IMI PNEUMATEX

Planning and Calculation

Planning and Calculation
Selection of the most suitable products for pressure maintenance, degassing and water make-up

Engineering GREAT Solutions

IMI Hydronic Engineering

Planning and Calculation

Reliable pressurisation and quality water are the basic requirements for a gentle and trouble-free operation of waterborne heating, solar and cooling systems. Our planning and calculation basics support you in choosing the right products, their size and performance.

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Calculation

Pressure maintenance for systems TAZ ≤ 110°C

Calculation following EN 12828, SWKI 93-1 *). Solar systems ENV 12977-1.

General Equations

Vs	Water capacity of the system		**Vs = vs · Q**	vs	*Specific water capacity, table 4.*
			Vs= Known		*System design, content calculation*
				Q	*Installed heat capacity*
Ve	Expansion volume	EN 12828	**Ve = e · Vs**	e	*Expansion coefficient for ts_{max}, table 1*
	heating:	SWKI 93-1	**Ve = e · Vs · X** [1]	e	*Expansion coefficient for $(ts_{max} + tr)/2$, table 1*
	cooling:	SWKI 93-1	**Ve = e · Vs + Vwr**	e	*Expansion coefficient for ts_{max}, table 1*
Vwr	Water reserve	EN 12828	**Vwr ≥ 0,005 · Vs ≥ 3 L**		
	heating:	SWKI 93-1	**Vwr is considered in Ve with the coefficient X**		
	cooling:	SWKI 93-1	**Vwr ≥ 0,005 · Vs ≥ 3 L**		
p0	Miniumum pressure [2]		**p0 = Hst/10 + 0,3 bar ≥ pz**	Hst	*Static height*
	Lower limit value for the pressure maintenance			pz	*Minimum required equipment pressure e.g. NPSH requirement for pumps or boilers*
pa	Initial pressure		**pa ≥ p0 + 0,3 bar**		
	Lower threshold for an optimum pressure maintenance				

Statico

PF	Pressure factor		**PF = (pe + 1)/(pe - p0)**		
pe	Final pressure				
	Upper threshold for an optimum pressure maintenance.	EN 12828	**pe ≤ psv - $dpsv_c$**	*psvs*	*Response pressure safety valve system*
	heating:	SWKI 93-1	**pe ≤ psvs/1.3**	*$dpsvs_c$*	*Closing pressure tolerance of the safety valve*
	cooling:		**pe ≤ psv - $dpsv_c$**	*$dpsvs_c$*	*0,5 bar for psvs ≤ 5 bar* [4]
				$dpsvs_c$	*0,1 · psvs for psvs > 5 bar* [4]
VN	Nominal volume of the expansion vessel [5]	EN 12828	**VN ≥ (Ve + Vwr + 1,1 · Vgsolar** [6] **+ 5** [3] **) · PF**	*Vgsolar*	*Collector volume* [6]
		SWKI 93-1	**VN ≥ (Ve + 1.1 · Vgsolar** [6] **+ 5** [3] **) · PF**		

Compresso

pe	Final pressure		**pe=pa+0,2**		
	Upper threshold for an optimum pressure maintenance	EN 12828	**pe ≤ psvs – $dpsvs_c$**	psvs	*Response pressure safety valve system*
		SWKI 93-1	**pe ≤ psvs/1,3**	$dpsvs_c$	*Closing pressure tolerance of the safety valve*
		cooling	**pe ≤ psvs – $dpsvs_c$**	$dpsvs_c$	*0,5 bar for psvs ≤ 5 bar* [4]
				$dpsvs_c$	*0,1 · psvs for psvs > 5 bar* [4]
VN	Nominal volume of the expansion vessel [5]	EN 12828	**VN ≥ (Ve + Vwr + 1.1 · Vgsolar** [6] **+ 5** [3] **) · 1.1**		
		SWKI 93-1	**VN ≥ (Ve + 1.1 · Vgsolar** [6] **+ 5** [3] **) · 1.1**		
TecBox			**Q = f(Hst)**		>> Quick selection Compresso

