Thinking solutions.

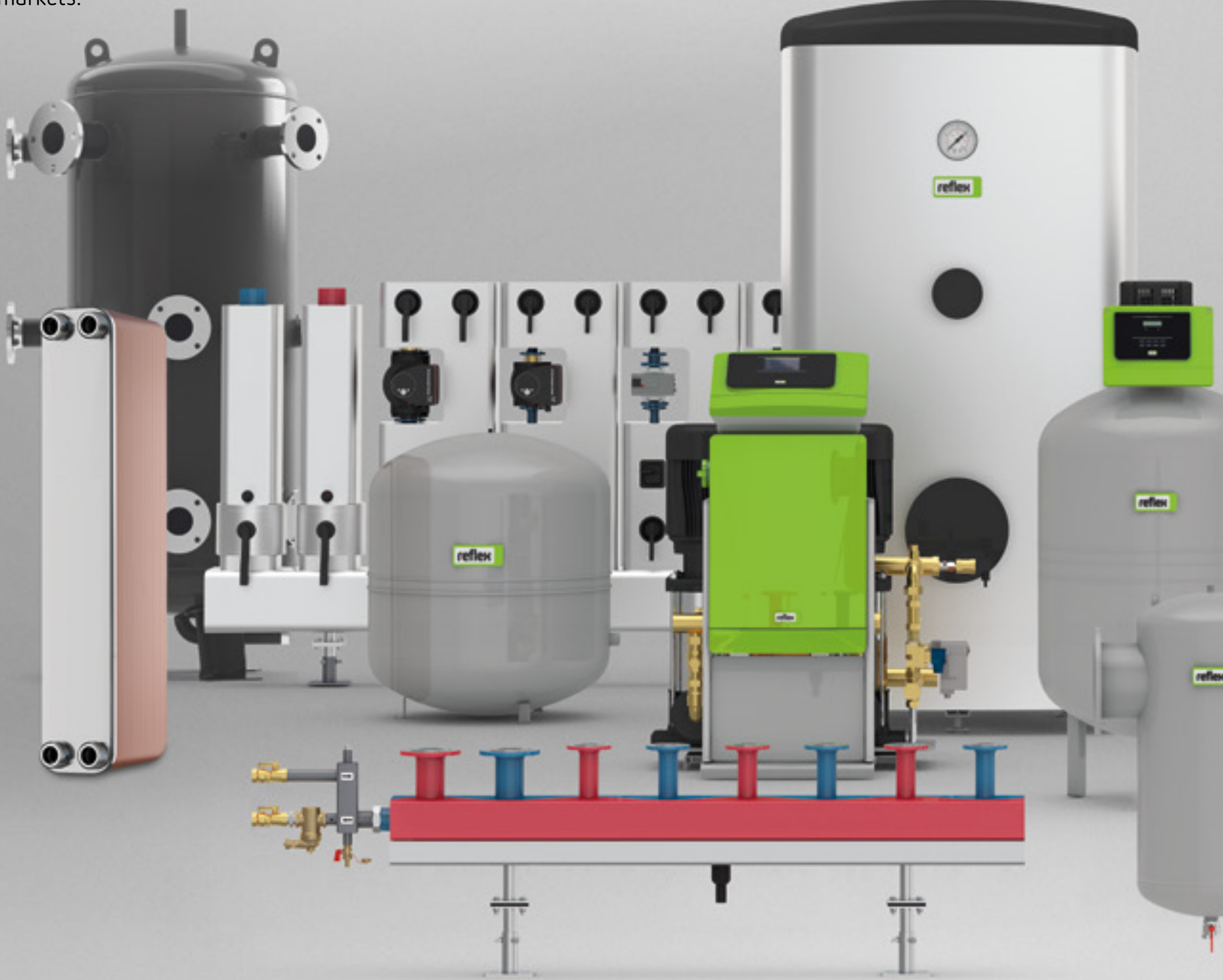
Expansion vessels

Reflex, Refix

Reflex—
a powerful brand for decades

Reflex Winkelmann GmbH—part of the Building+Industry division—is a leading provider of high-quality heating and hot water supply technology systems. Under its Reflex brand, the company, which has its headquarters in Ahlen in the German region of Westphalia, develops, produces and sells not only diaphragm expansion vessels, but also innovative components and holistic solutions for pressure maintenance, water make-up, degassing and water treatment, storage water heaters and plate heat exchangers, as well as hydraulic manifold and tank components. Reflex Winkelmann GmbH has over 2,000 employees worldwide, giving it an international presence in all major markets.

With its energy-efficient and sustainable products, the company is already doing its bit to help the environment, as evidenced by its commitment to sustainability and the climate policy goals agreed by the German Federal Government. This support is built on proven technologies and future-oriented innovations. What's more, Reflex Winkelmann GmbH works together with others as equals, always maintains its focus on the customer and offers additional services such as its own factory service centre fleet and a comprehensive range of training options.



Contents

Our configuration software

Reflex Solutions **Pro**
rsp.reflex.de/en

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Reflex City

Reliable pressure maintenance for all requirements
Living, shopping, working and producing: city-life means diversity. Supply technology requirements are as individual as the buildings themselves. Whether it's a 5 kW facility in a detached home or a safety-related cooling system in a computer centre — Reflex offers products and solutions for systems of all sizes and complexities. As shown in our Reflex City concept.

Wherever there is a need for the correct pressure, that's where you will find Reflex pressure maintenance systems. As the market leader, Reflex services many different application areas: from solar systems in homes, via direct installation in boilers, to drinking water supplies in residential complexes.

Pressure maintenance

Pressure maintenance system tasks

Correct pressure ratios are a basic precondition for correct functioning of heating, solar and cooling water systems and pressure booster systems. Like all other substances, the volume of water changes with its temperature. Unlike other liquids, water does not expand proportionately to the temperature. As water cannot be compressed, this means the pressure increases significantly in closed systems as the temperature changes.

Optimum pressure maintenance is achieved with two different pressure maintenance systems depending on the application:

- Static pressure maintenance systems (expansion vessels)
- Dynamic pressure maintenance systems

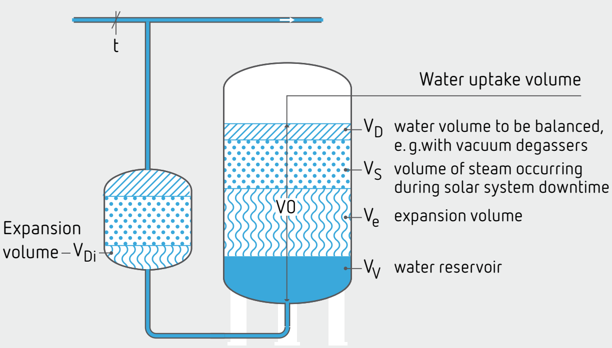
Further information can be found in the brochure: Pressurisation Systems

Essentially, pressure maintenance systems have to fulfil three fundamental tasks:

1. Maintain the pressure within permissible limits at all points in the facility system. This means ensuring the permissible operating pressure is not exceeded but also maintaining a minimum pressure to avoid negative pressures, cavitation and evaporation.
2. Compensating fluctuations in the volume of the facility water as a result of fluctuations in temperature.
3. Balancing systemic water losses using a water reservoir.

Water uptake volume of a pressure expansion vessel

Pressure maintenance is required to compensate fluctuations in volume between the maximum and the minimum system temperature and thus to maintain the pressure within a permissible range. To achieve this, there must be a sufficient water uptake volume which must correspond to the expansion volume V_e and the water reservoir V_V. If devices are installed which extract and feed back a volume of water V_D from the system during operation, such as a vacuum degasser, this must also be taken into consideration. This also applies to volumes of steam V_S which occur during downtimes in solar collectors. If the temperature of the medium drops below 0 °C or exceeds 70 °C at the connection point of the pressure maintenance in the facility system, an auxiliary vessel is to be installed in order to protect the bladder of the expansion vessel.

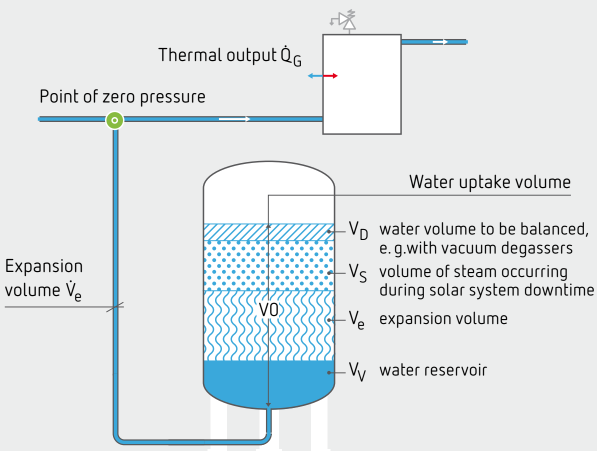


- in heating systems proportion of V_e for t > 70 °C
- in cooling systems proportion of V_e for t < 0 °C

Expansion volume flow and point of zero pressure

A balancing volume flow must be transported via the expansion line between the system and pressure maintenance such that the calculated pressures for the pressure maintenance are produced correctly at the point of zero pressure.

In closed heating, solar and cooling systems, it is assumed that the expansion volume flow $\dot{V}_e$ is the largest possible balancing volume flow. It occurs when the thermal output $\dot{Q}_G$ of heating or cooling sources is switched on or off.



Static pressure maintenance systems

Expansion vessels work as expansion or buffer vessels without electricity, a compressor or pump. Expansion vessels have to balance the volume fluctuations between the greatest and the lowest temperature. Product in the Reflex portfolio are used as expansion vessels in heating, solar and cooling water systems and products in the Refix portfolio are used to save potable water in hot water heating systems.

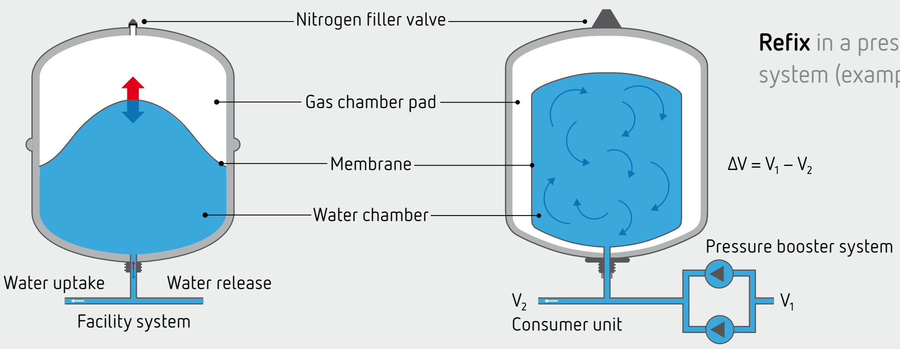
Buffer and control vessels have to provide an intermediate storage for the difference between the requested and the required volume flow. If the requirement is to reduce the switching frequency of the feed device, this is also known as a control vessel. In principle, the Refix product range is used as a buffer vessel in a pressure booster system while the Reflex range is used as a control vessel in pump-driven pressure maintenance stations.

