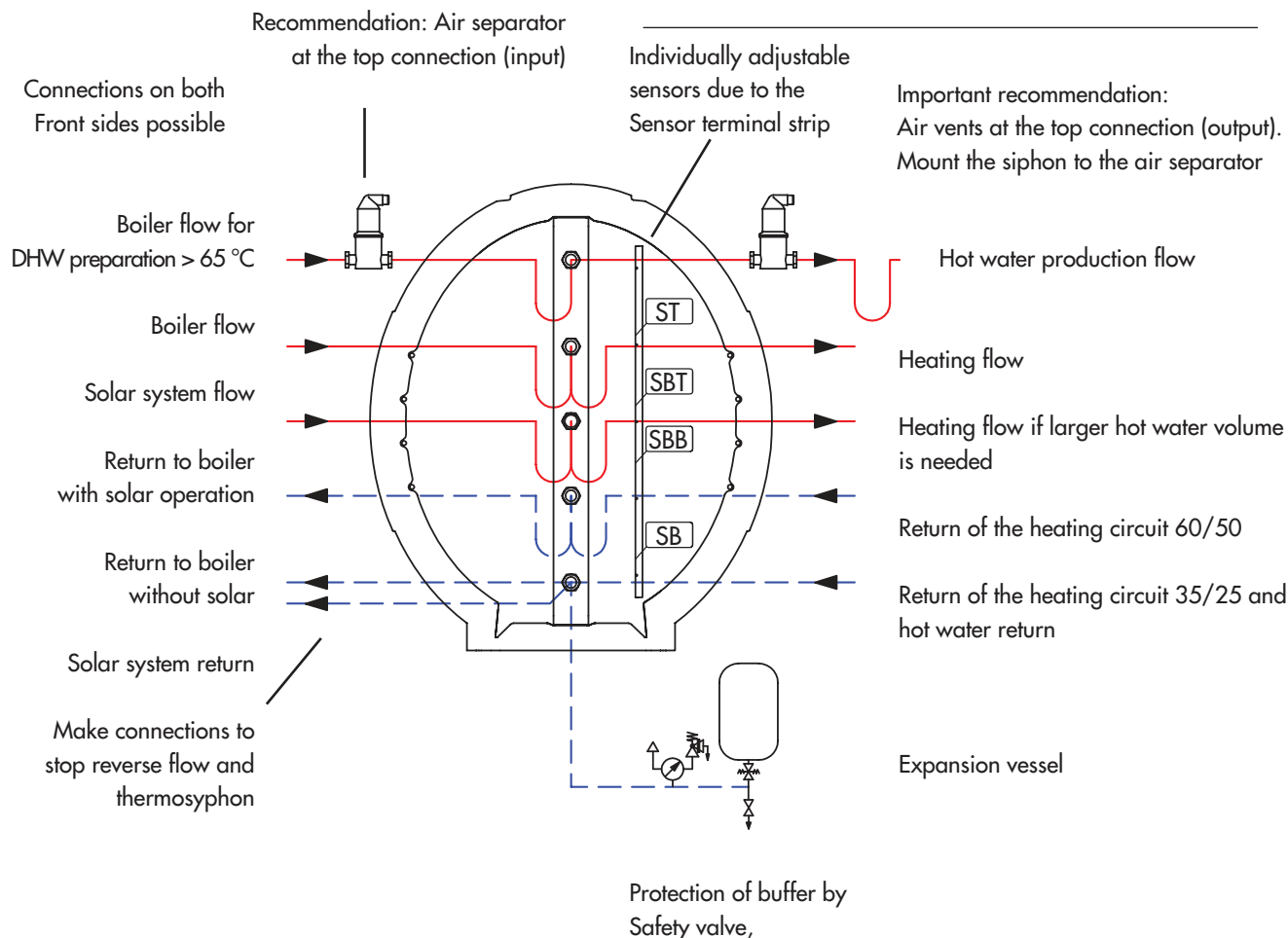
5.1 General

The modular buffer store is a central component in the system to be installed. The energy generated is stored in the buffer store and removed on demand.

A variety of connection options, are shown for both the generation and distribution of heat for heating and hot water.

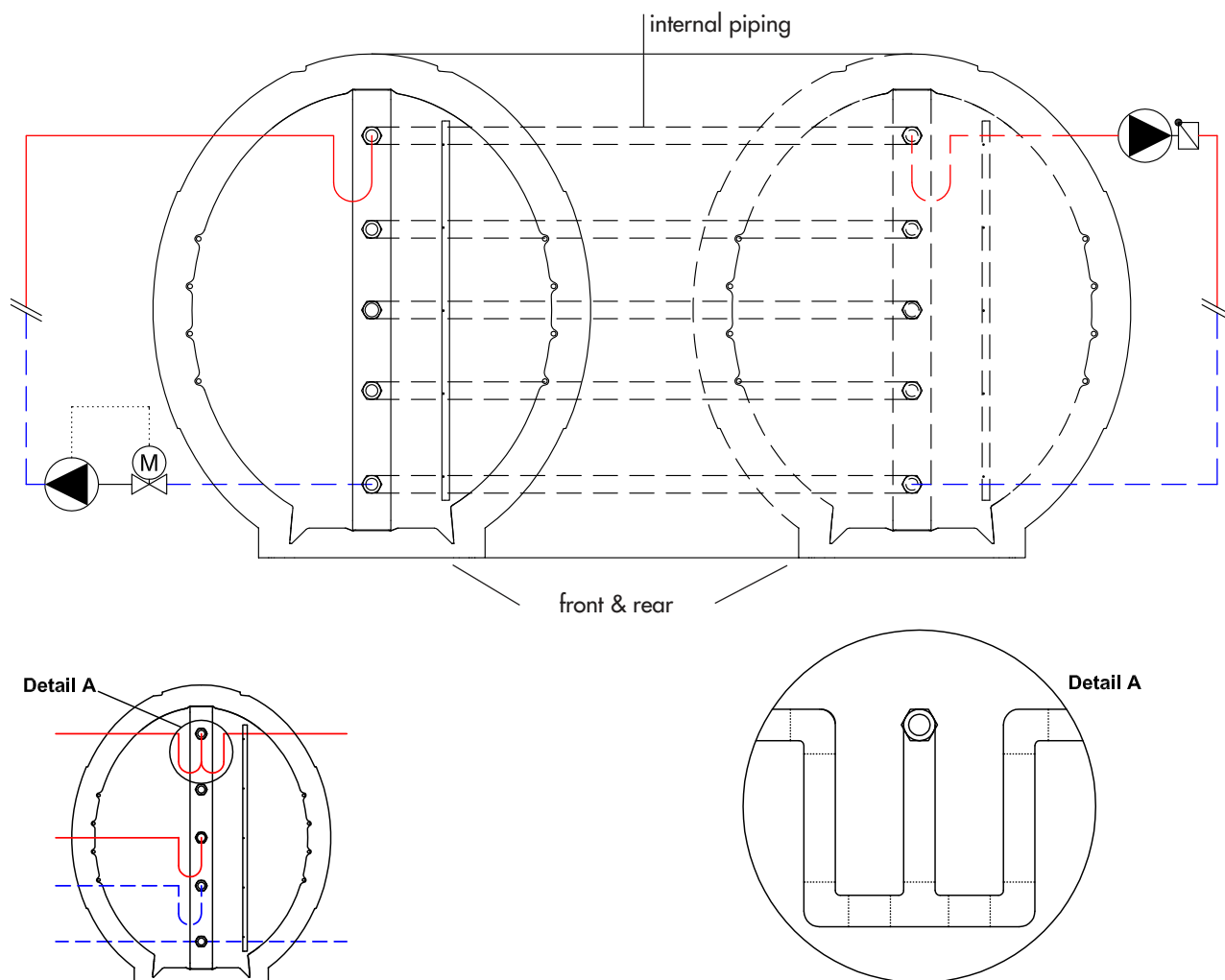
Special applications are to be agreed with the manufacturer. Depending on the design of the circuits, an adjustment and review of the hydraulic schematic is necessary.

NOTE: The following hydraulic connections are a schematic representation of the components and are used as an aid for planning. They do not include all the necessary safety devices according to EN 12828, components maintaining constant pressure and possible additional shut-off devices for maintenance and service work.



Attention: Double-sided connection

If the connections of both ends are used, pay special attention to the prevention of accidental incorrect currents at both ends of the store. Spring-loaded non-return valves or motorised valves must be used.



Syphoning of the connections

Syphon connections should be used.

The height of the Syphon drop should be at least 10 cm,
pipe work should be thin-walled steel or stainless steel tube
- no CU pipe should be used.

Proper syphon connection pipes are offered as accessories.

Double connection to a single outlet

If a storage connection with double connections is planned,
the tee can be attached at the lower end of the syphon, if
the size is not reduced.

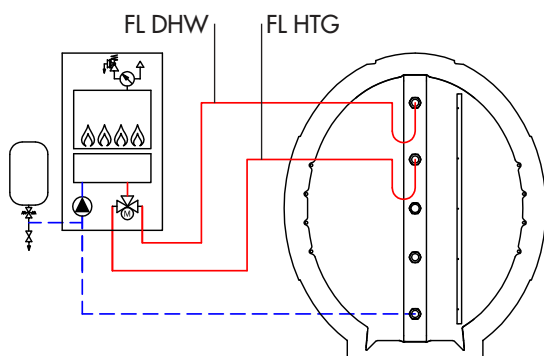
Legend of abbreviations

ST	= Store top
SBT	= Store heating buffer top
SBB	= Store heating buffer bottom
SB	= Store bottom
C	= Collector
CI	= Circulation
HF	= Heating flow

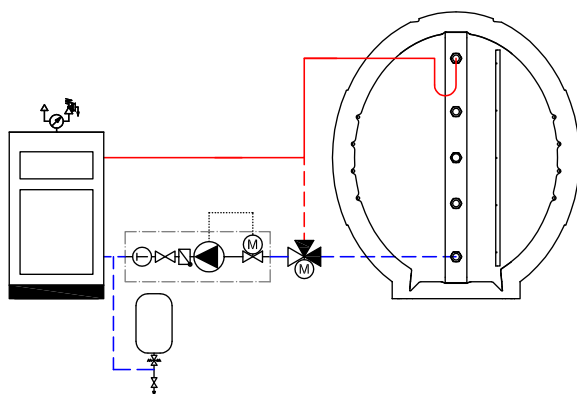
5.2 Integration of heat generator

Notes on the integration of different heat generators:

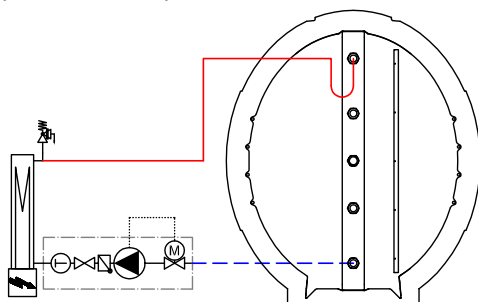
- Flow hot water / heating depending on the system at the appropriate height connection
- Return without solar at the bottom
- Observe information from the boiler manufacturer
- Return protection depending on the boiler maybe necessary to prevent sooting. Follow the manufacturers instructions.