Transfero

pe	Final pressure		**pe = pa + 0,4**		
	Upper threshold for an optimum pressure maintenance.	EN 12828	**pe ≤ psvs – $dpsvs_c$**	*psvs*	*Response pressure safety valve system*
		SWKI 93-1	**pe ≤ psvs/1.3**	*$dpsvs_c$*	*Closing pressure tolerance of the safety valve*
		cooling	**pe ≤ psvs – $dpsvs_c$**	*$dpsvs_c$*	*0,5 bar for psvs ≤ 5 bar* [4]
				$dpsvs_c$	*0,1 · psvs for psvs > 5 bar* [4]
VN	*Nominal volume of the expansion vessel* [5]	EN 12828	**VN ≥ (Ve + Vwr + 1.1 · Vgsolar** [6] **+ 5** [3] **) · 1.1**		
		SWKI 93-1	**VN ≥ (Ve + 1.1 · Vgsolar** [6] **+ 5** [3] **) · 1.1**		
TecBox			**Q = f(Hst)**		*>> Quick selection Transfero*

Intermediate vessels [5]

VN	Nominal volume of the expansion vessel [5]	**VN ≥ Vs · Δe + 1.1 · Vgsolar** [6] **+ 5** [3]	*Δe for tr and t_{min}, table 3*

1) Q ≤ 30 kW: X = 3 | 30 kW < Q ≤ 150 kW: X = 2 | Q > 150 kW: X = 1,5
2) The formula for the minimum pressure p0 applies to the installation of the pressure maintenance on the suction side of the circulation pump. In case of a pressure-side installation p0 is to be increased by the pump pressure Δp.
3) Add 5 litre when a Vento is installed in the system.
4) The safety valves must work within these limits.
5) Please select a vessel which has an equal or higher nominal content.
6) In solar systems to ENV12977-1: collector volume VK that can evaporate when not in operation; otherwise VK = 0.
*) SWKI 93-1: Valid for Switzerland

Our calculation program HySelect is based on an advanced calculation method and data base. Therefore results may deviate.

Table 1: e expansion coefficient

t (TAZ, ts_{max}, tr, ts_{min}), °C		20	30	40	50	60	70	80	90	100	105	110
e Water	= 0°C	0,0016	0,0041	0,0077	0,0119	0,0169	0,0226	0,0288	0,0357	0,0433	0,0472	0,0513
e % weight MEG*												
30%	= -14,5°C	0,0093	0,0129	0,0169	0,0224	0,0286	0,0352	0,0422	0,0497	0,0577	0,0620	0,0663
40%	= -23,9°C	0,0144	0,0189	0,0240	0,0300	0,0363	0,0432	0,0505	0,0582	0,0663	0,0706	0,0750
50%	= -35,6°C	0,0198	0,0251	0,0307	0,0370	0,0437	0,0507	0,0581	0,0660	0,0742	0,0786	0,0830
e % weight MPG**												
30%	= -12,9°C	0,0151	0,0207	0,0267	0,0333	0,0401	0,0476	0,0554	0,0639	0,0727	0,0774	0,0823
40%	= -20,9°C	0,0211	0,0272	0,0338	0,0408	0,0481	0,0561	0,0644	0,0731	0,0826	0,0873	0,0924
50%	= -33,2°C	0,0288	0,0355	0,0425	0,0500	0,0577	0,0660	0,0747	0,0839	0,0935	0,0985	0,1036

Table 2: pv vapour over-pressure (bar)

TAZ, °C	105	110
pv Water	0,1948	0,4196
pv % weight MEG*		
30%	0,1793	0,3864
40%	0,1671	0,3601
50%	0,1523	0,3284
pv % weight MPG**		
30%	0,1938	0,4176
40%	0,1938	0,4175
50%	0,1938	0,4174

Table 3: Δe expansion (in chilled water systems when tr < 5°C; in heating systems when tr > 70°C)

tr, °C		-35	-30	-25	-20	-15	-10	-5	0		80	90	100	105	110
Δe Water	= 0°C	-	-	-	-	-	-	-	-	-	0,0062	0,0131	0,0207	0,0246	0,0287
Δe % weight MEG*															
30%	= -14,5°C	-	-	-	-	-	0,0032	0,0023	0,0012	-	0,0070	0,0145	0,0226	0,0269	0,0312
40%	= -23,9°C	-	-	-	0,0081	0,0069	0,0055	0,0038	0,0019	-	0,0073	0,0150	0,0231	0,0274	0,0318
50%	= -35,6°C	0,0131	0,0121	0,0109	0,0094	0,0076	0,0056	0,0038	0,0019	-	0,0075	0,0154	0,0236	0,0279	0,0324
Δe % weight MPG**															
30%	= -12,9°C	-	-	-	-	-	0,0068	0,0045	0,0023	-	0,0078	0,0163	0,0252	0,0298	0,0347
40%	= -20,9°C	-	-	-	0,0125	0,0099	0,0077	0,0052	0,0026	-	0,0083	0,0170	0,0265	0,0313	0,0363
50%	= -33,2°C	-	0,0187	0,0162	0,0137	0,0111	0,0086	0,0058	0,0029	-	0,0088	0,0179	0,0276	0,0325	0,0376

