DHW heating
DHW cylinders and
cylinder loading systems

Technical guide

DHW heating

Central DHW heating
- **with Viessmann DHW cylinders**
- **with Viessmann cylinder loading system**
- **with Viessmann freshwater module**

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Sizing systems for DHW heating

1.1 Basics

1

General information

When sizing DHW heating systems, 2 main principles must be taken into consideration: For reasons of hygiene, size the volume of the DHW heating system so that it is as small as possible. However, for reasons of convenience, it should be as large as required. This means that the system must be designed as accurately as possible. In practice, various approaches are taken: For residential buildings, systems are often configured in accordance with **DIN 4708 Part 2**. Taking into account the sanitary amenities of the individual apartments/residential units, the occupancy/user rate and utilisation factors, the demand factor N can be determined.

Systems operating according to the instantaneous water heater principle, e.g. freshwater modules, may also be sized according to peak flow rate with reference to DIN 1988-300.

Irregular DHW demand

For buildings with irregular demand, e.g. schools, commercial enterprises, hotels or sports complexes with shower facilities, sizing is often carried out via the **peak output**/maximum draw-off rate over 10 min. It is important to ensure here that the DHW heating system is not oversized, but also to consider the heat-up time for the DHW cylinder until the next peak in demand occurs.

It is therefore also important to identify the available heating and transfer outputs. Ensure that the DHW can be adequately heated in the time between the peaks in demand.

Constant DHW demand

For applications where there is constant demand for DHW, for example businesses that prepare food or operate swimming pools, the DHW heating system is sized according to the constant demand of the consumer (continuous output). The size of the heat exchanger and the available heating output are crucial factors.

Sizing according to the **continuous output** is also practical when special consideration must be given to the return temperatures of the heating system (e.g. district heating systems).

High DHW demand

For extremely high demands, sizing the DHW heating system according to both the peak output and the continuous output is recommended, e.g. **cylinder loading systems**.

EDIS calculation program

For reliable sizing of DHW systems, Viessmann provides free EDIS software. This can be used for calculations for both residential buildings (to DIN 4708-2) and non-residential buildings (e.g. hotels, army barracks, industrial enterprises). Various complementary calculation processes are used.

Hydraulic connection

The following are important for safe and reliable operation of the DHW heating system:
- Sizing of the DHW cylinder
- Hydraulic connection of the DHW cylinder
- Overall system operation

The following are important for hygienic operation of the DHW heating system:
- Correct operating temperature
- Design of the DHW circulation pipe
- Connection of the DHW circulation pipe to the DHW cylinder

Specifically observe:
- DVGW Code of Practice W 551
- TRWI (DIN 1988)
- Valid Drinking Water Ordinance [Germany] (TrinkwV)
- Directive 98/83/EC of the Council of the European Union

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2.1 Product description

Vitocell 100-H (type CHA)

130, 160 and 200 l capacity, horizontal, enamelled, internal indirect coil
Horizontal DHW cylinder with internal indirect coil.
Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver finish.

Vitocell 300-H (type EHA)

160, 200, 350 and 500 l capacity, horizontal, made from stainless steel, internal indirect coil
Horizontal DHW cylinder made from high-alloy stainless steel with internal indirect coil.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver finish.

Cylinder banks
Vitocell 300-H, 350 and 500 l capacity can be combined with on-site manifolds for the heating water and DHW sides to form cylinder banks (700 l, 1000 l, 1500 l).
The DHW cylinders are supplied as individual units for easy installation and handling.

Vitocell 100-V (types CVA, CVAA, CVAA-A)

160, 200 and 300 l capacity, vertical, enamelled, internal indirect coil
Vertical DHW cylinder with internal indirect coil.
Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver or white finish.

Additionally for **Vitocell 100-V (type CVAA-A), 160 and 200 l capacity**:
- Vacuum-insulated panel for minimum standby losses

500, 750 and 1000 l capacity, vertical, enamelled, internal indirect coil
Vertical DHW cylinder with internal indirect coil.
Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.
The DHW cylinders feature all-round thermal insulation in Vitosilver.
The removable thermal insulation is supplied separately.

Cylinder banks
Vitocell 100-V, 300 to 1000 l capacity can be combined with manifolds to form cylinder banks (600 l, 1000 l, 1500 l, 2000 l, 3000 l).
Ready-to-fit manifolds for the heating water and DHW side are available for DHW cylinders up to 500 l capacity. For DHW cylinders with 750 and 1000 l capacity, manifolds need to be provided on site.
The DHW cylinders are supplied as individual units for easy installation and handling.

Vitocell 100-V (type CVW)

390 l capacity, vertical, enamelled, internal indirect coil
Vertical DHW cylinder with large internal indirect coil, especially for DHW heating in conjunction with heat pumps.
Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.
The DHW cylinders feature all-round thermal insulation in Vitosilver.
The removable thermal insulation is supplied separately.

Vitocell 300-V (type EVA)

130, 160 and 200 l capacity, vertical, made from stainless steel, heated by a peripheral indirect coil
Vertical DHW cylinder with components on the DHW side made from high-alloy stainless steel with peripheral indirect coil.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver finish.
The Vitocell 300-V with 160 and 200 l capacity is also available in white.

Vitocell 300-V (type EVI)

200 and 300 l capacity, vertical, made from stainless steel, internal indirect coil
Vertical DHW cylinder made from high-alloy stainless steel with internal indirect coil.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver finish.

500 l capacity, vertical, made from stainless steel, internal indirect coil
Vertical DHW cylinder made from high-alloy stainless steel with internal indirect coil.
The DHW cylinders feature all-round thermal insulation in Vitosilver.
The removable thermal insulation is supplied separately.

Cylinder banks
The Vitocell 300-V with 300 and 500 l capacity can be combined with manifolds for the heating water and DHW sides to form cylinder banks. Ready-to-fit manifolds are available.

The DHW cylinders are supplied as individual units for easy installation and handling.

Vitocell 100-W (types CUGA, CUGA-A)

120 and 150 l capacity, vertical, enamelled, internal indirect coil
Vertical DHW cylinder with internal indirect coil especially for installation below a wall mounted oil or gas boiler. Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.

The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a white finish.

Additionally with **Vitocell 100-W (type CUGA-A)**:
- Vacuum-insulated panel for minimum standby losses

Vitocell 100-L (type CVL) and Vitotrans 222

500, 750 and 1000 l capacity, cylinder loading system, enamelled
Vertical DHW cylinder for connecting an external heat exchanger set.
Steel loading cylinder, Ceraprotect enamel coating and protective magnesium anode for anti-corrosion protection.
The loading cylinders feature all-round thermal insulation in Vitosilver. The removable thermal insulation is supplied separately.

Vitotrans 222
Heat exchanger set comprising plate heat exchanger with thermal insulation, cylinder loading pump, heating water pump and line regulating valve.

Vitocell 100-B (types CVB, CVBB), Vitocell 100-U (type CVUB) and Vitocell 100-W (type CVUC-A)

300 l capacity, vertical, enamelled, for solar DHW heating
Vertical DHW cylinder with 2 internal indirect coils for dual mode DHW heating.
Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver or white finish.

Additionally with **Vitocell 100-U (type CVUB)**:
- With fitted Solar-Divicon and solar control unit Vitosolic 100, type SD1, or solar control module, type SM1

Additionally with **Vitocell 100-W (type CVUC-A)**:
- Option for displaying system states, yields and histograms via Vitotronic 200, type HO2B with colour touchscreen.
- Vacuum-insulated panel for minimum standby losses
- Only available in white.

400 and 500 l capacity, vertical, enamelled, for solar DHW heating
Vertical DHW cylinder with 2 internal indirect coils for dual mode DHW heating.
Cylinder and internal indirect coil made from steel, corrosion protection through Ceraprotect enamel coating and protective magnesium anode.
The DHW cylinders feature all-round thermal insulation in Vitosilver. The removable thermal insulation is supplied separately.

Additionally with **Vitocell 100-B (type CVB), 400 l capacity**:
- Also available in white.

Vitocell 300-B (type EVB)

300 l capacity, vertical, made of stainless steel, for solar DHW heating
Vertical DHW cylinder made of high-alloy stainless steel, with 2 internal indirect coils for dual mode DHW heating.
The DHW cylinders feature all-round thermal insulation enclosed within an epoxy-coated sheet steel casing in a Vitosilver finish.

500 l capacity, vertical, made of stainless steel, for solar DHW heating
Vertical DHW cylinder made of high-alloy stainless steel, with 2 internal indirect coils for dual mode DHW heating.
The DHW cylinders feature all-round thermal insulation in Vitosilver. The removable thermal insulation is supplied separately.

Vitocell 340-M, Vitocell 360-M (types SVKC/SVSB)

750 or 950 l capacity
Multi mode heating water buffer cylinder for hygienic DHW heating in continuous operation with internal indirect coil made from a high alloy corrugated stainless steel pipe. With a solar indirect coil for solar DHW heating and central heating backup.
With all-round thermal insulation in Vitosilver. The removable thermal insulation is supplied separately.

Additionally with **Vitocell 360-M**:
- Stratification system for stratification of solar heat in relation to temperature. This makes DHW heated by solar energy available very quickly.

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Vitotrans 353 (freshwater module)

Draw-off rate 25 l/min, 48 l/min, 68 l/min
Freshwater module for hygienic DHW heating in accordance with the instantaneous water heater principle.
Available for wall mounting as types PBS, PBM and PBL or as types PZS and PZM for installation on the heating water buffer cylinder Vitocell 100-E, Vitocell 120-E, Vitocell 140-E and Vitocell 160-E.

Freshwater modules of the type for installation on the heating water buffer cylinder include a DHW circulation pump and a diverter valve for directed return stratification (also available for wall mounting as an option).
All pumps are highly efficient.
With types PBM (48 l/min) and PBL (68 l/min), cascades with up to 4 identical modules are possible.

2.2 Overview of product features

Cylinder		Nominal capacity in l		Material			Version		Heat exchanger		Colour	
	Type	of	to	Stainless steel	Enamelled	Steel (buffer)	Horizontal	Vertical	Number	Sep. DHW coil	Vitosilver	White
Vitocell 100-H	CHA	130	200				X		1		X	
Vitocell 300-H	EHA	160	500	X			X		1		X	
Vitocell 100-V	CVA CVAA CVAA-A	160	1000		X			X	1		X	X
Vitocell 100-V	CVW	390	390		X			X	1		X	
Vitocell 300-V	EVA	130	300	X				X	1		X	X
Vitocell 300-V	EVI	200	500	X				X	1		X	
Vitocell 100-W	CUGA CUGA-A	120	150		X			X	1			X
Vitocell 100-L	CVL	500	1000		X			X			X	
Vitocell 100-B	CVB CVBB	300	500		X			X	2		X	X
Vitocell 100-U	CVUB CVUC-A	300	300		X			X	2		X	X
Vitocell 300-B	EVB	300	500	X				X	2		X	
Vitocell 340-M	SVKC	750	950	X		X		X	1	X	X	
Vitocell 360-M	SVSB	750	950	X		X		X	1	X	X	

All cylinders are supplied with thermal insulation. Cylinders with "-A" (e.g. CUGA-A) in their type designation are additionally equipped with a vacuum-insulated panel and thus they achieve ErP energy efficiency class A. These cylinders are also available as types without "-A", with standard thermal insulation. Horizontal and vertical cylinders with a nominal capacity of ≤ 300 l are encased in foam. Vertical cylinders with a nominal capacity of > 300 l are supplied with separate thermal insulation.

2.3 Intended use of Viessmann cylinders

The appliance is only intended to be installed and operated in sealed unvented systems that comply with EN 12828 / DIN 1988, or solar thermal systems that comply with EN 12977, with due attention paid to the associated installation, service and operating instructions. DHW cylinders are only designed to store and heat water of potable water quality. Heating water buffer cylinders are only designed to hold fill water of potable water quality. Only operate solar collectors with the heat transfer medium approved by the manufacturer.

Intended use presupposes that a fixed installation in conjunction with permissible, system-specific components has been carried out.

Commercial or industrial usage for a purpose other than heating the building or DHW shall be deemed inappropriate.

Any usage beyond this must be approved by the manufacturer for the individual case.

Incorrect usage or operation of the appliance (e.g. the appliance being opened by the system user) is prohibited and results in an exclusion of liability.

Incorrect usage also occurs if the components in the system are modified from their intended use (e.g. through direct DHW heating in the collector).

Adhere to statutory regulations, especially concerning the hygiene of potable water.

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Selecting the cylinder type

The detailed specification and performance parameters, including the continuous output diagrams for the DHW cylinder can be found in the datasheets. The following tables help with initial selection.

3.1 Selection according to N_L factor

The calculated demand factor N (see from page 12) is used to select the DHW cylinder performance factor N_L ($N_L \geq N$), which can be found in the first column of the following selection diagrams. DHW cylinders that have a corresponding performance factor are marked grey.

Example:
DHW heating in a two-family house in conjunction with a solar thermal system
Demand factor N = 2.3 ①

Selection: Vitocell 100-B, 400 l ② (from Vitocell 100 selection diagram) or Vitocell 300-B, 300 l ② (from Vitocell 300 selection diagram).
In the top line, the flow temperature of 70 °C ③ required for this output can now be read for Vitocell 100-B, 400 l with a performance factor N_L = 2.5 or of 80 °C ③ for Vitocell 300-B, 300 l with a performance factor N_L = 3.5.
The selection of the DHW cylinder should be checked using the specification in the datasheet.

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Vitocell 100 selection diagram

N_L	Vitocell 100-H 130-200 l			Vitocell 100-V 160-1000 l			Vitocell 100-B 300-500 l Ⓐ			Vitocell 100-U 300 l		
	70 °C	80 °C	90 °C	70°C	80 °C	90 °C	70 °C	80 °C	90 °C	70 °C	80 °C	90 °C
1.0	130 l						③					
1.2		130 l										
1.4			130 l				300 l			300 l		
1.6	160 l							300 l	300 l		300 l	300 l
1.8												
2.0		160 l										
① 2.2			160 l	160 l			②					
2.4	200 l				160 l		400 l					
2.6						160 l						
2.8												
3.0								400 l	400 l			
3.2												
3.4		200 l		200 l								
3.6			200 l									
3.8					200 l							
4.0						200 l						
4.2												
4.4												
4.6												
4.8												
5.0							500 l					
5.2												
5.4												
5.6												
5.8												
6.0								500 l	500 l			
6.2												
6.4												
6.6												
6.8												
8.0												
8.2												
8.4												
8.6				300 l								
8.8												
9.0												
9.2					300 l							
9.4												
9.6						300 l						
9.8												
10.0												
11.0												
12.0				390 l								
13.0												
14.0												
15.0					390 l							
16.0				500 l		390 l						
17.0												
18.0												
19.0					500 l							
20.0												
21.0						500 l						
22.0												
23.0												
24.0												
25.0												
26.0				750 l								
27.0												
28.0												
29.0												
30.0												
31.0												
32.0												
33.0												
34.0					750 l							
35.0												
36.0												
37.0												
38.0												
39.0												
40.0				1000 l		750 l						
41.0												
42.0												
43.0					1000 l							
44.0												
45.0						1000 l						

① - ③ Selection example
Ⓐ Upper indirect coil

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Vitocell 300 selection diagram

N_L	Vitocell 300-H 160-500 l			Vitocell 300-V 130-500 l			Vitocell 300-B 300 and 500 l		
	70 °C	80 °C	90 °C	70 °C	80 °C	90 °C	70 °C	80 °C	90 °C
1.0								③	
1.2									
1.4				130 l EVA					
1.6									
1.8	160 l				130 l EVA				
2.0				160 l EVA			300 l		
① 2.2		160 l						②	
2.4			160 l			130 l EVA			
2.6									
2.8					160 l EVA				
3.0				200 l EVI					
3.2				200 l EVA		160 l EVA			
3.4	200 l							300 l	
3.6									
3.8									
4.0									300 l
4.2									
4.4									
4.6									
4.8									
5.0		200 l							
5.2					200 l EVA				
5.4									
5.6							500 l		
5.8									
6.0					200 l EVI				
6.2									
6.4									
6.6			200 l						
6.8						200 l EVA/EVI		500 l	500 l
7.0									
7.2									
7.4									
7.6									
7.8									
8.0									
8.2				300 l EVI					
8.4									
8.6									
8.8									
9.0									
9.2									
9.4									
9.6									
9.8									
10.0	350 l				300 l EVI				
11.0									
12.0		350 l	350 l						
13.0						300 l EVI			
14.0									
15.0									
16.0									
17.0									
18.0				500 l EVI					
19.0	500 l								
20.0									
21.0					500 l EVI				
22.0		500 l				500 l EVI			
23.0									
24.0			500 l						
25.0									

① - ③ Selection example

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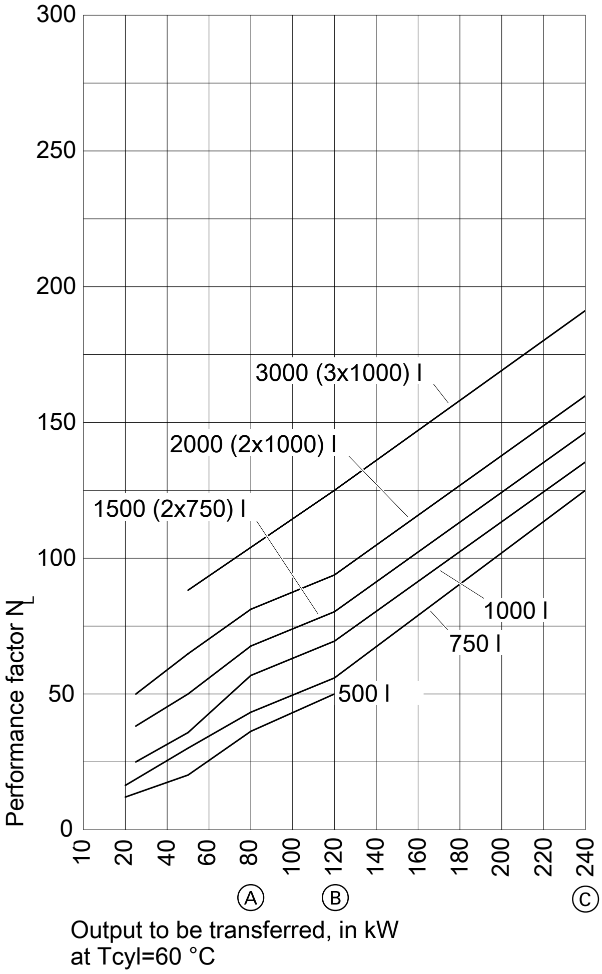
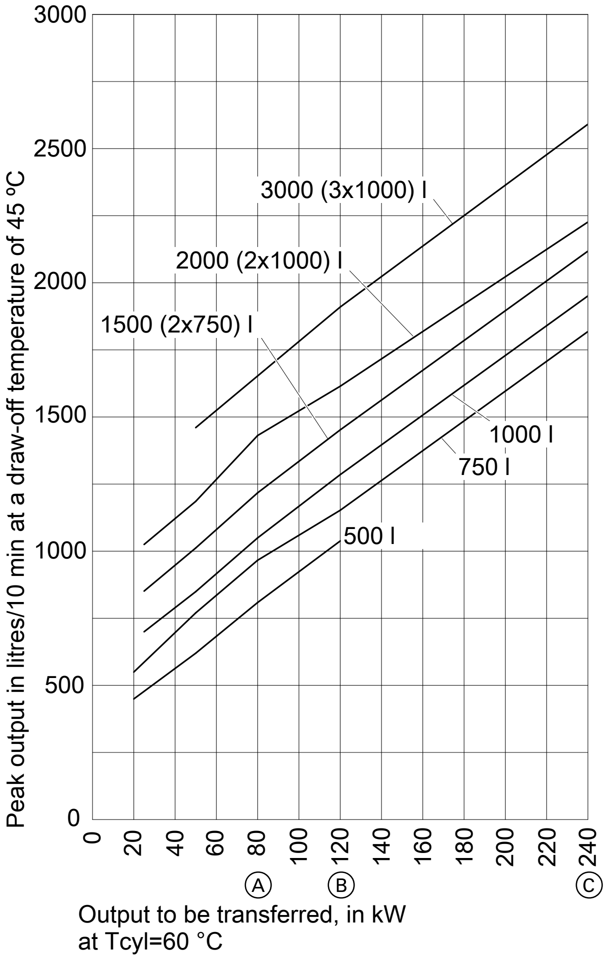
Selection diagrams, cylinder loading system Vitocell 100-L, type CVL, with Vitotrans 222

Performance factor N_L
The performance factor N_L depends on the cylinder storage temperature T_{cyl}.
Standard values
– T_{cyl} = 60 °C → 1.0 × N_L
– T_{cyl} = 55 °C → 0.75 × N_L
– T_{cyl} = 50 °C → 0.55 × N_L
– T_{cyl} = 45 °C → 0.3 × N_L



Ⓐ Vitotrans 222, 80 kW
Ⓑ Vitotrans 222, 120 kW
Ⓒ Vitotrans 222, 240 kW

Peak output (during a 10 min period)
The peak output over 10 min. depends on the cylinder storage temperature T_{cyl}.
Standard values
– T_{cyl}= 60 °C → 1.0 × peak output
– T_{cyl} = 55 °C → 0.75 × peak output
– T_{cyl} = 50 °C → 0.55 × peak output
– T_{cyl} = 45 °C → 0.3 × peak output



Ⓐ Vitotrans 222, 80 kW
Ⓑ Vitotrans 222, 120 kW
Ⓒ Vitotrans 222, 240 kW

3.2 Selection according to continuous output

In accordance with the required heating from 10 to 45 °C or from 10 to 60 °C and the planned flow temperature, the relevant column in the following selection table is selected. The required continuous output (see from page 22) is found in the column and the cylinder type in the first column is read off.

Example:
DHW heating from 10 to 60 °C, flow temperature 70 °C ①
Required continuous output: 20 kW ②, enamelled DHW cylinder, adjacent in the first column ③: Vitocell 100-V 200 l or Vitocell 100-V, 300 l

The most suitable DHW cylinder is now selected based on the specification and the continuous output diagrams in the Vitocell datasheets.

Note
The stated continuous output is only achieved if the rated boiler heating output is greater than the continuous output.
When engineering systems with the specified or calculated continuous output, factor in a matching circulation pump.

Selecting the cylinder type (cont.)