Reflex for closed heating, solar and cooling water systems

Refix for potable and process water systems as well as special applications

Installation and function

Reflex in a heating system (example)

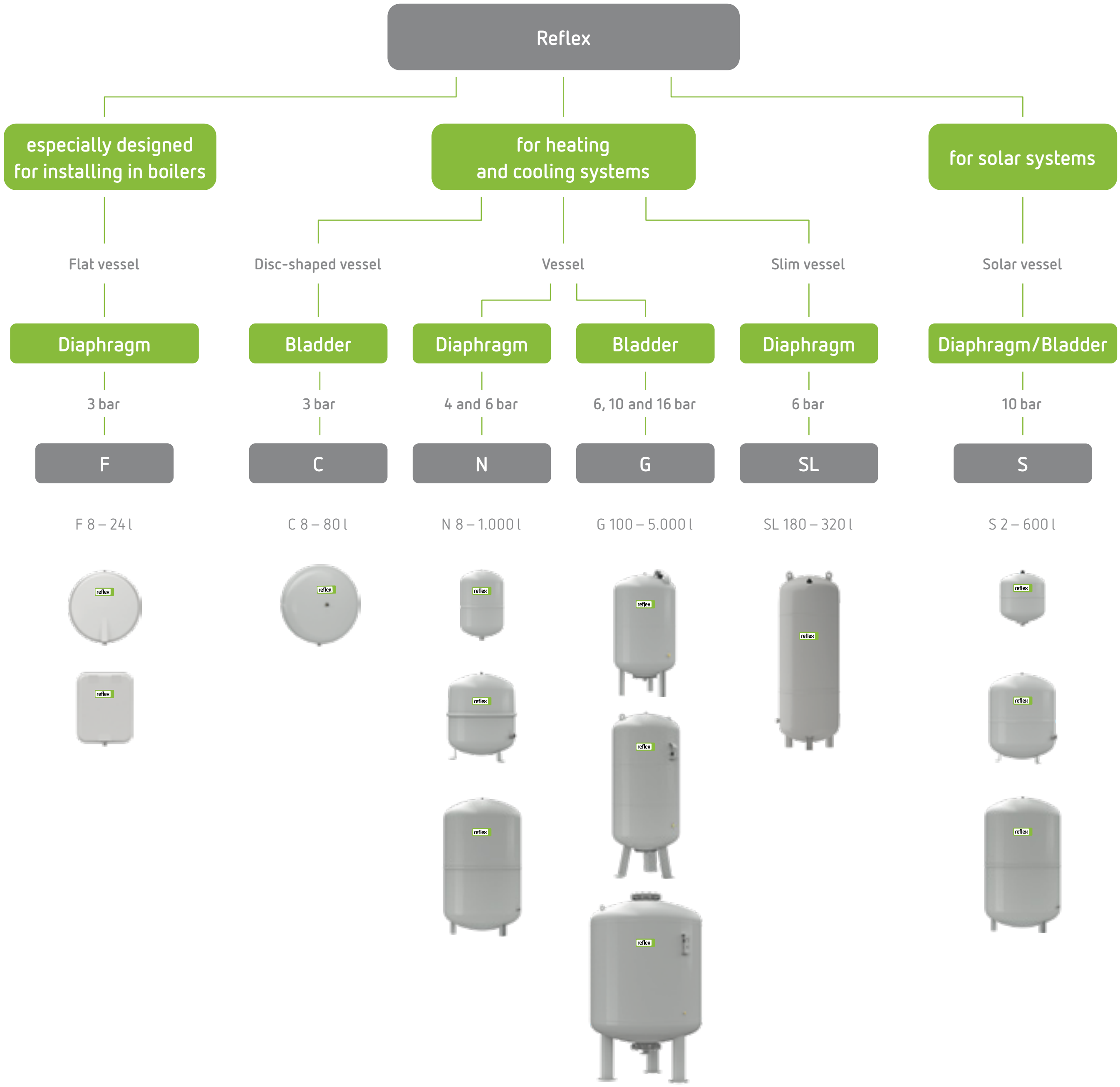


Refix in a pressure booster system (example)

The pressure pad supports the water column in the system and is adjusted accordingly before the vessel is filled with a volume of water. As the system is heated, the pressure increases resulting in the expanding water flowing from the facility system to the water chamber. The pressure pad in the gas chamber is compressed and the pressure increases. As the system cools, the volume decreases and the pressure drops: the expansion water flows out of the water chamber back into the facility system. The pressure pad in the gas changer is adjusted to just under the cut-in pressure of the feed device. When the pressure drops below the cut-in pressure, the pump switches on and feeds the water.
If the consumer units remove a lesser amount, the difference is temporarily stored in the buffer tank until the pressure pad is compressed to the cut-out pressure and the pressure booster system switches off. The resulting pressure drop leads to a reduction in volume. If the consumer units draw water, temporarily stored water is extracted from the buffer tank until the cut-in pressure occurs at the pressure pad and the pressure booster system is switched on again.

Expansion vessels

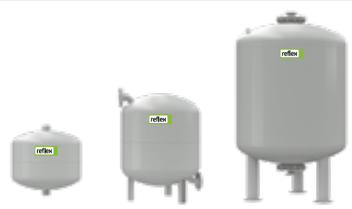
for heating, solar and cold water systems



V Auxiliary vessels

Without membrane

V 500 – 5.000 → 6 bar/110 °C
V 6 – 5.000 → 10 bar/110 °C

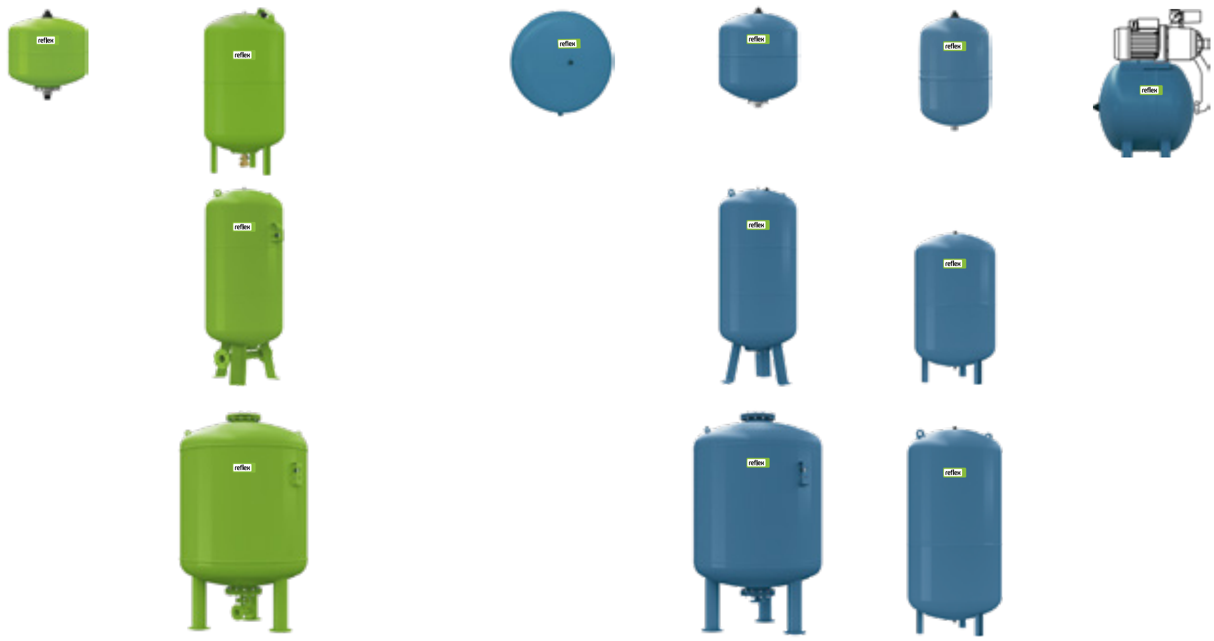


Other pressure ratings available on request

for drinking and non-drinking systems

Refix

- **for drinking water, pressure-boosting and water heating systems according to DIN 1988 norm**
  - Small vessel – Bladder – 10, 16 and 25 bar – **DD** – DD 2 – 33 l
  - Large vessel – Bladder – 10 and 16 bar – **DT** – DT 60 – 3.000 l
- **only for systems not subject to the requirements of the DIN 1988 norm***
  - Disc-shaped vessel – Bladder – 10 bar – **C-DE** – C-DE 8 – 80 l
  - Vessel – Bladder – 10, 16 and 25 bar – **DE** – DE 2 – 5.000 l
  - Vessel – Diaphragm – 10 bar – **DC** – DC 25 – 600 l
  - Vessel for domestic water systems – Bladder – 10 bar – **HW** – HW 25 – 100 l



Water shock arrestor | Diaphragm | WD** | 0,165 l/10 bar**

For example, installation directly at the draw-off point

* For example, fire extinguishing and non-drinking water systems, underfloor heating, geothermal energy.