Modulating condensing boiler



Return protection, soot prevention

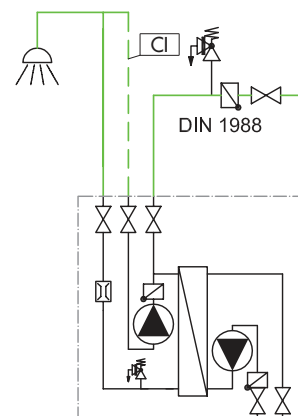
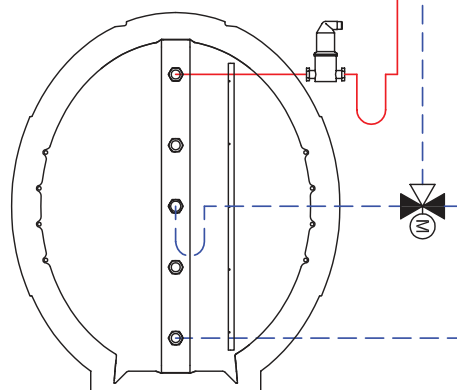


External electric heating source

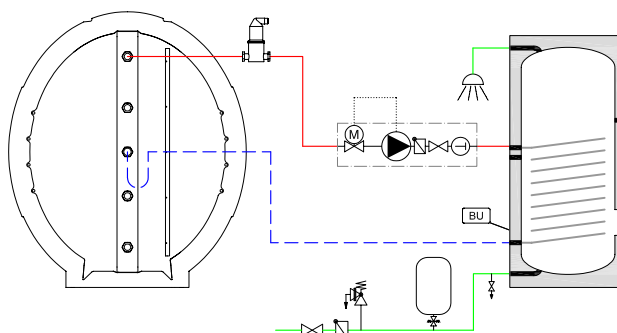
5.3 Hot water

Hot water preparation via central fresh water station. With secondary recirculation divert the warm return to the middle of the buffer.

Follow the manufacturers instructions.

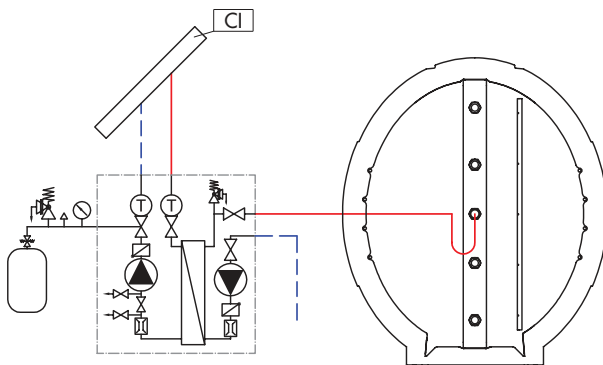


Fresh water station, divert valve for the recirculation mode



DHW storage from central buffer

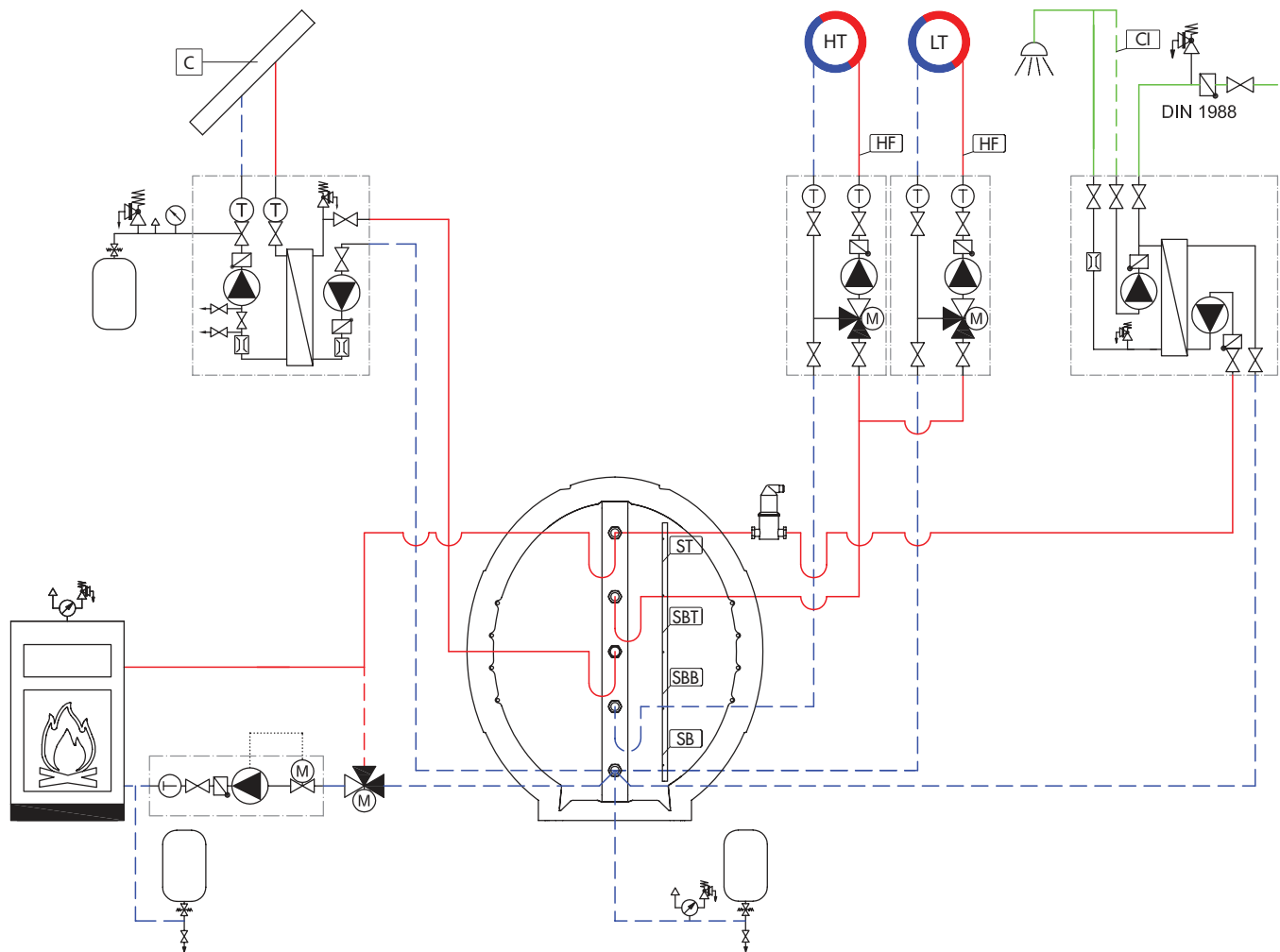
5.4 Solar system



System separation of collectors for frost protection function

5.5 Biomass boiler

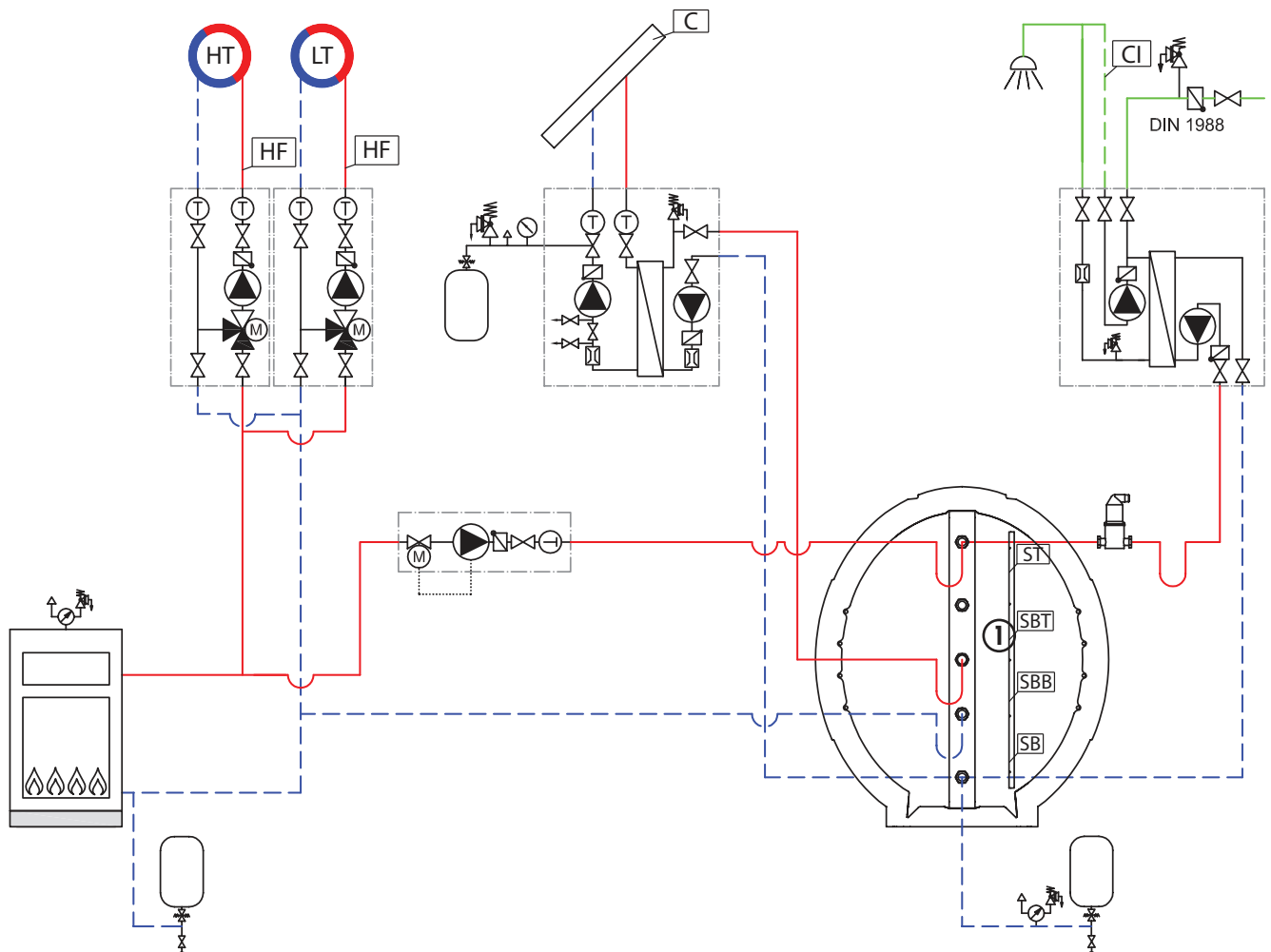
Solar heating support + DHW



Biomass boiler with return protection, fresh water station, 2 mixed heating circuits (HT high temperature and low temperature LT)