Table for selection according to continuous output

Device	Type	Capacity	Continuous output in kW for DHW heating from 10 to 60 °C			Continuous output in kW for DHW heating from 10 to 45 °C				
Flow temperature			**90 °C**	**80 °C**	**70 °C** ①	**90 °C**	**80 °C**	**70 °C**	**60 °C**	**50 °C**
Horizontal DHW cylinders										
Vitocell 100-H	CHA	130 l	27	20	14	28	23	19	14	—
		160 l	32	24	17	33	28	22	16	—
		200 l	38	29	19	42	32	26	18	—
Vitocell 300-H	EHA	160 l	28	23	15	32	28	20	14	—
		200 l	33	25	17	41	30	23	16	—
		350 l	70	51	34	80	64	47	33	—
		500 l	82	62	39	97	76	55	38	—
DHW cylinders for wall mounted boilers										
Vitocell 100-W	CUGA	120 l	—	—	—	—	24	—	—	—
	CUGA-A	150 l	—	—	—	—	24	—	—	—
Vertical DHW cylinders										
Vitocell 100-V	CVA	160 l	36	28	19	40	32	25	9	—
	CVAA-A	200 l ③	36	28	19 ②	40	32	17	9	—
	CVAA	300 l	45	34	23	53	44	23	18	—
	CVA	500 l	53	44	33	70	58	32	24	—
		750 l	102	77	53	123	99	53	28	—
		1000 l	121	91	61	136	111	59	33	—
	CVW	390 l	98	78	54	109	87	77	48	26
Vitocell 300-V	EVA	130 l	32	25	16	37	30	22	13	9
		160 l	36	28	19	40	32	24	15	10
		200 l	57	43	25	62	49	38	25	12
	EVI	200 l	63	48	29	71	56	44	24	13
		300 l	82	59	41	93	72	52	30	15
		500 l	81	62	43	96	73	56	37	18
Dual mode DHW cylinders Ⓐ										
Vitocell 100-U	CVUB CVUC-A	300 l	23	20	15	31	26	20	15	11
Vitocell 100-B	CVBB	300 l	23	20	15	31	26	20	15	11
	CVB	400 l	36	27	18	42	33	25	17	10
		500 l	36	30	22	47	40	30	22	16
Vitocell 300-B	EVB	300 l	74	54	35	80	64	45	28	15
		500 l	74	54	35	80	64	45	28	15
Freshwater module										
Vitotrans 353	PBS PZS		108	88	65	81	81	81	61	39
	PBM PZM		195	164	127	146	146	146	117	79
	PBL		277	233	181	203	203	203	166	113

① - ③ Selection example
Ⓐ Upper indirect coil

Note
For more values, see the "Vitotrans 353" datasheet.

Sizing

4.1 Sizing according to peak draw-off rate and DIN 4708-2

For residential buildings, the DHW demand is calculated based on the demand factor N. The calculations are set out in DIN 4708-2 and described below. Based on the demand factor N, a DHW cylinder with a corresponding performance factor N_L is then selected ($N_L \geq N$).

The performance factor N_L of a DHW cylinder can also be expressed as the peak output over 10 minutes. Systems for DHW heating are sized according to this "peak draw-off rate" if a specific volume of DHW has to be provided for a short period of time, after which a longer period of time is available to reheat the cylinder again. This may occur, e.g. in commercial enterprises or schools (intermittent operation). The 10-minute peak output is determined almost exclusively by the volume of water stored (cylinder capacity).

Calculation program EDIS/DIN 4708-2

DHW cylinders can also be sized with the aid of the EDIS calculation program. The program sizes DHW cylinders on the basis of DIN 4708 for residential units and includes various calculation processes, e.g. for hotels, catering businesses, hospitals, retirement homes, campsites, sports halls.
You can obtain the Viessmann "EDIS" calculation program by contacting one of our sales offices.

The performance factor N_L and the maximum continuous output of the DHW cylinders is given in the tables from page 9. For the detailed specifications, performance parameters and continuous output diagrams, see the datasheet for the relevant DHW cylinder.

Calculating the heat demand for DHW heating in residential buildings

This calculation is based on DIN 4708 (central DHW heating systems) Part 2.

DIN 4708 is the basis for the standard calculation of the heat demand for central DHW heating systems in residential buildings. For the purposes of calculating the heat demand, a standard residential unit is defined as follows:
The standard residential unit is a dwelling based on statistical values, for which the demand factor N = 1 is as follows:
- Room factor r = 4 rooms
- Occupancy factor p = 3.5 people
- Draw-off demand w_v = 5820 Wh/draw-off volume for a bath

The following information is required to calculate the demand

a) All sanitary equipment on all floors, e.g. from the building design drawing or details supplied by architect or client
b) Number of living spaces (number of rooms) without ancillary rooms such as kitchen, hallway, bathroom and storage room, e.g. from the building design drawing or details supplied by architect or client
c) Number of people per residential unit (occupancy factor).
If the number of occupants for each residential unit cannot be ascertained, a statistical occupancy factor p can be calculated on the basis of the room factor r for the residential unit concerned using table 1.

Calculating the occupancy factor p

If the number of people per residential unit cannot be ascertained, this table can be used to calculate the occupancy factor p.

Table 1

Room factor r	Occupancy factor p
1.0	2.0*1
1.5	2.0*1
2.0	2.0*1
2.5	2.3
3.0	2.7
3.5	3.1
4.0	3.5
4.5	3.9
5.0	4.3
5.5	4.6
6.0	5.0
6.5	5.4
7.0	5.6

Establishing the number of draw-off points to be taken into account when calculating the demand

The number of draw-off points must be taken into account when calculating the overall demand. This varies according to the specifications of the residential unit (basic or deluxe) and can be derived from tables 2 or 3.

4

Table 2 – Residential unit with standard equipment level

Existing amenities per residential unit		To be taken into account for calculating the demand
Room	Equipment	
Bathroom	1 bath 140 l (according to table 4, no. 1, on page 14) or 1 shower cubicle with/without mixer tap and standard shower head	1 bath 140 l (according to table 4, no. 1, on page 14)
	1 washbasin	Not taken into account
Kitchen	1 kitchen sink	Not taken into account

*1 *If the residential building concerned mainly comprises residential units with 1 and 2 main rooms, increase the occupancy factor p by a factor of 0.5.*

Table 3 – Residential unit with deluxe equipment level

Existing amenities per residential unit		To be taken into account for calculating the demand
Room	Equipment	
Bathroom	Bath*2	As existing, according to table 4, no. 2 to 4
	Shower cubicle*2	As existing, incl. any additional facilities according to table 4, no. 6 or 7, if arranged to permit simultaneous use*3
	Washbasin*2	Not taken into account
	Bidet	Not taken into account
Kitchen	1 kitchen sink	Not taken into account
Guest room	Bath	Per guest room: As existing, according to table 4, no. 1 to 4, with 50 % of the draw-off demand w_v
	or Shower cubicle	As existing, incl. possible additional equipment as per table 4, no. 5 to 7, with 100 % of the draw-off demand w_v
	Washbasin	At 100 % of the draw-off demand w_v according to table 4*4
	Bidet	At 100 % of the draw-off demand w_v according to table 4*4

Calculating the applicable draw-off demand per draw-off point to be considered

Take the respective draw-off demand w_v for the draw-off points included in the calculation of the demand factor N from table 4.

Table 4 – Draw-off demand w_v

No.	Sanitary equipment or draw-off point	DIN code	Draw-off volume per use or useful capacity in l	Draw-off demand w_v per use in Wh
1	Bath	NB1	140	5820
2	Bath	NB2	160	6510
3	Small bath and sit bath	KB	120	4890
4	Large bath (1800 mm × 750 mm)	GB	200	8720
5	Shower cubicle*5 with mixer tap and economy shower head	BRS	40*6	1630
6	Shower cubicle*5 with mixer tap and standard shower*7	BRN	90*6	3660
7	Shower cubicle*5 with mixer tap and deluxe shower head*8	BRL	180*6	7320
8	Washbasin	WT	17	700
9	Bidet	BD	20	810
10	Washbasin	HT	9	350
11	Kitchen sink	SP	30	1160

For baths with capacities that vary considerably, apply the draw-off demand w_v in accordance with formula $w_v = c \times V \times \Delta T$ in Wh and use it in the calculation ($\Delta T = 35$ K).

Calculating the demand factor N

In order to establish the heat demand for DHW to all residential units, it is first necessary to convert the data into the heat demand for DHW of the standard residential unit.
The following characteristics of the standard residential unit are agreed:
1. Room factor r = 4 rooms
2. Occupancy factor p = 3.5 people
3. Draw-off demand w_v = 5820 Wh (for one bath)

The heat demand for DHW for the standard residential unit with 3.5 occupants × 5820 Wh = 20370 Wh corresponds to the demand factor N = 1
N = total of the heat demand for DHW for all residential units to be supplied with DHW, divided by the heat demand for DHW for the standard residential unit

$$N = \frac{\Sigma(n \cdot p \cdot v \cdot w_v)}{3.5 \cdot 5820} = \frac{\Sigma(n \cdot p \cdot v \cdot w_v)}{20370}$$

n = Number of similar residential units
p = Occupancy factor per similar residential unit
v = Number of similar draw-off points per similar residential unit
w_v = Draw-off demand in Wh

$(n \cdot p \cdot v \cdot w_v)$ must be calculated for each relevant draw-off point per similar residential unit.

*2 *Size different from standard equipment level.*
*3 *If no bath is installed, a bath is assumed instead of a shower cubicle as with the standard equipment (see table 4, no. 1) unless the draw-off demand of the shower cubicle exceeds that of the bath (e.g. deluxe shower).*
If several different shower cubicles are installed, at least one bath is assumed for the shower cubicle with the highest draw-off demand.
*4 *If no bath or shower cubicle is assigned to the guest room.*
*5 *To be included in calculations only if the bath and shower cubicle are in separate rooms, i.e. if simultaneous use is possible.*
*6 *Corresponding to 6 minutes in use.*
*7 *Fitting flow rate class A to EN 200.*
*8 *Fitting flow rate class C to EN 200.*

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Now use the calculated demand factor N, to select the required DHW cylinder at the appropriate heating water flow temperature from the tables on pages 9 and 10. Select a DHW cylinder with an N_L factor at least equal to N.
The demand factor N is identical to the number of standard residential units in the building project.
It does not necessarily correspond to the actual number of residential units.

Example:
For a residential building project, design the DHW system on the basis of demand factor N.

The numbers of similar residential units, the room factor and the equipment level listed in table 5 have been taken from the building plans.
The occupancy factor p was determined using the room factor r and table 1 on page 13.
The number of draw-off points to be used in the design was calculated using table 2 on page 13 and table 3 on page 14.

Table 5

No. of residential units **n**	**Room factor** **r**	**Occupancy factor** **p**	**Amenities in the residential unit** **Number, description**	**Apply for the demand calculation** **No. of draw-off points, description**
4	1.5	2.0	1 shower cubicle with standard shower head 1 washbasin in the bathroom 1 sink in the kitchen	according to table 2 on page 13 1 shower cubicle (BRN)
10	3	2.7	1 bath 140 l 1 washbasin in the bathroom 1 sink in the kitchen	according to table 2 on page 13 1 bath (NB1)
2	4	3.5	1 shower cubicle with mixer tap and deluxe shower head 1 shower cubicle with standard shower head (in a physically separate location) 1 washbasin in the bathroom 1 sink in the kitchen	according to table 3 on page 14 1 shower cubicle (BRL)
4	4	3.5	1 bath 160 l 1 shower cubicle with deluxe shower head in a separate room 1 washbasin in the bathroom 1 bidet 1 sink in the kitchen	according to table 3 on page 14 1 bath (NB2) 1 shower cubicle (BRL)
5	5	4.3	1 bath 160 l 1 washbasin in the bathroom 1 bidet 1 bath 140 l, in the guest room 1 washbasin in the guest room 1 sink in the kitchen	according to table 3 on page 14 1 bath (NB2) 1 bath (NB1) with 50 % of the draw-off demand w_v 1 washbasin (WT) 1 bidet (BD)

Form for calculating the heat demand for DHW heating in residential buildings

Calculating the demand of residential units with centralised supply systems — **Project no:** **Sheet no:**

Calculating the demand factor N for determining the required DHW cylinder size
Project
Occupancy factor p based on statistical values as per table 5, page 15

1	2	3	4	5	6	7	8	9	10	11
Sequential number of residential unit groups	Room factor r	No. of residential units n	Occupancy factor p	n · p	No. of draw-off points to consider (per residential unit) No. of draw-off points v	Short code	Draw-off demand w_v in Wh	$v \cdot w_v$ in Wh	$n \cdot p \cdot v \cdot w_v$ in Wh	Comments
1	1.5	4	2.0	8.0	1	NB1	5820	5820	46560	NB1 for BRN
2	3.0	10	2.7	27.0	1	NB1	5820	5820	157140	
3	4.0	2	3.5	7.0	1	BRL	7320	7320	51240	
					1	BRN	3660	3660	25620	
4	4.0	4	3.5	4.0	1	NB2	6510	6510	91140	
					1	BRL	7320	7320	102480	
5	5.0	5	4.3	21.5	1	NB2	6510	6510	139965	
					(0.5)	NB1	5820	5820	62565	50 % w_v acc. to Tab. 3 on page 14

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Calculating the demand of residential units with centralised supply systems	**Project no:** **Sheet no:**

$\Sigma\, n_i = 25$ $\Sigma\,(n \cdot p \cdot v \cdot w_v) = 676710$ Wh

$$N = \frac{\Sigma(n \cdot p \cdot v \cdot w_v)}{3.5 \cdot 5820} = \frac{676710}{20370} = 33.2$$

Now use the calculated demand factor N = 33.2 to select the required DHW cylinder from the tables in the relevant datasheets at the available heating water flow temperature (e.g. 80 °C) and a cylinder storage temperature of 60 °C. Select a DHW cylinder with an N_L factor at least equal to N.

Note
The performance factor N_L varies subject to the following variables:
- *Flow temperature*
- *Storage temperature*
- *Available or transferable output*

For deviating operating conditions, modify the performance factor N_L from the values shown in the tables in the relevant datasheets.

Possible DHW cylinders:
- From selection diagram from page 10 and the Vitocell 300-H datasheet:
  Vitocell 300-H with 700 l capacity (N_L = 35) as cylinder bank comprising 2 x Vitocell 300-H, each with 350 l capacity
- From selection diagram from page 10 and the Vitocell 300-V datasheet:
  Vitocell 300-V with 600 l capacity (N_L = 38) as cylinder bank comprising 2 x Vitocell 300-V, each with 300 l capacity

Selected DHW cylinder:
2 × Vitocell 300-V, each with 300 l capacity.

Boiler supplement Z_K

According to DIN 4708-2 and VDI 3815, the rated heating output of a boiler must be increased by the boiler supplement Z_K to cover the DHW heating demand (see table 6).
Observe the explanations in DIN/VDI [or local regulations].

DIN 4708 specifies 3 main demands for the rated heating output of the heat source:

Demand 1
The performance factor must be at least equal to or greater than the demand factor:
$\mathbf{N_L \geq N}$

Demand 2
Only if the rated boiler heating output $\dot{Q}_K$ or Φ_K is higher or at least equal to the continuous output, can the DHW cylinder deliver the performance factor N_L stated by the manufacturer:
$\dot{Q}_K \geq \dot{Q}_D$ **or** $\Phi_K \geq \Phi_D$

Demand 3
Heat generating systems used for both DHW and central heating must cover the additional output Z_K as well as the standard heat load $\Phi_{HL\ buil.}$ EN 12831 (previously DIN 4701):
$\Phi_K \geq \Phi_{HL\ buil.} + Z_K$
On the basis of DIN 4708-2, VDI 3815 is used for calculating a supplement to the rated boiler heating output as a function of the demand factor N and a minimum cylinder capacity (see table 6).
It has proved successful in practice to take the boiler supplement into account according to the following relations:
$\Phi_K \geq \Phi_{HL\ buil.} \cdot \phi + Z_K$
ϕ = Factor for utilisation of building heating (all rooms heated)

Number of residential units per building	ϕ
up to 20	1
21 to 50	0.9
> 50	0.8

Table 6 – Boiler supplement Z_K

Demand factor N	Boiler supplement Z_K in kW
1	3.1
2	4.7
3	6.2
4	7.7
5	8.9
6	10.2
7	11.4
8	12.6
9	13.8
10	15.1
12	17.3
14	19.5
16	21.7
18	23.9
20	26.1
22	28.2
24	30.4
26	32.4
28	34.6
30	36.6
40	46.7
50	56.7
60	66.6
80	85.9
100	104.9
120	124.0
150	152.0
200	198.4
240	235.2
300	290.0

Note
In buildings with an extremely low heat load $\Phi_{HL\ buil.}$, a check must be carried out to determine whether the output of the heat source, including supplement Z_K, is sufficient for the selected performance factor. It may be necessary to select a larger DHW cylinder.

Calculating the heat demand for DHW heating in commercial enterprises

1. Calculating the demand
Allow for a suitable number of washing facilities (washing/shower units) for the type of business concerned (see the earlier DIN 18228, sheet 3, page 4).
Per 100 users (numbers in the most numerous shift), the washing facilities listed in table 7 are required.

Table 7 – Standard working conditions[*9]

Activity	Number of washing facilities per 100 users	Splitting the washing facilities Washing facilities/shower cubicles
Slightly dirty	15	–/–
Moderately dirty	20	2/1
Very dirty	25	1/1

2. Sizing the DHW heating system
The following example is used to illustrate how to size the DHW heating system.

Example:

Number of employees during the most numerous shift:	150 employees
Working pattern:	2-shift operation
Type of activity:	Moderately dirty
Required DHW outlet temperature:	35 to 37 °C
Cylinder storage temperature:	60 °C
Cold water inlet temperature:	10 °C
Heating water flow temperature:	90 °C

Calculating the DHW demand
Table 7 shows that for moderately dirty work, 20 washing facilities are required per 100 employees. The ratio of washbasins to shower cubicles is 2:1.
Therefore, 20 washbasins and 10 shower cubicles are required for 150 employees.

Table 8 – Consumption figures for washing facilities and shower cubicles with a DHW outlet temperature of 35 to 37 °C

Consumption point	DHW volume in l/min	Utilisation time in min	DHW consumption per use in l
Washbasins with tap	5 to 12	3 to 5	30
Washbasins with spray head	3 to 6	3 to 5	15
Circular communal washbasin for 6 people	approx. 20	3 to 5	75
Circular communal washbasin for 10 people	approx. 25	3 to 5	75
Shower cubicle without changing cubicle	7 to 12	5 to 6[*10]	50
Shower cubicle with changing cubicle	7 to 12	10 to 15[*11]	80

Assuming:
The washing facilities (washbasin with spray head) are used by 120 employees (6 times in sequence) and the shower cubicles (showers without changing cubicles) are used by 30 employees (3 times in sequence).

Using table 8, we arrive at the following DHW volume required:
a) DHW demand of the washing facilities: 120 × 3.5 l/min × 3.5 min = 1470 l
b) DHW demand of the showers: 30 × 10 l/min × 5 min = 1500 l
Together, a) and b) result in a total DHW demand of 2970 l at approx. 36 °C water temperature for a utilisation period of approx. 25 minutes.
Conversion to an outlet temperature of 45 °C results in:

$$V_{(45°C)} = V_{(36°C)} \cdot \frac{\Delta T_{(36°C - 10°C)}}{\Delta T_{(45°C - 10°C)}}$$

$$= 2970 \cdot \frac{26}{35} = 2206\ l$$

As 8 hours are available between the shifts for reheating the DHW cylinder, the cylinder capacity should be sized for storage purposes. For this, the details for the peak output (10-minute peak output) in the tables in the relevant datasheets for the DHW cylinders are used.

From the corresponding table in the Vitocell 300-V datasheet: For Vitocell 300-V with 500 l capacity and a heating water flow temperature = 90 °C, the peak output is 10/45 °C 627 l/10 min.
Number of DHW cylinders n = calculated total volume/selected peak output (10 min output) of the individual cylinder

$$n = \frac{2206}{627} = 3.5\ \text{pce.}$$

Selected DHW cylinder:
4 × Vitocell 300-V, each with 500 l capacity.

Calculating the required heating output
7.5 hours are available for heating up the DHW cylinder; this gives a minimum connected load (i.e. boiler heating output) of:

$$\dot{Q}_A = \Phi_A = \frac{c \cdot V \cdot \Delta T_A}{Z_A}$$

$$= \frac{1 \cdot 2000 \cdot 50}{860 \cdot 7.5} = 15.5\ kW$$

$\dot{Q}_A$ or Φ_A	=	Minimum connected load for heating the DHW cylinder in kW
V	=	Selected cylinder capacity in l
c	=	Spec. thermal capacity $\left(\frac{1\ kWh}{860\ l \cdot K}\right)$
ΔT_A	=	Temperature differential between the cylinder storage temperature and the cold water inlet temperature (60 °C – 10 °C) = 50 K
Z_A	=	Heat-up time in h

As an empirical value, a heat-up time of approx. 2 hours is selected. In the above example, this means that the boiler and the circulation pump for cylinder heating (required heating water volume) should be sized for a heat-up rating of approx. 60 kW.

Calculating the heat demand for DHW heating in hotels, guest houses and residential homes

To calculate the DHW demand, it is necessary to establish the points of use in every room. For this, only consider the largest point of use per single/double room.

*9 *In businesses with exceptionally dirty working conditions, 25 washing facilities are required per 100 users.*
*10 *Showering time excluding changing.*
*11 *Showering time 5 to 8 min; rest of time for changing.*

Table 9 – Draw-off demand per point of use at a DHW temperature of 45 °C

Point of use	Volume of hot water drawn off per use in l	Draw-off demand $Q_{h\,max.}$	
		per single room in kWh	per double room in kWh
Bath	170	7.0	10.5
Shower cubicle	70	3.0	4.5
Washbasin	20	0.8	1.2

Calculating the required cylinder capacity

$Q_{h\,max.}$ = Draw-off demand per draw-off point in kWh
n = Number of rooms with identical draw-off demand
ϕ_n = Utilisation factor (simultaneity); can be applied conditionally:

Number of rooms	1 to 15	16 to 36	35 to 75	76 to 300
ϕ_n *12	1	0.9 to 0.7	0.7 to 0.6	0.6 to 0.5

ϕ_2 = Hotel grading factor
The following factors can be applied to reflect the category of hotel:

Hotel category	Normal	Good	High
ϕ_2	1.0	1.1	1.2

Z_A = Heat-up time in h
The heat-up time is subject to the rated heating output available for DHW heating. Subject to the rated boiler heating output, you can select a smaller Z_A value than 2 h.
Z_B = Duration of the peak DHW demand in h
Assumption: 1 to 1.5 h
V = Volume of the DHW cylinder in l
T_a = Cylinder storage temperature in °C
T_e = Cold water inlet temperature in °C
a = 0.8
This takes into account the heat-up condition of the DHW cylinder.