** Not approved for drinking water.

Reflex

Key advantages

High-quality expansion vessels

- For closed heating and cooling water systems as well as solar applications and process water
- Long-lasting, wear-resistant membrane reliably maintains the pressure
- Approved in accordance with pressure equipment guidelines 2014/68/EU

Wide range of designs

- Extremely broad pressure ranges and vessel volumes
- Extremely wide range of forms, types and comprehensive range of accessories
- With diaphragm or bladder
- Many years of experience with special, customer-specific solutions

Rapid design and installation

- Intuitive design configuration software for rapid selection and calculation
- Rapid installation

Reflex G

CE

G 100 – 500 l

G 600 – 1,000 l

G 1,000 (Ø1,000) – 2,000 l

G 1,000 – 5,000 l

Technical Features

- for closed heating and cooling systems
- Upright configuration
- Connections:
  → up to 1,000 l / Ø 740 mm with threaded connections
  → From 1,000 l / Ø 1,000 mm with flange connections DN65 / PN6 or DN65 / PN16
- Replaceable bladder according to DIN EN 13831
- Max. operating temperature 70 °C
- For antifreeze additive of at least 25 – 50 %
- Approval according to Pressure Equipment Directive 2014 / 68 / EU
- The following types are equipped with a diaphragm break detector coupling:
  → 6 bar: ≥ 1,000 l / Ø 1,000 mm
  → 10 bar: ≥ 600 l
  → 16 bar
- With inspection opening (from 1,000 litres with Ø 1,000 mm)
- Pressure gauge and supply pressure valve protected by clip
- Durable epoxy resin coating
- With factory-pressurised gas chamber
- Max. permissible system temperature 120 °C

Reflex G

CE

	Type	Art. No. grey	DG	PQ [pce]	Inlet pressure [bar]	Connection c	Ø d [mm]	Height h [mm]	Height h2 [mm]	Weight [kg]
6 bar 70 °C	G 100	8519000	0021	4	3.50	G1"	480	850	145	19.20
	G 200	8519100	0021	4	3.50	G 1 ¼"	634	967	144	36.50
	G 300	8519200	0021	1	3.50	G 1 ¼"	634	1,267	144	41.60
	G 400	8521605	0021	1	3.50	G1"	740	1,276	146	43.00
	G 500	8521705	0021	1	3.50	G1"	740	1,494	146	51.00
	G 600	8522605	0021	1	3.50	G1"	740	1,739	146	66.00
	G 800	8523610	0021	1	3.50	G1"	740	2,186	149	94.00
	G 1000/740	8546605	0021	1	3.50	G1"	740	2,593	146	150.00
	G 1000/1000	8524605	0022	1	3.50	DN65/PN6	1,000	1,973	307	228.00
	G 1500	8526605	0022	1	3.50	DN65/PN6	1,200	1,971	305	280.00
	G 2000	8527605	0022	1	3.50	DN65/PN6	1,200	2,451	291	300.00
	G 3000	8544605	0022	1	3.50	DN65/PN6	1,500	2,490	334	620.00
	G 4000	8529605	0022	1	3.50	DN65/PN6	1,500	3,065	334	770.00
	G 5000	8530605	0022	1	3.50	DN65/PN6	1,500	3,598	334	849.00
10 bar 70 °C	G 100	8518000	0021	4	3.50	G1"	480	850	146	19.20
	G 200	8518100	0021	4	3.50	G 1 ¼"	634	966	144	33.40
	G 300	8518200	0021	1	3.50	G 1 ¼"	634	1,267	144	34.60
	G 400	8521005	0021	1	3.50	G 1 ¼"	740	1,275	133	52.00
	G 500	8521006	0021	1	3.50	G 1 ¼"	740	1,494	133	60.00
	G 600	8522006	0021	1	3.50	G 1 ½"	740	1,859	263	118.00
	G 800	8523005	0021	1	3.50	G 1 ½"	740	2,324	263	166.00
	G 1000/740	8546005	0021	1	3.50	G 1 ½"	740	2,804	263	190.00
	G 1000/1000	8524005	0022	1	3.50	DN65/PN16	1,000	2,001	286	335.00
	G 1500	8526005	0022	1	3.50	DN65/PN16	1,200	1,991	291	390.00
	G 2000	8527005	0022	1	3.50	DN65/PN16	1,200	2,451	291	528.50
	G 3000	8544005	0022	1	3.50	DN65/PN16	1,500	2,542	320	830.00
	G 4000	8529005	0022	1	3.50	DN65/PN16	1,500	3,117	320	1,120.00
	G 5000	8530005	0022	1	3.50	DN65/PN16	1,500	3,652	320	1,274.00
16 bar 70 °C	G 100	8518400	0021	1	3.50	DN25/PN16	480	992	231	25.00
	G 200	8518500	0021	1	3.50	DN25/PN16	634	1,088	221	57.00
	G 300	8518600	0021	1	3.50	DN25/PN16	634	1,392	221	66.00
	G 400	8510206	0021	1	3.50	DN40/PN16	740	1,373	198	118.00
	G 500	8518700	0021	1	3.50	DN40/PN16	740	1,618	197	130.00
	G 600	8522007	0021	1	3.50	DN40/PN16	740	1,871	198	158.00
	G 800	8523906	0021	1	3.50	DN40/PN16	740	2,336	198	221.00
	G 1000/740	8546906	0021	1	3.50	DN40/PN16	740	2,804	201	260.00
	G 1000/1000	8524205	0022	1	3.50	DN65/PN16	1,000	2,031	276	468.00
	G 1500	8526305	0022	1	3.50	DN65/PN16	1,200	2,021	281	650.00
	G 2000	8527100	0022	1	3.50	DN65/PN16	1,200	2,481	281	731.00
	G 3000	8544705	0022	1	3.50	DN65/PN16	1,500	2,550	310	960.00
	G 4000	8529405	0022	1	3.50	DN65/PN16	1,500	3,110	310	890.00
	G 5000	8529705	0022	1	3.50	DN65/PN16	1,500	3,645	310	1,020.00

Reflex V

CE

	Type	Art. No. grey	DG	PQ [pce]	Connection c	Ø d [mm]	Height h [mm]	Height h2 [mm]	Weight [kg]
6 bar 110 °C	V 500	8852803	0024	1	DN40/PN6	750	1,652	208	160.00
	V 750	8851801	0024	1	DN40/PN6	750	2,273	208	205.00
	V 1000	8851908	0024	1	DN65/PN6	1,000	2,020	305	310.00
	V 1500	8852306	0024	1	DN65/PN6	1,200	2,020	305	405.10
	V 2000	8852408	0024	1	DN65/PN6	1,200	2,478	305	545.00
	V 3000	8852506	0024	1	DN65/PN6	1,500	2,537	337	775.00
	V 4000	8853406	0024	1	DN65/PN6	1,500	3,112	337	1,060.00
	V 5000	8854806	0024	1	DN65/PN6	1,500	3,648	337	1,095.00
10 bar 110 °C	V 6	8303100	0024	96	R ¾"	206	244	–	4.00
	V 12	8303200	0024	56	R ¾"	280	244	–	3.30
	V 20	8303300	0024	56	R ¾"	280	360	–	3.30
	V 40	8303400	0024	20	R 1"	409	562	113	9.75
	V 60	8303500	0024	12	R 1"	409	732	172	12.40
	V 200	8303600	0024	4	DN40/PN16	634	901	142	35.25
	V 300	8303700	0024	1	DN40/PN16	634	1,201	142	48.00
	V 350	8303800	0024	1	DN40/PN16	634	1,341	142	51.00
	V 500	8854807	0024	1	DN40/PN16	750	1,652	208	290.00
	V 750	8854808	0024	1	DN40/PN16	750	2,283	197	420.00
	V 1000	8854809	0024	1	DN65/PN16	1,000	2,055	286	560.00
	V 1500	8854810	0024	1	DN65/PN16	1,200	2,045	284	636.10
	V 2000	8854811	0024	1	DN65/PN16	1,200	2,505	284	940.00
	V 3000	8854812	0024	1	DN65/PN16	1,500	2,563	313	1,405.00
	V 4000	8854813	0024	1	DN65/PN16	1,500	3,138	313	1,930.00
	V 5000	8854814	0024	1	DN65/PN16	1,500	3,674	313	2,015.00

Reflex accessories

Safe shut-offs

According to **DIN EN 12828** "the water chamber in expansion vessels must be ... able to be emptied. All expansion vessels are to be designed such that they can be shut-off from the heating system."

We recommend the following for standard systems:

- use same size Reflex cap valve as the expansion vessel for expansion vessel with R ¾ threaded connections and R 1
- for expansion vessel with flange connections the same size as the expansion line → see page 23 for range

Cap valve

- Secured shut-off for maintenance and dismanting of expansion vessels
- With drainage
- According to DIN EN 12828
- 10 bar / 120 °C

AG connection set

- For rapid assembly and maintenance of membrane expansion vessels
- Incl. secured shut-off and connecting bend with screw connection
- With drainage cock (G ½") and hose nozzle
- According to DIN EN 12828
- 10 bar / 100 °C

Wall-hung holders

Wall-hung console with multi-connections

- Wall-hung console with multiconnections for Reflex 8 – 25 litres
- With vessel connection at the top

Wall mounting bracket with clamping strap

- Console with clamping strap for Reflex 6 – 25 litres
- Upright assembly

Bladder rupture detector

- Indication of membrane rupture in vessels
- Consisting of an electrode relay and an electrode (factory fitted)
- Power supply 230 V / 50 Hz
- Floating output (changeover contact)
- Delivery only in combination with a vessel with MBM coupling

Digital pressure gauge

- Inlet pressure tester up to about 9 bar

Type	Art. No.	DG	Weight [kg]
Cap valve SU R ¾" x ¾"	7613000	0084	0.26
Cap valve SU R 1" x 1"	7613100	0084	0.57
AG connection set AG 1"	9119204	0080	0.85
AG connection set AG 1 ¼"	9119205	0080	1.00
AG connection set AG 1 ½"	9119206	0080	1.15
Wall mounting bracket with clamping strap	7611000	0075	0.22
Wall-hung console with multi-connections	7612000	0075	0.90
Bladder rupture detector MBM II	7857700	0086	0.62
Digital pressure gauge	9119198	0086	0.06