Table 4: vs approx. water capacity * of central heatings referred to the installed heat capacity Q**

ts_{max} | tr	°C	90 | 70	80 | 60	70 | 55	70 | 50	60 | 40	50 | 40	40 | 30	35| 28
Radiators	vs liter/kW	14,0	16,5	20,1	20,6	27,9	36,6	-	-
Flat radiators	vs liter/kW	9,0	10,1	12,1	11,9	15,1	20,1	-	-
Convectors	vs liter/kW	6,5	7,0	8,4	7,9	9,6	13,4	-	-
Air handlers	vs liter/kW	5,8	6,1	7,2	6,6	7,6	10,8	-	-
Floor heating	vs liter/kW	10,3	11,4	13,3	13,1	15,8	20,3	29,1	37,8

*) MEG = Mono-Ethylene Glycol
**) MPG = Mono-Propylene Glycol
***) Water capacity = heat generator + distribution net + heat emitters

Table 5: DNe standard values for expansion pipes with Statico and Compresso

Length up to approx. 30 m	**DNe**	**20**	**25**	**32**	**40**	**50**	**65**	**80**
Heating:								
EN 12828	Q | kW	1000	1700	3000	3900	6000	11000	15000
SWKI 93-1	Q | kW	300	600	900	1400	3000	6000	9000
Cooling:								
$ts_{max} \leq 50$ °C	Q | kW	1600	2700	4800	6300	9600	18100	24600

Table 6: DNe standard values for expansion pipes with Transfero T_ *

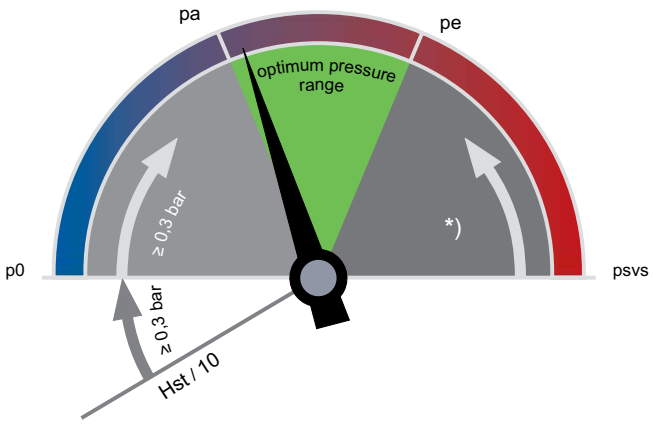
		T_4.1	**T_6.1**	**T_8.1**	**T_10.1**	**T_4.2**	**T_6.2**	**T_8.2**	**T_10.2**	**TPV...P**
Length up to approx. 10 m	**DNe**	32	32	32	32	50 | 40	50 | 40	50 | 40	50 | 40	50
	Hst | m	all	all	all	all	< 20 | ≥ 20	< 25 | ≥ 25	< 35 | ≥ 35	< 50 | ≥ 50	all
Length up to approx. 30 m	**DNe**	32	40 | 32	40 | 32	40 | 32	50 | 40	50 | 40	50 | 40	50 | 40	65
	Hst | m	all	< 25 | ≥ 25	< 30 | ≥ 30	< 45 | ≥ 45	< 25 | ≥ 25	< 35 | ≥ 35	< 48 | ≥ 48	< 65 | ≥ 65	all

*) 2 expansion pipes DNe for Transfero TV, TPV due to degassing; 1 expansion pipe DNe for Transfero T, TP.

Table 7: DNe standard values for expansion pipes with Transfero TI

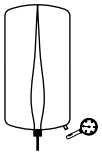
		TI ..0.2	**TI ..1.2**	**TI ..2.2**	**TI ..3.2**
Length up to approx. 10 m	**DNe**	50	65	80	100
Length up to approx. 30 m	**DNe**	65	80	100	125

Precision pressure maintenance
Air controlled Compresso or water controlled Transfero minimize the pressure variations between pa and pe.
Compresso ± 0,1 bar
Transfero ± 0,2 bar

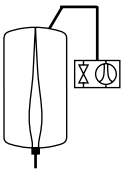


*)
≥ psvs · 0.9 ≥ 0.5
≥ psvs · 0.3/1.3 SWKI 93-1 heating

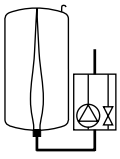
p0 Minimum pressure



Statico
p0 is set as pre set pressure on the gas side.