Example:
Hotel with 50 rooms (30 double rooms and 20 single rooms)
- Amenities of the single rooms:
  5 single rooms with bath, shower cubicle and washbasin
  10 single rooms with shower cubicle and washbasin
  5 single rooms with washbasin
- Amenities of double rooms:
  5 double rooms with bath and washbasin
  20 double rooms with shower cubicle and washbasin
  5 double rooms with washbasin
- Heating water flow temperature = 80 °C
- Required heat-up time of the DHW cylinder 1.5 hours
- Duration of peak demand 1.5 hours

Heat demand for DHW heating

Type of room	Equipment level (draw-off point)	n	$Q_{h\,max.}$ in kWh	$n \times Q_{h\,max.}$ in kWh
Single room:	Bath	5	7.0	35.00
	Shower cubicle	10	3.0	30.00
	Washbasin	5	0.8	4.00
Double rooms:	Bath	5	10.5	52.50
	Shower cubicle	20	4.5	90.00
	Washbasin	5	1.2	6.00
	$\Sigma (n \cdot Q_{h\,max.}) = 217.50$			

$$V = \frac{860 \cdot \Sigma(n \cdot Q_{h\,max.}) \cdot \phi_n \cdot \phi_2 \cdot Z_A}{(Z_A + Z_B) \cdot (T_a - T_e) \cdot a}$$

$$= \frac{860 \cdot 217.5 \cdot 0.65 \cdot 1 \cdot 1.5}{(1.5 + 1.5) \cdot (60 - 10) \cdot 0.8}$$

$$= 1520 \text{ l}$$

Selected DHW cylinders:
3 × Vitocell 300-H, each with 500 l capacity
or
3 × Vitocell 300-V, each with 500 l capacity

Calculating the required heat-up output

$$\dot{Q} = \Phi = \frac{V \cdot c \cdot (T_a - T_e)}{Z_A}$$

$$= \frac{1500 \cdot (60 - 10)}{860 \cdot 1.5} = 58 \text{ kW}$$

$\dot{Q}$ or Φ = Heat-up output in kW
V = Selected capacity in l
c = Spec. thermal capacity $\left(\frac{1 \text{ kWh}}{860 \text{ l} \cdot \text{K}}\right)$
T_a = Cylinder storage temperature in °C
T_e = Cold water inlet temperature in °C
Z_A = Heat-up time in h

The boiler and circulation pump for cylinder heating must be sized accordingly for the required heat up output.
To guarantee adequate heating of the building during winter too, this heat volume must be added to the heat load.

Calculating the heat demand for DHW heating in commercial saunas

Assuming:
The sauna is used by 15 people/h.
5 showers with 12 l/min are available, i.e. the showers are utilised 3 times in a row. A showering time of 5 min results in a DHW demand of 60 l per use.
The heat load of the building is $\dot{Q}_N = \Phi_{HL\,buil.} = 25$ kW.
Two points must be observed to safeguard adequate DHW heating:
a) Adequate cylinder capacity (sized according to peak output).
b) The boiler must be large enough to cover the DHW heating and $\dot{Q}_N$.

Regarding a)
Calculating the cylinder capacity:
15 persons @ 60 l = 900 l at 40 °C at the DHW outlet.
The cylinder storage temperature is 60 °C.
As a low temperature boiler is to be installed, the peak output at a heating water flow temperature of 70 °C must be calculated; see tables in the datasheets for the relevant DHW cylinders.
Conversion to an outlet temperature of 45 °C results in:

*12 *For spa hotels, trade fair hotels or similar installations, select a utilisation factor of ϕ_n = 1.*

$$V_{(45°C)} = V_{(40°C)} \cdot \frac{\Delta T_{(40\,°C - 10\,°C}}{\Delta T_{(45\,°C - 10\,°C}}$$

$$= 900 \cdot \frac{30}{35} = 771\ l$$

Suggestion: 2 Vitocell 300-V, each with 300 l capacity with a peak output of 375 l per cylinder and 698 l as a cylinder bank (DHW temperature 45 °C).

Regarding b)
Required boiler size
As the showering process repeats hourly, the selected cylinder capacity must be heated up within 1 hour. The heat volume required to achieve this is calculated as follows:

$$\dot{Q}_A = \Phi_A = \frac{V_{cyl.} \cdot \Delta T_A \cdot c}{Z_A}$$

$$= \frac{600 \cdot 1 \cdot (60 - 10)}{860 \cdot 1}$$

$$= 34.9\ kW$$

$\dot{Q}_A$ or Φ_A	=	Minimum connected load for heating the DHW cylinder in kW
V_{cyl}	=	Capacity in litres
ΔT_A	=	Temperature differential between the cylinder storage temperature and the cold water inlet temperature
c	=	Spec. thermal capacity $\left(\frac{1\ kWh}{860\ l \cdot K}\right)$
Z_A	=	Heat-up time in h

To guarantee adequate heating of the building during winter too, this heat volume must be added to the heat load. EnEV [Germany] permits this supplement for the following reasons:
1. This is commercial utilisation.
2. There is no output restriction when using a low temperature boiler.

4

Calculating the heat demand for DHW heating for sports halls

Observe DIN 18032-1, April 1989 "Sports grounds, sports halls" as a guideline for the sizing, design and installation of the DHW system. DHW is drawn-off in sports halls in short bursts.
Therefore, when it comes to selecting suitable DHW cylinders, the main criterion is the "Peak draw-off rate" (10-minute peak output). The DHW heating system must be capable of ensuring the DHW delivery over the entire period of use (throughout the year).

The following values are assumed for sizing the DHW heating system:

DHW draw-off temperature:	max. 40 °C
Water consumption per person $\dot{m}$:	8 l/min
Shower duration per person t:	4 min
Heat-up time Z_A:	50 min
People per heat-up time and training unit n:	min. 25 people
Cylinder storage temperature T_a:	60 °C

Example for a simple sports hall:

1. Calculating the required DHW volume:

m_{MW} = $t \cdot \dot{m} \cdot n$
= 4 min/person · 8 l/min · 25 people
= 800 l DHW volume at 40 °C

Selected capacity: 700 l
The selected capacity should roughly correspond to the required DHW volume.
Peak output from the corresponding tables in the datasheets for the relevant DHW cylinders.
Conversion to DHW outlet temperature of 40 °C at

$m_{(40\,°C)}$ = Peak output at a DHW outlet temperature of 40 °C
$m_{(45\,°C)}$ = Peak output at a DHW outlet temperature of 45 °C (according to table in DHW cylinder datasheet)

$$m_{(40°C)} = m_{(45°C)} \cdot \frac{45 - 10}{40 - 10}$$

= 2 · 424 l/10 min

$$= 848 \cdot \frac{35}{30}$$

= 989 l/10 min

Selected DHW cylinders:
2 x Vitocell 300-H, each with 350 l,
peak output at 70 °C heating water flow temperature = 989 l at 40 °C

2. Calculating the required heat-up output for the calculated cylinder capacity:

$$\dot{Q}_A = \Phi_A = \frac{V \cdot c \cdot (T_a - T_e)}{Z_A}$$

$$= \frac{700 \cdot (60 - 10)}{860 \cdot 0.833} = 49 \text{ kW}$$

$\dot{Q}_A$ or Φ_A = Heat-up output in kW
V = Cylinder capacity in l
c = Spec. thermal capacity $\left(\frac{1 \text{ kWh}}{860 \text{ l} \cdot \text{K}}\right)$
T_a = Cylinder storage temperature in °C
T_e = Cold water inlet temperature in °C

Size the boiler and circulation pump for cylinder heating according to the required heat-up output.
To guarantee adequate heating of the building during winter too, add this heat amount to the heat load. EnEV [Germany] permits this supplement for the following reasons:
1. This is commercial utilisation.
2. There is no output restriction when using a low temperature boiler.

Calculating the heat demand for DHW heating in connection with district heating systems

DHW heating systems heated by district heating systems instead of boilers cannot be sized according to the values contained in the DHW cylinder tables because of different heating water flow temperatures and return temperatures in winter and summer.
The following example gives one sizing option.

Example:
Heat load of the building

$\dot{Q}_{NW}$ or $\Phi_{HL\ buil.\ W}$:	20 kW
DHW demand factor N:	1.3
Heating water flow/return temperature	
– in winter:	110/50 °C
– in summer:	65/40 °C
Selected DHW cylinder:	1 Vitocell 300-V, type EVI, 200 l capacity with N_L = 1.4

1. Calculating the required district heating water volume

$\dot{m}_W$ = District heating water volume in winter in l/h
$\dot{Q}_{NW}$ or $\Phi_{HL\ buil.\ W}$ = Connected load in winter in kW
c = Spec. thermal capacity $\left(\frac{1 \text{ kWh}}{860 \text{ l} \cdot \text{K}}\right)$
ΔT_W = Temperature differential in winter between district heating water flow and return temperature in K

$$\dot{m}_W = \frac{\dot{Q}_{NW}}{c \cdot \Delta T_W} = \frac{\Phi_{HL\ buil.\ W}}{c \cdot \Delta T_W} = \frac{860 \cdot 20}{110 - 50} = 287 \text{ l/h}$$

2. Calculating the connected load in summer with a constant district heating water volume ($\dot{m}_S = \dot{m}_W$)

$\dot{m}_S$ = District heating water volume in summer in l/h
$\dot{Q}_{NS}$ or $\Phi_{HL\ buil.\ S}$ = Connected load in summer in kW
ΔT_S = Temperature differential in summer between the district heating water flow and return temperature in K

$$\dot{Q}_{NS} = \Phi_{HL\ buil.\ S} = \dot{m}_S \cdot c \cdot \Delta T_S$$
with ($\dot{m}_S = \dot{m}_W$)
$$= 287 \cdot \frac{1}{860} \cdot (65 - 40) = 8.33 \text{ kW}$$

Table 10 – Performance data with return temperature limit
Vitocell 100-V on request.

Vitocell 300-V (type EVI)

Cylinder capacity	**l**	**200**	**300**	**500**
Continuous output at Heating water flow and return temperature 65/40 °C and DHW heating from 10 to 45 °C	kW l/h	15 375	16 393	19 467
Performance factor N_L (with return temperature limit) at a heating water flow and return temperature 65/40 °C and cylinder storage temperature T_{cyl} = 50 °C		1.4	3.0	6.0
10-minute peak output	l	164	230	319

Note
The performance data for DHW cylinders when there is a return temperature limit can be found in the continuous output diagrams in the relevant datasheets.
Note: When return temperatures are restricted, a check must be carried out to determine whether the hygiene requirements in accordance with TRWI/DVGW are met. A transfer pump may have to be provided.

4.2 Sizing according to peak flow rate with reference to DIN 1988-300

For DHW heating systems operating according to the instantaneous water heater principle, e.g. freshwater modules, the DHW demand can be determined according to the peak flow rate principle.

For this, the assumption is made that the peak flow rate to DIN 1988-300 determined for calculating the pipe dimensions for the DHW pipework will also have to be heated by the DHW heating system.

The peak flow rate is the sum of all connected individual consumers (total flow rate), reduced by a simultaneity factor. This is subject to the type of building.

However, to avoid oversizing, the calculated peak flow rate must not be higher than the sum of the two largest individual consumers that may be operating simultaneously. For systems with several independent consumers, e.g. in apartment buildings, also carry out this check with the total flow rate of the respective largest consumer, e.g. of all apartments.

Calculating the DHW demand

This is based on determining the peak flow rate $\dot{V}_S$ to DIN 1988-300.

$\dot{V}_S = a (\Sigma \dot{V}_R)^b - c$
(Valid for $\dot{V}_R$ max. = 500 l/s)

$\dot{V}_S$ = Peak flow rate
$\dot{V}_R$ = Total flow rate (sum of calculation flow rate of all consumers)
a, b, c = Constants subject to building and its type of use (see table 11)

Table 11

Building type	**Constants**		
	a	**b**	**c**
Residential buildings	1.48	0.19	0.94
Hospital ward	0.75	0.44	0.18
Hotel	0.70	0.48	0.13
School	0.91	0.31	0.38
Administration building	0.91	0.31	0.38
Facility for supported living, retirement home	1.48	0.19	0.94
Care home	1.40	0.14	0.92

$\dot{V}_R$ describes the total flow rate of all consumers. The values of the DHW calculation flow rate of individual consumers is added to this. For details of the DHW calculation flow rate, see consumer manufacturers, e.g. tap manufacturer. If no details are available, use values from DIN 1988-300:

Table 12 - Calculation flow rate for the connections on the cold and warm water sides

Mixer taps for type of draw-off point	**DN**	**Calculation flow rate $\dot{V}_R$**
Shower tray	15	0.15 l/s
Bath	15	0.15 l/s
Kitchen sink	15	0.07 l/s
Washbasin	15	0.07 l/s
Bidet	15	0.07 l/s

Example:
Detached house with 2 bathrooms, 1 kitchen with kitchen sink, 1 guest toilet with washbasin.
Equipment, bathroom 1: Shower, washbasin
Equipment, bathroom 2: Bath, shower with body showers, 2 washbasins

Assuming:
A manufacturer datasheet is available for the shower with body shower.
The calculation DHW flow rate is: 20 l/min = 0.33 l/s.
Standard values from Table 12 are used for the remaining consumers.
The total flow rate of the detached house is:

$\dot{V}_R$ = Shower 0.15 l/s + washbasin 0.07 l/s + bath 0.15 l/s + shower with body shower 0.33 l/s + 2 washbasins 0.07 l/s + kitchen sink 0.07 l/s + washbasin 0.07 l/s
= 0.98 l/s

To calculate the peak flow rate, factors a, b, c for a residential building are selected from Table 11:

a = 1.48
b = 0.19
c = 0.94

Peak flow rate:

$\dot{V}_S = a (\Sigma \dot{V}_R)^b - c$
$= 1.48 \times 0.98^{0.19} - 0.94$
$= 0.53$ l/s

The calculated peak flow rate of 0.53 l/s is greater than the sum of the two simultaneously operating consumers (shower in bathroom 1 = 0.15 l/s and shower with body shower in bathroom 2 = 0.33 l/s) = 0.48 l/s. Therefore, the value of 0.48 l/s is taken as the peak flow rate.
The DHW heating system must heat 0.48 l/s = approx. 29 l/min of DHW from 10 to 60 °C. This results in a transfer rate of approx. 101 kW. Subject to the heating water temperature or heating water storage temperature in the heating water buffer cylinder (assumption: 70 °C) select a Vitotrans 353 freshwater module from the datasheet.
Example: Vitotrans 353, type PZM for installation on a Vitocell 100-E buffer cylinder (see Table 13).
The values for Vitotrans 353, type PBM (for wall mounting) are the same as those for the Vitotrans 353, type PZM (for installation on a cylinder).

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Table 13 - Excerpt from "Vitotrans 353", type PBM/PZM datasheet

Heating water temperature in the heating water buffer cylinder	Set DHW temperature	Max. draw-off rate from Vitotrans 353	Transfer output	Required heating water buffer cylinder volume per l of DHW	At 10 °C cold water inlet temperature: Max. draw-off rate at the mixing valve at				return temperature to the heating water buffer cylinder
					40 °C	45 °C	50 °C	55 °C	
in °C	in °C	in l/min	in kW	in l	in l/min	in l/min	in l/min	in l/min	in °C
	40	60	125	0.4	—	—	—	—	14
	45	60	146	0.5	70	—	—	—	15
70	50	52	144	0.8	68	58	—	—	17
	55	44	137	0.9	65	56	49	—	20
→	60	37	127	1.1	60	52	45	40	23

Calculating the required buffer volume

To provide the energy required for DHW heating, a freshwater module is normally connected to a heating water buffer cylinder. The heating water buffer cylinder volume depends on the DHW demand of the installation, the storage temperature in the heating water buffer cylinder and the user behaviour.
The following applies:

$V_P = \dot{V} \times t \times (T_P/T_{WW}) \times s_N$

V_P = Required minimum volume of the heating water buffer cylinder
$\dot{V}$ = Calculated peak flow rate of the freshwater module
t = Length of time for which the peak flow rate is required. The value can be based on e.g. the time taken to fill the bath, information provided by the user, or the standard value from DIN 4708 (10 min).
(T_P/T_{WW}) = for the temperature spread between heating water buffer cylinder and DHW:
- 0.5 = when temperature spread is large (e.g. 90/45 °C)
- 0.7 = when temperature spread is medium (e.g. 70/45 °C)
- 1.0 = when temperature spread is small (e.g. 55/45 °C)

s_N = Safety factor for consideration of user behaviour:
- 1 = normal draw-off pauses
- 2 = short draw-off pauses
- 3 ... 4 = very short draw-off pauses

Example:
A buffer cylinder is to be selected for the detached house in the example on page 21 (chapter "Calculating the DHW demand").
The peak flow rate is 29 l/min.
The future system user has indicated that he "enjoys long showers". He has indicated a demand duration of 15 min.
For reasons of energy efficiency, the storage temperature in the buffer cylinder should be no more than 70 °C.
The draw-off temperature is 60 °C.
This results in a low temperature spread of 70/60 °C, giving a correction factor of 1.
As the future system user has indicated that he "enjoys long showers", short draw-off pauses have been assumed. Therefore, the safety factor s_N is 2.
The minimum buffer volume V_P is therefore:

$V_P = \dot{V} \times t \times (T_P/T_{WW}) \times s_N$
$= 29\ l/min \times 15\ min \times 1 \times 2$
$= 870\ l$

According to the datasheet, a Vitocell 100-E with a volume of 950 l is selected.

4.3 Sizing according to continuous output

Sizing according to continuous output is employed if hot water is to be continuously drawn from the DHW cylinder. This sizing method is therefore mainly used for commercial applications.

Determining the required DHW cylinder, example 1 (with constant flow temperatures)

Requirements:
- Continuous output in l/h or kW
- DHW outlet temperature in °C
- Cold water inlet temperature in °C
- Heating water flow temperature in °C

The DHW cylinder "Specification" is used to determine:
- Capacity and number of DHW cylinders
- Flow rate on the heating water side
- Delivery head of the circulation pump for cylinder heating

The DHW cylinders are sized in the same way.

The following example illustrates the calculation procedure.

Example:
For production purposes, a factory requires 4100 l/h DHW at 60 °C. The boilers deliver a heating water flow temperature of 90 °C. The cold water inlet temperature is 10 °C.

Continuous output	=	4100 l/h
DHW outlet temperature	=	60 °C
Cold water inlet temperature	=	10 °C
Heating water flow temperature	=	90 °C
Required cylinder type	=	Stainless steel, vertical

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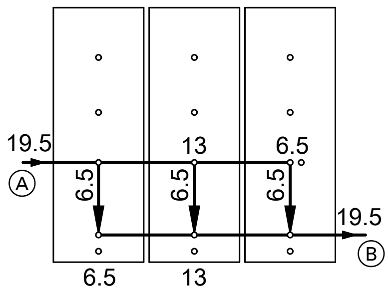
Calculating the number and size of the DHW cylinders

Procedure:
1. Select Vitocell 300-V, type EVI
2. Refer to the specification for cylinder banks in the Vitocell 300-V datasheet.
3. In the table, find the line for "Continuous output from 10 to 60 °C" and Heating water flow temperature "90 °C".
4. In the column Cylinder capacity = 500 l and Number of cylinders = 3, a continuous output of 4179 l/h is specified.

Selected DHW cylinders:
3 x Vitocell 300-V, type EVI, each with 500 l capacity.
The continuous output of the selected DHW cylinders must be at least equal to the required continuous output.

Calculating heating water flow rate
A heating output of 243 kW is required for the calculated continuous output (see table "Specification" in the datasheet for the DHW cylinder). The required heating water flow rate is provided in the table column for the selected DHW cylinder: 19.5 m^3/h; i.e. size the circulation pump for cylinder heating for a heating water flow rate of 19.5 m^3/h.

Calculating the pressure drop on the heating water side
The total flow rate of 19.5 m^3/h must be taken into account for the heating water flow and return lines (e.g. valves, bends) as well as the boiler when calculating the pressure drop in the complete system.
Where several cylinders are connected in parallel, the total pressure drop is equal to the pressure drop of an individual cylinder. The pressure drop of the DHW cylinder on the heating water side for the head of the circulation pump for cylinder heating is calculated as follows:
As the 3 cylinders are connected in parallel, each cylinder has a heating water flow rate of 6.5 m^3/h (see following diagram). Refer to the diagram "Pressure drop on the heating water side" in the datasheet for "Vitocell 300-V, type EVI". For a heating water throughput of 6500 l/h, read the pressure drop off the straight line of the cylinder with a capacity of 500 l: 400 mbar (40 kPa)



Ⓐ Heating water flow
Ⓑ Heating water return

This means:
Total heating water flow rate = 19.5 m^3/h
Heating water flow rate per cylinder = 6.5 m^3/h
Pressure drop on the heating water side of the DHW cylinder = 400 mbar (40 kPa)

Sizing the circulation pump for cylinder heating
The circulation pump for cylinder heating must therefore deliver a heating water flow rate of 19.5 m^3/h and overcome the pressure drop on the heating water side of 400 mbar (40 kPa) for the 3 cylinders, plus the pressure drop of the boiler, the pipework between the cylinders and the boiler, and the individual pressure drop values of fittings and valves.
The following rule of thumb applies: If the available boiler heating output $\dot{Q}_K$ (to DIN 4701) or Φ_K (to EN 12831) is lower than the continuous output $\dot{Q}_{cyl}$ or Φ_{cyl}, it is sufficient to size the circulation pump for cylinder heating to suit the transfer of the boiler heating output. If, on the other hand, the boiler heating output is greater than the continuous output $\dot{Q}_{cyl}$ or Φ_{cyl}, the circulation pump for cylinder heating can be sized to suit the continuous output as a maximum rating.