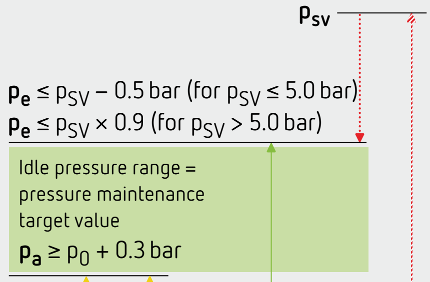
Selection and calculation

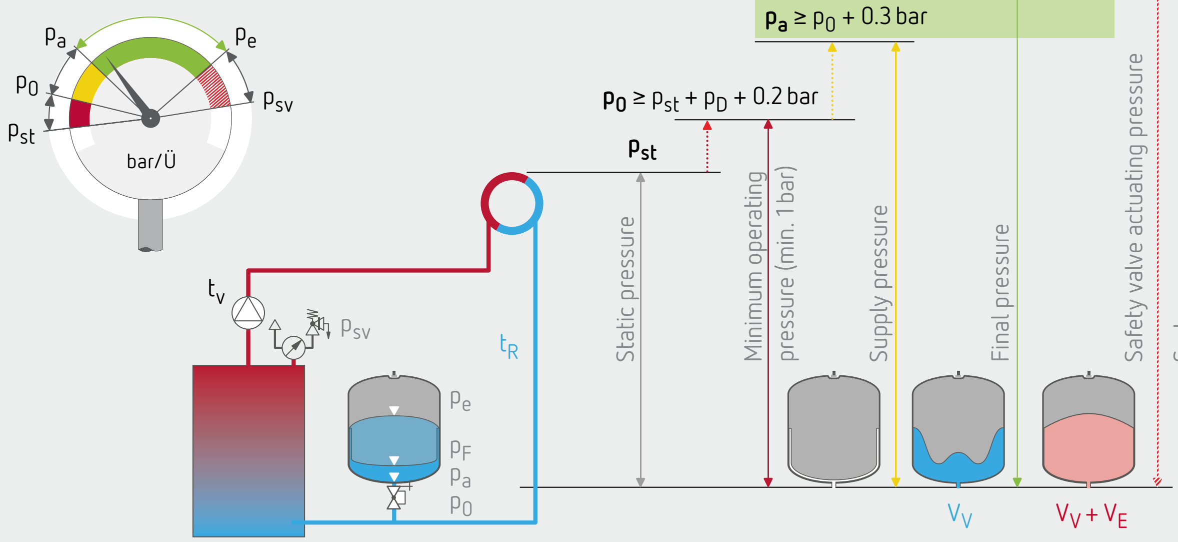
Pressures in the system

Valid for supply pressure maintenance in heating, cooling and solar thermal systems

Excess pressures

p_{st} = static pressure
p_0 = minimum operating pressure
p_a = supply pressure
p_e = final pressure
p_{SV} = safety valve actuating pressure





Calculation values

Pressures are given as excess pressures and relate to the connecting pieces for the expansion vessel up to the highest point in the system.

Reflex recommendations

- Set the safety valve operating pressure sufficiently high: $p_{SV} \geq p_0 + 1.5$ bar
- If possible, when calculating the inlet gas pressure, select an extra 0.2 bar: $p_0 \geq \frac{H\,[m]}{10} + 0.2$ bar
- Select an supply pressure of at least 1 bar on account of the necessary supply pressure for the flow-through pumps — even for rooftop infrastructure centres: $p_0 \geq 1$ bar
- Set the fill or supply pressure on the water side in vented systems in cold condition at least 0.3 bar above the supply pressure to ensure a water reservoir inthe expansion vessel ($V_V = 0.005 \times V_A$ **at least** 3 l for $V_n > 15$ l minimum volume indication according to the standard): $p_F \geq p_0 + 0.3$ bar

Quick selection table for expansion vessels

Heating Systems: 70/50 °C

Safety Valve p_{SV} [bar]	2.5			3.0				4.0			
Inlet Pressure p_0 [bar]	0.5	1.0	1.5	0.5	1.0	1.5	1.8	1.5	2.0	2.5	3.0
V_n [litres]	Contents V_A [litres]										
8	107	48	–	133	82	31	–	87	48	8	–
12	161	71	–	199	122	46	–	131	71	12	–
18	268	134	–	325	210	96	27	223	134	45	–
25	424	238	52	504	344	185	89	362	238	114	–
35	639	387	126	730	536	313	179	561	387	213	–
50	912	608	238	1,043	782	504	313	811	608	362	114
80	1,460	973	461	1,668	1,251	834	580	1,298	973	649	263
100	1,825	1,217	608	2,086	1,564	1,043	730	1,622	1,217	811	362
140	2,555	1,703	852	2,920	2,190	1,460	1,022	2,271	1,703	1,135	561
200	3,650	2,433	1,217	4,171	3,128	2,086	1,460	3,244	2,433	1,622	811
250	4,562	3,041	1,521	5,214	3,910	2,607	1,825	4,055	3,041	2,028	1,014
300	5,474	3,650	1,825	6,257	4,692	3,128	2,190	4,866	3,650	2,433	1,217
400	7,299	4,866	2,433	8,342	6,257	4,171	2,920	6,488	4,866	3,244	1,622
500	9,124	6,083	3,041	10,428	7,821	5,214	3,650	8,110	6,083	4,055	2,028
600	10,949	7,299	3,650	12,513	9,385	6,257	4,380	9,732	7,299	4,866	2,433
800	14,599	9,732	4,866	16,684	12,513	8,342	5,839	12,976	9,732	6,488	3,244
1,000	18,248	12,165	6,083	20,855	15,641	10,428	7,299	16,221	12,165	8,110	4,055

Reflex

Customised planning with our configuration software

Reflex Solutions **Pro**

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Key data

Safety valve p_{SV} = 3 bar

Static height H_{st} = 13 m

Heat generator capacity b = 40 kW

Panel radiators rated temperature T = 70/50 °C

Volume buffer storage tank V_{PH} = 1,000 l

Calculation

Water content (approximately)

Radiators:
$V_A = \dot{Q}[kW] \times 13.5\,l/kW$

Panel radiators:
$V_A = \dot{Q}[kW] \times 8.5\,l/kW$

$V_A = 40\,kW \times 8.5\,l/kW + 1{,}000\,l = 1{,}340\,l$

$$p_0 \geq \frac{H_{st}\,[m]}{10}\,bar + 0.2\,bar$$

$$p_0 \geq \frac{13}{10}\,bar + 0.2\,bar = 1.5\,bar$$

Result

From the table

with p_{SV} = 3 bar
and p_0 = 1.5 bar
V_A = 1.340 l

→ V_n **= 140 l** (for V_A max. 1,460 l)

selected

1 × **Reflex N 140,** 6 bar, → page 11

1 × **cap ball valve,** → page 20

Example calculation
for Reflex N

Heating Systems: 70/50 °C

	Safety Valve p_{SV} [bar]	5.0					6.0					
	Inlet Pressure p_0 [bar]	2.0	2.5	3.0	3.5	4.0	2.0	2.5	3.0	3.5	4.0	5.0
	V_n [litres]	Contents V_A [litres]										
Reflex	8	91	58	26	–	–	118	90	63	35	7	–
	12	136	88	39	–	–	177	136	94	52	10	–
	18	231	158	85	12	–	293	230	167	105	42	–
	25	373	272	170	69	–	459	372	285	197	110	–
	35	576	434	292	150	8	679	574	452	330	208	–
	50	829	664	475	272	69	969	827	684	529	354	6
	80	1,327	1,062	796	515	191	1,551	1,323	1,095	867	639	89
	100	1,659	1,327	995	664	272	1,939	1,654	1,369	1,083	798	145
	140	2,322	1,858	1,393	929	434	2,714	2,315	1,916	1,517	1,118	257
	200	3,318	2,654	1,991	1,327	664	3,878	3,307	2,737	2,167	1,597	424
	250	4,147	3,318	2,488	1,659	829	4,847	4,134	3,422	2,709	1,996	564
	300	4,977	3,981	2,986	1,991	995	5,817	4,961	4,106	3,250	2,395	684
	400	6,636	5,309	3,981	2,654	1,327	7,755	6,615	5,474	4,334	3,193	912
	500	8,295	6,636	4,977	3,318	1,659	9,694	8,269	6,843	5,417	3,992	1,141
	600	9,954	7,963	5,972	3,981	1,991	11,633	9,922	8,212	6,501	4,790	1,369
	800	13,271	10,617	7,963	5,309	2,654	15,511	13,230	10,949	8,668	6,387	1,825
	1,000	16,589	13,271	9,954	6,636	3,318	19,389	16,537	13,686	10,835	7,984	2,281

Selecting expansion lines

Expansion lines are to be sized and installed in accordance with local provisions. DIN EN 12828 requires that, each heat generator is connected to at least one expansion line with one or more expansion vessels. It is essential to ensure frost-free conditions.

Expansion lines	DN 25 1"	DN 32 1¼"	DN 40 1½"	DN 50 2"	DN 65	DN 80	DN 100
$\dot{Q}$ / kW Lengths ≤ 10 m	2,100	3,600	4,800	7,500	14,000	19,000	29,000
$\dot{Q}$ / kW Lengths > 10 m ≤ 30 m	1,400	2,500	3,200	5,000	9,500	13,000	20,000

If the length of the expansion line is **> 10 m,** we recommend selecting the nominal diameter one dimension larger.

Comprehensive calculation and design notes

Before selecting the products, first collate the most important system data for temperature, pressure and water content and calculate the parameters for selecting the products from this information.

Water volume	V_A
Heat output	$\dot{Q}_{ges}$
Expansion volume flow	$\dot{V}_e$
Water uptake volume	V_0
Safety valve actuating pressure	p_{SV}
Minimum operating pressure	p_0
Final pressure	p_E

- The necessary basic data are preferable to be taken from the design documents / manufacturer's data. If these are not available, the data must be collected on site or estimated. Proxy values for calculating and estimating the water volumes are given in the tables. The extreme requirements of industrial heat supply and district heat supply can be accommodated thanks to the Variomat Giga.

Proxy values for calculation

Coefficient of expansion n for anti-freeze additives* z

z	t_{max} °C	30	40	50	60	70	80	90	100	105	110	120	130	140	150
0 %	n %	0.37	0.72	1.15	1.66	2.24	2.88	3.58	4.34	4.74	5.15	6.03	6.96	7.96	9.03
34 %		1.49	1.99	2.53	3.11	3.71	4.35	5.01	5.68	-	6.39	7.11	7.85	8.62	9.41

* Values apply for Antifrogen N. We recommend a concentration of 25 to 50 %. Lower doses lead to a risk of corrosion!

Evaporation pressure** p_D for anti-freeze additives* z

z	t_{max} °C	30	40	50	60	70	80	90	100	105	110	120	130	140	150
0 %	p_D bar	−0.96	−0.93	−0.88	−0.80	−0.69	−0.53	−0.3	0.01	0.21	0.43	0.98	1.7	2.61	3.76
34 %				−0.90	−0.80	−0.70	−0.60	−0.40	−0.10	–	0.23	0.70	1.33	2.13	3.15

* Values apply for Antifrogen N. We recommend a concentration of 25 to 50 %. Lower doses lead to a risk of corrosion!