Use of the complete buffer volume for the heat generator and the solar system

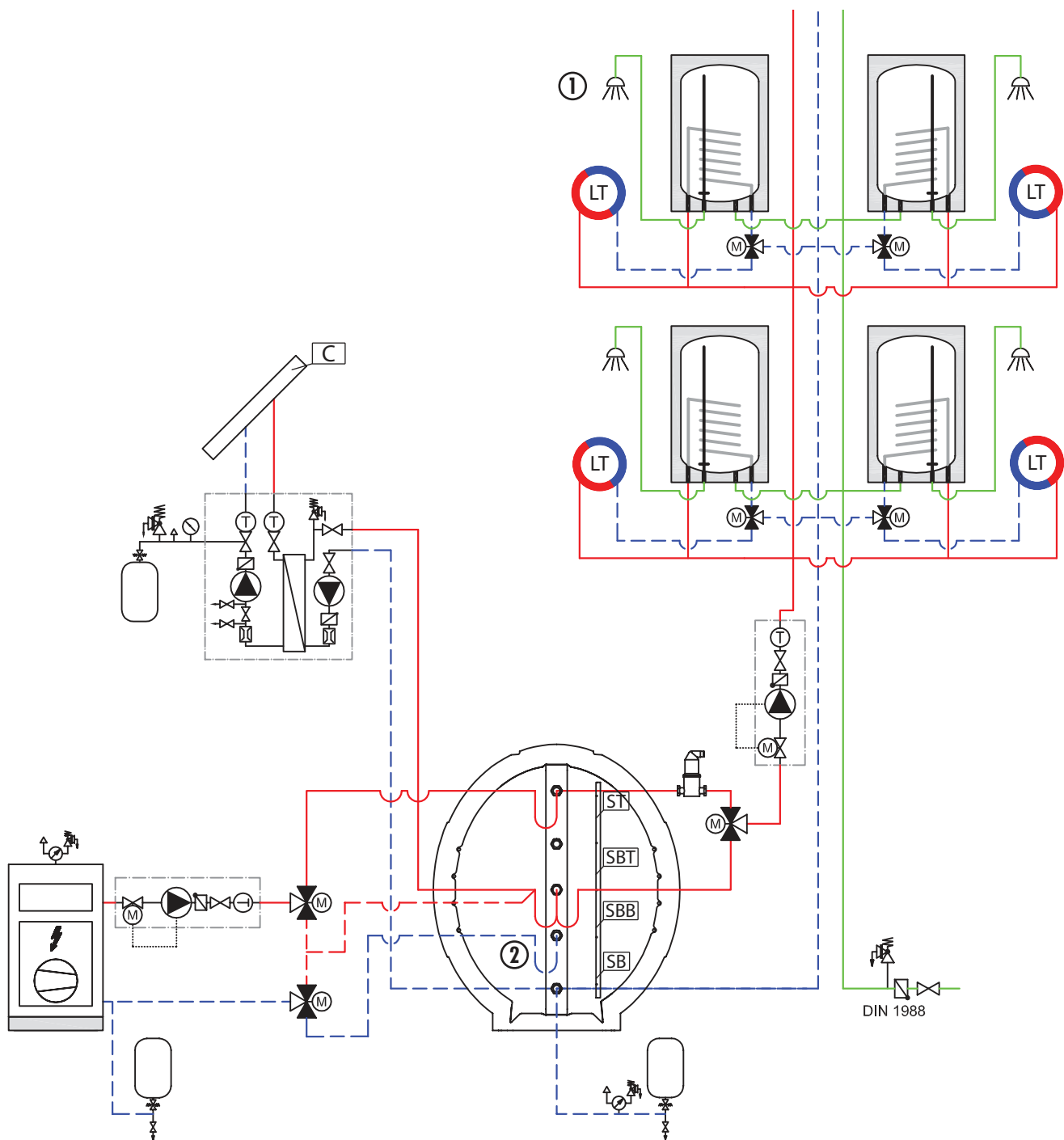
5.6 Automatic boilers



Automatic boiler directly supplies the heating circuits, buffer only for DHW preparation via fresh water station, HTG directly from the boiler, solar

1.) If smaller DHW volume is sufficient: use higher solar flow and boiler return connections.

5.7 Heat pump remote DHW preparation

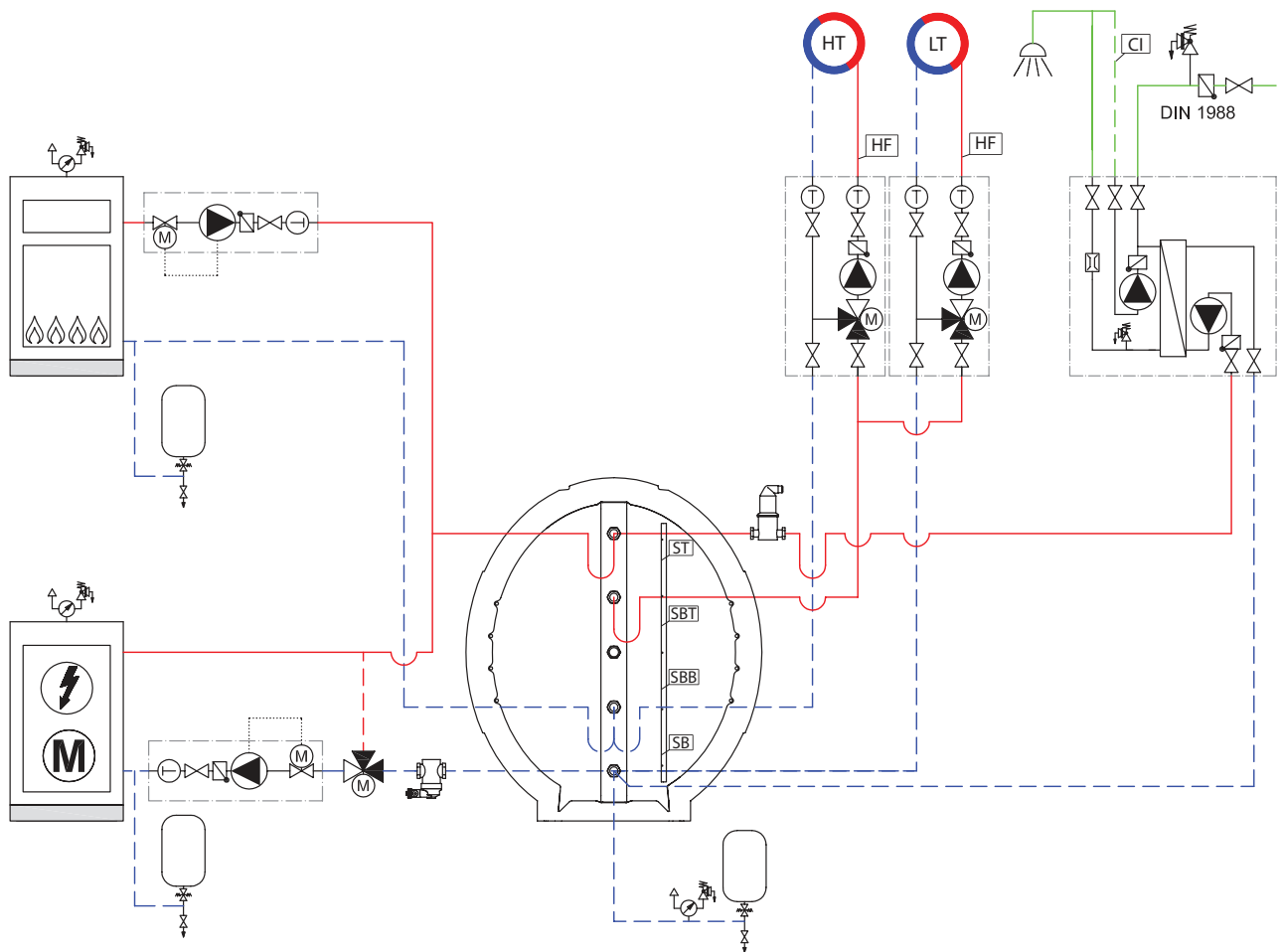


- 1.) Incomplete representation:
Depending on the number and type of heating circuits
Valves or pumps required.
- 2.) If without solar: Connect return pipe of the heat pump
at the bottom

Heat pump with decentralized storage of domestic hot water, solar transfer station

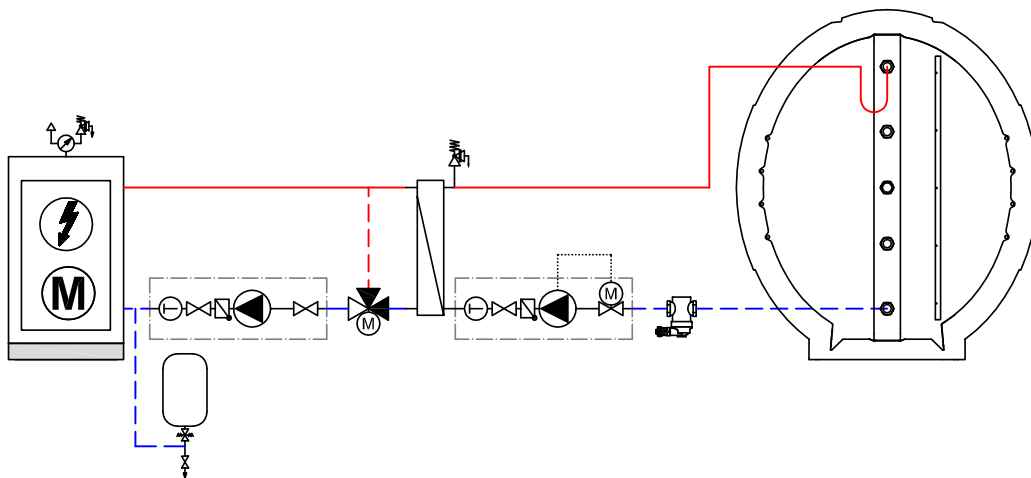
Generally, the district network can be supplied with the low radiant temperature. The temperature is raised only to fixed DHW reheating times

5.8 CHP

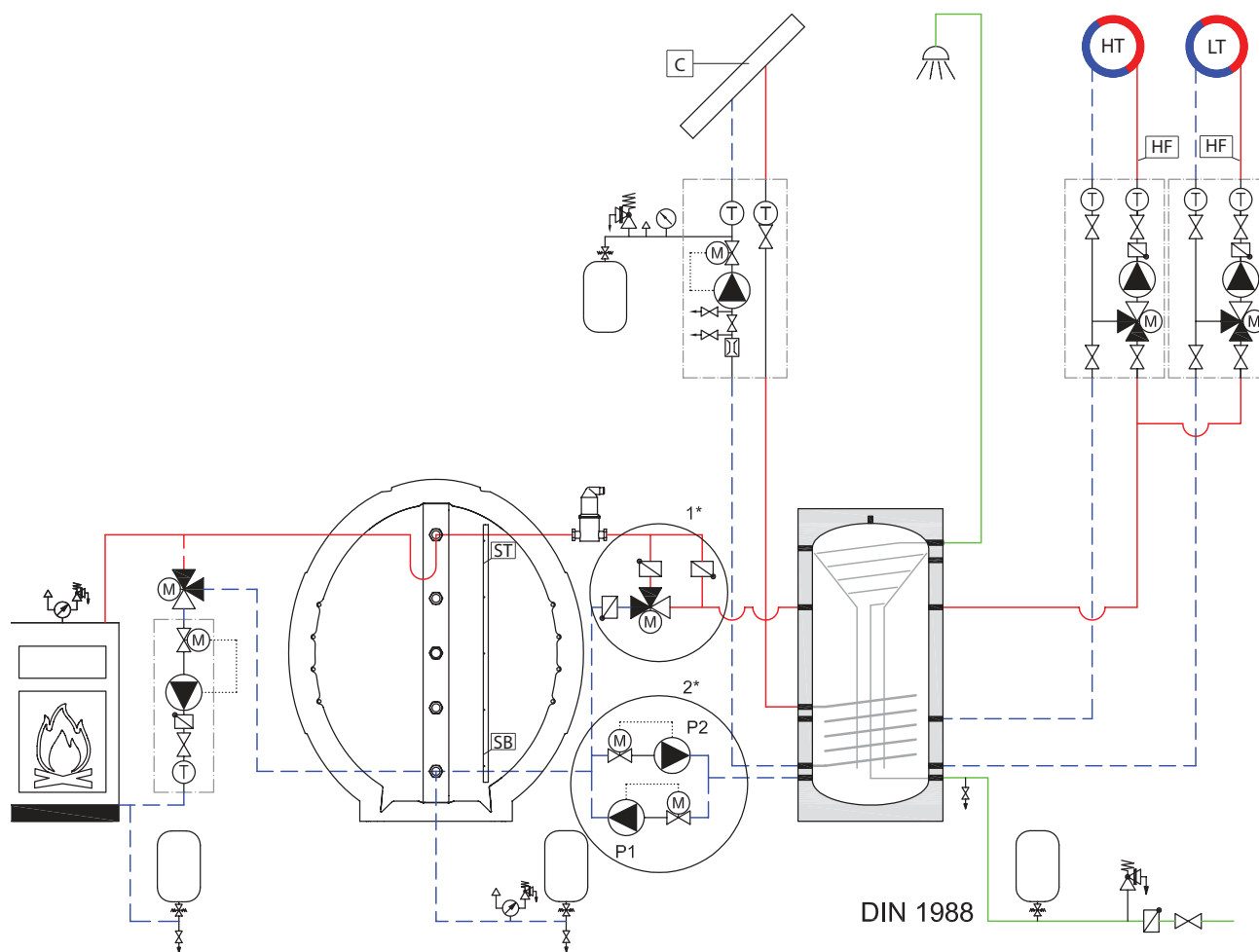


CHP basic supply with peak-load boilers, 2 mixed heating circuits, Central fresh water station