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Determining the required DHW cylinder, example 2 (with a fixed heat source temperature differential)

Requirements:
- Required continuous output in kW or in l/h (conversion required)
- DHW outlet temperature in °C
- Cold water inlet temperature in °C
- Heating water flow temperature in °C
- Heating water return temperature in °C

Conversion of continuous output from l/h to kW

$\dot{Q}_{req.}$ or $\Phi_{req.}$	=	Continuous output in kW
$\dot{m}_{WW}$	=	Continuous output in l/h
c	=	Spec. thermal capacity $\left(\frac{1\ kWh}{860\ l \cdot K}\right)$
ΔT_{WW}	=	Temperature differential between DHW outlet temperature and cold water inlet temperature in K
$\dot{Q}_{req.}$ or $\Phi_{req.}$	=	$\dot{m}_{DHW} \cdot c \cdot \Delta T_{DHW}$

The size and number of DHW cylinders required can be calculated using the diagrams for the continuous output of the DHW cylinders concerned.

Example:

Required continuous output	=	3000 l/h
Heating water flow temperature	=	80 °C
Heating water return temperature	=	60 °C
Heating water temperature differential	=	80 °C – 60 °C = 20 K
Cold water inlet temperature	=	10 °C
DHW outlet temperature	=	45 °C

A vertical DHW cylinder has to be used on account of the structural characteristics of the building.

Conversion of continuous output from l/h to kW

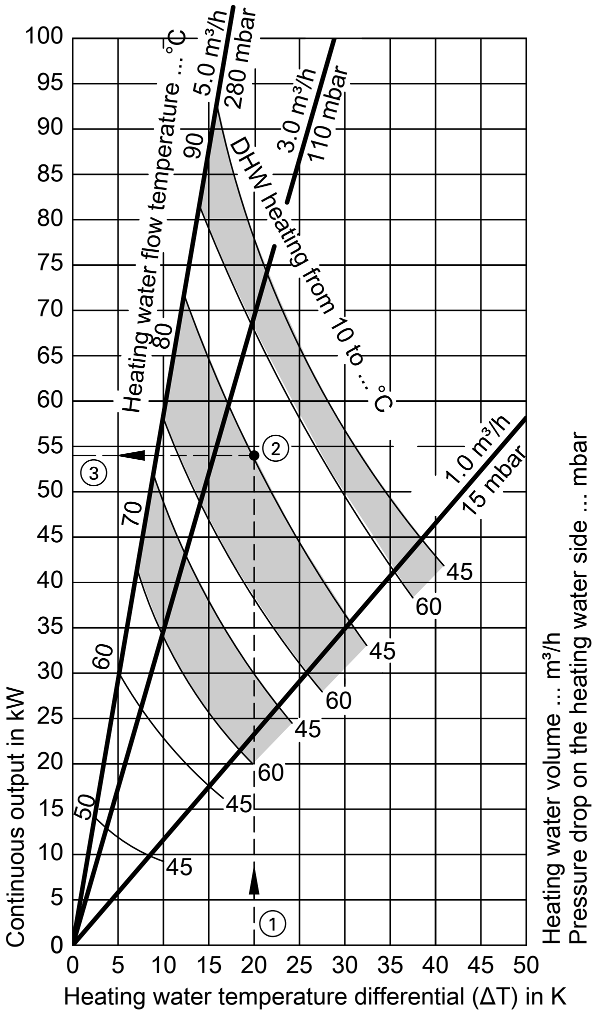
$$\dot{Q}_{req.} \text{ or } \Phi_{req.} = \dot{m}_{WW} \cdot c \cdot \Delta T_{WW}$$

$$= 3000 \cdot \frac{1}{860} \cdot (45 - 10)$$

$$= 122 \text{ kW}$$

Calculating the continuous output of the various cylinder sizes
As the method of calculation is the same for all cylinder sizes, the process for calculating the continuous output of the Vitocell 300-V DHW cylinder with 300 l capacity is shown as an example (see "Vitocell 300-V" datasheet).

From point ① (20 K) via point 2 (required DHW heating: from 10 °C to 45 °C at heating water flow temperature 80 °C) read at point ③: Continuous output of DHW cylinder 54 kW



Calculating the required number of DHW cylinders of a given size

n	=	Required number of DHW cylinders
$\dot{Q}_{req.}$ or $\Phi_{req.}$	=	Required continuous output in kW
$\dot{Q}_{cyl}$ or Φ_{cyl}	=	Continuous output of the selected DHW cylinders in kW

$$n = \frac{Q_{req.}}{\dot{Q}_{cyl.}} = \frac{\Phi_{req.}}{\Phi_{cyl.}}$$

$$= \frac{122\ \text{kW}}{54\ \text{kW}} = 2.26$$

Required number of DHW cylinders = 2

Calculating the required flow rate on the heating water side

$\dot{m}_{HW}$	=	Flow rate on the heating water side in l/h
$\dot{Q}_{req.}$ or $\Phi_{req.}$	=	Required continuous output in kW
ΔT_{HW}	=	Heating water temperature differential in K
c	=	Spec. thermal capacity $\left(\frac{1\ \text{kWh}}{860\ \text{l} \cdot \text{K}}\right)$

$$\dot{m}_{HW} = \frac{\dot{Q}_{req.}}{c \cdot \Delta T_{HW}} = \frac{860 \cdot \dot{Q}_{req.}}{\Delta T_{HW}}$$

$$= \frac{\Phi_{req.}}{c \cdot \Delta T_{HW}} = \frac{860 \cdot \Phi_{req.}}{\Delta T_{HW}}$$

$$= \frac{860 \cdot 122}{20}$$

= 5246 l/h (total)

= 2623 l/h (per DHW cylinder)

On the basis of the calculated heating water flow rate, the pressure drop on the heating water side can now be calculated as described in the example on page 23 and with the aid of the diagram for Vitocell 300-V, type EVI.
This means:
Pressure drop on the heating water side of the DHW cylinder = 80 mbar (8 kPa).

Cylinder loading systems — Vitocell 100-L with Vitotrans 222

5.1 Applications and advantages

The Viessmann cylinder loading system is a combination of a Vitocell 100-L DHW cylinder and a modular Vitotrans 222 heat exchanger set.
The cylinder loading system for DHW heating is a preferred choice for the following applications and conditions:

- Heating circuits requiring low return temperatures or where the return temperatures are limited, e.g. for district heating or condensing boilers:

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Heating from the heating temperature (10 °C) to the end temperature (60 °C) is achieved in one circulation via the heat exchanger of the Vitotrans 222. This wide temperature spread on the DHW side results in a low return temperature on the heating water side. A low return temperature enables a high condensation rate when utilising condensing technology.

- Large cylinder capacities with offset heating and draw-off times, e.g. where water is drawn off at peak times in schools, sports centres, hospitals, army barracks, council facilities, apartment buildings
- Short-term peak loads, i.e. high draw-off rates and varying reheat times, e.g. DHW heating in swimming pools, sports facilities, industrial enterprises and abattoirs.
- Limited space as the cylinder loading system can transfer a high output.

Vitocell 100-L with Vitotrans 222

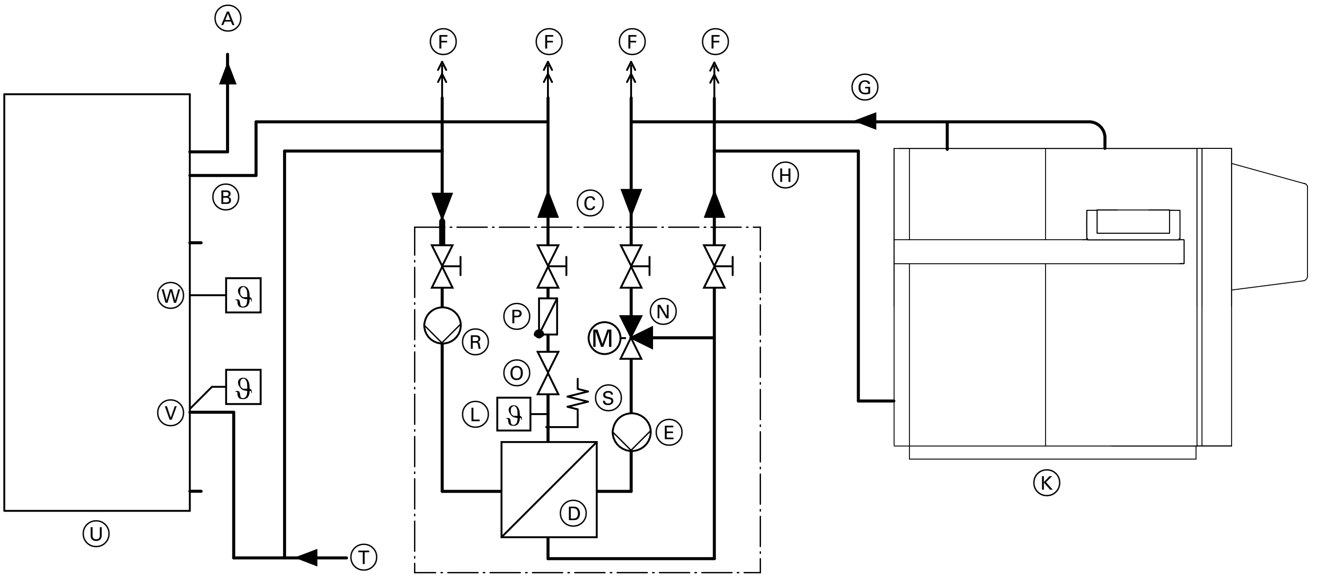
- Corrosion-resistant steel cylinder with Ceraprotect enamel coating. Additional cathodic protection via a magnesium anode; impressed current anode available as an accessory.
- Easy handling through low weight and removable thermal insulation.
- Low heat losses due to high grade, all-round thermal insulation.
- No critical germination zones through thorough heating of the entire water content.
- In conjunction with the Vitotrans 222 heat exchanger set (accessories) as a cylinder loading system, particularly suitable for combination with condensing boilers.
- Accurate cylinder heating to the right degree even with modulating flow temperature.
- Vitotrans 222, comprising a plate heat exchanger, highly efficient cylinder loading pump and heating water pump, available as an accessory.
- Electric immersion heater and heating lance for use in conjunction with heat pumps, available as accessories.

5.2 Function description of the cylinder loading system

Operation with modulating flow temperature

During the heating process (no draw-off), loading pump Ⓡ within the cylinder loading system withdraws cold water Ⓣ from the bottom of DHW cylinder Ⓤ; this is then heated in heat exchanger set Ⓒ and resupplied to the top Ⓑ of the DHW cylinder.
To avoid disturbing the thermal stratification layers inside the DHW cylinder, cylinder loading pump Ⓡ will only be switched on if temperature sensor Ⓛ signals that the set temperature has been reached.
The required heat exchanger transfer output is set by line regulating valve Ⓞ.
Mixer assembly (accessories) Ⓝ mixes the heating water on the primary side in accordance with the set DHW temperature. A set DHW temperature of max. 60 °C prevents scaling of the plate heat exchanger.
Pasteurisation is feasible in conjunction with Viessmann boilers with the Vitotronic boiler control units or with the Vitotronic 200-H heating circuit control units (accessories).

The base load is covered by the continuous output of the Vitotrans 222.
Any additional hot water demand during peak times is covered by the cylinder capacity.
During draw-off and once draw-off has ended, the cylinder volume is reheated to the set temperature via the Vitotrans 222. In the fully heated state (no draw-off), cylinder loading pump Ⓡ and heating circuit pump Ⓔ in the Vitotrans 222 are switched OFF.
Provided the above set heating water and DHW temperatures are observed, the Vitotrans 222 heat exchanger set can be operated up to a total water hardness of 20 °dH (total of alkaline earths 3.6 mol/m^3).



Ⓐ	DHW	Ⓝ	Mixer assembly
Ⓑ	Hot water inlet from the heat exchanger	Ⓞ	Line regulating valve
Ⓒ	Vitotrans 222 heat exchanger set	Ⓟ	Non-return valve
Ⓓ	Plate heat exchanger	Ⓡ	Cylinder loading pump (secondary), highly efficient
Ⓔ	Heating circuit pump (primary), highly efficient	Ⓢ	Safety valve, does not replace the DHW cylinder safety valve to DIN 1988.
Ⓕ	Air vent valve	Ⓣ	Shared cold water connection with safety assembly to DIN 1988
Ⓖ	Heating water flow	Ⓤ	Vitocell 100-L, (here: 500 l capacity)
Ⓗ	Heating water return	Ⓥ	Lower cylinder temperature sensor (OFF)
Ⓚ	Boiler	Ⓦ	Upper cylinder temperature sensor (ON)
Ⓛ	Temperature sensor		

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Operation with constant flow temperature

The Vitotrans 222 heat exchanger set is operated without a mixer assembly. Limit the heating water temperature to 75 °C.
The required DHW temperature and transfer output are set by adjusting the circulating volume for the heating process according to the heating output of the heat exchanger at line regulating valve Ⓛ.
If the available boiler output is below that of the Vitotrans 222, the setting is done according to the boiler output.
High or medium draw-off rates are covered by the DHW cylinder. Cold water flows into the DHW cylinder to replace the hot water drawn. If the cold water layer inside the DHW cylinder reaches upper temperature controller Ⓣ, the Vitotrans 222 starts.

The base load is covered by the continuous output of the Vitotrans 222. Any additional hot water demand during peak times is covered by the cylinder capacity.
During draw-off and once draw-off has ended, the cylinder volume is reheated to the set temperature via the Vitotrans 222. In the fully heated state (no draw-off), cylinder loading pump Ⓝ and heating circuit pump Ⓔ in the Vitotrans 222 are switched OFF.
Provided the above set heating water and DHW temperatures are observed, the Vitotrans 222 heat exchanger set can be operated up to a total water hardness of 20 °dH (total of alkaline earths 3.6 mol/m^3).

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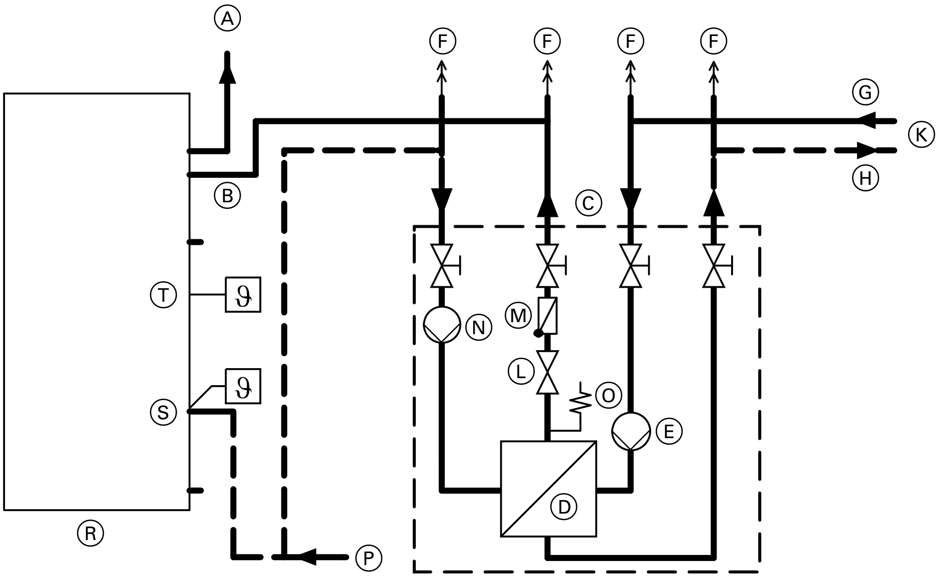
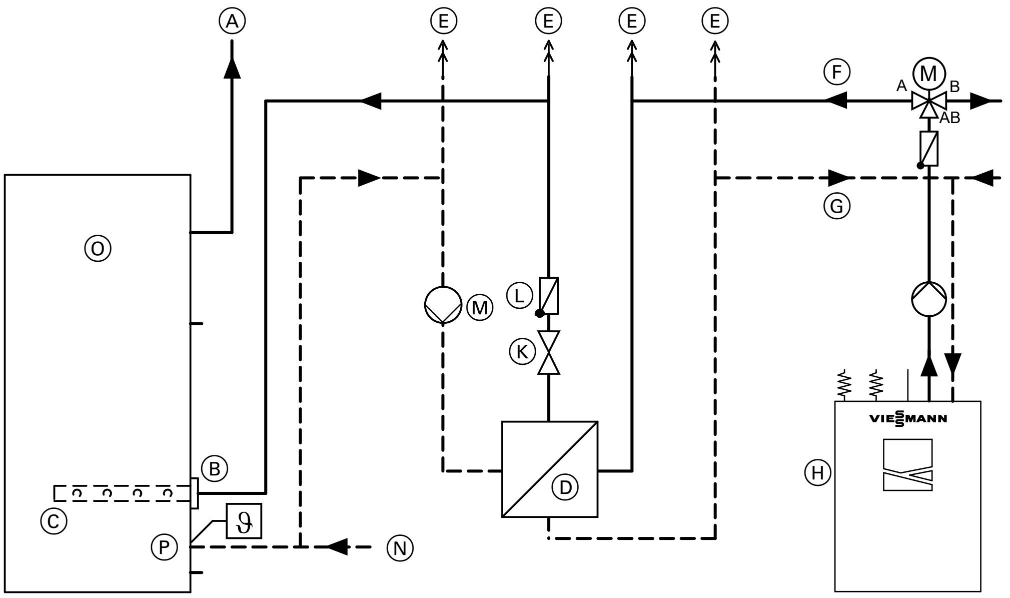


Ⓐ DHW
Ⓑ Hot water inlet from the heat exchanger
Ⓒ Vitotrans 222 heat exchanger set
Ⓓ Plate heat exchanger
Ⓔ Heating circuit pump (primary), highly efficient
Ⓕ Air vent valve
Ⓖ Heating water flow
Ⓗ Heating water return
Ⓚ Heat source with a constant flow temperature (e.g. district heating, max. 75 °C)
Ⓛ Line regulating valve
Ⓜ Non-return valve
Ⓝ Cylinder loading pump (secondary), highly efficient
Ⓞ Safety valve
Ⓟ Shared cold water connection with safety assembly to DIN 1988
Ⓡ Vitocell 100-L, (here: 500 l capacity)
Ⓢ Lower temperature controller (OFF)
Ⓣ Upper temperature controller (ON)

Operation with a heat pump in conjunction with a heating lance for DHW heating

In the cylinder loading system, a loading pump Ⓜ withdraws the cold water from the bottom of DHW cylinder Ⓞ during the cylinder heating process (no draw-off). The water is heated in plate heat exchanger Ⓓ and resupplied to the DHW cylinder via heating lance Ⓒ mounted in flange Ⓑ. The generously sized outlet apertures in the heating lance result in low flow velocities, which in turn provide a clean temperature stratification inside the DHW cylinder.

Installation of the optional immersion heater EHE (accessories) into the DHW cylinder flange enables DHW heating to be boosted further.



- Ⓐ DHW
- Ⓑ Hot water inlet from the heat exchanger
- Ⓒ Heating lance
- Ⓓ Plate heat exchanger
- Ⓔ Air vent valve
- Ⓕ Heating water flow from the heat pump
- Ⓖ Heating water return to the heat pump
- Ⓗ Heat pump
- Ⓚ Line regulating valve
- Ⓛ Non-return valve
- Ⓜ Cylinder loading pump
- Ⓝ Shared cold water connection with safety assembly to DIN 1988
- Ⓞ Vitocell 100-L
- Ⓟ Cylinder temperature sensor of the heat pump

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5.3 General formulas for calculating the cylinder loading system

With reference to EN 12831, Q = Φ is used for heat volume and $\dot{Q}$ = L for the heating output (continuous output) instead of the values previously used in DIN 4701.

Calculation based on water volume

$$V_D = \frac{L \cdot t}{c \cdot \Delta T} \text{ in l}$$

$$V_{ttl.} = V_D + V_{cyl.} \text{ in l}$$

$$= n_Z \cdot \dot{V} \cdot t \text{ in l}$$

Calculation based on heat volume

$$\Phi_D = L \cdot t \text{ in kWh}$$

$$\Phi_{ttl.} = V_{ttl.} \cdot \Delta T \cdot c \text{ in kWh}$$

$$= \Phi_{cyl.} + \Phi_D \text{ in kWh}$$

$$= V_{ttl.} \cdot \Delta T \cdot c = \Phi_{cyl.} + \Phi_D$$

$$\Phi_{cyl.} = V_{cyl.} \cdot c \cdot (T_a - T_e) \text{ in kWh}$$

5.4 Sample calculation

A sports centre is equipped with 16 showers which are limited to **15 l/min**.
According to design requirements, **8 showers** are operated simultaneously for up to **30 min** continuously. The drawing temperature should be **40 °C**. A max. of **100 kW boiler output** is available for DHW heating.

c = Spec. thermal capacity $\left(\frac{1 \text{ kWh}}{860 \text{ l} \cdot \text{K}}\right)$

n = Number of DHW cylinders
n_Z = Number of draw-off points
Φ_D = Heat volume in kWh available by continuous output
L = Continuous output in kW
Φ_{ttl} = Total heat demand in kWh (for production and demand)
Φ_{cyl} = Usable heat volume of the total cylinder volume in kWh
$\Phi_{cyl. ind.}$ = Usable heat volume of a single DHW cylinder in kWh
t = Time in h
T_a = Cylinder storage temperature in °C
T_e = Cold water inlet temperature in °C
ΔT = Temperature differential between draw-off temperature and cold water inlet temperature in K
$\dot{V}$ = Draw-off rate per draw-off point in l/h
V_D = DHW heated by continuous output in l
V_{ttl} = Total draw-off volume in l
V_{cyl} = Usable cylinder capacity in l

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Calculation of the cylinder size based on water volume

Over a period of 30 min, a total water volume V_{ttl} at a temperature of 40 °C is required.

$$V_{ttl.} = n_Z \cdot \dot{V} \cdot t$$
$$= 8 \text{ showers} \cdot 15 \text{ l/min} \cdot 30 \text{ min}$$
$$= 3600 \text{ l}$$

Of the 3600 l, the 100 kW connected load can deliver a water volume V_D over a period of 30 min.

$$V_D = \frac{L \cdot t}{c \cdot \Delta T}$$

$$V_D = \frac{100 \text{ kW} \cdot 0.5 \text{ h} \cdot 860 \text{ l} \cdot \text{K}}{1 \text{ kWh} \cdot (40 - 10) \text{ K}}$$

$$= 1433 \text{ l}$$

This means that the DHW cylinder must make the following water volume available at a temperature of 40 °C:

3600 l – 1433 l = 2167 l

At a storage temperature of 60 °C, the required cylinder volume V_{cyl} results.

$$V_{cyl.} = \frac{2167 \text{ l} \cdot (40 - 10) \text{ K}}{(60 - 10) \text{ K}} = 1300 \text{ l}$$

The calculated number n of Vitocell 100-L with a volume of 750 l each results from the following:

$$n = \frac{1300 \text{ l}}{750 \text{ l}} = 1.73$$

Selected cylinder loading system:
2 Vitocell 100-L, each with 750 l capacity, and 1 Vitotrans 222 heat exchanger set with a heating output of 120 kW (in accordance with max. available boiler output according to the sample calculation, i.e. 100 kW).