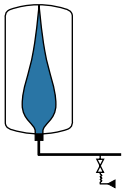


Compresso
p0 and the switching points are calculated by the BrainCube.

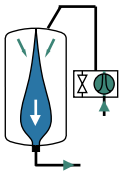


Transfero
p0 and the switching points are calculated by the BrainCube.

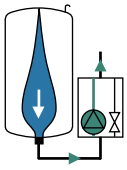
pa Initial pressure



Statico
pa is the cold fill pressure which determines the water reserve:
pa ≥ p0 + 0,3 bar;
water make-up «on»: pa – 0,2 bar.

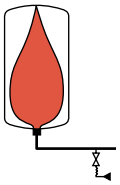


Compresso
If the system pressure is < pa, the compressor starts.
pa = p0 + 0,3

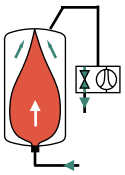


Transfero
If the system pressure is < pa, the pump starts.
pa = p0 + 0,3

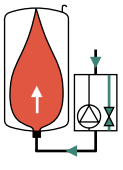
pe Final pressure



Statico
pe is reached after heating up to ts_{max}.
pe ≤ psvs – $dpsvs_c$
pe ≤ psvs/1.3 (SWKI 93-1 heating)



Compresso
If system pressure is > pe the air relief valve opens.
pe = pa + 0,2



Transfero
If system pressure is > pe, the relief valve opens.
pe = pa + 0,4

Statico

Expansion vessels with fixed air cushion

Quick selection

Heating systems TAZ ≤ 100°C, without addition of antifreeze, EN 12828.
For exact calculation please use software HySelect.

	psv = **2,5** bar			psv = 3,0 bar			psv = **3,0** bar		
	Hst ≤ 7 m ≥ p0 = **1,0** bar			Hst ≤ 7 m ≥ p0 = **1,0** bar			Hst ≤ 12 m ≥ p0 = **1,5** bar		
	Radiators	Flat radiators		Radiators	Flat radiators		Radiators	Flat radiators	
	90 | 70	90 | 70	70 | 50	**90 | 70**	90 | 70	70 | 50	90 | 70	90 | 70	70 | 50
Q [kW]	**Nominal volume VN** [liter]			**Nominal volume VN** [liter]			**Nominal volume VN** [liter]		
10	25	25	18	25	18	18	35	25	25
15	35	25	25	25	18	18	35	35	25
20	50	35	25	35	25	25	50	35	35
25	50	35	35	50	35	25	80	50	35
30	80	50	35	50	35	35	80	50	50
40	80	50	50	80	50	35	80	80	50
50	140	80	50	80	50	50	140	80	80
60	140	80	80	80	80	50	140	80	80
70	140	80	80	140	80	80	140	140	80
80	140	140	80	140	80	80	200	140	140
90	200	140	140	140	80	80	200	140	140
100	200	140	140	140	140	80	200	140	140
150	300	200	200	200	140	140	300	200	200
200	400	300	200	**300**	200	200	400	300	300
250	500	300	300	400	300	300	500	400	300
300	500	400	300	400	300	300	600	400	400
400	800	500	400	600	400	300	800	500	500
500	1000	600	500	800	500	400	1000	800	600
600	1000	800	600	800	500	500	1500	800	800
700	1500	800	800	1000	600	600	1500	1000	800
800	1500	1000	800	1500	800	600	1500	1000	1000
900	1500	1000	1000	1500	800	800	2000	1500	1000
1000	2000	1500	1000	1500	1000	800	2000	1500	1500
1500	3000	2000	1500	2000	1500	1500	3000	2000	2000

Example
Q = 200 kW
psv = 3 bar
Hst = 7 m
Radiators 90 | 70 °C

Selected:
Statico SU 300.3
p0 = 1 bar
Reduce the factory set preset pressure from 1,5 bar to 1 bar!