According to the manufacturer's specifications and type of pipe network or heating water, it may be necessary to indirectly connect the CHP. -> see the following drawing



5.9 Biomass boilers and combined thermal store



Biomass boiler with return protection, loading with combined thermal store, 2 mixed heating circuits (high temperature HT and low temperature LT).
Use of the complete buffer volume for the boiler and the solar system

Control principle:

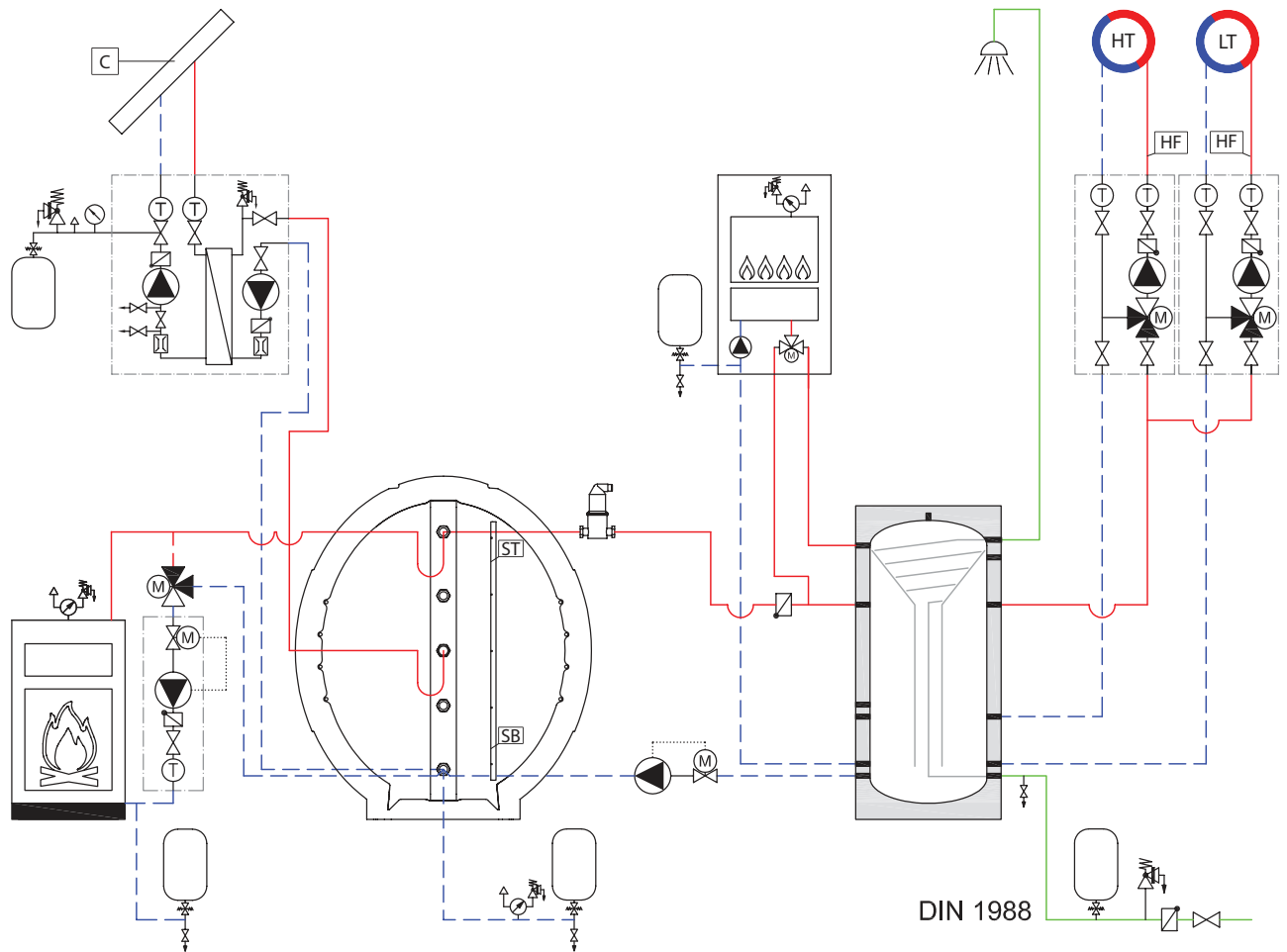
When heating requirements in combined thermal store will be loaded to P1.

When solar Combisystems to higher temperatures is loaded as a buffer and unloaded with P2.

1*: Temperature controlled mixing unit to prevent calcification of the DHW heat exchanger. Can be omitted in the case of sufficient mixing volume in the combined thermal store.

2*: Reloading can also be with a pump and 2 changeover valves. Scalding protection DHW and DHW recirculation not drawn

5.10 Large solar system



Solar system with external heat exchanger, Biomass boiler with return flow maintenance and with reloading of combined thermal store.

Auxiliary heating of Combisystems by condensing boiler.

2 Heating circuits (high temperature HT and Low temperature LT).

Use of the complete buffer volume for the biomass boiler and the solar system.

Scald protection DHW and DHW recirculation not drawn.

6 Assembly instructions

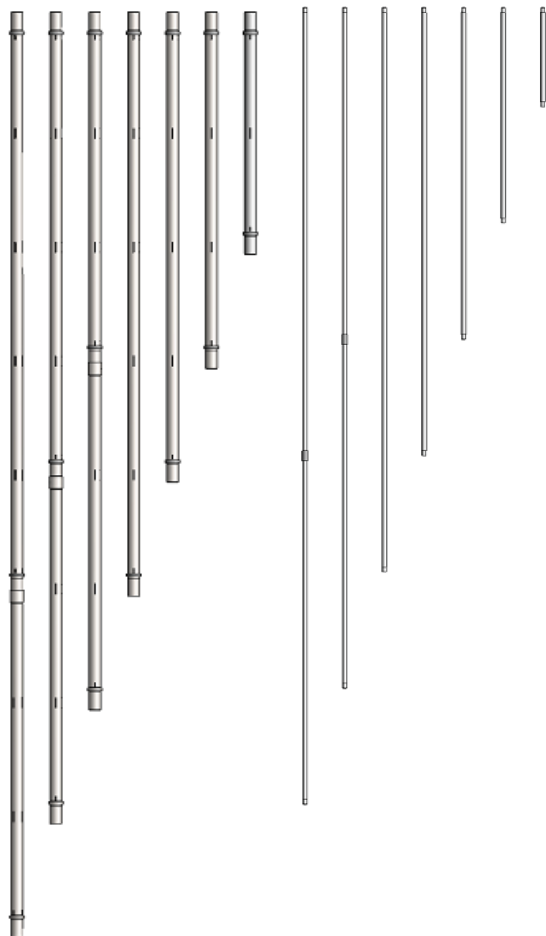
6.1 Check on delivery

- ☐ All components on the delivery note are complete
- ☐ All components are intact, in particular:
 - Storage modules (without dents, etc.)
 - Loading and unloading pipes (thread, sealing surfaces)
- ☐ All seals on the modules are protected by caps

NOTE: The seals may not be removed!

Included loading and unloading pipes and connecting rods (dimensions in mm):

5 x 1890 + 5 x 3230	8 modules	8 x 1890 + 8 x 2428	8 modules
5 x 1890 + 5 x 2600	7 modules	8 x 1890 + 8 x 1798	7 modules
5 x 1890 + 5 x 1970	6 modules	8 x 3058	6 modules
5 x 3230	5 modules	8 x 2428	5 modules
5 x 2600	4 modules	8 x 1798	4 modules
5 x 1970	3 modules	8 x 1168	3 modules
5 x 1340	2 modules	8 x 538	2 modules



6.2 Tools

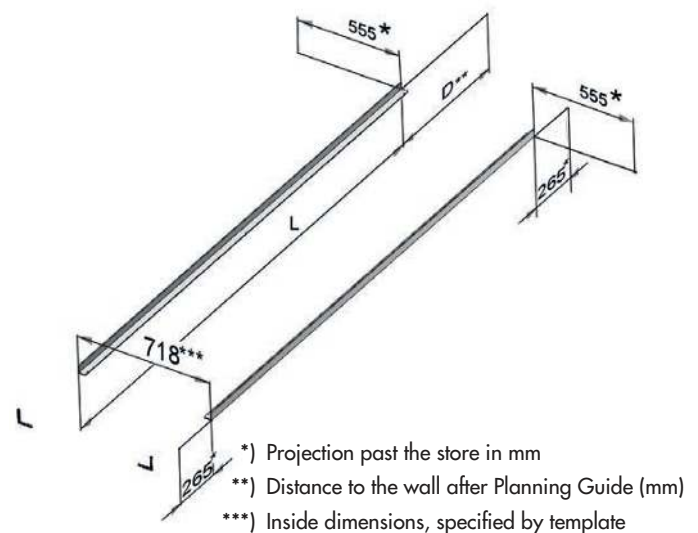
Tools required for installation:

- Spanner size 10 + 36
- Pipe wrench for diameter 70
- Impact drill and masonry drill bit M8
- Phillips screwdriver
- Spirit level or cross line laser, scale and pencil
- Step Ladder

6.3 Floor preparation

The store must be mounted on the bottom rails. Set the position of the bottom rails with the store projection (see illustration below and Chapter 3 planning aid). Take into account the dimensions for the future plumbing and maintenance access.

L = length of the track rails in mm	
2 modules	1380
3 modules	2010
4 modules	2640
5 modules	3270
6 modules	1890 + 2010 = 3900
7 modules	1890 + 2640 = 4530
8 modules	1890 + 3270 = 5160

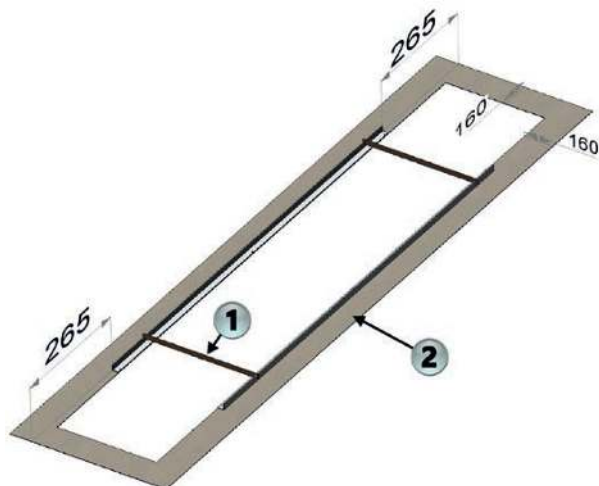


The floor under the store must be leveled with a levelling compound (see figure next page), if the rails do not lie flat. The levelling compound must have an approved load per surface of minimum 35 000 kg/m², or EN 13813 compressive strength class C8 or above. Note the curing time.

NOTE: Quick-setting levelling compound is available as an accessory. The processing time is 15 minutes, the curing time 60 minutes.

With the levelling compound (2) create a flat surface with a

width of min. 160 mm so that the insulation, which touches the ground next to the rail, is flush. Preferably apply the layer as thin as possible.

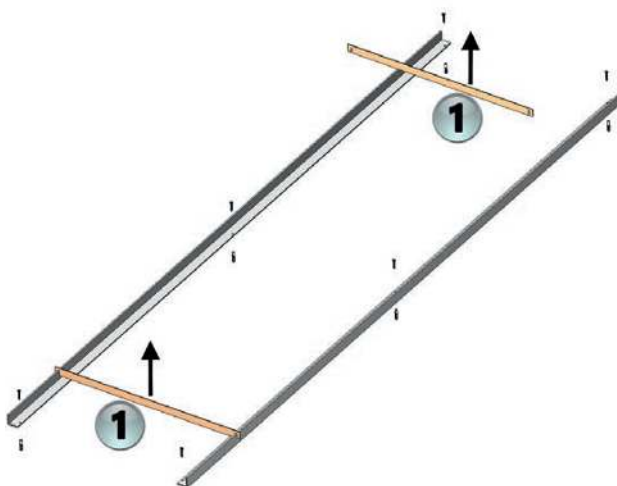


NOTE: Alternatively compensate only area under rails with levelling compound and joint (such as with silicone) the gaps between the floor and the insulation after mounting the insulation.