Calculation of the cylinder size based on heat volume

Over a period of 30 min (as per calculation), a total water volume of 3600 l at a temperature of 40 °C is required. This corresponds to a heat volume of Φ_{ttl}.

$$\Phi_{ttl.} = V_{ttl.} \cdot \Delta T \cdot c$$

$$= 3600 \text{ l} \cdot 30 \text{ K} \cdot \frac{1 \text{ kWh}}{860 \text{ l} \cdot \text{K}} = 126 \text{ kWh}$$

The connected load can, over the drawing period of 30 min, provide a heat volume of Φ_D.

$$\Phi_D = L \cdot t$$
$$= 100 \text{ kW} \cdot 0.5 \text{ h} = 50 \text{ kWh}$$

This means that the DHW cylinder must store a heat volume of Φ_{cyl}.

$$\Phi_{cyl.} = \Phi_{ttl.} - \Phi_D$$
$$= 126 \text{ kWh} - 50 \text{ kWh} = 76 \text{ kWh}$$

Each individual Vitocell 100-L DHW cylinder with 750 l cylinder capacity stores the following heat volume $\Phi_{cyl.\ ind.}$:

$$\Phi_{cyl.\ ind.} = 750 \text{ l} \cdot (60 - 10) \text{ K} \cdot \frac{1 \text{ kWh}}{860 \text{ l} \cdot \text{K}}$$
$$= 43.6 \text{ kWh}$$

This results in the calculated number of cylinders n.

$$n = \frac{\Phi_{cyl.}}{\Phi_{cyl.\ ind.}}$$

$$= \frac{76 \text{ kWh}}{43.6 \text{ kWh}} = 1.74$$

Selected cylinder loading system:
2 Vitocell 100-L, each with 750 l cylinder capacity, and 1 Vitotrans 222 heat exchanger set with a heating output of 120 kW (in accordance with max. available boiler output according to the sample calculation, i.e. 100 kW).

6

Installation — DHW cylinders

6.1 Connection on the DHW side

See the diagrams from page 33 or 40 regarding the connection on the DHW side of DHW cylinders installed as a cylinder bank.

Note
Dishwashers and washing machines can be connected to the central hot water supply.
Washing machines must have separate cold and hot water connections. By supplying hot water directly from the DHW cylinder, the electrical heating of the water in the dishwasher or washing machine is reduced. This saves time, energy and costs. Follow the manufacturer's recommendations.

Limit the DHW temperature in the downstream pipes to 60 °C (according to the EnEV [Germany, check local regulations]) by installing a suitable mixing device, e.g. a thermostatic mixing valve. This does not apply to DHW systems that demand higher temperatures for their intended use or that require a pipe length of less than 5 m.
Please note:
Consult the relevant manufacturer's installation instructions when fitting thermostatic mixing valves. The mixing device does not prevent the risk of scalding at the draw-off point. The installation of a mixer tap at the draw-off point is essential.
Only for cylinder banks Vitocell 300-H:
With DHW outlet temperatures in excess of 60 °C, the connection line on the DHW side can also be connected in series, in multi cylinder banks. Connect the connection line on the heating water side as shown in the diagrams on page 38.

Fittings that are installed in the connection line must conform to DIN 1988 (see diagrams on page 31) and DIN 4753 [or local regulations].

These fittings comprise the following:

- **Shut-off valves**
- **Drain valve**
- **Pressure reducer** (to DIN 1988)
  Install this device if the pressure in the pipework at the connection point exceeds 80 % of the safety valve response pressure.
  It is advisable to install the pressure reducer immediately downstream of the water meter. This creates nearly the same pressures in the entire DHW system, which is thereby protected against overpressure and water hammer.
  According to DIN 4109, the static pressure of the water supply system after distribution over the various floors upstream of the fittings should not be higher than 5 bar (0.5 MPa).
- **Safety valve**
  The system must be equipped with a type-tested diaphragm safety valve as protection against overpressure.
  Permiss. operating pressure: 10 bar (1 MPa).
  The connection diameter of the safety valve must be as follows:
  - up to 200 l capacity
    min. R ½ (DN 15),
    max. heat input 75 kW,
  - between 200 and 1000 l capacity
    min. R ¾ (DN 20),
    max. heat input 150 kW,
  - between 1000 and 5000 l capacity
    min. R 1 (DN 25),
    max. heat input 250 kW.

  Install the safety valve in the cold water line. It must not be able to be isolated from the DHW cylinder (or the cylinder bank). There must be no restrictions in the pipework between the safety valve and the DHW cylinder. Never seal off the safety valve discharge pipe. Ensure that any expelled water is safely and visibly drained into a drainage system. Position a sign close to the safety valve discharge pipe, or ideally on the safety valve itself, with the following inscription:
  "For safety reasons, water may be discharged from the discharge pipe during heating. Never seal off."
  Install the safety valve above the top edge of the DHW cylinder.
- **Non-return valve**
  This prevents system water and heated water from flowing back into the cold water pipe or into the mains water supply.
- **Pressure gauge**
  Provide a connection for a pressure gauge.
- **Flow regulating valve**
  We recommend that a flow regulating valve is installed and the maximum water flow rate is adjusted in accordance with the 10-minute peak output of the DHW cylinder.
- **Drinking water filter**
  Install a drinking water filter in accordance with DIN 1988. The installation of a drinking water filter prevents dirt from being introduced into the drinking water system.

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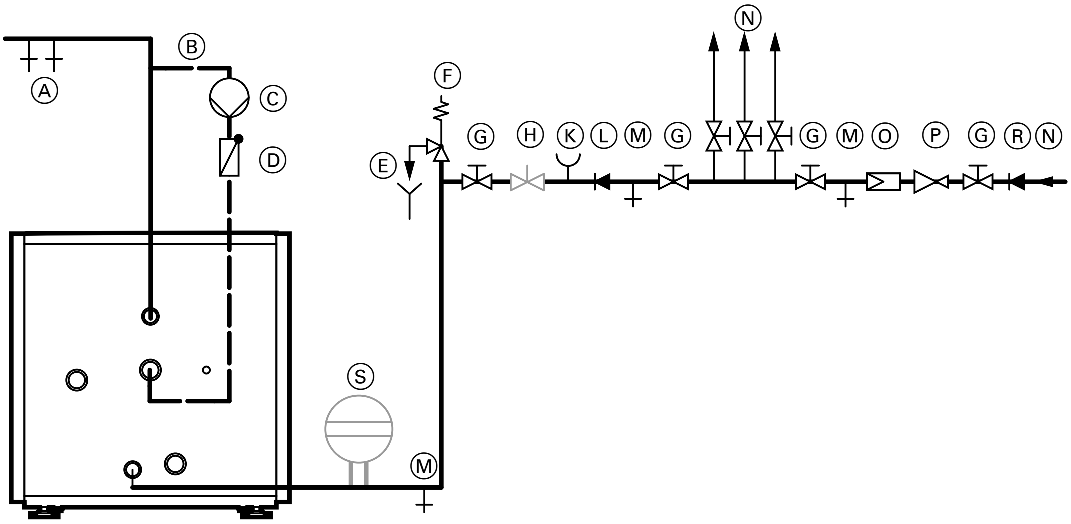
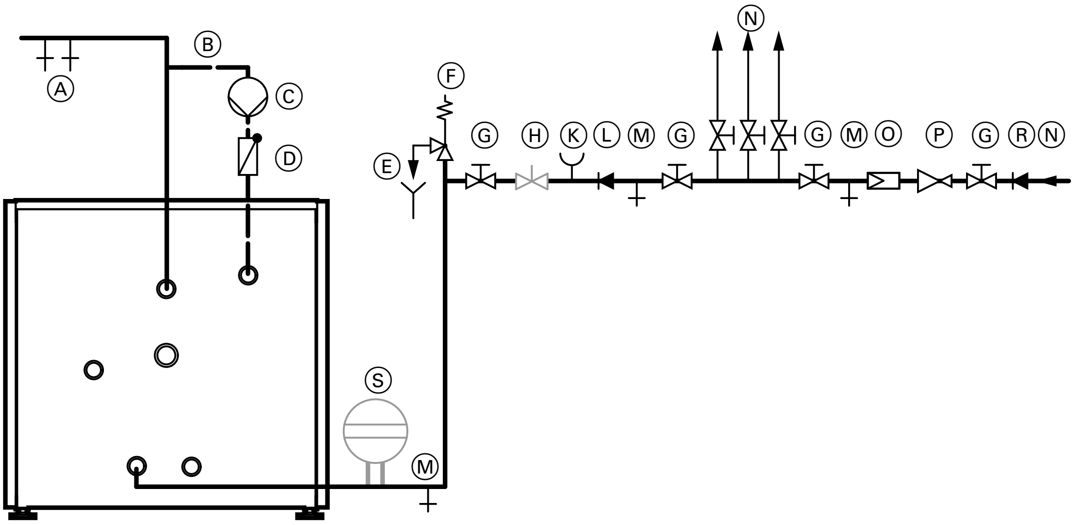
Vitocell 100-H and Vitocell 300-H up to 200 l capacity



Connection on the DHW side to DIN 1988

Ⓐ DHW
Ⓑ DHW circulation pipe
Ⓒ DHW circulation pump
Ⓓ Spring-loaded check valve
Ⓔ Visible discharge pipe outlet point
Ⓕ Safety valve
Ⓖ Shut-off valve
Ⓗ Flow regulating valve
Ⓚ Pressure gauge connection
Ⓛ Non-return valve
Ⓜ Drain
Ⓝ Cold water
Ⓞ Drinking water filter
Ⓟ Pressure reducer
Ⓡ Non-return valve/pipe separator
Ⓢ Diaphragm expansion vessel, suitable for potable water

Vitocell 300-H, from 350 l capacity



Connection on the DHW side to DIN 1988

Ⓐ DHW
Ⓑ DHW circulation pipe
Ⓒ DHW circulation pump
Ⓓ Spring-loaded check valve
Ⓔ Visible discharge pipe outlet point
Ⓕ Safety valve
Ⓖ Shut-off valve
Ⓗ Flow regulating valve
Ⓚ Pressure gauge connection
Ⓛ Non-return valve
Ⓜ Drain
Ⓝ Cold water
Ⓞ Drinking water filter
Ⓟ Pressure reducer

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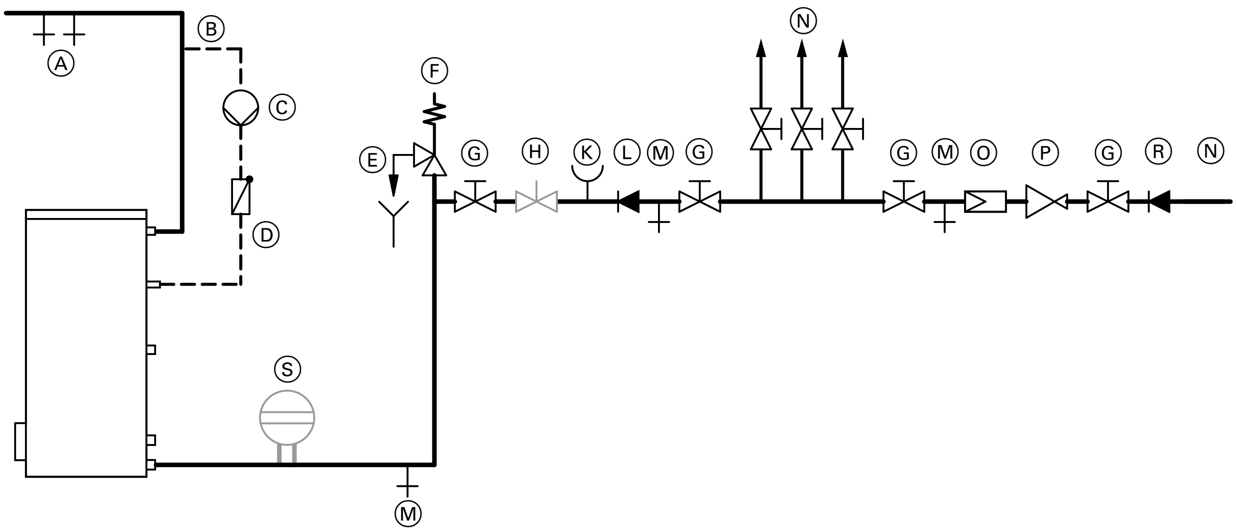
Ⓡ Non-return valve/pipe separator
Ⓢ Diaphragm expansion vessel, suitable for potable water

Vitocell 100-V and Vitocell 300-V



Connection on the DHW side in accordance with DIN 1988

Ⓐ DHW
Ⓑ DHW circulation pipe
Ⓒ DHW circulation pump
Ⓓ Spring-loaded check valve
Ⓔ Visible discharge pipe outlet point
Ⓕ Safety valve
Ⓖ Shut-off valve
Ⓗ Flow regulating valve
Ⓚ Pressure gauge connection
Ⓛ Non-return valve
Ⓜ Drain
Ⓝ Cold water
Ⓞ Drinking water filter
Ⓟ Pressure reducer
Ⓡ Non-return valve/pipe separator
Ⓢ Diaphragm expansion vessel, suitable for potable water

Note

- *Safety valve Ⓕ must be installed.*
- *Recommendation: Install the safety valve higher than the top edge of the cylinder. This protects the valve against dirt, scaling and high temperatures. It also means that the DHW cylinder does not need to be drained when working on the safety valve.*
- *Observe information on the safety valve on* *page 30.*

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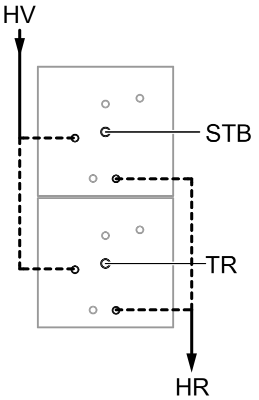
Connection on the DHW side of cylinder banks with Vitocell 300-H

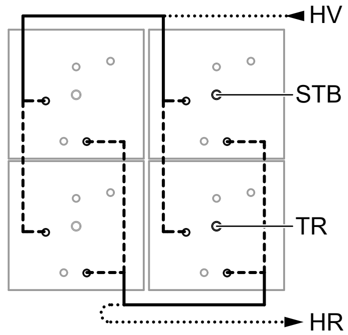
Note

- *Observe stacking height:*
  Vitocell 300-H, 350 l: max. 2 pce
  Vitocell 300-H, 500 l: max. 3 pce
- *Observe the cross-sections of DHW connecting pipes.*

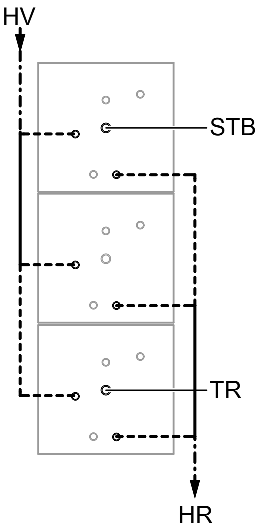
700 and 1000 l (2 cylinders)



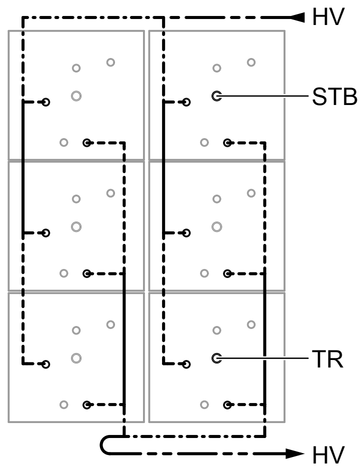
2 x 700 l and 2 x 1000 l (2 x 2 cylinders)



1500 l (3 cylinders)



2 x 1500 l (2 x 3 cylinders)



- - - - - - - -	DN 32
————	DN 50
-·-·-·-	DN 80
....	DN 100
– – – ——	DN 125

HR	Heating water return
HV	Heating water flow
HLSC	High limit safety cut-out (if required)
TR	Temperature controller

6.2 DHW circulation pipes

For reasons of hygiene and convenience, DHW circulation pipes are installed in DHW heating systems. Observe the applicable standards and rules. As a fundamental principle, "gravity circulation systems", which used to be commonly used, are no longer permissible nowadays for hygiene reasons. Always fit DHW circulation pipes or DHW circulation systems with appropriate pumps, hydraulically adjust and thermally insulate them in accordance with the applicable regulations. Take the applicable standards and regulations into account (e.g. DVGW Codes of Practice W551/W553 and DIN 1988/TRWI). The flow rate of the circulation system is determined according to the scale of the pipework, the thermal insulation and the targeted or required maximum temperature differential between the cylinder outlet (DHW) and the DHW circulation inlet (DHW circulation).

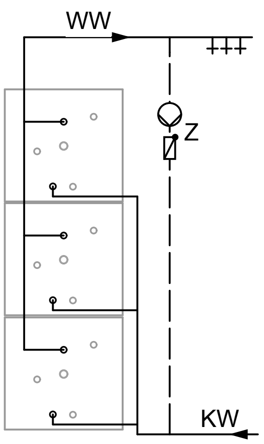
Depending on the type of DHW heating system, there are various connection options for the DHW circulation pipe. Virtually all DHW cylinders are fitted with connections for the DHW circulation pipe in the upper third of the cylinder. The exception to this is DHW heating systems in continuous operation such as freshwater stations or combi cylinders with an integral DHW indirect coil (Vitocell 340-M/ Vitocell 360-M). They have a "threaded DHW circulation fitting", which means that the DHW circulation line is routed partially into the heat exchanger. If this is not the case, the DHW circulation pipe can also be connected to the cold water inlet of the DHW cylinder.

Connecting to the cold water inlet is also an option for DHW cylinders where, due to the ratio of the draw-off rate and/or the flow rate of DHW circulation to the cylinder capacity, continuous mixing of the DHW cylinder content must be expected, e.g. in case of very small DHW cylinders. Connecting to the cold water inlet may also be advisable in the case of extremely high DHW circulation flow rates. In poorly insulated pipework or very widely branched systems in particular, extremely high flow rates may be necessary. It is then important to ensure that high flow velocities cannot lead to any settling inside the DHW cylinder. The resulting mixing in the standby part may lead to extremely long heat-up times and fluctuating outlet temperatures (DHW). In this case too, connecting the DHW circulation pipe to the cold water inlet may be advantageous in terms of the operating characteristics of the DHW heating system.

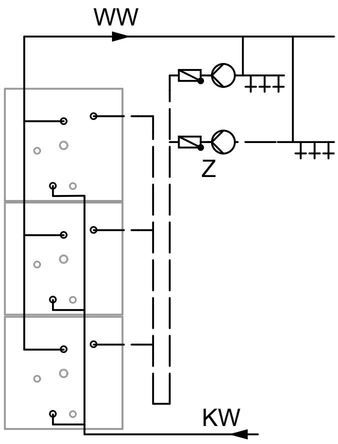
6.3 Connection of the DHW circulation pipe with cylinder banks

- Connect the DHW circulation pipe with detachable fittings.
- Install the cylinder banks with DHW circulation according to the diagrams below to ensure that each individual cylinder is heated evenly.