** p_D with respect to ±0 m NN, we recommend an additional 0.1 bar for each 1 km height.

Standard values for sizing expansion lines, make-up pipes and lines to control vessel

DN		20	25	32	40	50	65	80	100
$\dot{V}$ l/h	1	630	1,040	1,830	2,410	3,700	6,960	9,450	14,130
	2	2,500	4,150	7,300	9,600	14,800	27,800	37,800	56,500

$\dot{V}$ permissible volume flow:
1 up to a maximum line length of 30 m
2 for a line length up to 1 m and to reductions, e. g. to vessel connections.
Not permissible for pressure controlled devices between pressure sensors and systems

When using anti-freeze, we recommend remaining within 25 – 50 % glycol in order to minimise the risk of corrosion.

Estimating the volume of water in heat generators

The volume of water V_W is calculated from the volume of water v_W and the nominal performance of the heat generator $\dot{Q}_W$ or from the installed collector area in solar panels A_G.

Conventional heat generators	v_W l/kW	
Cast iron boiler with atmospheric burner	1.10	$V_W = v_W \times \dot{Q}_W$
Cast iron boiler with forced-air burner	1.40	
Steel boiler with forced-air burner	1.80	
Solid fuel boiler	2.00	
Wall-mounted condensing boiler	0.15	
Heat exchanger	0.60	
CHP	0.60	
Heat pump	0.60	
Solar panels	**v_K l/m²**	
Flat panel	2.0	$V_K = v_K \times A_G$
Direct vacuum tube	1.0	
Heat-pipe vacuum tube	3.0	

Estimating the volume of water in heat surfaces and distribution lines

The volume of water V_A is determined from the specific volume of water v_A and the installed output of the heat consumer unit $\dot{Q}_{ges}$. It includes the water content of the heating surfaces, the distribution pipes and the pipelines in the central heating system. Pipelines between the central heating plant and the heating system should be considered separately.

Types of heating surface	$t_{max\,C}$ | t_R °C	90 | 70	70 | 55	70 | 50	55 | 45	45 | 35	35 | 30	
Elements	v_A l/kW	11.5	17.6	18.1	27.7	44.6	83.3	$V_A = v_A \times \dot{Q}_{ges.}$
Pipes		15	23.2	24.1	36.3	59.3	111.5	
Plates		6.5	9.6	9.4	14.9	21.9	41.0	
Convectors		4	5.9	5.4	9.4	13.4	27.1	
Ventilation		3.3	4.7	4.1	7.4	9.8	19.7	
Underfloor heating system		–	–	–	–	21.1	35.6	

Volume of vacuum spray pipe degasser V_D ,which has to be absorbed by pressure maintenance

Degassing	V_D l
Servitec 25…30	1
Servitec 35…120	6
Special Servitec …–2…4	35
Special Servitec …–6…8	70

Specific volume of water V_P in pipelines

The volume of water V_P is determined from the specific volume of water v_P and the length of the installed pipeline L.

Example for steel pipelines

DN	25	32	40	50	60	65	80	100	125	150	200
v_P l/m	0.58	1.01	1.34	2.1	3.2	3.9	5.3	7.9	12.3	17.1	34.2

Example for plastic pipelines (PE_X pipes)

Model	20 × 2	25 × 2.3	32 × 2.9	40 × 3.7	50 × 4.6	63 × 5.8	75 × 6.8	90 × 8.2	110 × 10
d_i in mm	16	20	26	33	41	51	61	74	90
v_P l/m	0.20	0.33	0.54	0.83	1.31	2.07	2.96	4.25	6.36

Expansion vessels in heating systems

Calculation
To DIN 4807 T2 and DIN EN 12828.

Circuit
Usually maintaining suction pressure (→ see sketch page 30) with upstream flow-through pump and expansion vessel in the return flow, i.e. on the suction side after the flow-through pump.

Material values n, p_D
Generally material values for pure water without anti-freeze.

Expansion volume V_e, maximum temperature t_{TR}
Determine the percentage expansion generally between the minimum temperature = fill temperature = 10 °C and the maxi-mumnominal value setting for the temperature controller t_{TR}.

Minimum operating pressure p_0
Particularly in the case of low-rise buildings and roof-mounted systems, the minimum supply pressure for the flow-through pump is to be taken from the manufacturer's specifications due to the low static pressure p_{st}. We also recommend a minimum operating pressure p_0 of no less than 1 bar is selected for lower static heads.

Note: Take care with low-rise buildings and roof-mounted systems Reflex recommendation: $p_0 \geq 1$ bar

Filling pressure p_F, supply pressure p_a
As the the filling temperature of 10 °C is generally the lowest system temperature, the filling pressure = the supply pressure for the expansion vessel. In pressure maintenance stations, it should be noted that the filling and make-up devices may have to run against the final pressure in some circumstances. This is only the case with Reflexomat.

Use Refix for systems where corrosion is a potential risk!
In systems with oxygen-rich water (e.g. geothermal systems or underfloor heating without any impermeable pipes), Refix D, Refix DE or Refix C is used up to 70 °C as all water-bearing parts are corrosion protected.

In order to achieve permanently safe automatic operation in cooling water systems, it is advisable to fit the pressure maintenance devices with make-up systems and to supplement this with Servitec degassing systems. This is particularly important in cooling water systems as there must be no thermal deaeration effects.

Pressure maintenance
Static pressure maintenance with Reflex N, F, S, G also in combination with make-up and degassing systems or as Variomat pressure maintenance station for pressure maintenance, degassing and make-up or as Reflexomat compressor controlled pressure maintenance station.

Degassing, venting, make-up
In order to achieve permanently safe automatic operation of the heating system, it is advisable to fit the pressure maintenance devices with make-up systems and to supplement this with Servitec degassing systems.

Auxiliary vessel
If a temperature of 70 °C is permanently exceeded at the pressure maintenance, an auxiliary vessel must be installed in order to protect the bladders.

Individual protection
According to DIN EN 12828, each heat generator must be connected to at least one expansion vessel. Only secured shut-offs (against unintentional closure) are permitted. If a heat generator is hydraulically blocked (e.g. sequential switching of the boiler), the connection to an expansion vessel must still be guaranteed. In systems with more than one boiler, each boiler is therefore usually secured with its own expansion vessel. This is only calculated for the respective boiler water content.

Due to the good degassing performance of Variomat pressure maintenance stations, we recommend to install an expansion vessel (e.g. Reflex N) is installed at the heat generator in order to minimise the switching frequency, even on single boiler systems.

Expansion vessel calculation in heating systems

Circuit: Maintaining supply pressure, expansion vessel in the return flow, upstream flow-through pump, follow-up pressure maintenance.

Initial data			see manufacturer's specifications/proxy values for calculation	
Heat generator ... heat output ... volume of water	 $\dot{Q}_W$ V_W	 [kw] [l]	Total for all heat generators	$\dot{Q}_{ges}$ = ... kw
Design ... inlet temperature ... return flow temperature Volume of water	 t_V t_R V_A	 [°C] [°C] [l]	At t_R > 70 °C install auxiliary vessel!	V_A = ... Litres
Maximum target value setting Temperature controller Anti-freeze additive	 t_{TR}	 [°C] [%]	Percentage expansion n (with anti-freeze additive n*)	n = ... %
Safety temperature limiter	t_{STB}	[°C]	Evaporation pressure p_D at > 100 °C (with anti-freeze additive p_D*)	p_D = ... bar
Static pressure	p_{st}	[bar]		p_{st} = ... bar
Pressure calculation				
Supply pressure	p_0	[bar]	$p_0 = p_{st} + p_D + 0.2$ bar (safety factor) Reflex recommendation: **$p_0 \geq 1.0$ bar** Req. Check supply pressure for flow-through pump (NPSH value) from manufacturer's specifications and maintenance of permissible operating pressure.	p_0 = ... bar
Safety valve actuating pressure	 p_{SV}	 [bar]	Reflex recommendation: for $p_{SV} \leq 5$ bar: **$p_{SV} \geq p_0 + 1.5$ bar** for $p_{SV} > 5$ bar: **$p_{SV} \geq p_0 + 2.0$ bar**	p_{SV} = ... bar
Final pressure	p_e	[bar]	$p_e \leq p_{SV}$ – final pressure differential for $p_{SV} \leq 5$ bar: $p_e \leq p_{SV} - 0.5$ bar for $p_{SV} > 5$ bar: $p_e \leq p_{SV} - 0.1 \times p_{SV}$	p_e = ... bar
Expansion vessel				
Expansion volume	V_e	[l]	$V_e = \frac{n}{100} \times V_A$	V_e = ... litres
Water reservoir	V_V	[l]	$V_V = 0.005 \times V_A$ **at least 3 l** for $V_n > 15$ l minimum water seal volume to standard	V_V = ... litres
Nominal volume	V_n	[l]	for $V_n > 15$ l: $V_n = (V_e + V_V + V_D{}^*) \times \frac{p_e + 1}{p_e - p_0}$ for $V_n \leq 15$ l: Water reservoir $V_V \geq 0.2 \times V_n$ $V_n = (V_e + V_V + V_D{}^*) \times \frac{p_e + 1}{p_e - p_0}$ **Note:** The pressure factor is used for simplified calculation of the nominal volume, which is larger than the water reservoir + expansion volume by the pressure factor.	V_n = ... litres
Control supply pressure	p_a	[bar]	$p_a = \dfrac{p_e + 1}{1 + \dfrac{(V_e + V_D{}^*)(p_e + 1)(n + n_R)}{V_n (p_0 + 1)\, 2n}} - 1$ bar **Precondition: $p_a \geq p_0 + 0.25...0.3$ bar, otherwise calculate for larger nominal volume**	p_a = ... bar
Result				
Reflex ... / ... bar ...litres			**p_0 = ... bar** Check before commissioning!	
			p_a = ... bar Check make-up setting!	
			p_e = ... bar	

* Only applies when using Reflex Servitec in accordance with the 'Degassing' table → see page 25

Expansion vessels in cooling water systems

The calculation is carried out in accordance with DIN EN 12828 and DIN 4807 part 2.

Material values n*

Anti-freeze additives (recommendation: 25 – 50 % concentration), depending on the lowest temperature of the system,must be taken into consideration when determining the percentage expansion n* according to the manufacturer's specifications.

Expansion volume V_e

Determination of the percentage expansion n* generally between the lowest system temperature (e.g. downtime during winter – 20 °C) and the highest system temperature (e.g. downtime during summer +40 °C).

Minimum operating pressure (supply pressure) p_0

As temperatures do not exceed 100 °C, special factors are not required.

Filling pressure p_F, supply pressure p_a

The lowest system temperature is frequently less than the filling temperature which means the filling pressure is greater than the supply pressure.