The correct distance between the rails is achieved with 2 stencils (1). Transfer the positions of the drill holes for the fixing screws to the floor and drill. Screw the bottom rails and control the evenness.

NOTE: The two rails must be absolutely parallel side to side and level in height!

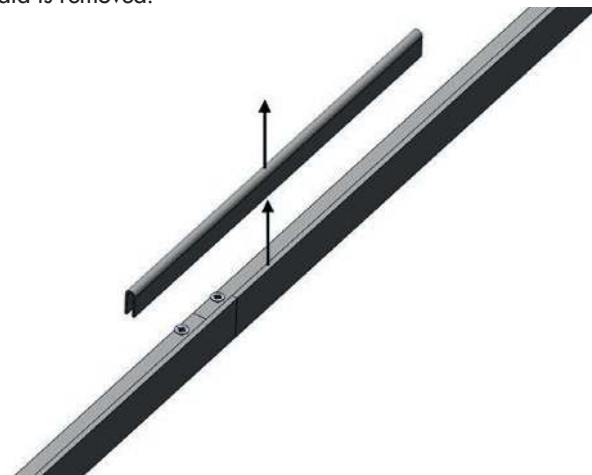
Remove the stencils (1).



Starting from 6 modules, the bottom rail is supplied in 2 parts. The supplied ground rail coupling aid (2) is used for proper alignment.

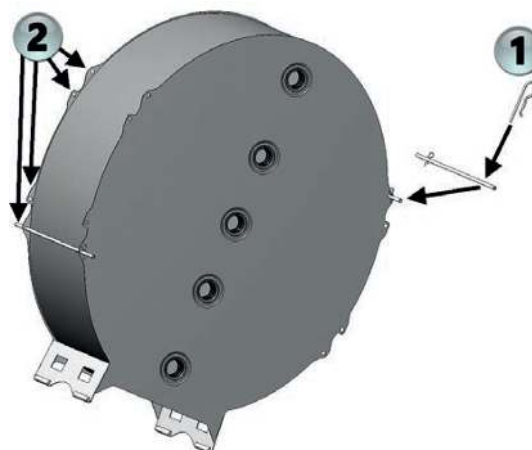


After proper alignment and fixing of the rails, the coupling aid is removed.

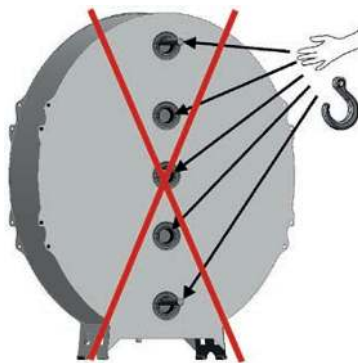


6.4 Transport

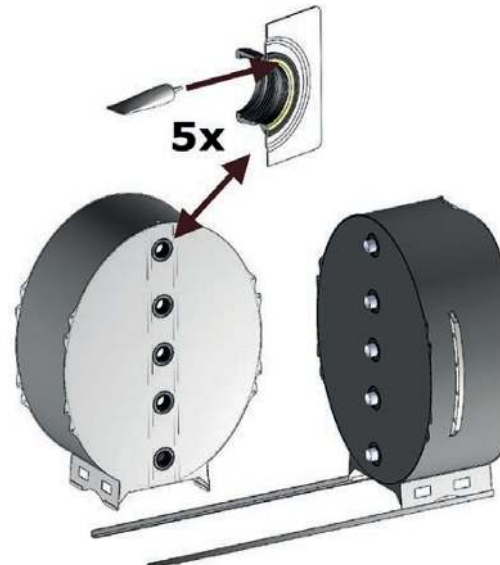
The carrying aids (1) can be attached to both modules at different positions (2) in order to transport them. Make sure that the spring catches fit correctly.



Do not carry using the openings or seals!

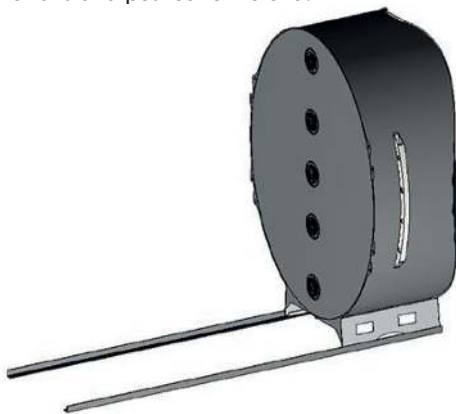


NOTE: Do not use any other lubricate.

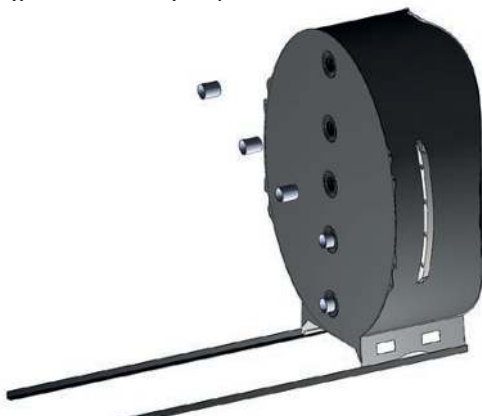


6.5 Container Assembly

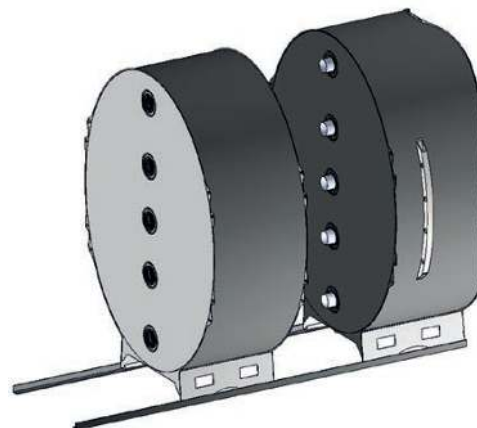
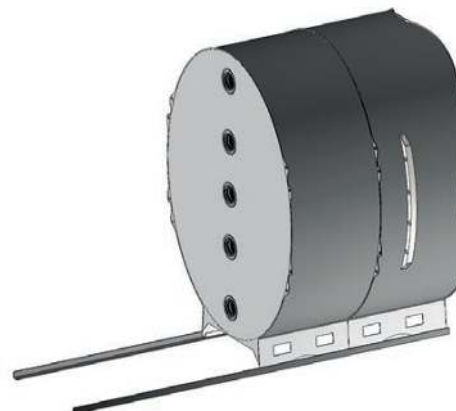
After hardening of floor material, an end module is placed on the rails and pushed to the end.



Insert the 5 sealing sleeves (pre-greased at the factory) into the gaskets until they stop.

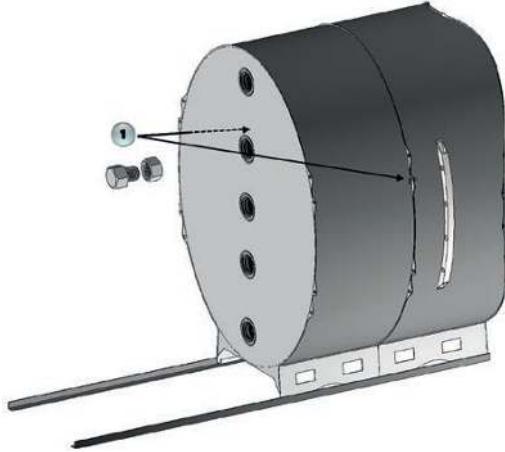


Place the intermediate module on to the rails and slide slowly up to the end module. Keep straight when entering the sleeves.



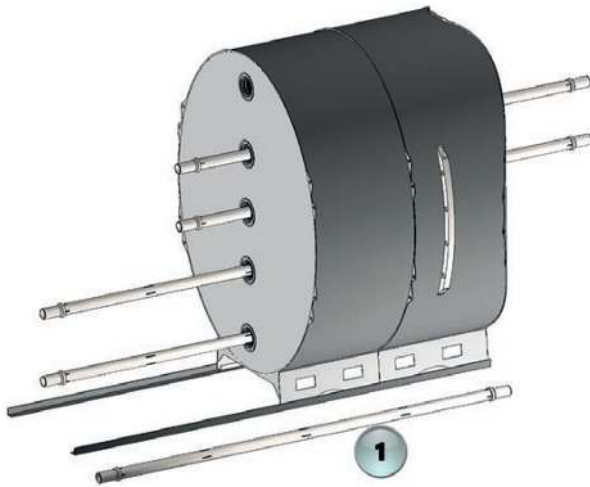
On the second module lubricate the 5 seals with the lubricating grease (1) in the outer conical area. The grease is enclosed with the shipment.

The modules must be centered and connected with 2 x M20 screws and nuts (1) on both sides.



NOTE: Optionally fit pipes early if space is constricted.

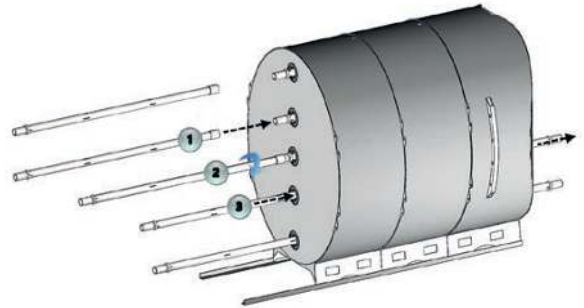
There might be not enough space in front of the store for the pipes to fit in (see technical data, minimum room size) after installation of all store modules. In this case it is possible to insert the 5 loading and unloading pipes (1) into the modules at this point. Make sure to observe the distance D to the face side.



NOTE: From 6 modules, the loading and unloading loading pipes are supplied in 2 parts.

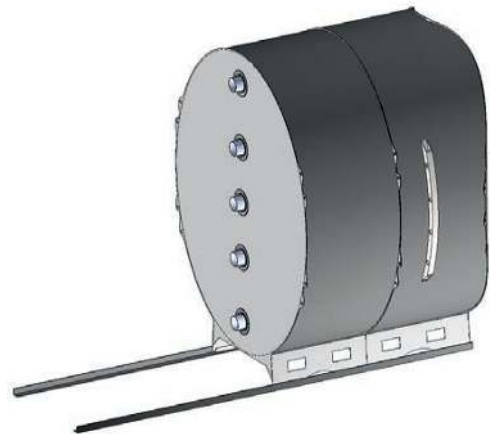
NOTE: Follow instructions for installation with insertion and carrying aid further back.

First the loading and unloading loading pipes are inserted without the extension (1), then the extension pipe is screwed on (2) and then the entire tube is pushed further in to place



ATTENTION: The extensions must be screwed as far as they will go without sealing compound.

Repeat the same steps for each successor module: Insert 5 sealing sleeves, lubricate the opposing seals with the enclosed grease and push them into the seals until they stop.



Place the next module on to the rails and slide slowly up to the previous module. Keep straight when entering the sleeves.



TDMA-VARICAL: Assembly instructions

Then slide the second end module. Connect all modules twice on both sides with the M20 nuts and bolts (1)

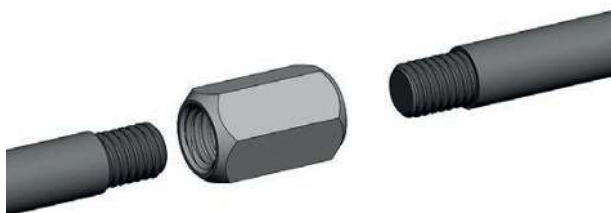


Slide the connecting rods through the two end modules.



NOTE: For 7 modules, the connecting rods are supplied in 2 parts.