In conjunction with boilers or district heating systems **without** a return temperature limit on the heating water side and for operation on the heating side with saturated steam up to 1 bar (0.1 MPa) pressure and a DHW circulation pipe:



In conjunction with district heating systems **with** a return temperature limit on the heating water side and/or several DHW circulation pipes:



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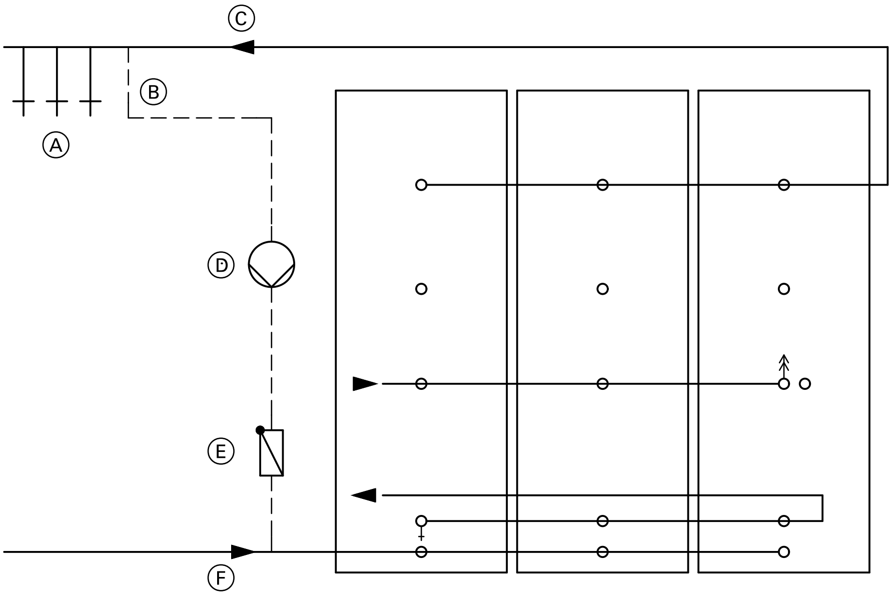
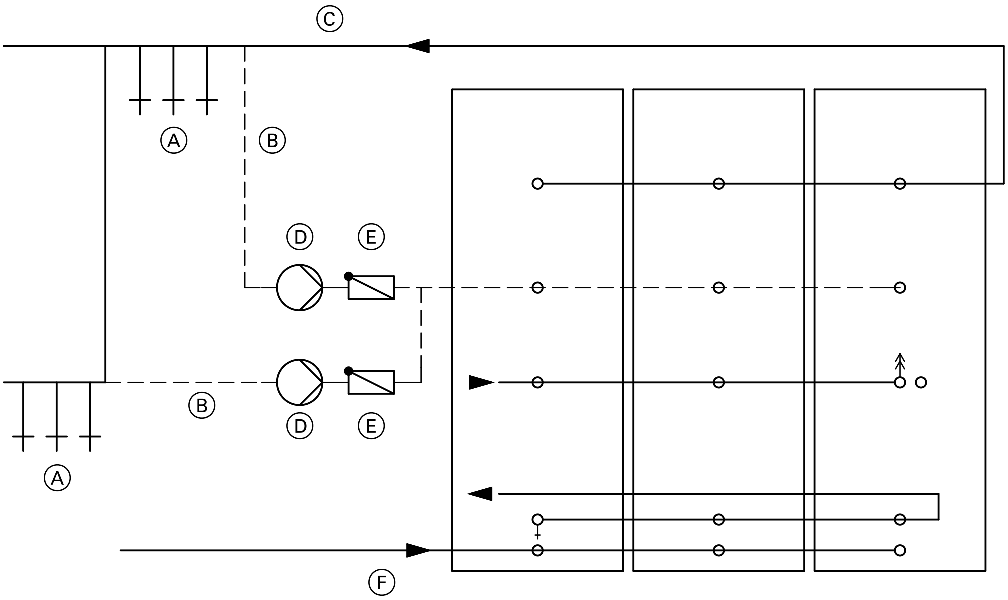
Installing the Vitocell 100-V and Vitocell 300-V as a cylinder bank



Connection in conjunction with a district heating system without return temperature limit or in conjunction with boilers (low temperature operation) and a simple DHW circulation pipe

Ⓐ Draw-off points
Ⓑ DHW circulation pipe
Ⓒ DHW
Ⓓ DHW circulation pump
Ⓔ Check valve
Ⓕ Cold water

Installing the Vitocell 100-V and Vitocell 300-V as a cylinder bank



Connection in conjunction with condensing boilers or district heating systems without return temperature limit and systems with branched DHW circulation networks

Ⓐ Draw-off points
Ⓑ DHW circulation pipe
Ⓒ DHW
Ⓓ DHW circulation pump
Ⓔ Check valve
Ⓕ Cold water

6.4 Connection on the heating side

Connection on the heating side

According to DIN 4753, the water in the DHW cylinder may be heated to approx. 95 °C.
To ensure that the DHW temperature never exceeds 95 °C, install a control unit to regulate the heat supply in accordance with the following circuit diagrams.
With the installation according to the diagrams on page 36 and 39, the circulation pump for the DHW cylinder is switched by the temperature controller. The spring-loaded check valve prevents continued heating of the DHW cylinder due to natural circulation.
A water temperature controller may also be used instead of the temperature controller (see diagrams on page 39).
When heating water flow temperatures exceed 110 °C, also fit a type-tested high limit safety cut-out. For this, the TR/HLSC combination device with 2 separate thermostatic systems (temperature limiter and high limit safety cut-out) is used (see diagrams on page 39).
Systems that already incorporate a high limit safety cut-out for limiting the temperature of the heating medium to 110 °C, (e.g. in the boiler), require no additional high limit safety cut-out in the DHW cylinder.

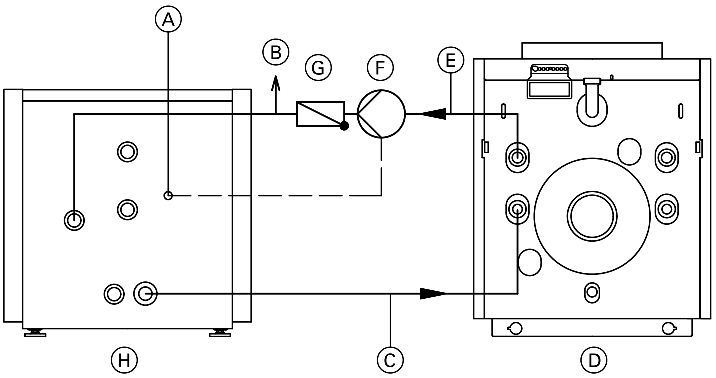
Cylinder banks
For cylinder banks, it is sufficient to install a temperature controller in only one of the cylinders.

Vitocell 100-H and Vitocell 300-H
Control by starting/stopping the circulation pump.

Vitocell 300-H:
With cylinder banks, make the connections on the heating water side and arrange the temperature controller and high limit safety cut-out (if required) as shown in the diagrams from page 38.
Vitocell 100-V and Vitocell 300-V:
The cylinder bank is controlled by one temperature controller. Therefore, the individual cylinders in a bank cannot be controlled separately. Install the temperature controller in the last cylinder as seen from the heating water flow (see diagrams on page 40).

Note
If, contrary to the diagram on page 40, the "heating water flow" is connected from the right, install the sensor well for the temperature controller in the last cylinder as seen from the heating water flow before the manifold is installed.

If individual cylinders in a cylinder bank need to be controlled separately, group the cylinders into several cylinder banks or install them as individual cylinders.



130, 160 and 200 l capacity: Connection on the heating water side with one boiler

- Ⓐ Temperature sensor/temperature controller and high limit safety cut-out (if required)
- Ⓑ Air vent valve
- Ⓒ Heating water return
- Ⓓ Boiler
- Ⓔ Heating water flow
- Ⓕ Circulation pump
- Ⓖ Spring-loaded check valve
- Ⓗ Vitocell 100-H or Vitocell 300-H

6

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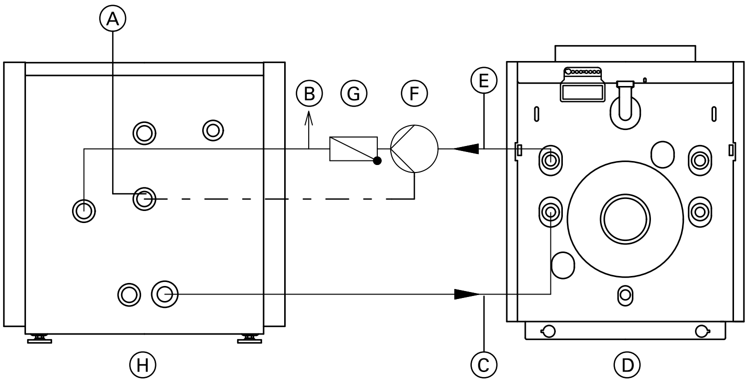

350 and 500 l capacity: Connection on the heating water side with one boiler

- Ⓐ Temperature sensor/temperature controller and high limit safety cut-out (if required)
- Ⓑ Air vent valve
- Ⓒ Heating water return
- Ⓓ Boiler
- Ⓔ Heating water flow
- Ⓕ Circulation pump
- Ⓖ Spring-loaded check valve
- Ⓗ Vitocell 100-H or Vitocell 300-H

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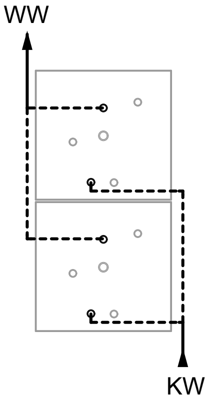
Vitocell 300-H as cylinder bank

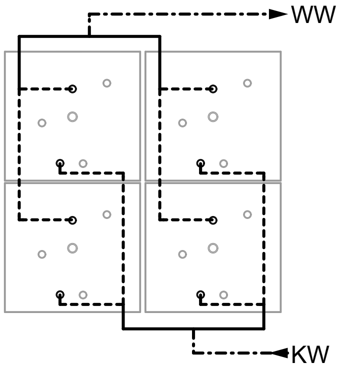
Connection on the heating water side and arrangement of the temperature controllers

Note
Observe the cross-sections of connection pipes on the heating water side.

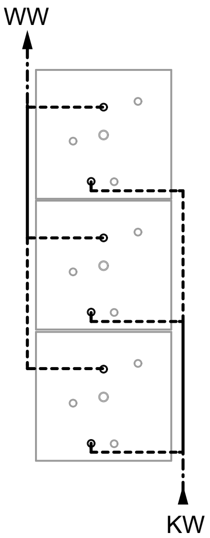
700 and 1000 l (2 cylinders)



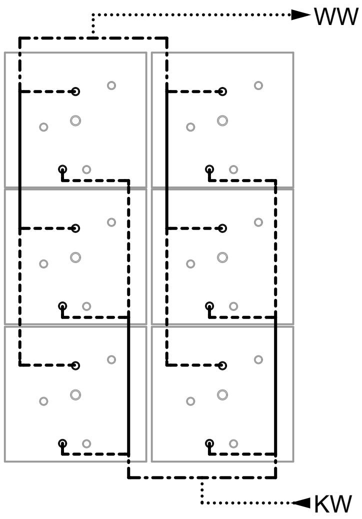
2 x 700 l and 2 x 1000 l (2 x 2 cylinders)



1500 l (3 cylinders)



2 x 1500 l (2 x 3 cylinders)



- - - - - - - -	DN 32
————	DN 40
-·-·-·-·	DN 50
....	DN 65

KW Cold water
WW DHW

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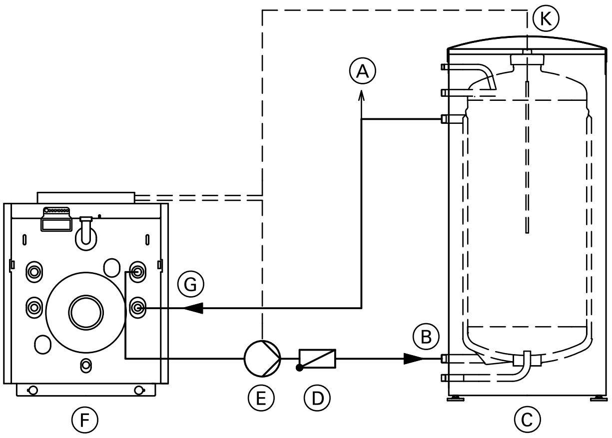
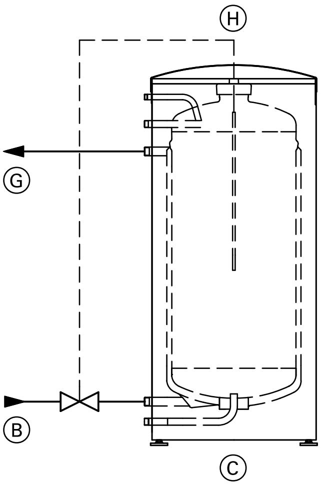
Vitocell 300-V, type EVA
Heating water connection



Control by starting/stopping the circulation pump

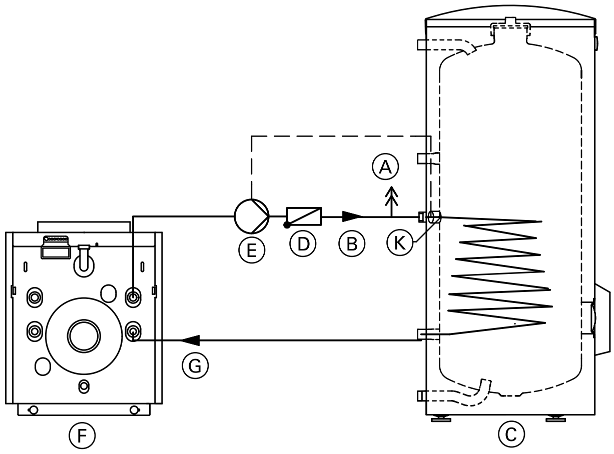
- Ⓐ Air vent valve
- Ⓑ Heating water flow
- Ⓒ Vitocell 300-V, type EVA
- Ⓓ Spring-loaded check valve
- Ⓔ Circulation pump
- Ⓕ Boiler
- Ⓖ Heating water return
- Ⓚ Cylinder temperature sensor



Control via a control valve

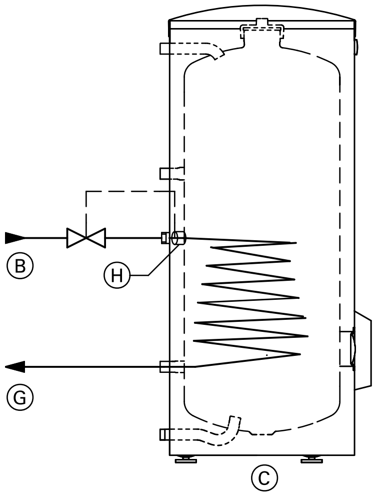
- Ⓑ Heating water flow
- Ⓒ Vitocell 300-V, type EVA
- Ⓖ Heating water return
- Ⓗ Sensor for water temperature controller

Vitocell 100-V and Vitocell 300-V, type EVI
Heating water connection



Control by starting/stopping the circulation pump

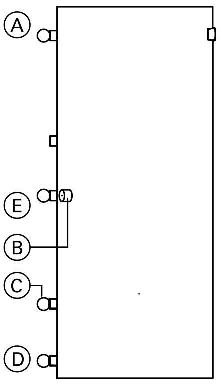
- Ⓐ Air vent valve
- Ⓑ Heating water flow
- Ⓒ Vitocell 100-V or Vitocell 300-V, type EVI
- Ⓓ Spring-loaded check valve
- Ⓔ Circulation pump
- Ⓕ Boiler
- Ⓖ Heating water return
- Ⓚ Temperature sensor/temperature controller and high limit safety cut-out (if required)

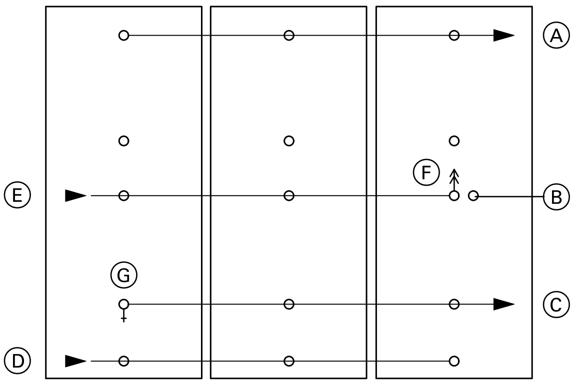


Control via a control valve

- Ⓑ Heating water flow
- Ⓒ Vitocell 100-V or Vitocell 300-V, type EVI
- Ⓖ Heating water return
- Ⓗ Sensor for water temperature controller

Vitocell 100-V and Vitocell 300-V as a cylinder bank
Connections on the heating water side





Ⓐ DHW
Ⓑ Temperature sensor/temperature controller
Ⓒ Heating water return
Ⓓ Cold water
Ⓔ Heating water flow
Ⓕ Air vent valve
Ⓖ Drain

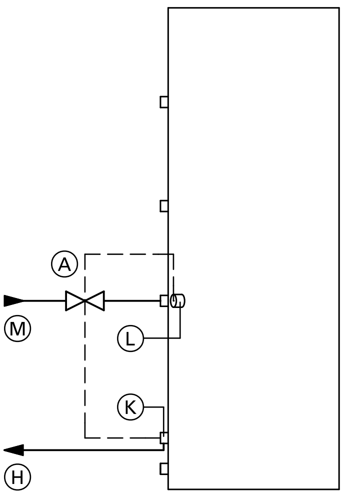
Connection on the heating side with return temperature limit

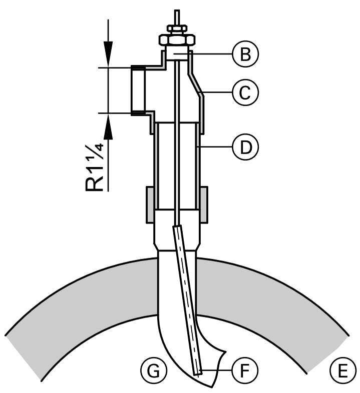
The return temperature limiting facility only needs to be installed if required by the relevant district heating plant.
To ensure that the heating water return temperature cannot exceed a specified value, use a return temperature limiter with control valve e.g. as offered by Samson, type 43-1, control range 25 to 70 °C.
For individual cylinders and cylinder banks, install the sensor as shown in the relevant diagrams. The customer is responsible for installing the necessary pipework.

The control valve is sized according to the required heating water flow rate and the system pressure drop.

Note
When return temperatures are restricted, a check must be carried out to determine whether the hygiene requirements in accordance with TRWI/DVGW are met. A transfer pump may have to be provided.

Vitocell 100-V and Vitocell 300-V, type EVI
Installation of the sensor for limiting the return temperature in the heating water return for individual cylinders.





Ⓐ Water temperature controller
Ⓑ Gland fitting
Ⓒ Tee
Ⓓ Fitting
Ⓔ Thermal insulation
Ⓕ Sensor for the return temperature limiter
Ⓖ Internal indirect coil
Ⓗ Heating water return
Ⓚ Sensor for return temperature limiter
Ⓛ Sensor for water temperature controller
Ⓜ Heating water flow

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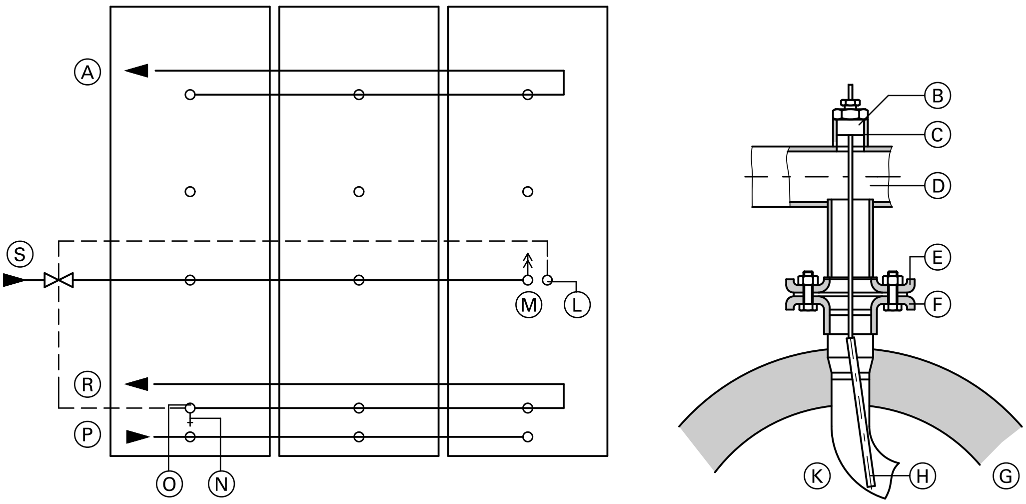
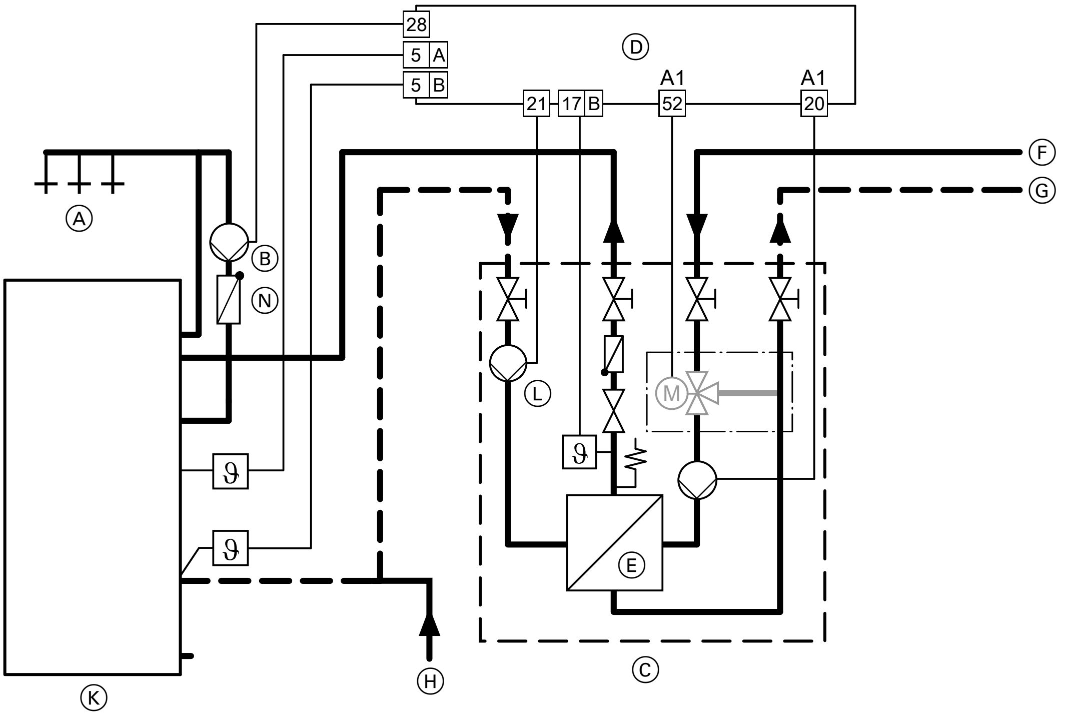
Vitocell 100-V and Vitocell 300-V as a cylinder bank
Installation of the sensor for limiting the return temperature in the heating water return.



Ⓐ DHW
Ⓑ Gland fitting
Ⓒ Female connection R ½ EN 10241 (on site)
Ⓓ Header
Ⓔ Flange
Ⓕ Threaded flange
Ⓖ Thermal insulation
Ⓗ Sensor for the return temperature limiter
Ⓚ Internal indirect coil
Ⓛ Sensor for water temperature controller
Ⓜ Air vent valve
Ⓝ Drain
Ⓞ Sensor for return temperature limiter
Ⓟ Cold water
Ⓡ Heating water return
Ⓢ Heating water flow

7.1 DHW connection

Version 1 — cylinder loading system with one Vitocell 100-L and Vitotrans 222 for modulating flow temperatures



Ⓐ Draw-off points (DHW)
Ⓑ DHW circulation pump
Ⓒ Vitotrans 222 heat exchanger set with mixer assembly
Ⓓ Vitotronic 200-H, type HK1B, HK3B
Vitotronic 100, type GC1B, GC4B
Vitotronic 200, type GW1B
Vitotronic 300, type GW2B, GW4B
Vitotronic 300-K, type MW1B, MW2B
Ⓔ Plate heat exchanger
Ⓕ Heating water flow
Ⓖ Heating water return
Ⓗ Shared cold water connection with safety assembly to DIN 1988
Ⓚ Vitocell 100-L, (here: 500 l capacity)
Ⓛ Cylinder loading pump (secondary), highly efficient
Ⓝ Spring-loaded check valve
Ⓞ Cylinder temperature sensor, top
(ON, plug 5 A)
Ⓟ Cylinder temperature sensor, bottom
(OFF, plug 5 B)

Note

- *Establish cold water connection Ⓗ with a tee with straight flow to the cold water connection of the Vitocell 100-L. Always make the cold water connection to the Vitotrans 222 as a tee branch.*
- *In larger DHW circulation networks, it may be necessary to briefly switch off the DHW circulation pump to enable heating of the Vitocell 100-L.*

Due to the necessary high flow temperatures of the heat source, never use a directly connected heating circuit without mixer.
For optimum operation, disable the DHW cylinder priority at the control unit.