Pressure maintenance

Generally used for static pressure maintenance with Reflex, also in combination with Control and Servitec make-up and degassing stations.

In order to achieve permanently safe automatic operation in cooling water systems, it is advisable to fit the pressure maintenance devices with make-up systems and to supplement this with Servitec degassing systems. This is particularly important in cooling water systems as there must be no thermal deaeration effects.

Degassing, venting, make-up

In order to achieve permanently safe automatic operation in cooling water systems, it is advisable to fit the pressure maintenance devices with make-up systems and to supplement this with Servitec vacuum spray pipe degassing systems. This is particularly important in cooling water systems as there must be no thermal deaeration effects.

Auxiliary vessels

The Reflex bladders are suitable for temperatures as low as – 20 °C and the vessels to – 10 °C however, this does not mean the bladder will not ‘freeze up’ in the vessel. We therefore recommend an auxiliary vessel is installed in the return flow to the chiller at temperatures ≤ 0 °C.

Individual protection

As with heating systems, we recommend individual protection if there is more than one chiller.

Expansion vessel calculation in cooling water systems

Circuit: Maintaining supply pressure, expansion vessel on the suction side, flow-through pump, with follow-up pressure maintenance.

Initial data			see manufacturer's specifications/proxy values for calculation	
Return flow temperature	t_R	[°C]	To the chiller; at $t_R > 70$ °C install auxiliary vessel!	
Inlet temperature	t_V	[°C]	From the chiller	
Minimum system temp.	t_{Smin}	[l]	e.g. downtime during winter	
Maximum system temp.	t_{Smin}	[l]	e.g. downtime during summer	
Anti-freeze additive		[%]	Percentage expansion with anti-freeze additive n*	**n* = ...%**
Percentage expansion		[%]	Between minimum temperature (−20 °C) and filling temperature (usually 10 °C)	**n*F = ...%**
Static pressure	p_{st}	[bar]		**p_{st} = ... bar**
Pressure calculation				
Supply pressure	p_0	[bar]	$p_0 = p_{st} + 0.2$ bar (safety factor) Reflex recommendation: **$p_0 \geq 1.0$ bar** Check permissible operating pressure is maintained.	**p_0 = ... bar**
Safety valve actuating pressure	p_{SV}	[bar]	Reflex recommendation: for $p_{SV} \leq 5$ bar: **$p_{SV} \geq p_0 + 1.5$ bar** for $p_{SV} > 5$ bar: **$p_{SV} \geq p_0 + 2.0$ bar**	**p_{SV}= ... bar**
Final pressure	p_e	[bar]	$p_e \leq p_{SV}$ − final pressure differential to TRD 721 for $p_{SV} \leq 5$ bar: $p_e \leq p_{SV} - 0.5$ bar for $p_{SV} > 5$ bar: $p_e \leq p_{SV} - 0.1 \times p_{SV}$	**p_e =... bar**
Expansion vessel				
System volume	V_A	[l]	V_A = chiller + cooling coil + pipelines + buffer storage + other	**V_A = ... litres**
Water reservoir	V_V	[l]	$V_V = 0.005 \times V_A$ **at least 3 l** for $V_n > 15$ l minimum water seal volume to standard	**V_V = ... litres**
Nominal volume	V_n	[l]	for $V_n > 15$ l: $V_n = (V_e + V_V + V_D{}^*) \times \frac{p_e + 1}{p_e - p_0}$ for $V_n \leq 15$ l: Water reservoir $V_V \geq 0.2 \times V_n$ $V_n = (V_e + V_V + V_D{}^*) \times \frac{p_e + 1}{p_e - p_0}$	**V_n = ... litres**
Control supply pressure	p_a	[bar]	$p_a = \dfrac{p_e + 1}{1 + \dfrac{(V_e + V_D{}^*)(p_e + 1)}{V_n (p_0 + 1)}} - 1$ bar **Precondition: $p_a \geq p_0 + 0.25...0.3$ bar, otherwise calculate for larger nominal volume**	**p_a = ... bar**
Result				
Reflex ... / ... bar ...litres			**p_0 = ... bar** Check before commissioning!	
			p_a = ... bar Check make-up setting!	
			p_F = ... bar Refill the system!	
			p_e =... bar	

* Only applies when using Reflex Servitec in accordance with the 'Degassing' table see page 25

Expansion vessels in solar systems

The calculation is carried out in accordance with VDI 6002 and DIN 4807 part 2.

Solar systems have a peculiarity in that the maximum temperature cannot be defined by the controller on the heat generator but is determined by the downtime temperature on the panel.

Nominal volume calculation without evaporation in the panel

The percentage expansion n* and the evaporation pressure p_D* are related to the downtime temperature. As a temperature of over 200 °C can be reached on certain panels, this calculation procedure is no longer valid at this point. Some indirectly heated pipe panels (system heat pipe) systems have a limit on the downtime temperature. If a minimum operating pressure of $p_0 \leq$ 4 bar is sufficient to avoid evaporation, the calculation can usually be completed with evaporation. In this variant, it should be noted that increased temperature loading reduces the anti-freeze effect of the heat transfer medium in the long term.

Nominal volume calculation with evaporation in the panel

Evaporation cannot be excluded in panels with downtime temperatures over 200 °C. The evaporation pressure is only taken into consideration up to the required evaporation point (110 – 120 °C). In this instance, the total panel volume V_K is taken into consideration in addition to the expansion volume V_e and the water reservoir V_V when determining the nominal volume of the expansion vessel. This variant is preferred as the lower temperature places less strain on the heat transfer medium and the frost protection effect has a longer duration.

Material values n*, p_D*

Anti-freeze additives of up to 40 % are to be taken into consideration when establishing the percentage expansion n* and the evaporation pressure p_D* in accordance with manufacturers' specifications. If evaporation is included in the calculation, the evaporation pressure p_D* is taken into account up to the boiling point of 110 °C or 120 °C. The percentage expansion n* is then determined between the lowest external temperature (e. g. −20 °C) and the boiling temperature. If evaporation is not included in the calculation, the evaporation pressure p_D* and the percentage expansion n* are dependent on the downtime temperature of the panel.

Supply pressure p_0, minimum operating pressure

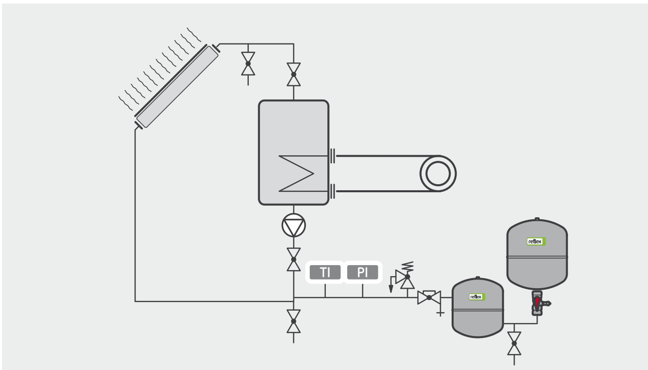
Depending on the calculation method, the minimum operating pressure (= supply pressure) is adjusted to the downtime temperature in the panel (= without evaporation) or the boiling temperature (= with evaporation). In both cases, the usual circuit for the circulating pump Δp_P stated above is to be taken into consideration as the expansion vessel is connected downstream of the flow-through pump on the pressure side (follow-up pressure maintenance).

Filling pressure p_F, supply pressure p_a

The filling temperature (10 °C) is usually well above the minimum system temperature which means the filling pressure is greater than the supply pressure.

Auxiliary vessels

If a stable return flow temperature of ≤ 70 °C cannot be guaranteed on the consumer side, an auxiliary vessel is to be installed on the expansion vessel.



Expansion vessel calculation in solar systems

Circuit: follow-up pressure maintenance, expansion vessel in the return flow to the panel.

Initial data			see manufacturer's specifications/proxy values for calculation	
Panels Volume of water	V_K	[l]	Total of all panels	V_{Kges} = … litres
Maximum inlet temp. Minimum external temp. Anti-freeze additive	t_V t_a	[°C] [°C] [%]	(110 °C or 120 °C for solar systems with evaporation) -20 °C Percentage expansion with anti-freeze additive n* and evaporation pressure with anti-freeze additive p_D*	n* = … % p_D* = … bar
Percentage expansion		[%]	Between minimum temperature (−20 °C) and filling temperature (usually 10 °C)	n*F = … %
Static pressure	p_{st}	[bar]		p_{st} = … bar
Differential at the flow-through pump	Δp_P	[bar]	Evaporation pressure p_D at > 100 °C (For anti-freeze additive p_D*) Req. Check supply pressure forflow-through pumps according to manufacturers' specifications.	Δp_P = … bar
Pressure calculation				
Supply pressure	p_0	[bar]	$p_0 = p_{st} + \Delta p_D + p_D^*$ Check permissible operating pressure is maintained.	p_0 = … bar
Safety valve actuating pressure	p_{SV}	[bar]	Reflex recommendation: for $p_{SV} \le 5$ bar: **$p_{SV} \ge p_0$ + 1.5 bar** for $p_{SV} > 5$ bar: **$p_{SV} \ge p_0$ + 2.0 bar**	p_{SV} = … bar
Final pressure	p_e	[bar]	$p_e \le p_{SV}$ − final pressure differential to TRD 721 for $p_{SV} \le 5$ bar: $p_e \le p_{SV} - 0.5$ bar for $p_{SV} > 5$ bar: $p_e \le p_{SV} - 0.1 \times p_{SV}$	p_e = … bar
Expansion vessel				
System volume	V_A	[l]	V_A = cooling coil + pipelines + buffer storage + other	V_A = … litres
Expansion volume	V_e	[l]	$V_e = \quad \times V_A$	V_e = … litres
Water reservoir	V_V	[l]	$V_V = 0.005 \times V_A$ **at least 3 l** for $V_n > 15$ l minimum water seal volume to standard	V_V = … litres
Nominal volume	V_n	[l]	for $V_n > 15$ l: $V_n = (V_e + V_V + V_{Kges}^*) \times \frac{p_e + 1}{p_e - p_0}$ for $V_n \le 15$ l: Water reservoir $V_V \ge 0.2 \times V_n$ $V_n = (V_e + V_V + V_{Kges}^*) \times \frac{p_e + 1}{p_e - p_0}$	V_n = … litres
Control Supply pressure	p_a	[bar]	$p_a = \dfrac{p_e + 1}{1 + \dfrac{(V_e + V_{Kges}^*)(p_e + 1)}{V_n (p_0 + 1)\, 2n}} - 1$ bar Precondition: $p_a \ge p_0 + 0.25 \ldots 0.3$ bar, otherwise calculate for larger nominal volume	p_a = … bar
Filling pressure	p_F	[bar]	$p_F = V_n \times \quad - 1$ bar	p_F = … bar
Result				
Reflex S / … bar … litres			**p_0 = … bar** Check before commissioning!	
			p_a = … bar Check make-up setting!	
			p_F = … bar Refill the system!	
			p_e =… bar	