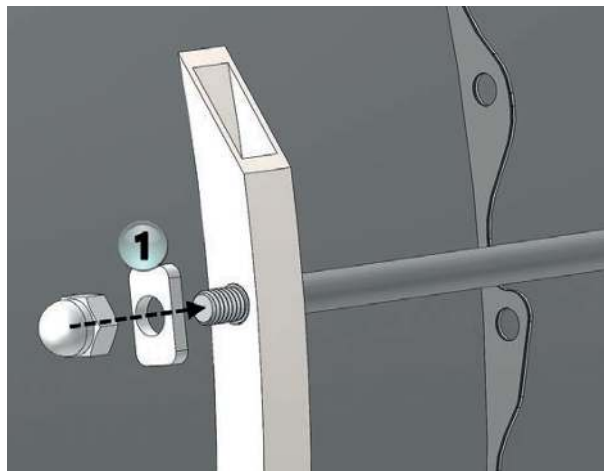
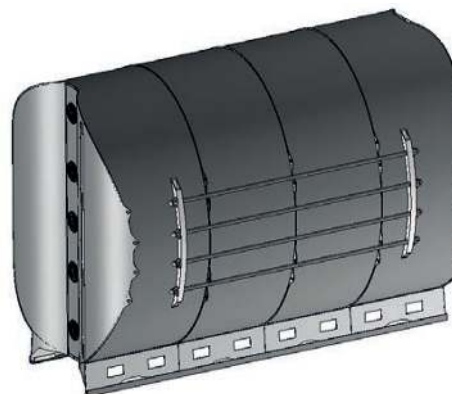
Connect both parts of the connecting rod using the coupling nut.



ATTENTION: The connecting rods must be screwed in until they touch.

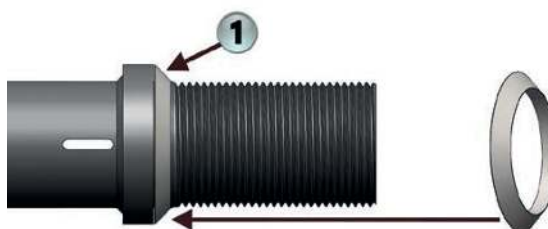
Screw on each side a spacer washer (1) and a cap nut (16

times in total). Tighten the cap nut to the end of the thread (inside stop).



If not already done slide in the loading/unloading tubes to the same protrusion at each end:

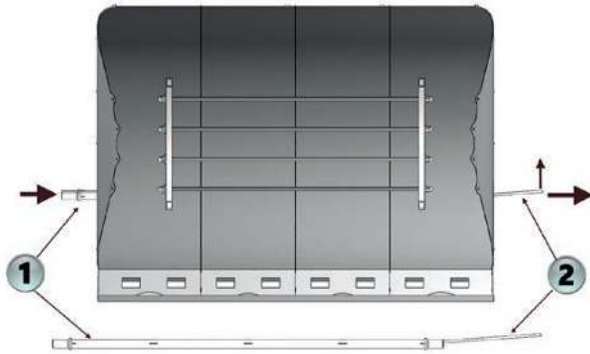
The insertion aid (1) is pushed onto the tube to be inserted.



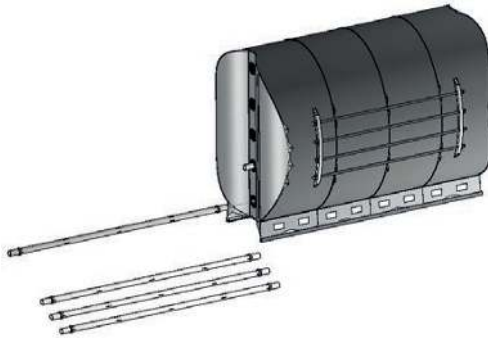
The pipe is carefully pushed through the outer and inner seals.

When the end of the loading and unloading tube is near the opposite end module, a second person can push the

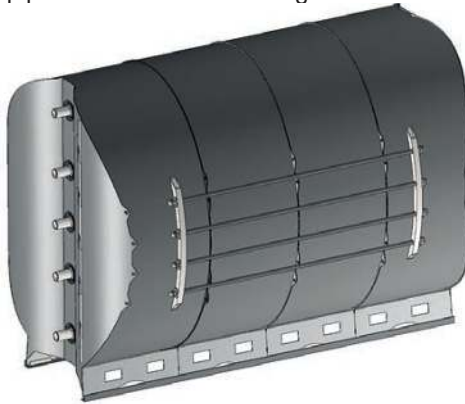
carrying aid (2) into the tube, guiding the tube out through the last seal.



The insertion aid is removed again and used for all tubes.



Align pipes with the same overhang on both sides.



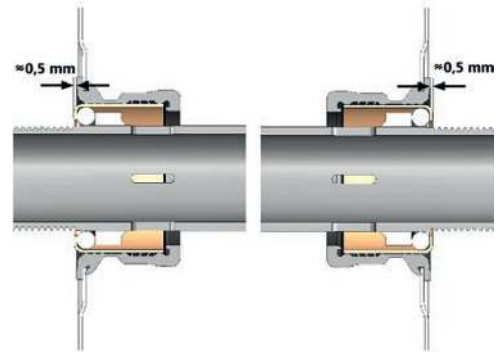
The O-ring seal and a seal end sleeve are pushed over the 2" thread. The sealing end sleeve has an area flared inward, which must point to the outside. The sealing end sleeve slides in the EPDM sealing of the container.



This is carried out on all ends of the loading and unloading pipes.

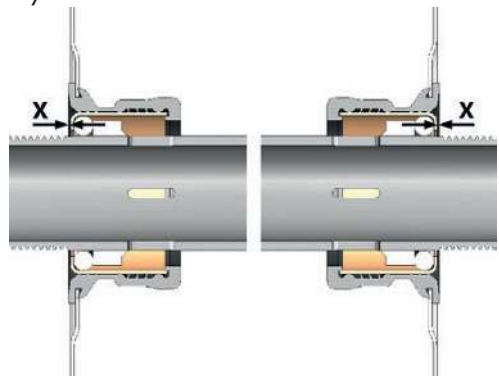
CONTROL:

On both sides of the accumulator, the end sleeves must protrude at least 0.5 mm above the EPDM seal. To check on both sides of the accumulator, press simultaneously with a flat washer on the seals.



If this gap is not present, the containers must again be pushed together completely.

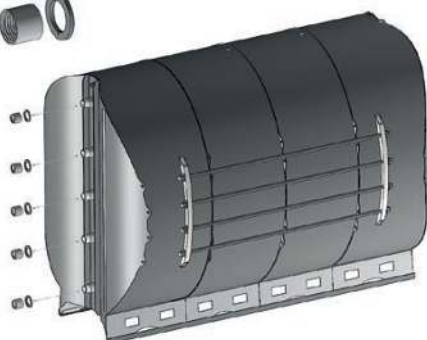
If this is not possible by hand, the distance X is measured around which the end sleeves lie behind the EPDM seal. The barrel nuts must be at least screwed in after mounting the pressure profile by the distance (X + 1 mm) after hand-tight assembly.



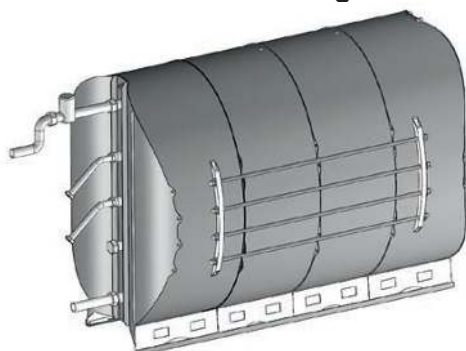
The pressure profiles are fitted to both ends of store over the 2" connections and held in place with 4 x M6 bolts.



Two barrel nuts with washers are screwed onto the top and bottom loading and unloading pipes. The 2" barrel nuts are initially tightened on both sides – if necessary, by the distance $(X + 1 \text{ mm})$ missing in the above control. The remaining 2" barrel nuts, together with the 2" washers, are hand-tightened on both sides of the loading and unloading pipes in order to position the pipes correctly. Then tighten the cylinder nuts evenly on each side with at least 1 turn, maximum 1.5 turns, in order to ensure the sealing of the end sleeve against the O-ring seal. Loosen the uppermost and lowermost cylinder nuts again, tighten again by hand, and tighten with 1 to 1.5 revolutions on both sides.



The connecting pipes can now be installed. **Observe the instructions in section 3 Planning aids!**



- ☐ Store modules tightly drawn together ($\leq 1 \text{ mm}$ gap)
- ☐ Between all store modules are 2 M20 bolts and the storage modules are aligned with each other.
- ☐ All cap nuts on the connecting rods and if necessary all extensions are installed and tight
- ☐ All 2" barrel nuts are evenly tightened: Ensure the same free thread length behind the cylinder nuts on both sides of the loading and unloading tubes.

6.7 Pressure test

The following points must be documented:

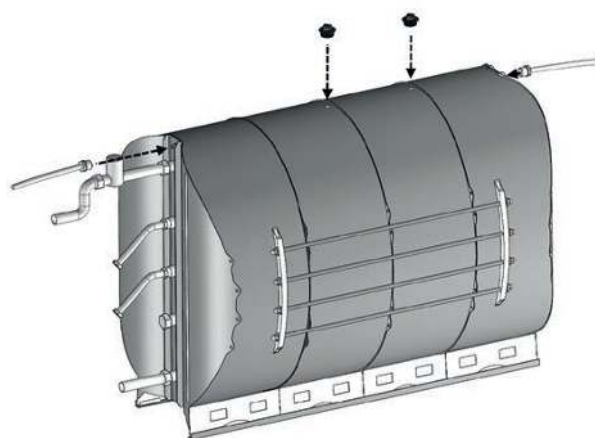
NOTE: Each intermediate module (on top) and each end module (on front) has a 1/2" connection for venting of the store while filling. In operation venting should be carried out by an air separator mounted at the outlet of the store on the top loading and unloading pipe, see planning aid 3.5.

NOTE: The store is drained from the lowest pipe connection. When emptying the store air should be introduced into the top loading/unloading pipe.

WARNING: Accident/hazard due to failure to observe the safety regulations!
Observe the relevant country-specific standards, health and safety regulations and rules for the operation of pressure tests.

NOTE: Damage of the heating system due to over pressure!
Don not connect the store to the heating system during pressure testing.

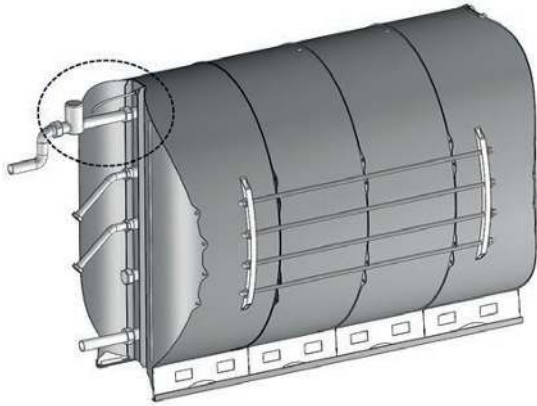
Slowly fill the store with water. Vent the store through the air vent and the top connection.



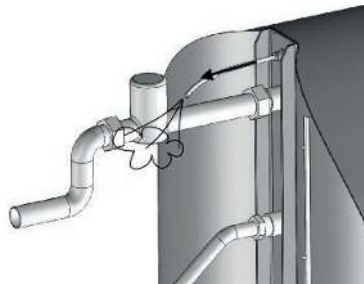
6.6 Control module Assembly

The following points must be documented:

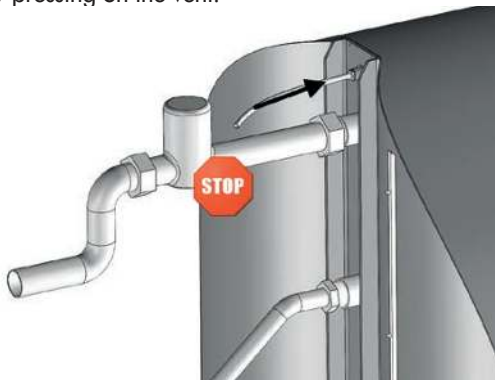
When the store is full to the top remove the last of the air through the air vent.