Technical data:
Datasheet *Statico*

Note for TAZ above 100 °C
Above 100°C the static height Hst decreases in the quick selection table.
TAZ = 105°C: Hst – 2 m
TAZ = 110°C: Hst – 4 m

Pre-set pressure setting p0
p0 = (Hst/10 + pv) + 0,3 bar
Recommended: p0 ≥ 1 bar

Filling pressure, initial pressure
pa ≥ p0 + 0,3 with cold, but vented system

Equipment

Lock shield valve DLV
Secured lock shield valve with draining for expansion vessels according to EN 12828, DLV 20 up to VN 800 litres, DN 40 for VN 1000 – 5000 litres to be locally supplied.

Expansion pipe
According to table 5.

Pleno
Water make-up as pressure maintenance monitoring device according to EN 12828.
Conditions:
• Pleno PI without pump: required fresh water pressure: pw ≥ p0 + 1,5 | pw ≤ 10 bar,
• Pleno PI 6, PI 9 with pump: pa Statico within the working pressure range dpu of the Pleno.

Vento
Degassing and central venting.
Conditions:
• pe, pa Statico within the working pressure range dpu of the Vento,
• Vs Vento ≥ Vs water capacity of the system.

Zeparo
Air vent Zeparo ZUT, ZUTX or ZUP at each high point for venting during the filling and during the draining process. Separator for dirt and magnetite in each system in the main return to the heat generator. If no central degassing (e.g. Vento or Compresso CPV) is installed a micro bubble separator can be installed in the main flow if possible before the circulation pump.
The static height, Hst_m, according to the following table above the micro bubble separators, must not be exceeded.

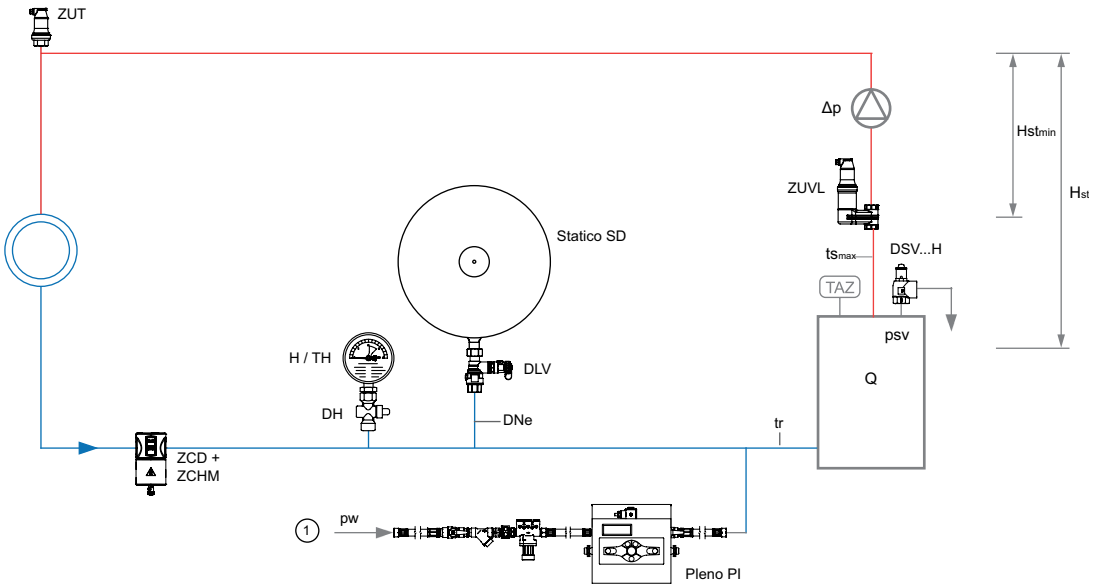
ts_{max} | °C	90	80	70	60	50	40	30	20	10
Hst_m | m	15,0	13,4	11,7	10,0	8,4	6,7	5,0	3,3	1,7

Further accessories, product and selection details:
Datasheets *Pleno, Vento, Zeparo* and *Accessories.*

Application examples

Statico SD

For heating system up to approx. 100 kW
(May require changes to meet local legislation)