* Only applies when using Reflex Servitec in accordance with the 'Degassing' table → see page 25

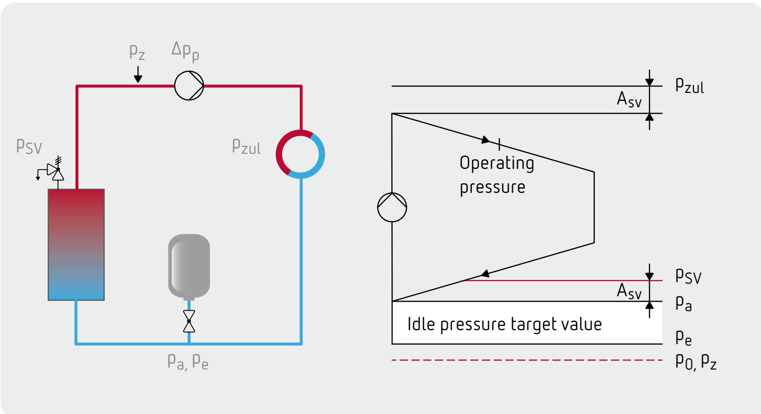
Installation and commissioning

Hydraulic integration

- Integration should preferably be on the suction side of the flow-through pump and in the return flow to the boiler, solar panel or chiller
- At return temperatures of > 70 °C a V auxiliary vessel is required, at return temperatures of < 0 °C, it is recommended.
- Provide a secured shut-off with drain to DIN EN 12828 (applies to all hydraulic systems) for maintenance work (order separately). In larger systems, it is also possible to arrange the drain and shut-off separately.
- Expansion lines are to be sized and installed in accordance with local provisions. DIN EN 12828 requires that each heat generator is connected to at least one expansion line with one or more expansion vessels. It is essential to ensure frost-free conditions.
- Make-up pipes are to be integrated into the flow-through facility water, not into the expansion line.

⚠ The relevant assembly and operating instructions are to be taken into consideration when installing and commissioning.

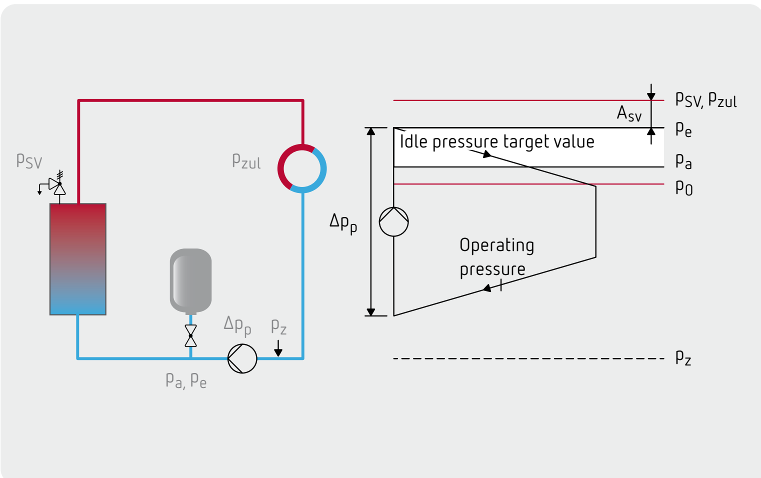
Supply pressure maintenance (suction pressure maintenance)



The pressure maintenance is integrated **upstream** of the flow-through pump, i.e. on the suction side. This method is used almost exclusively because it is the easiest to control.

- **Benefits**:
  + low idle pressure level
  + working pressure → idle pressure, therefore no risk of vacuum formation
- **Disadvantages:**
  – at high flow-through pump pressure (large systems) with high working pressure, observe the network load p_{zul}

Follow-up pressure maintenance



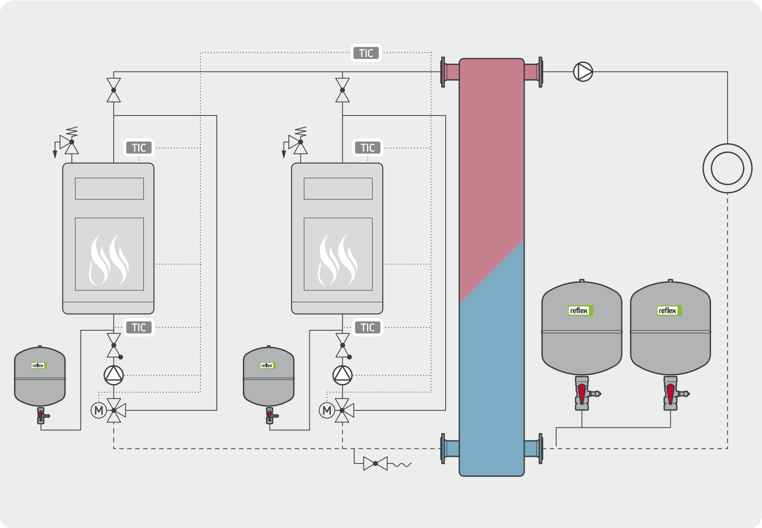
Pressure maintenance is integrated **downstream** of the flow-through pump, i.e. on the pressure side. When determining the idle pressure, a facility-specific differential pressure component for the flow-through pump (50 ... 100 %) must be included in the calculation. For use in only a limited number of cases → solar systems.

- **Benefits**:
  + low idle pressure level providing the entire pump pressure does not have to be loaded
- **Disadvantages:**
  – high idle pressure
  – greater attention to maintaining the required supply pressure p_Z in accordance with manufacturers' specifications

Integrating multi-boiler systems

It is possible to have either individual protection for each boiler with an expansion vessel or overall boiler and system protection. Care should be taken to ensure the relevant boiler remains connected to at least one expansion vessel when shutting off the boiler's sequential switching. Always agree the best switching sequence with the boiler manufacturer. The system pressure and the medium characteristics (glycol component) must be the same in both circuits.

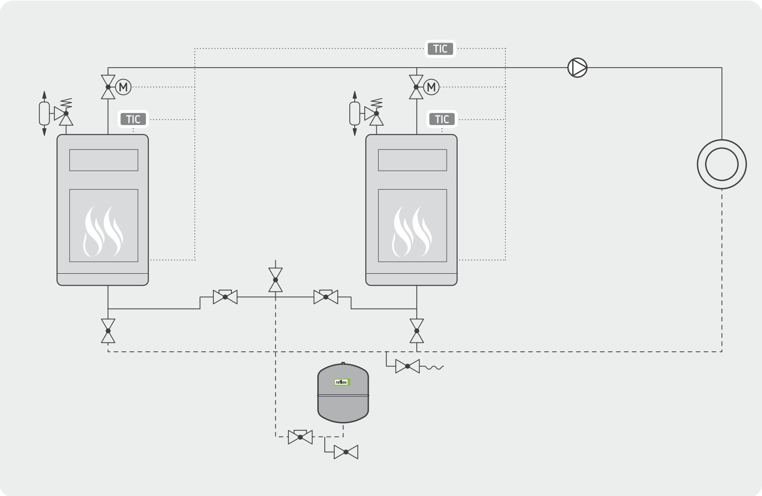
Reflex N serial circuit in a multi-boiler system with individual protection



The serial circuit of several Reflex N 6 or 10 bar vessels generally produces economical alternatives to Reflex G large vessels.

With the burner, the corresponding boiler circuit pump is switched off via the temperature control TIC and the motor valve Ⓜ is closed. The boiler remains connected to its Reflex vessel. The most frequent switching occurs with boilers with minimum return temperature. Switching the burner off reliably prevents circulation via the boiler.

Reflex in a multi-boiler system with common boiler and system protection

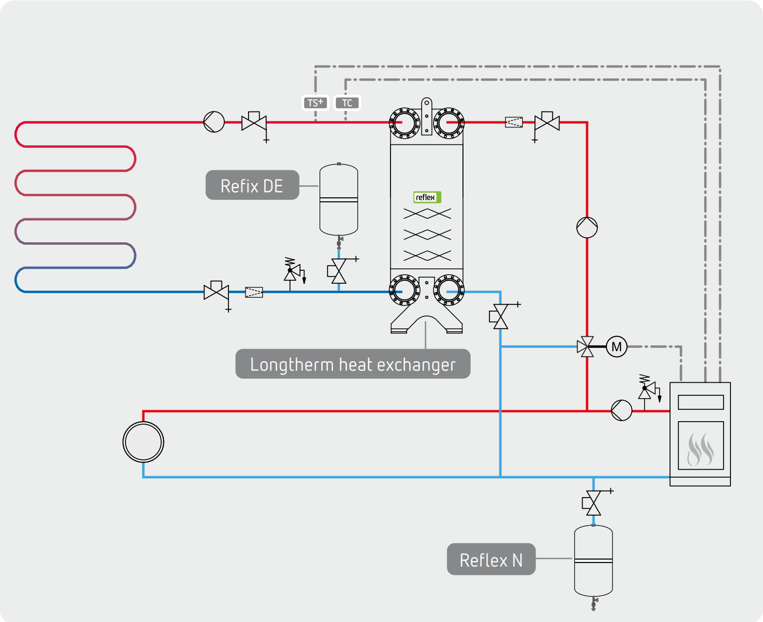


When the burner is switched off, the final control element Ⓜ is closed by the temperature controller TIC preventing incorrect circulation via the shut-off boiler. Joining the boiler expansion line above the centre of the boiler prevents gravity circulation. Preferred inset in systems without minimum boiler return flow temperature (e.g. condensing boiler systems).

The diagrams serve only as illustrations of the connections.
They are to be amended to local conditions and to be made more specific.