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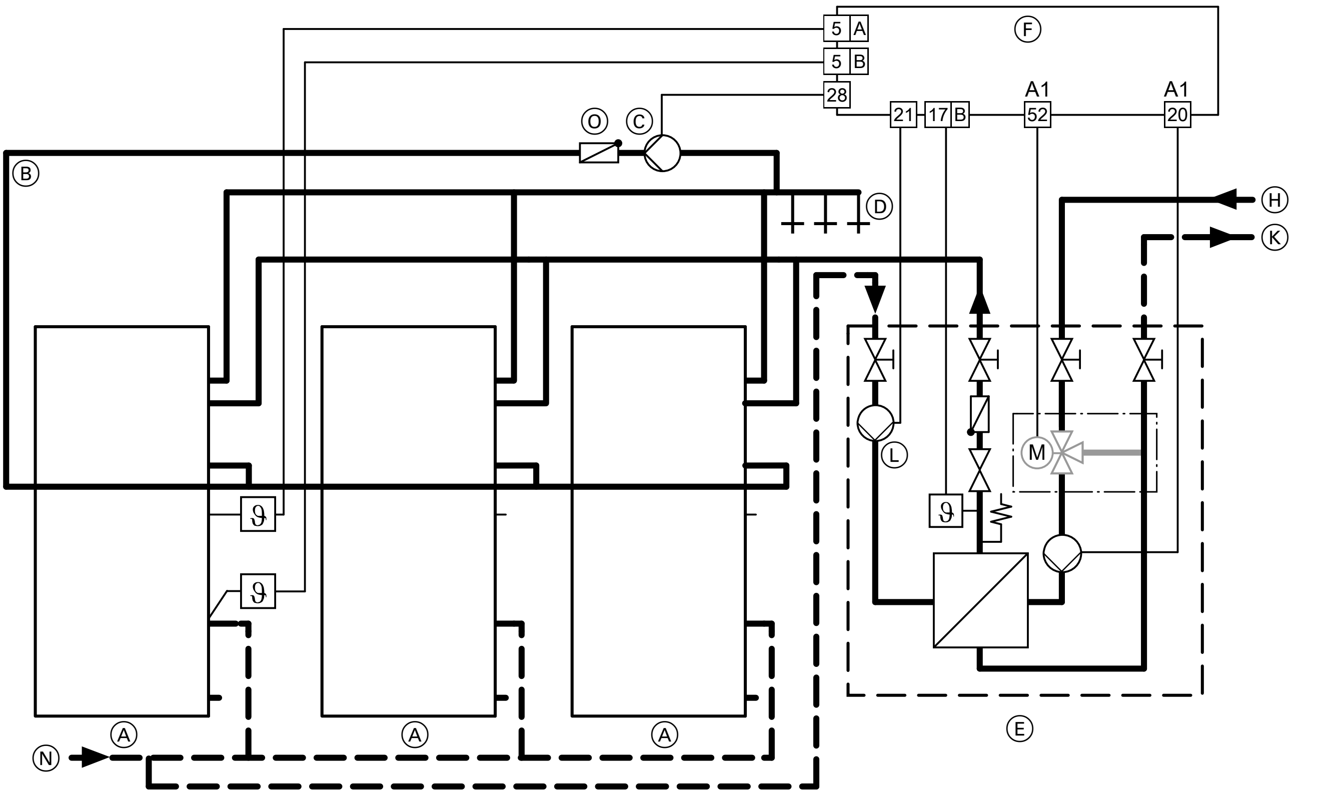
Version 2 — cylinder loading system with several Vitocell 100-L in parallel and Vitotrans 222 for modulating flow temperatures



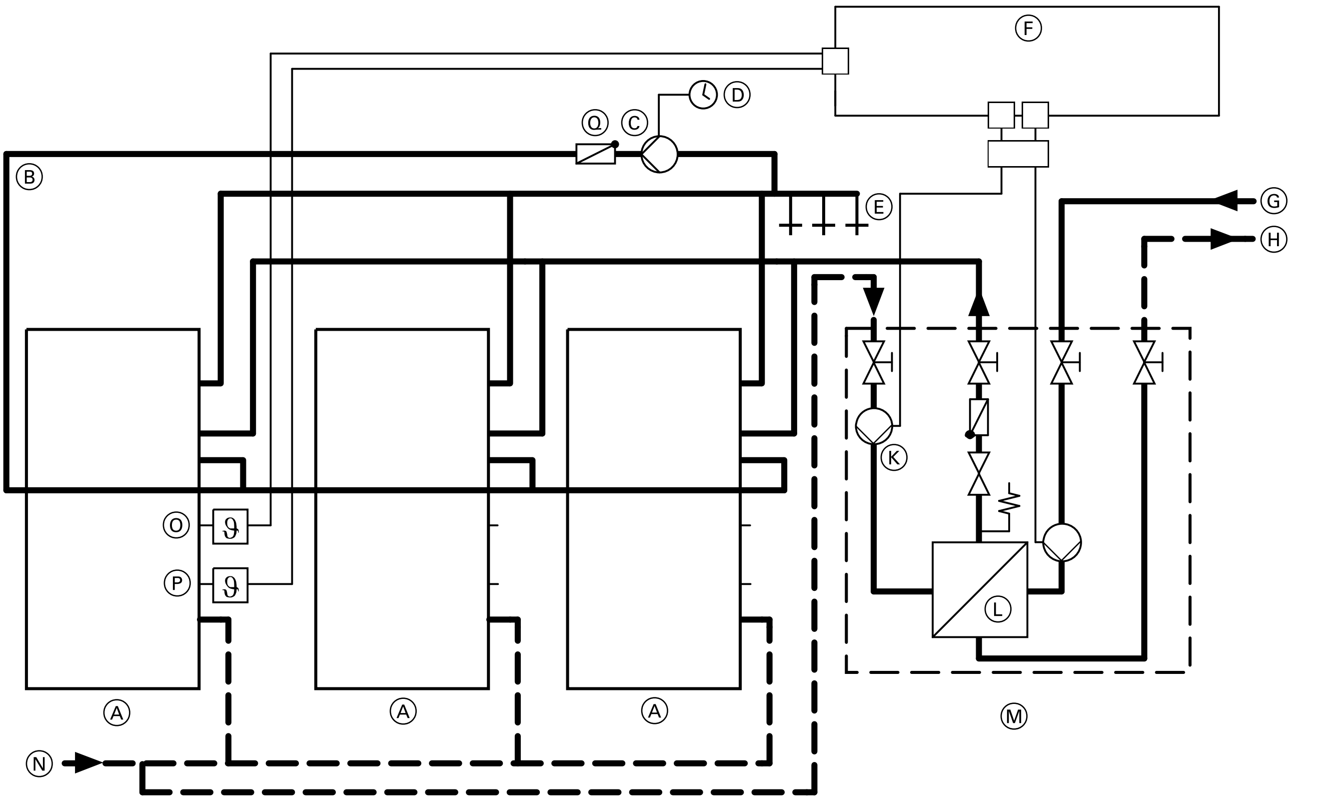
- Ⓐ Vitocell 100-L, (here: 500 l capacity)
- Ⓑ DHW circulation pipe
- Ⓒ DHW circulation pump
- Ⓓ Draw-off points (DHW)
- Ⓔ Vitotrans 222 heat exchanger set with mixer assembly
- Ⓕ Vitotronic 200-H, type HK1B, HK3B
  Vitotronic 100, type GC1B, GC4B
  Vitotronic 200, type GW1B
  Vitotronic 300, type GW2B, GW4B
  Vitotronic 300-K, type MW1B, MW2B
- Ⓖ Plate heat exchanger
- Ⓗ Heating water flow
- Ⓚ Heating water return
- Ⓛ Cylinder loading pump (secondary), highly efficient
- Ⓝ Shared cold water connection with safety assembly to DIN 1988
- Ⓞ Spring-loaded check valve
- Ⓟ Cylinder temperature sensor, top
  (ON, terminals 5A)
- Ⓠ Cylinder temperature sensor, bottom
  (OFF, terminals 5B)

Note
Establish cold water connection Ⓝ with a tee with straight flow to the cold water connection of the Vitocell 100-L. Always make the cold water connection to the Vitotrans 222 as a tee branch.

Parallel operation is particularly suitable for systems where the dominant design criterion is a high peak output, e.g. sports halls, sports grounds, swimming pools or shower rooms in commercial enterprises.

With parallel operation, the max. draw-off rate can be extracted from each DHW cylinder. The DHW cylinders can be reheated in a short time after the hot water has been drawn off subject to a sufficiently high heat exchanger output being available.
Due to the necessary high flow temperatures of the heat source, never use a directly connected heating circuit without mixer.
For optimum operation, disable the DHW cylinder priority at the control unit.

Version 3 — cylinder loading system with several Vitocell 100-L in parallel and Vitotrans 222 for constant flow temperatures



- Ⓐ Vitocell 100-L, (here: 500 l capacity)
- Ⓑ DHW circulation pipe
- Ⓒ DHW circulation pump
- Ⓓ Time switch
- Ⓔ Draw-off points (DHW)
- Ⓕ Junction box (on site)
- Ⓖ Heating water flow
- Ⓗ Heating water return
- Ⓚ Cylinder loading pump (secondary), highly efficient
- Ⓛ Plate heat exchanger
- Ⓜ Vitotrans 222 heat exchanger set
- Ⓝ Shared cold water connection with safety assembly to DIN 1988
- Ⓞ Upper temperature controller (ON)
- Ⓟ Lower temperature controller (OFF)
- Ⓠ Spring-loaded check valve

Note
Establish cold water connection Ⓝ with a tee with straight flow to the cold water connection of the Vitocell 100-L. Always make the cold water connection to the Vitotrans 222 as a tee branch.

Due to the necessary high flow temperatures of the heat source, never use a directly connected heating circuit without mixer.

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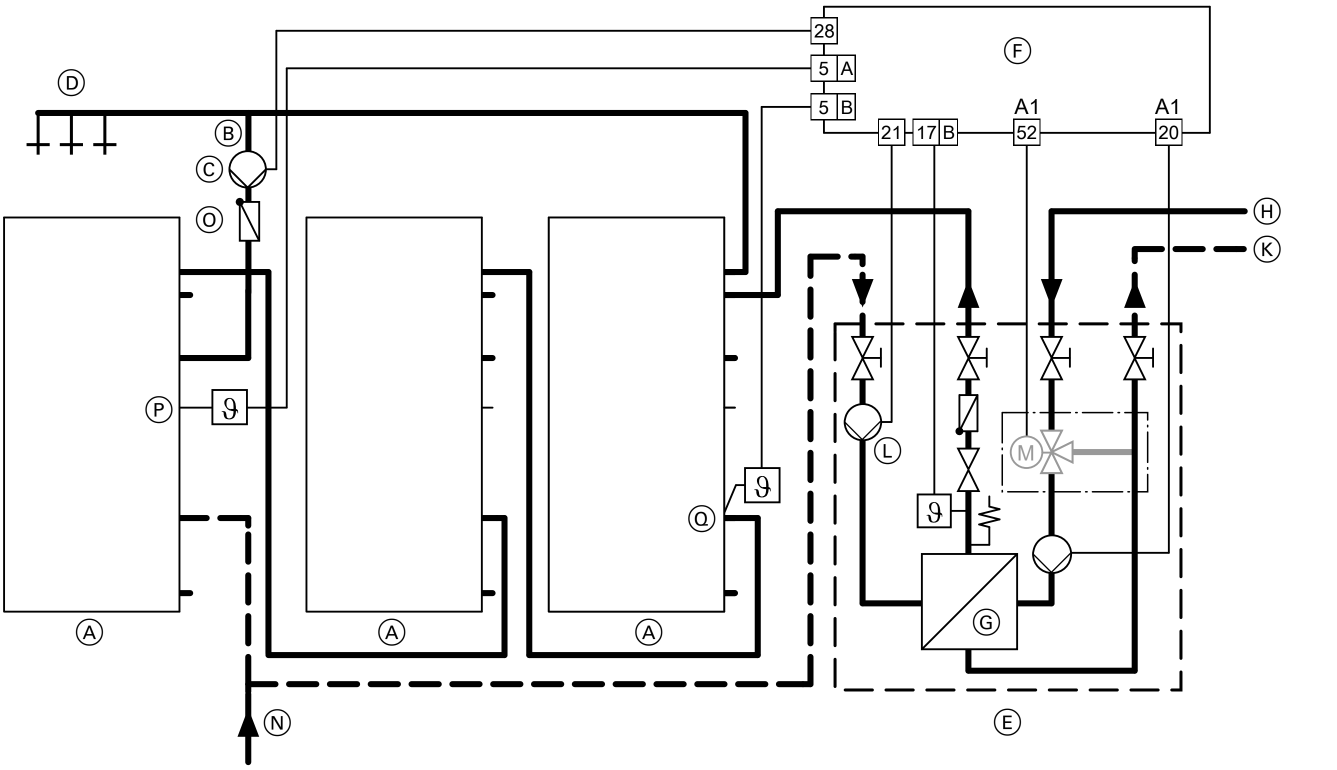
Version 4 — cylinder loading system with several Vitocell 100-L in series and Vitotrans 222 for modulating flow temperatures



Ⓐ Vitocell 100-L, (here: 500 l capacity)
Ⓑ DHW circulation pipe
Ⓒ DHW circulation pump
Ⓓ Draw-off points (DHW)
Ⓔ Vitotrans 222 heat exchanger set with mixer assembly
Ⓕ Vitotronic 200-H, type HK1B, HK3B
Vitotronic 100, type GC1B, GC4B
Vitotronic 200, type GW1B
Vitotronic 300, type GW2B, GW4B
Vitotronic 300-K, type MW1B, MW2B
Ⓖ Plate heat exchanger
Ⓗ Heating water flow
Ⓚ Heating water return
Ⓛ Cylinder loading pump (secondary), highly efficient
Ⓝ Shared cold water connection with safety assembly to DIN 1988
Ⓞ Spring-loaded check valve
Ⓟ Cylinder temperature sensor, top
(ON, terminals 5 A)
Ⓠ Cylinder temperature sensor, bottom
(OFF, terminals 5 B)

Note
- *Establish cold water connection Ⓝ with a tee with straight flow to the cold water connection of the Vitocell 100-L. Always make the cold water connection to the Vitotrans 222 as a tee branch.*
- *In order to ensure fault-free heating operation, the residual head of cylinder loading pump Ⓛ must be* ***greater*** *than that of DHW circulation pump Ⓒ, giving due consideration to the pipework pressure drop.*

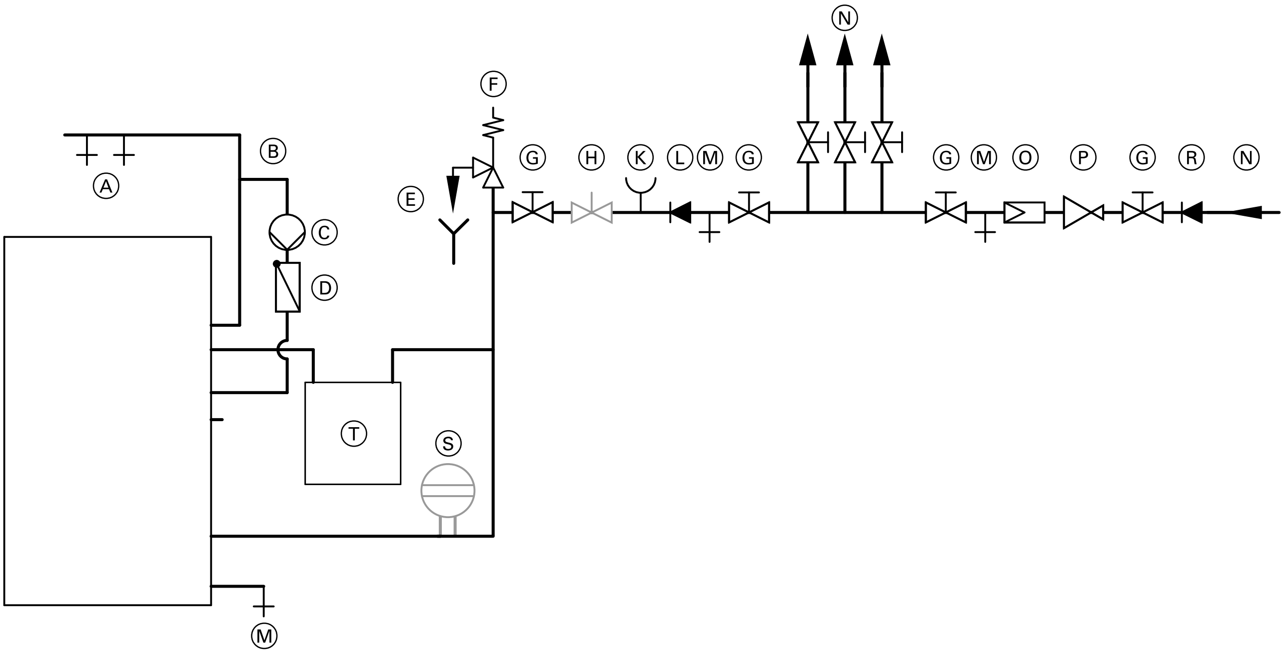
Connect in series if relatively continuous DHW demand can be expected, e.g. in large apartment buildings.

Note the max. draw-off rate when sizing for DHW heating. According to DIN 1988, the max. flow velocity should not be higher than 2 m/s (affects stratification inside the DHW cylinder).
The benefits of connection in series are particularly evident when heat exchangers with low output ratings are combined with large cylinder capacities, as a large cylinder capacity makes it possible to use smaller boilers or the input of district heating.
Due to the necessary high flow temperatures of the heat source, never use a directly connected heating circuit without mixer.
For optimum operation, disable the DHW cylinder priority at the control unit.

7.2 Connections

Connection on the DHW side of the Vitotrans 222 (accessories) in conjunction with a Vitocell 100-L

(Connection to DIN 1988)



- Ⓐ Draw-off points (DHW)
- Ⓑ DHW circulation pipe
- Ⓒ DHW circulation pump
- Ⓓ Spring-loaded check valve
- Ⓔ Visible discharge pipe outlet point
- Ⓕ Safety valve
- Ⓖ Shut-off valve
- Ⓗ Flow regulating valve
- Ⓚ Pressure gauge connection
- Ⓛ Non-return valve
- Ⓜ Drain
- Ⓝ Cold water
- Ⓞ Drinking water filter
- Ⓟ Pressure reducer
- Ⓡ Non-return valve/pipe separator
- Ⓢ Diaphragm expansion vessel, suitable for potable water
- Ⓣ Vitotrans 222

Note
- *The pipework downstream of the Vitotrans 222 must **not be made from zinc-plated steel pipes**.*
- *Establish the cold water connection with a tee with straight flow to the cold water connection of the Vitocell 100-L. Always make the cold water connection to the Vitotrans 222 as a tee branch.*
- *The safety valve underneath the Vitotrans 222 does not replace the safety valve of the safety assembly to DIN 1988.*

The following are part of the safety assembly according to DIN 1988:
- **Shut-off valves**
- **Drain valve**
- **Pressure reducer**
  Install this device if the pressure in the pipework at the connection point exceeds 80 % of the safety valve response pressure.
  It is advisable to install the pressure reducer immediately downstream of the water meter. This creates nearly the same pressures in the entire DHW system, which is thereby protected against overpressure and water hammer.
  According to DIN 4109, the static pressure of the water supply system after distribution over the various floors upstream of the fittings should not be higher than 5 bar (0.5 MPa).
- **Safety valve**
  The system must be equipped with a type-tested diaphragm safety valve as protection against overpressure.
  Permiss. operating pressure: 10 bar (1 MPa).
  The connection diameter of the safety valve must be as follows:
  – for 500 to 1000 l cylinder capacity at least R ¾ (DN 20), max. heat input 150 kW
  – between 1000 and 5000 l cylinder capacity at least R 1 (DN 25), max. heat input 250 kW
  Install the safety valve in the cold water line. Ensure it cannot be shut off from the DHW cylinder. There must be no restrictions in the pipework between the safety valve and the DHW cylinder.
  Never seal off the safety valve discharge pipe. Ensure that any expelled water is safely and visibly drained into a drainage system. Position a sign close to the safety valve discharge pipe, or ideally on the safety valve itself, with the following inscription:
  "For safety reasons, water may be discharged from the discharge pipe during heating. Never seal off."
  Install the safety valve above the top edge of the DHW cylinder.
- **Non-return valve**
  This prevents system water and heated water from flowing back into the cold water pipe and into the mains water supply.
- **Pressure gauge**
  Provide a connection for a pressure gauge.