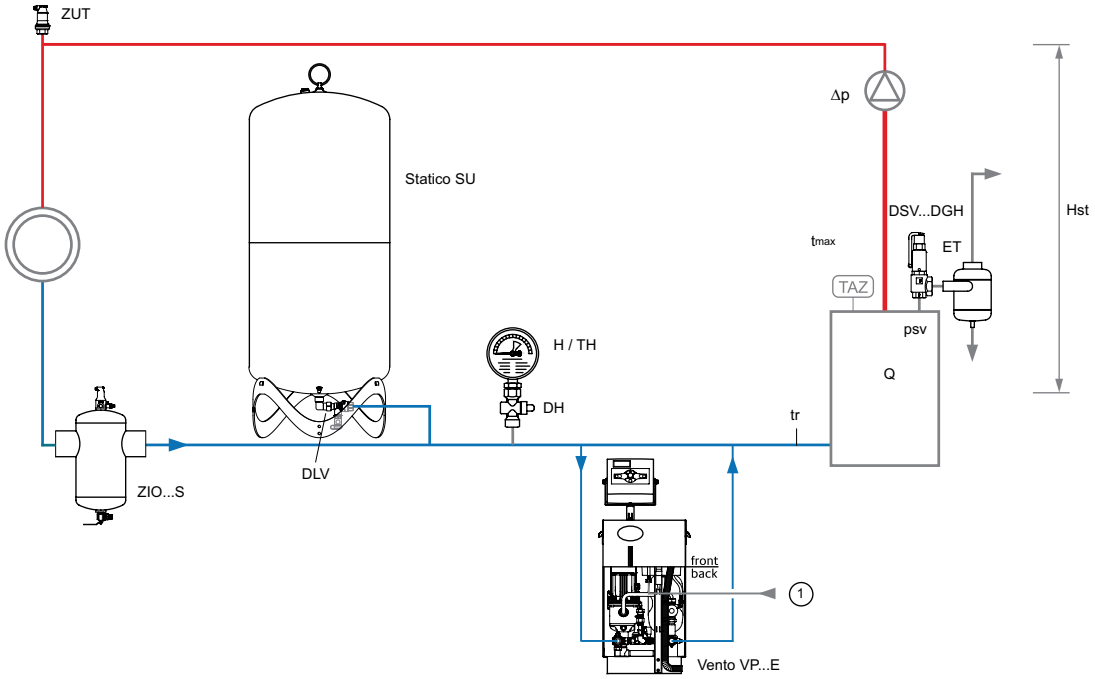


1. Water make-up connection

Pleno PI water make-up as pressure maintenance monitoring device according to EN 12828.
Zeparo ZUVL for the central separation of micro bubbles.
Zeparo Zyclone ZCD with ZCHM for the central separation of sludge, with magnetic action.
Zeparo ZUT for automatic venting during filling and during draining.
Further accessories, product and selection details:
Datasheets Pleno, Zeparo and Accessories.

Statico SU

For heating system up to approx. 700 kW
(May require changes to meet local legislation)



1. Water make-up connection

Vento VP...E for the central venting and degassing, with water make-up as pressure maintenance monitoring device according to EN 12828.
Zeparo ZIO...S optional for micro bubbles or sludge particles, in this case configured as sludge separator.
Zeparo ZUT for automatic venting during filling and during draining.
Further accessories, product and selection details, see:
Datasheets Vento, Zeparo and Accessories.

Compresso

Pressure maintenance systems with compressors

Quick selection

Heating systems TAZ ≤ 110°C, without addition of antifreeze, EN 12828, SWKI 93-3.
For exact calculation please use software HySelect.

	TecBox				Primary vessel			
	1 compressor	2 compressors	1 compressor	2 compressors	Radiators		Flat radiators	
	C 10.1, C 10.1 F	C 10.2 *	C 15.1 **	C 15.2 *	90 | 70	70 | 50	90 | 70	70 | 50
Q [kW]	Static height Hst [m]				Nominal volume VN [liter]			
≤ 300	46,1	46,1	81,4	81,4	200	200	200	200
400	46,1	46,1	81,4	81,4	300	300	200	200
500	46,1	46,1	81,4	81,4	300	300	200	200
600	45,0	46,1	80,2	81,4	400	400	300	300
700	41,0	46,1	71,8	81,4	500	500	300	300
800	**37,5**	46,1	65,0	81,4	**500**	500	400	300
900	34,6	46,1	59,4	81,4	600	600	400	400
1000	32,0	46,1	54,7	81,4	600	600	400	400
1100	29,8	45,7	50,6	81,4	800	800	500	400
1200	27,7	43,3	47,0	81,4	800	800	500	500
1300	25,9	41,1	43,8	81,4	800	800	500	500
1400	24,2	39,2	41,0	77,1	1000	1000	600	500
1500	22,7	37,4	38,5	73,1	1000	1000	600	600
2000	16,6	30,3	28,7	58,0	1500	1500	800	800
2500	12,1	25,3	22,0	47,9	1500	1500	1000	1000
3000	8,6	21,4	17,0	40,5	2000	2000	1500	1500
3500	-	18,3	13,1	34,7	3000	3000	1500	1500
4000	-	15,7	9,9	30,1	3000	3000	2000	1500
4500	-	13,5	7,2	26,3	3000	3000	2000	2000
5000	-	11,6	-	23,1	3000	3000	2000	2000
5500	-	9,9	-	20,3	4000	4000	3000	2000
6000	-	8,4	-	17,8	4000	4000	3000	3000
6500	-	7,0	-	15,7	4000	4000	3000	3000
7000	-	-	-	13,7	5000	5000	3000	3000
8000	-	-	-	10,4	5000	5000	4000	3000
9000	-	-	-	7,6			4000	4000
10000	-	-	-	5,3			4000	4000