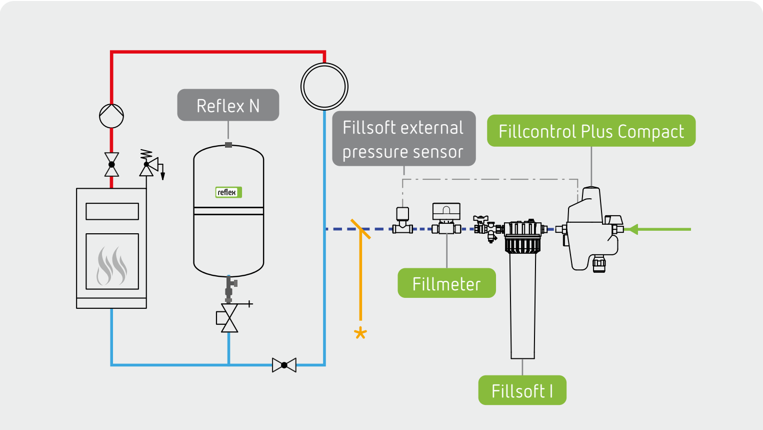
Systems with pipework at risk of corrosion

Underfloor heating without any impermeable pipes



- In systems with oxygen-rich water such as underfloor heating without any impermeable pipes, we recommend the systems are separated (separate the boiler heating circuit medium from the oxygenrich underfloor heating circuit medium) using a Longtherm heat exchanger.
- A Refix expansion vessel is used in underfloor heating circuits due to the risk of corrosion (corrosion protection for all water-bearing parts).

Maintaining VDI 2035



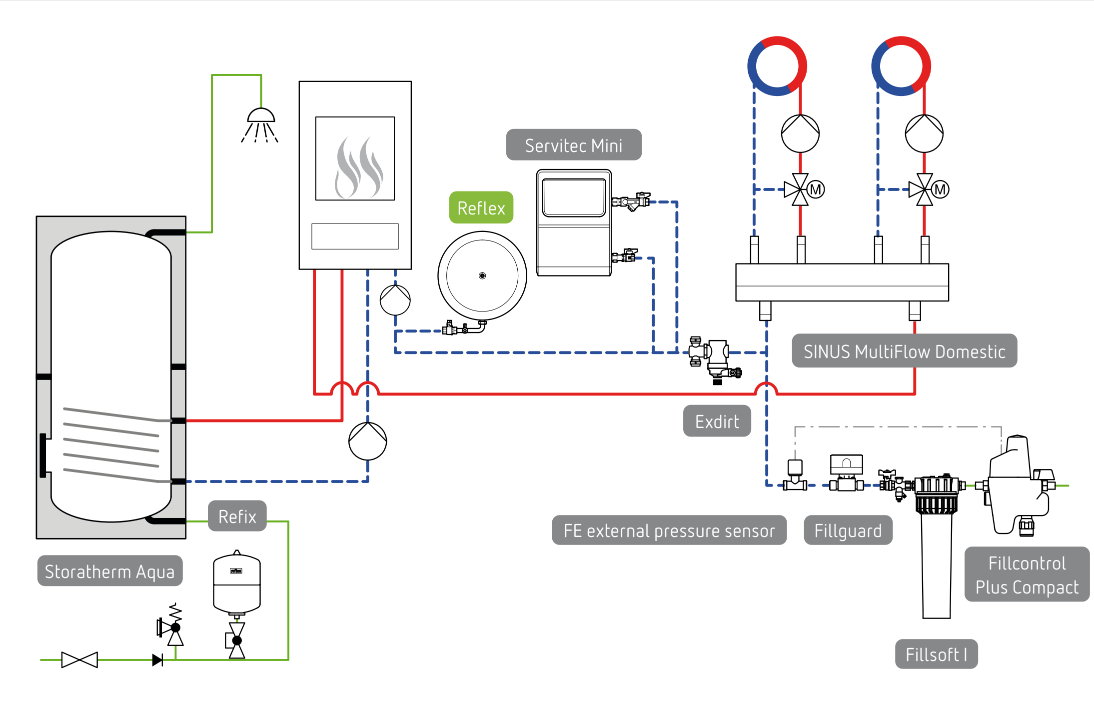
- To ensure compliance with VDI 2035, use a Fillsoft housing with a softening or demineralising cartridge (depending on the quality of the water or the specifications of the operator / boiler manufacturer).
- The Fillcontrol Plus Compact automatic make-up station which also has a system separator for the potable water supply system ensures an adequate water reservoir.

The directive VDI 2035 describes the state of the art for water quality in hot water heating systems and contributes to minimising damage due to corrosion and scale deposits in these systems. The Fillsoft series of Reflex products comply with this directive. Further information can be found in our Make-up and Water Treatment brochure.

Installation examples

Reflex vessel with automatic make-up

Solution № 01

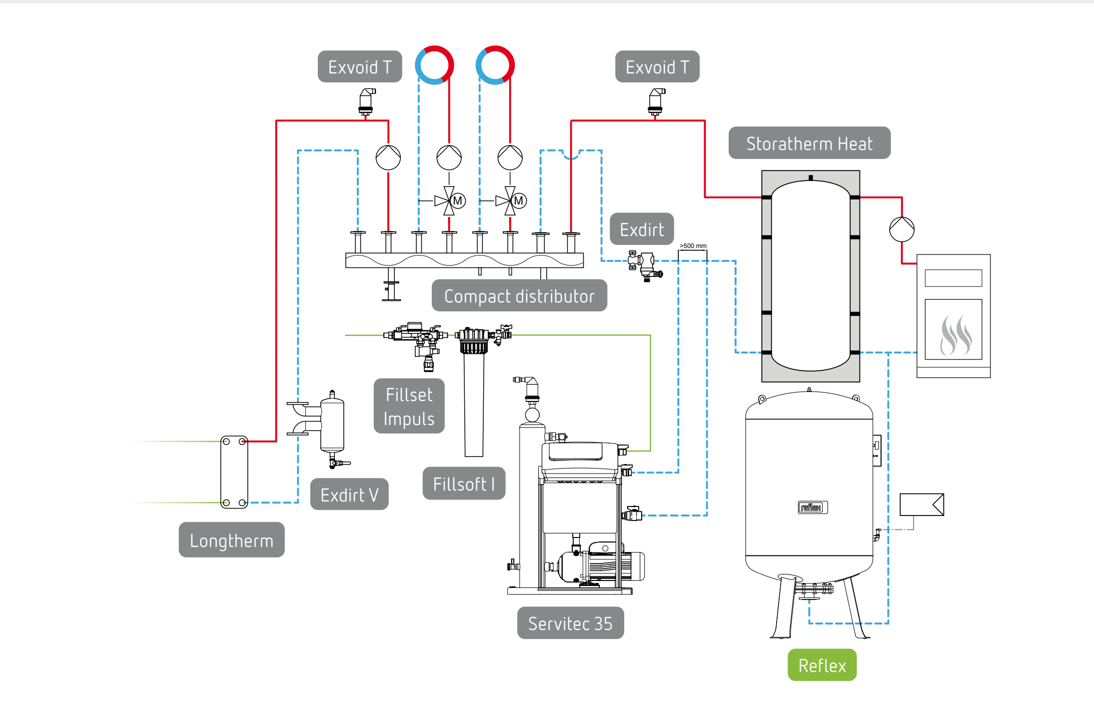


We recommend the use of an automatic make-up such as Reflex Fillcontrol Plus Compact combined with static pressure maintenance in order to ensure an adequate water seal.

Servitec vacuum spray pipe degassing and the dirt and sludge separators remove disruptive factors such as gasses and dirt from the facility water.

Reflex with flaw detector

Solution № 04



Reflex vessel with flaw detector for monitoring the bladder (from 1,000 litres and Ø 1,000 mm).

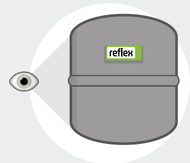
A Longtherm heat exchanger is used to separate the heating and potable water circuit.

Fillset Impuls acts as a system separator to the potable water supply system. The contact water meter for determining filling and make-up quantities is connected with the Servitec controller and evaluated by it.

Operation & Maintenance

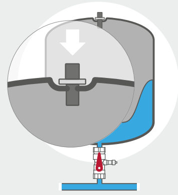
Industrial Safety Regulations require expansion vessels to be checked on an annual basis. The relevant notes for installers and operators in the Reflex Assembly, Operating and Maintenance Instructions are to be observed.

1. Visual inspection



- Inspect vessel for damage, corrosion, etc.
  In the event of damage, complete repairs or replace and determine the possible cause.
- Match vessel suitability to on-site use.

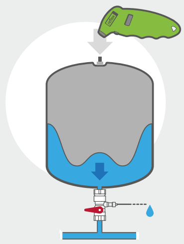
2. Check bladder



Briefly activate the gas filling valve. If water leaks out:

- For vessels which do not have a facility for replacing the bladder, replace the expansion vessel.
- for vessels which have a facility for replacing the bladder, replace the bladder or alternatively contact Reflex Service for further advice.

3. Setting gas supply pressure



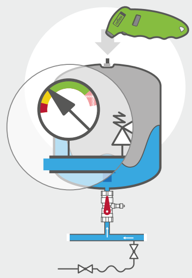
Isolate the Reflex vessel from the system using the cap valve and empty on the water side (check system pressure).
Measure supply pressure p_0 at the gas filling valve and if necessary reset to the required minimum operating pressure for the system.

$$p_0\,[\text{bar}] = p_{st} + 0{,}2\,\text{bar} + p_D^{*} + \Delta p_p^{**}$$

* Evaporation pressure p_D only relevant for hot water systems >100 °C.
** Used to maintain follow-up pressure maintenance (expansion vessel downstream of the pump on the pressure) e.g. In solar thermal systems.

- If the pressure is too high, blow off the gas with the gas filling valve.
- If the pressure is too low, refill with nitrogen from a pressurised container.
- Enter the reset or corrected supply pressure p_0 on the type plate.

4. Functional inspection during operation

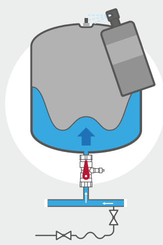


- Close drain at the cap valve and carefully open cap valve.
- Note system pressure and do not allow it to fall below p_0.
- Fill the system up to the filling pressure p_F in accordance with the system temperature.

$$p_F\,[\text{bar}] \geq p_0 + 0{,}3\,\text{bar} \quad \text{(at filling temperature 10 °C)}$$

- Checking gas pressure during operation: the gas pressure must now be the same as the system pressure (working vessel).

5. Gas filling valve leak test



Remove optional aids for filling and measuring at the gas filling valve and inspect with leak test spray to see whether the gas filling valve leaks after use. Finally, refit the cap valve, which provides the seal, on the gas filling valve.