The manual air vent on the end module opens by pulling on the hose.



It closes by pressing on the vent.



With a test **pressure of 3.9 bar** (based on the requirements of the European pressure equipment directive, 1.3 times nominal pressure) perform the pressure test. Use a class 1 pressure gauge.

CONTROL

The following points must be documented:

- ☐ Passages on end seals dry (check slot in 2" washer), otherwise **depressurise store** and tighten barrel nuts of loading and unloading loading pipes in **small increments: not only the affected gland, but also the others**, so that the entire pressure profile gets more pressed against the container. **Re-tighten alternately on either side in doing so.**
- ☐ Floor between storage modules dry
- ☐ Vent plugs dry.

After successful testing of the pressure, release the pressure, before the store is connected to the heating system.

Procedure for leaking end seal behind pressure profile

If a passage at the end seal is leaking despite re-tightened barrel nut, proceed as follows:

1. Empty modules
2. Remove the nut of the loading and unloading pipes on the affected side and remove the pressure profile.
3. Pull out loading and unloading tubes with end seal so far that the affected seal is free.
4. Check for cause of leakage.

Procedure for leaking connection between internal modules

Leaking module connections are found during pressure test, as described below:

1. Empty modules
2. Remove the nuts of the loading and unloading pipes.
3. If enough space, it is sufficient to dismantle only one pressure profile. The loading and unloading pipes are pulled out to this side. Otherwise, remove the pressure profile on both sides.
4. Pull out loading and unloading tubes with end seal so far that the affected seal is free.
5. Remove the connecting rod, loosen and remove centreing bolts on affected modules.
6. Slide modules apart where leaking.

Check for cause of leakage

1. Leakage between store plate and gasket?
 - ▶ Does the seal fit properly in the sheet metal?
 - ▶ Is the gasket sleeve damaged?
2. Leakage between the gasket and stainless steel sleeve?
 - ▶ Is the stainless steel sleeve damaged?
 - ▶ Is the gasket sleeve damaged?
3. End seal: leaks at O-ring seal?
 - ▶ Is the O-ring sealing surface of the stainless steel end sleeve damaged?
 - ▶ Is the O ring damaged?
4. If necessary consultation with technical support and, if necessary, order a replacement seal.
5. Fix cause of the leakage.
6. Slide the modules together.
7. Replace connecting rod and loading and unloading loading pipes.
8. Insert the end seal and bolts, tighten nuts.
9. Pressure test and fill in accordance with procedure above.

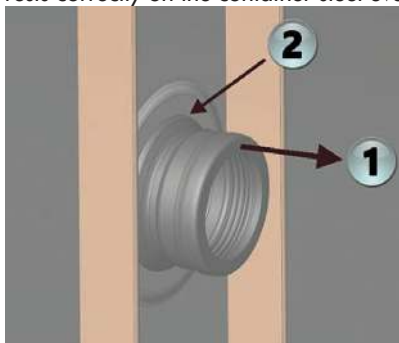
CAUTION: If a gasket is removed and replaced, ensure that it is resealed correctly.

Clean the sealing surfaces on the container and remove any traces of rust. Apply a thin layer of lubricating grease

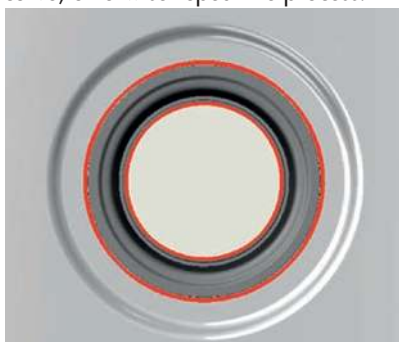
evenly to the sealing surfaces on the inside of the store and on the sheet metal bore radially. Insert the module seal. Through the hole, grasp the gasket inside (1) all around and manover to the center of the hole.



The manovering (1) ensures that the inner sealing lip (2) of the seal rests correctly on the container steel everywhere.



Then the seal inside and outside must have a uniform circular curve, otherwise repeat the process.



6.8 Connection to the heating system, Equipotential bonding

Connect the heating system to the store and fill. Please note the instructions in Chapter 3 planning assistance, to remove air from the store and the whole system. Check connections for leaks.

Equipotential bonding by grounding a suitable position of the container - for example the feet. It is sufficient to ground

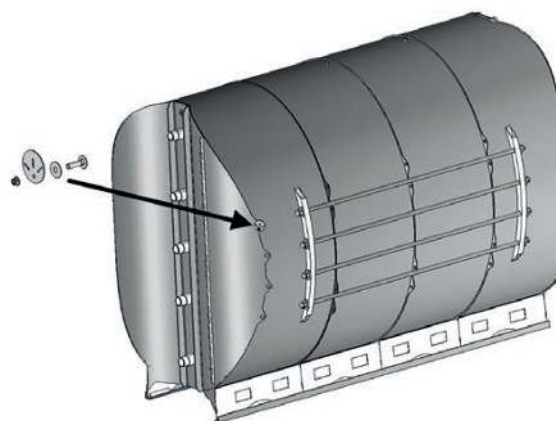
one module, since all modules are metallically interconnected.

6.9 Insulation installation

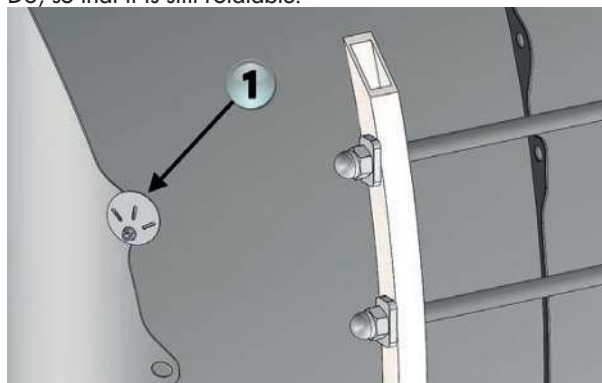
NOTE: The connection pipes are not shown in the following!

Securing discs for insulation jacket

Screw a hook on both sides of the two end modules. Secure the discs after mounting the insulation jacket to avoid gaps appearing during fitting.



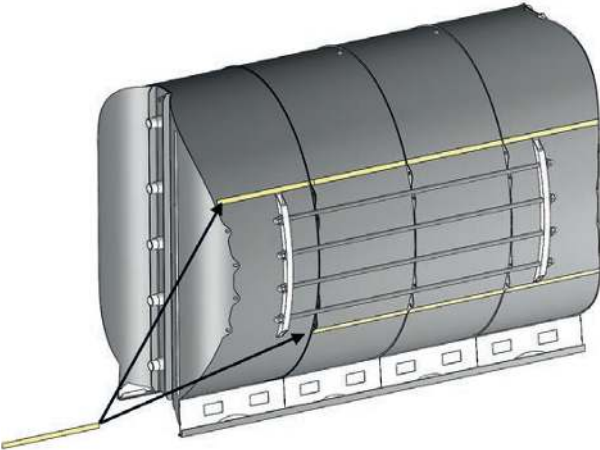
Screw securing discs with M6 bolt to corresponding hole D6, so that it is still rotatable.



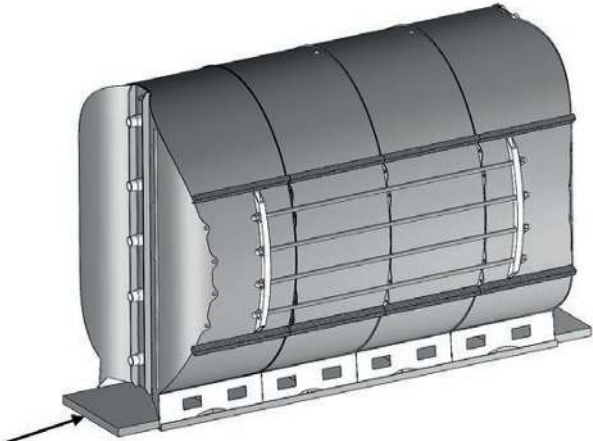
Convection control

Install convection brakes on each store module at the same

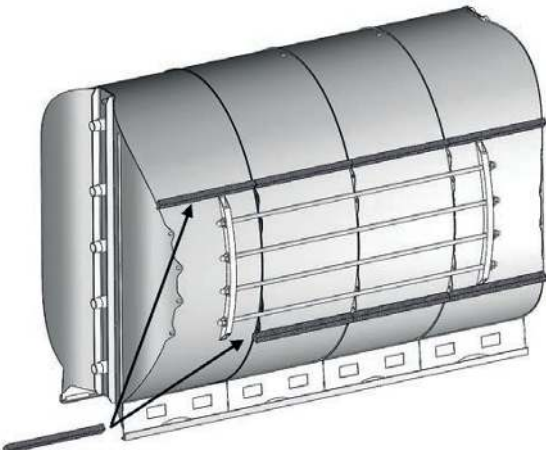
height: Apply double sided tape directly above and below the square profile of the end modules.



on both sides under the store.

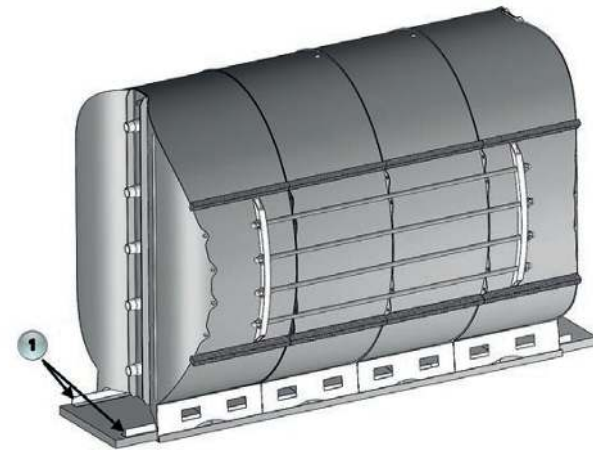


Glue on convection brake (fleece strips).

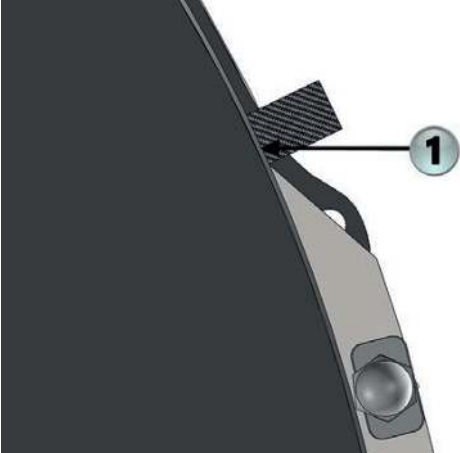


Optional: version with vacuum panels

The guide runners (1) are placed on the left and right side of the floor insulation.



Glued surface = narrow side (1) of the strip.



The vacuum insulation panels (VIP) (2) are placed between the runners and slid under the store.



Floor insulation

The floor plates are pushed under the store. It must protrude

Modules	2	3	4	5	6	7	8
Number of VIP on base plate	6	8	10	13	15	18	20

ATTENTION: The insulation jacket is pressure sensitive! The assembly of the insulation jacket should only be carried out after completion of all work in the immediate vicinity.

Preparation of convection control

The insulation jacket is first fitted with a foam strip convection brake:

The enclosed double-sided adhesive tape (1) is stuck to the top of only one of two insulation shells.



After removing the protective film from the double-sided tape the convection brake (foam strip) is also stuck on the insulation jacket. This must be done on the insulation shells all the way along the store.