Example
Q = 800 kW
Radiators 90 | 70 °C
TAZ = 100 °C
Hst = 35 m
psvs = 6 bar

Selected:
TecBox C 10.1-6
Primary vessel CU 600.6

Setting of BrainCube:
Hst = 35 m
TAZ = 100 °C

Check psvs:
for TAZ = 100 °C
EN 12828: psvs: 35/10 + 1,3 = 4,8 < 6 o.k.

SWKI 93-1: psvs: (35/10 + 0,8) · 1,3 = 5,59 < 6 o.k.

* 50% output per compressor, full redundancy in the framed area

** The value decreases with
TAZ = 105°C by 2 m
TAZ = 110°C by 4 m

Equipment

Expansion pipes
According to table 5. With multiple vessels to be calculated depending on the output per vessel.

Lock shield valve DLV
Included in the scope of delivery.

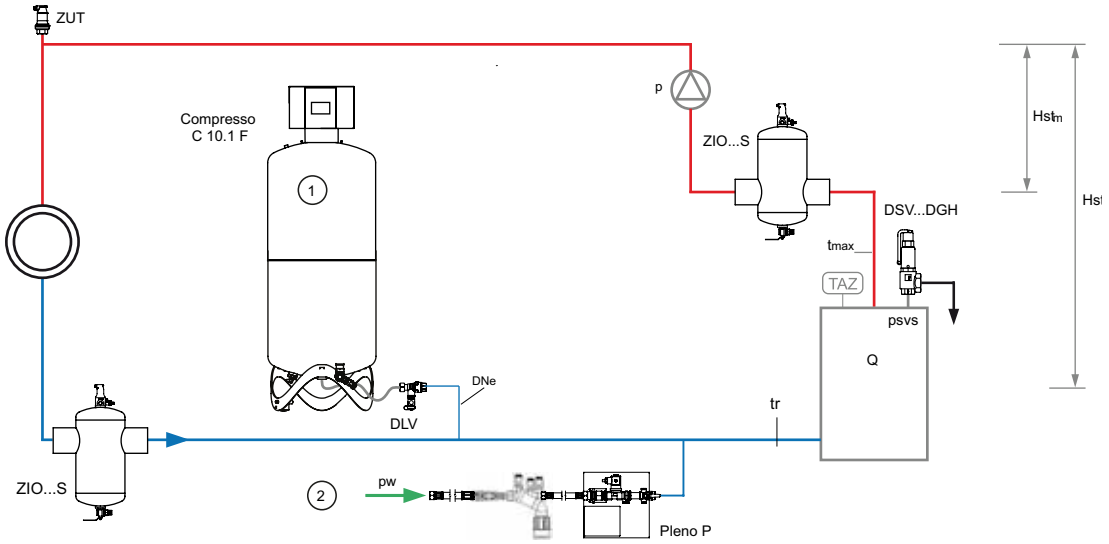
Zeparo
Air vent Zeparo ZUT, ZUTX or ZUP at each high point for venting during the filling and during the draining process. Separator for dirt and magnetite in each system in the main return to the heat generator. If no central degassing (e.g. Vento or Compresso CPV) is installed a micro bubble separator can be installed in the main flow if possible before the circulation pump.
The static height, Hst_m, according to the following table above the micro bubble separators, must not be exceeded.