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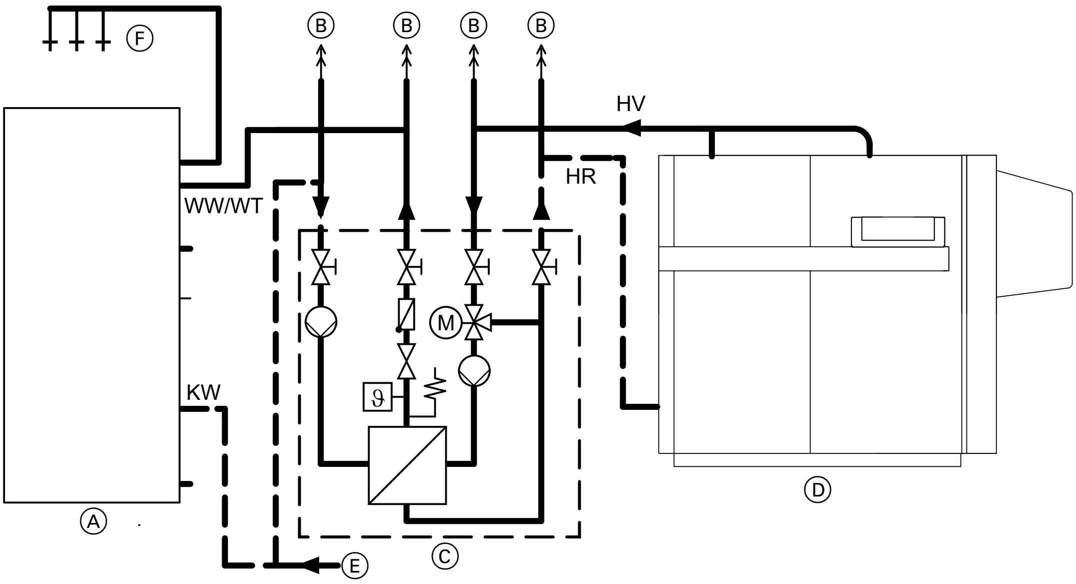
- **Flow regulating valve**
  We recommend installing a flow regulating valve and adjusting the maximum water flow rate in accordance with the 10-minute peak output (see table in the datasheet).
- **Drinking water filter**

According to DIN 1988, a drinking water filter should be installed in systems with metal pipework. A drinking water filter should also be installed in plastic pipework. The installation of a drinking water filter prevents dirt from being introduced into the drinking water system.

Connections on the heating water side



Ⓐ	Vitocell 100-L, (here: 500 l capacity)	Ⓕ	Draw-off points (DHW)
Ⓑ	Vent connector	HR	Heating water return
Ⓒ	Vitotrans 222	HV	Heating water flow
Ⓓ	Boiler	KW	Cold water
Ⓔ	Shared cold water connection with safety assembly to DIN 1988	WW/WT	Hot water inlet from the heat exchanger

7.3 Sample applications

Cylinder loading systems under various connection conditions

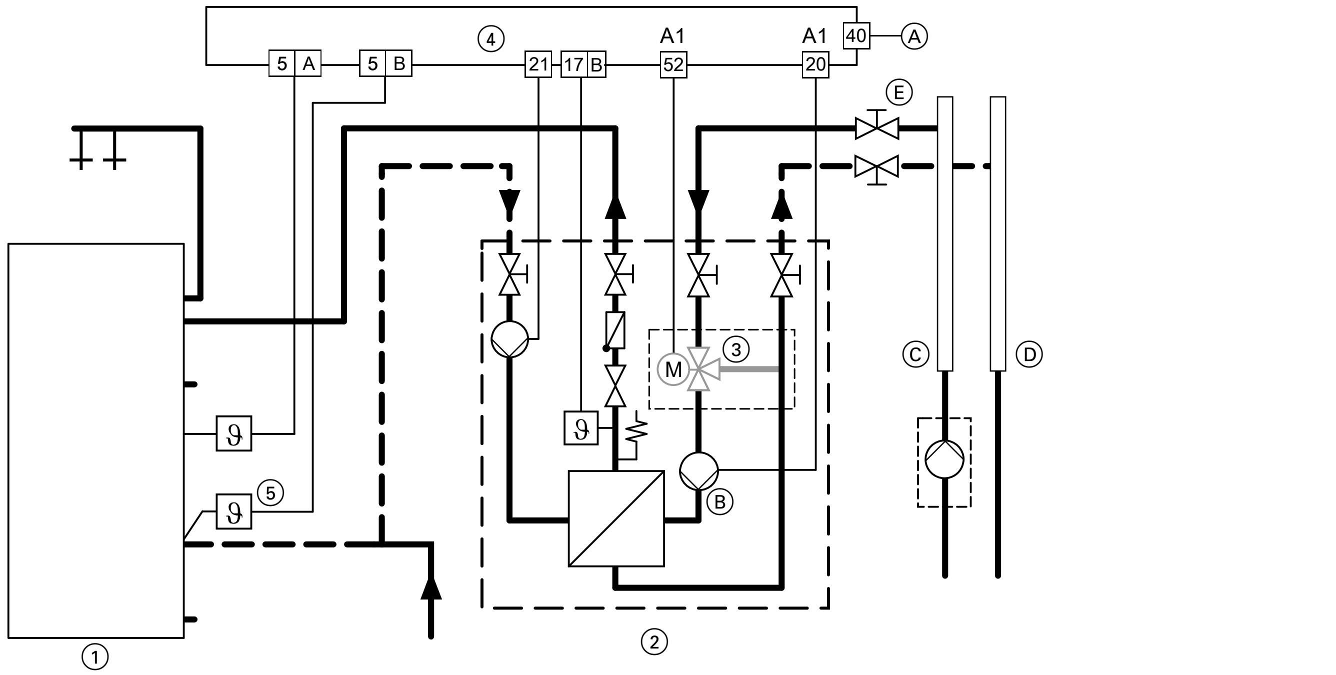
The cylinder loading system can be integrated into systems with varying operating parameters and control systems.
The electrical wiring and the hydraulic connection of the cylinder loading system must be matched to the hydraulic and the control conditions.
Possible installation of the cylinder loading system in conjunction with:
- Vitotronic boiler control units (modulating boiler operation)
- Vitotronic 200-H with third party control units and modulating boiler operation
- Constant flow temperatures (e.g. standard boiler)
- District heating system

Corresponding water and wiring designs are shown on the following pages.

Note
In multi boiler systems, connect the cylinder loading system to the Vitotronic 300-K.

Sample application 1 – Vitocell 100-L with Vitotrans 222 and boiler with Vitotronic

(modulating boiler operation)



Ⓐ Power supply connection 230 V~ 50 Hz; install a mains isolator in accordance with regulations
Ⓑ Heating circuit pump (primary), highly efficient
Ⓒ Flow distributor (under pressure)
Ⓓ Return collector
Ⓔ Additional motorised valve in the flow to the Vitotrans 222 if the differential pressure between the flow distributor and the return collector is >3 bar (0.3 MPa)

The Viessmann NTC cylinder temperature sensor, which is part of the Vitotronic standard delivery (accessory for Vitotronic 200-H and Vitotronic 100), is supplemented by a second cylinder temperature sensor (mixer assembly standard delivery).
The top cylinder temperature sensor is connected to plug [5]A, while the bottom one is connected to plug [5]B.

System-specific code on Vitotronic ④
Set code "4C : 1":
Use of output [20] as primary pump for the heat exchanger set.
Set code "4E : 1":
Use of output [52] as primary control for the heat exchanger set.
Set code "55 : 3":
Use of cylinder temperature control for the heat exchanger set.
Set code "6A : 113":
With Vitotrans 222, 240 kW, servomotor runtime 113 s.

Required components

Pos.	Description	Number	Part no.
①	Vitocell 100-L	Subject to system	See Viessmann pricelist
②	Vitotrans 222	1	See Viessmann pricelist
③	Mixer assembly (incl. 3-way mixing valve, servomotor, sensors, pipework) for the Vitotrans 222	1	See Viessmann pricelist
④	Vitotronic 200-H and Vitotronic 100, type GC1B or GC4B	1	See Viessmann pricelist
⑤	In conjunction with the Vitotronic 200-H and Vitotronic 100, type GC1B or GC4B:		
	Immersion temperature sensor (Viessmann NTC) as cylinder temperature sensor	1	7438 702

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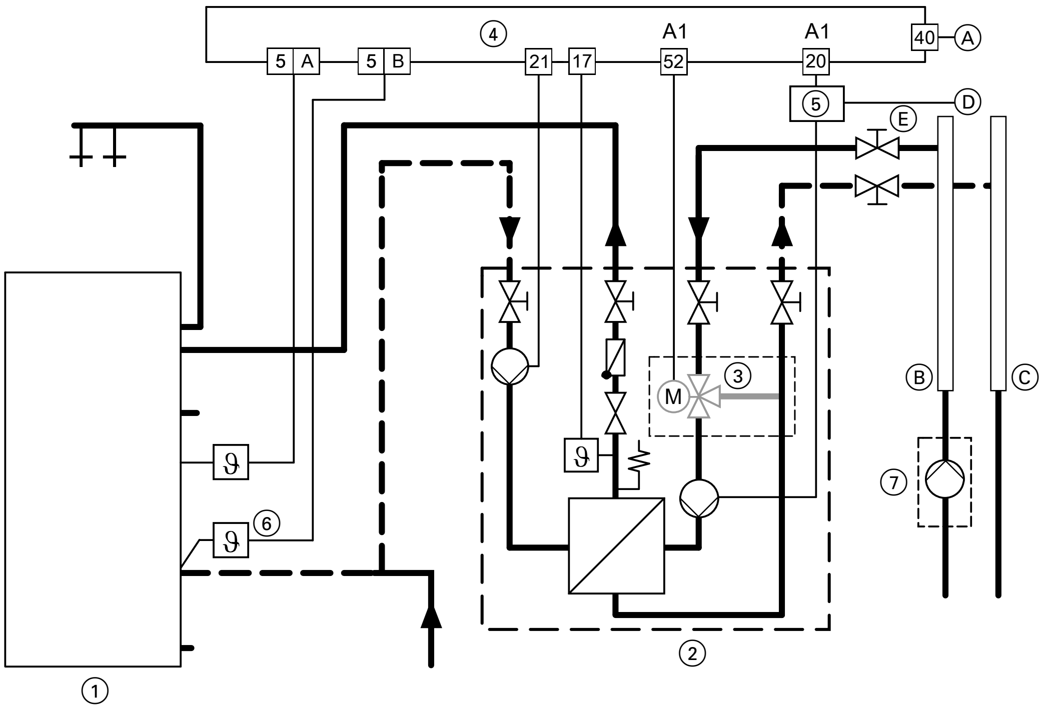
Sample application 2 – Vitocell 100-L with Vitotrans 222 and a third party control unit

(modulating boiler operation)

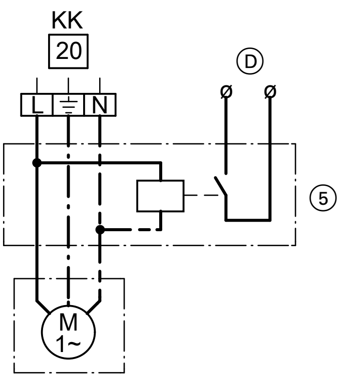


Ⓐ Power supply connection 230 V~ 50 Hz; install a mains isolator in accordance with regulations
Ⓑ Flow distributor (under pressure)
Ⓒ Return collector
Ⓓ Floating contact for burner start by the third party control unit
Ⓔ Additional motorised valve in the flow to the Vitotrans 222 if the differential pressure between the flow distributor and the return collector is >3 bar (0.3 MPa)

In conjunction with a third party control unit, the cylinder loading pump is regulated by the Vitotronic 200-H.
The top cylinder temperature sensor is connected to plug 5A, while the bottom one is connected to plug 5B.

System-specific code on Vitotronic ④
Set code "4C : 1":
Use of output 20 as primary pump for the heat exchanger set.
Set code "4E : 1":
Use of output 52 as primary control for the heat exchanger set.
Set code "55 : 3":
Use of cylinder temperature control for the heat exchanger set.
Set code "6A : 113":
With Vitotrans 222, 240 kW, servomotor runtime 113 s.
Set code "9F : 1" if no outside temperature sensor is connected (e.g. Vitotronic 200-H, type HK1B, only regulates the Vitotrans 222).

Contactor relay connection



Required components

Pos.	Description	Number	Part no.
①	Vitocell 100-L	Subject to system	See Viessmann pricelist
②	Vitotrans 222	1	See Viessmann pricelist
③	Mixer assembly (incl. 3-way mixing valve, servomotor, sensors, pipework) for the Vitotrans 222	1	See Viessmann pricelist
④	Vitotronic 200-H	1	See Viessmann pricelist
⑤	Contactor relay	1	7814 681
⑥	In conjunction with the Vitotronic 200-H: Immersion temperature sensor (Viessmann NTC) as cylinder temperature sensor	1	7438 702
⑦	Feed pump (distributor)	Subject to system	On site

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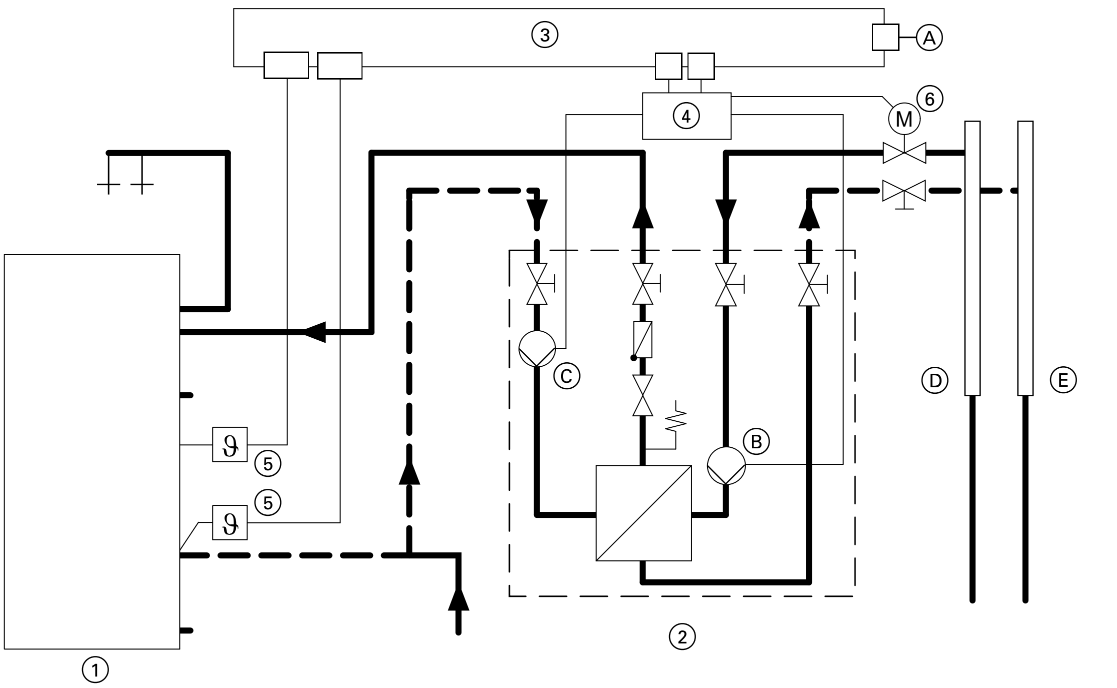
Sample application 3 – Vitocell 100-L with Vitotrans 222 and constant flow temperatures



Ⓐ Power supply connection 230 V~ 50 Hz; install a mains isolator in accordance with regulations
Ⓑ Heating circuit pump (primary), highly efficient
Ⓒ Cylinder loading pump (secondary), highly efficient
Ⓓ Flow distributor (under pressure)
Ⓔ Return collector

Cylinder heating will be initiated by the upper temperature controller. The lower temperature controller terminates cylinder heating. You can select the temperature at the temperature controller.

Example:
Max. 55 °C ON, 50 °C OFF (at a heating temperature of 60 °C).

Install a motorised valve in the flow line when connecting the Vitotrans 222 heat exchanger set for constant flow temperatures without mixer assembly to a pressurised flow distributor (boiler with heating circuit pump to distributor). The motorised valve will be closed during non-heating periods, preventing a forced flow through the Vitotrans 222 during such times.

Required components

Pos.	Description	Number	Part no.
①	Vitocell 100-L	Subject to system	See Viessmann pricelist
②	Vitotrans 222	1	See Viessmann pricelist
③	Wiring chamber	1	On site
④	Contactor relay*13	1	7814 681
⑤	Temperature controller	2	7151 989
⑥	Motorised valve*13	1	On site

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*13 *Only required for pressurised flow distributors.*

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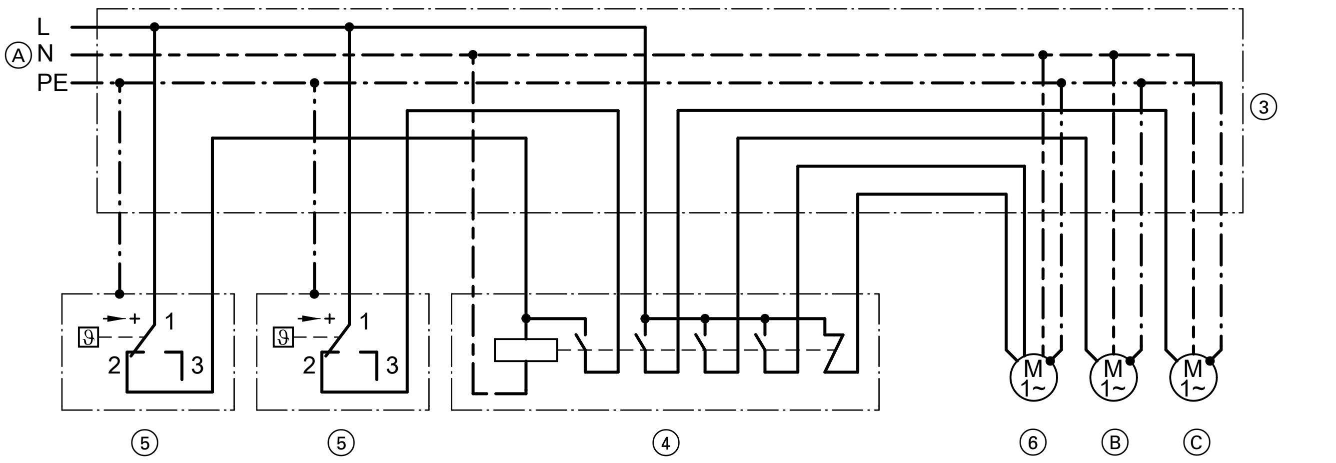
Wiring diagram for connecting the temperature controller, contactor relay and motorised valve



Motorised valve ⑥ is only required for pressurised flow distributors.

For the key and required components, see page 50.

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8.1 Questionnaire regarding the sizing of DHW cylinders

DHW cylinders in DHW heating systems

1. Address

Name	
Street	
Postcode / Town	
Telephone (for any queries)	
Date	
Project	

2. Essential details

Required cylinder temperature		°C
Flow temperature of the heat source		°C
Spread (Δt)	☐ Optimised	K
☐ Required heating output is calculated with EDIS		
☐ Max. available heating output		kW

3. Selection of calculation method

☐ Residential units

Type of residential unit	N_L factor	Number
1-2 room studio apartment with shower	0.71	
3-room apartment with standard bath	0.77	
Standard residential unit with standard bath	1.00	
Standard residential unit with deluxe bath	1.12	
Deluxe apartment with standard bath and shower	1.63	
Standard residential unit with guest room	1.89	
Other		

☐ Hotels and guest houses

Equipment	Demand (kWh)	Number
Single room with 1 bath and 1 washbasin	7.0	
Single room with 1 shower and 1 washbasin	3.0	
Single room with 1 washbasin	0.8	
Double room with 1 bath and 1 washbasin	10.5	
Double room with 1 shower and 1 washbasin	4.5	
Double room with 1 washbasin	1.2	
Covers	0.6	

Hotel category (star rating)	
Demand period	Hours
Heat-up time	Hours

☐ Catering businesses (e.g. restaurant, canteen, dining hall)

Location of catering facilities	☐ Restaurant	☐ Canteen	☐ Other	
			DHW demand	l/cover
Number of covers	Number of draw-off points		Demand period	Hours

☐ Hospitals and clinics

Number of beds	DHW demand (45 °C)	l/bed
Number of additional draw-off events	DHW demand (45 °C)	l/draw-off event
Total number of draw-off points	Demand period	Hours

☐ Shared accommodation (e.g. residential home, army barracks)

Number of occupants	Shower frequency	Number of users/hour and shower
Number of showers	DHW demand (45 °C)	l/shower taken
Number of additional draw-off events	DHW demand	l/draw-off event
Number of additional draw-off events		

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☐ Retirement home, nursing home

Number of beds	DHW demand (45 °C) l/bed
Number of covers	DHW demand (45 °C) l/cover
Number of additional draw-off points	Demand period Hours
Number of draw-off points per room	

☐ Campsite, recreational camp

Number of campers	Shower frequency Number of users/hour and shower
Number of showers	DHW demand l/shower taken
Number of additional draw-off points	DHW demand (45 °C) l/draw-off point

☐ Leisure facilities (e.g. sports hall, swimming pool)

Number of showers	Heat-up time min
Demand period min	Shower time min
DHW demand/shower (40 °C) l/min	

☐ Commercial enterprises

Number of employees	Activity ☐ Slightly dirty ☐ Moderately dirty ☐ Very dirty	
Consumption point	DHW volume (l/min)	Number
Washbasins with tap	8.50	
Washbasins with spray head	4.50	
Circular communal washbasin for 6 people	20.00	
Circular communal washbasin for 10 people	25.00	
Shower cubicle without changing cubicle	9.50	
Shower cubicle with changing cubicle	9.50	
Demand period	Hours	
Heat-up time	Hours	

4. Selected DHW cylinder

☐ Vitocell 100, type: ....

☐ Vitocell 300, type: ....

8.2 Checklist for heat exchanger enquiries/sizing

Purpose: Water/water

☐ System separation, underfloor heating system
☐ System separation, district heating system
☐ DHW heating
☐ Other:

System temperatures

Primary	Secondary
Inlet °C	Inlet °C
Outlet °C	Outlet °C
Output kW	

Limits (e.g. max.)
Pressure drop

Primary mbar kPa	Secondary mbar kPa

Limits

Pressure stages	bar MPa		

Limits

Temperatures	°C		

Special conditions?

Specification of heat exchanger type
☐ System separation, underfloor heating system
☐ System separation, district heating system

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8.3 Checklist for heat exchanger enquiries/sizing

Purpose: Steam/water

☐ System separation, district heating system
☐ Other:

Saturated steam pressure/system temperatures			
Primary		Secondary	
Steam pressure	bar MPa	Inlet	°C
Condensate outlet	°C	Outlet	°C
Output	kW		
Limits (e.g. max.) Pressure drop Primary	mbar kPa	Secondary	mbar kPa
Limits Pressure stages	bar MPa		
Limits Temperatures	°C		
Special conditions?			

Specification of heat exchanger type
Tubular heat exchanger
☐ Vertical
☐ Horizontal (Viessmann only supplies vertical version)

Keyword index

Subject to technical modifications.

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