Optional: version with vacuum panels

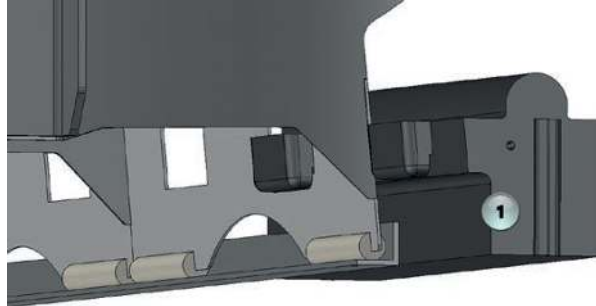
The vacuum panels are pushed into the slots of each insulation shell. Be careful when handling the panels.

The vacuum panels must not protrude! (1)



Assembly of the insulation around the base.

The insulation pieces are hooked into the store base plate.



First hook in two insulation pieces on the end module opposing each other with half the section protruding beyond the store.



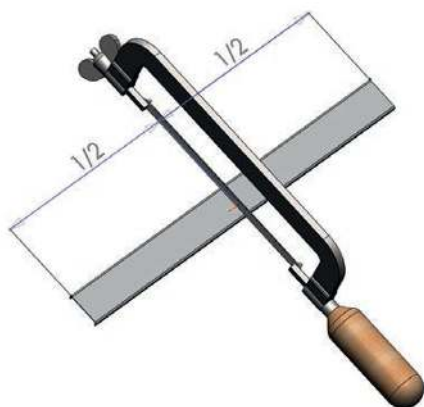
Assembly of insulation jacket shell

The shell locks in to the base part (1), then folds upwards (2).



NOTE: Carefully knock the insulation shells tightly together from both sides by tapping the surfaces by hand.

Cut one clamping profile in half with a saw.



Insert one half of the clamping profile into the slots of the jacket on the top at one end.

Mounting instructions clamp profile

NOTE: For the installation of the insulation, a ladder is recommended.

Lubricate the channels of the insulation with silicone grease before inserting the clamps.



It maybe necessary to spread the legs of the clamping profile to get it engaged.



The clamp profile is then curved and pushed into place.



Hang the next base insulation piece. Slide the base piece slightly away from the first section so that a gap is created.



TDMA-VARICAL: Assembly instructions

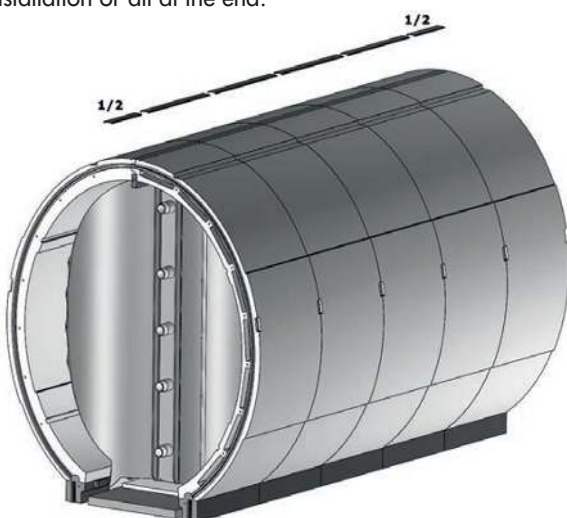
Insert the next section of the insulation shell and push together at the top.



Slide the 2 pieces of insulation together.



Repeat steps until the insulation is fully assembled. Clamp the shells with the profiles either as you go during the installation or all at the end.



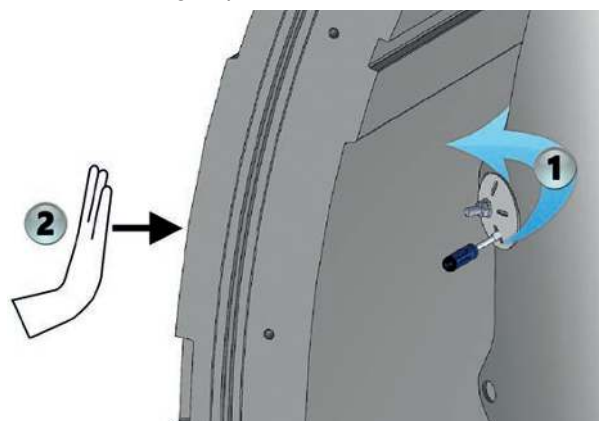
NOTE: Labelling the sensors with tape flags is recommended.



After the Assembly of the insulation jacket, make sure that there are no gaps. Then, secure the insulation using the hooks installed earlier (1).

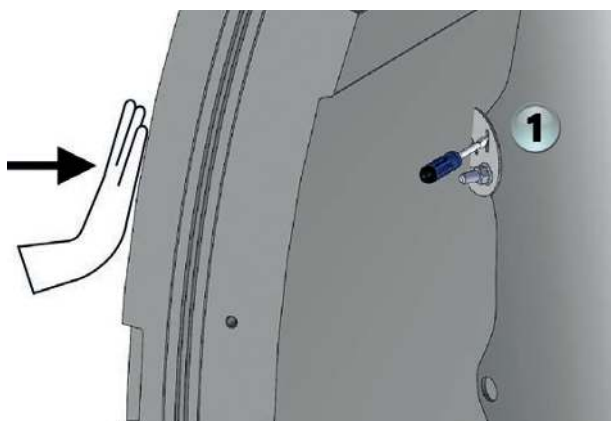


For this purpose, the fixing discs (1) are pressed into the jacket insulation. In doing so, press the insulation from the outside.



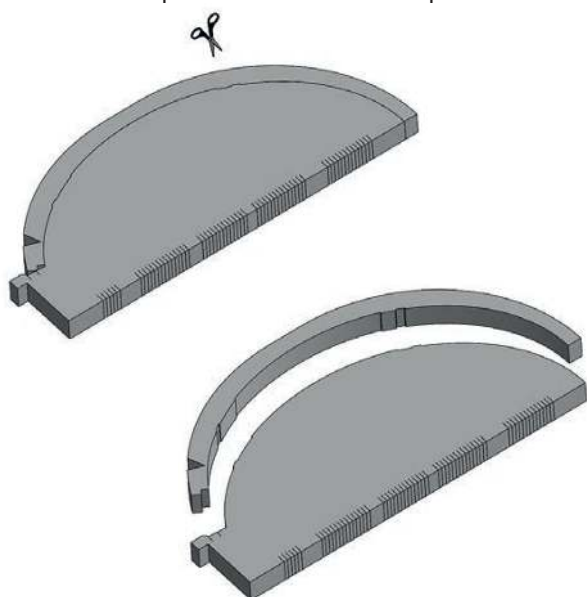
Temperature sensor

Insert all temperature sensors (1) according to the wiring diagram in the terminal strips on the store.

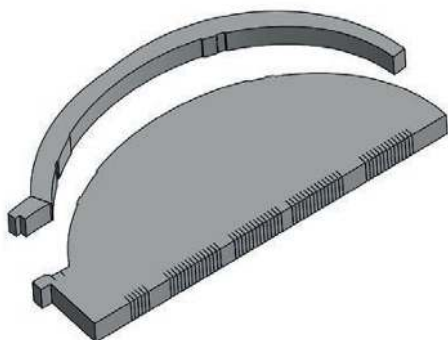


Front insulation (fleece)

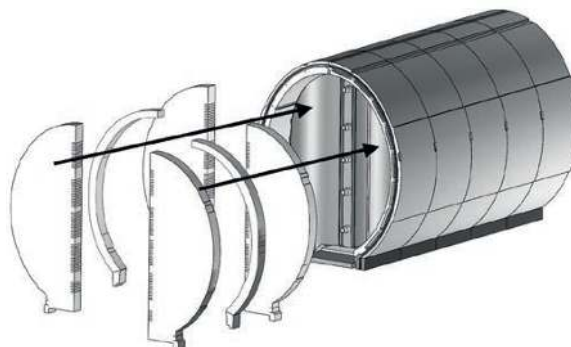
Remove outer strip from the front insulation piece.



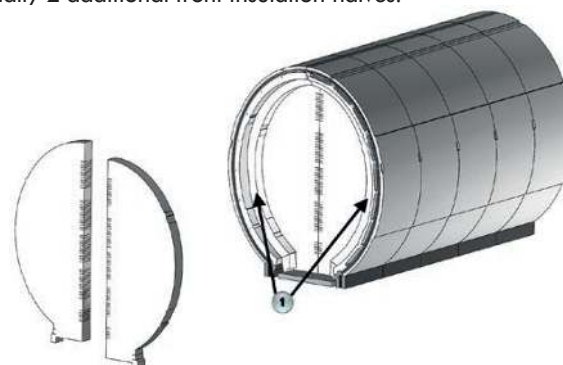
Angle the lower end of the perimeter strip.



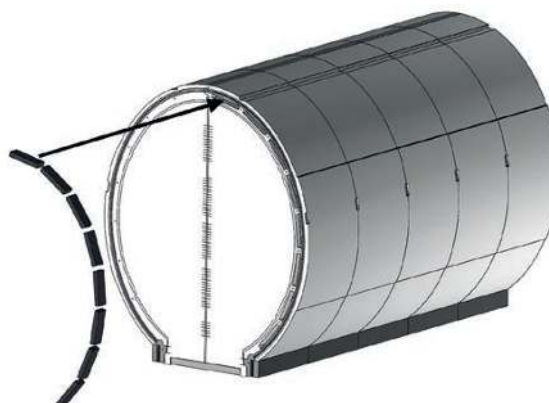
Insert 4 x front insulation and 2 x strips at each end of the store.



First 2 are pushed to the face of the store so contact is made around the perimeter with an air gap down the middle. Then the two side strips are used (1) left and right and finally 2 additional front insulation halves.



8 strips of fleece should be placed in the slots of the outer shell on each side if not using the VIPs.



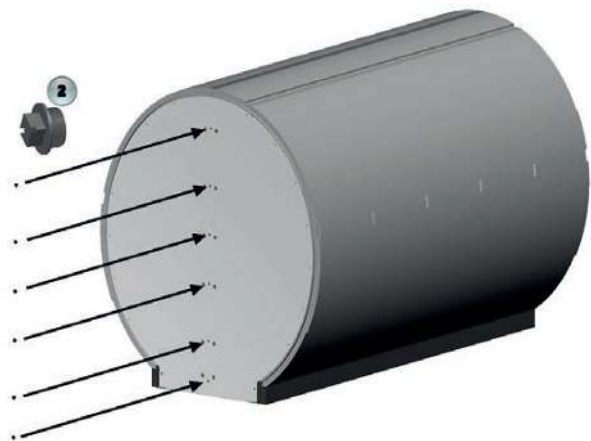
CONTROL:

The following points must be documented:

- ☐ All insulation shells side and top sections pushed together without gaps
- ☐ Front insulation is installed tight to the side and floor pieces.
- ☐ Pipe passes through front insulation without air gaps

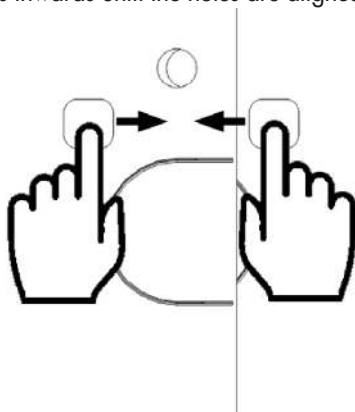
TDMA-VARICAL: Assembly instructions

The two halves of the front insulation are screwed together with the plastic screws.



The store is fully insulated.

Then, the two halves of the front plate in the midline are connected with the help of the plastic plug (2). The front halves can be drawn together using the holes next to the pipe passages. In addition the insulation jacket shell should be pulled from both sides inwards until the holes are aligned.



6.10 Maintenance: Vent access

If the end module is to be vented, the upper plastic screw can be removed. Then the two front panel halves can be opened at the top and vented by pulling the vent hose, see section 6.7.



ATTENTION: Hold a container under the breather hose so that the insulation does not get wet.

6.11 Disassembly

At the end of the service life, the store can be dismantled for recycling in the reverse order of the assembly steps.



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NOTE:

The information provided in the technical documentation and instructions do not claim to be exhaustive and do not replace proper planning.
Changes and errors excepted.

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Changes and errors excepted.