ts_{max} | °C	90	80	70	60	50	40	30	20	10
Hst_m | mWs	15,0	13,4	11,7	10,0	8,4	6,7	5,0	3,3	1,7

Application examples

Compresso C 10.1 F Connect
TecBox with 1 compressor on the primary vessel, precision pressure maintenance ± 0,1 bar with Pleno P water make-up

For heating systems up to approx. 2 000 kW
(May require changes to meet local legislation)

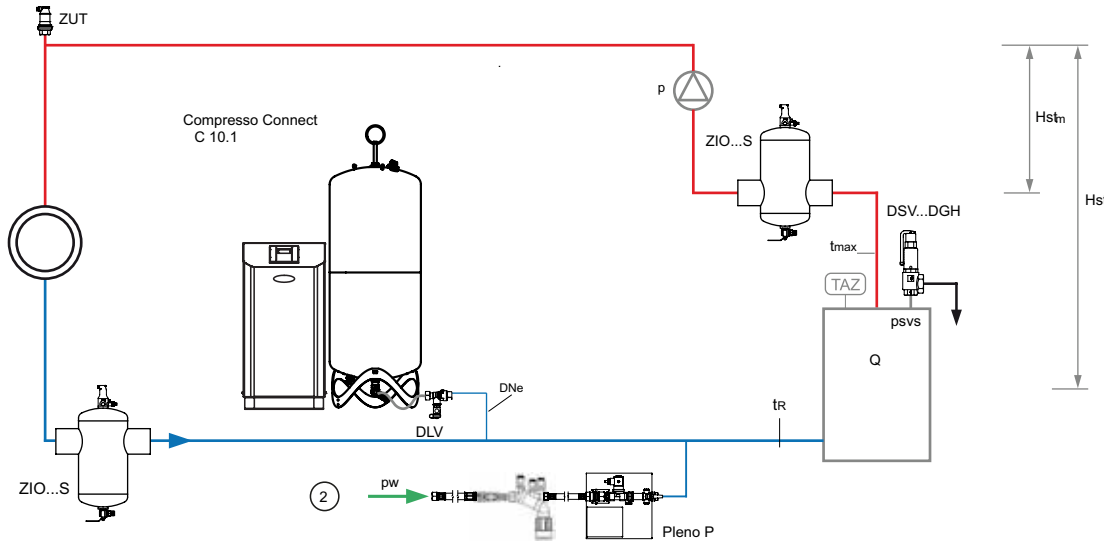


1. Compresso Primary vessel CU
2. Water make-up connection, pw ≥ p0 + 1,7 bar (max. 10 bar)

Zeparo ZIO...S configured as micro bubble separator in the flow, as dirt separator in the return.
Zeparo ZUT for automatic venting during filling and during draining.
Further accessories, product and selection details, see:
Datasheet *Pleno, Zeparo* and *Accessories.*

Compresso C 10.1 Connect
TecBox with 1 compressor ground standing beside the primary vessel, precision pressure maintenance ± 0,1 bar with Pleno P water make-up

For heating systems up to approx. 6 500 kW
(May require changes to meet local legislation)



1. Compresso Primary vessel CU
2. Water make-up connection, pw ≥ p0 + 1,7 bar (max. 10 bar)

Zeparo ZIO...S configured as micro bubble separator in the flow, as dirt separator in the return.
Zeparo ZUT for automatic venting during filling and during draining.
Further accessories, product and selection details, see:
Datasheet *Pleno, Zeparo* and *Accessories.*

Transfero

Pressure maintenance system with pumps

Quick selection

Heating systems TAZ ≤ 110°C, without addition of antifreeze, EN 12828.
For exact calculation please use software HySelect.

	TecBox				TecBox					Primary vessel			
	1 pump				2 pumps *					Radiators		Flat radiators	
	T_ 4.1	**T_ 6.1**	T_ 8.1	T_ 10.1	T_ 4.2	T_ 6.2	T_ 8.2	T_ 10.2	TPV 19.2 P	90 | 70	70 | 50	**90 | 70**	70 | 50
Q [kW]	**Static height Hst** [m] **				**Static height Hst** [m] **					**Nominal volume VN** [liter]			
≤ 300	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	200	200	200	200
400	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	300	300	200	200
500	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	300	300	200	200
600	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	400	400	300	300
700	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	500	500	300	300
800	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	500	500	400	300
900	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	600	600	400	400
1000	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	600	600	400	400
1100	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	800	800	500	400
1200	28,4	38,2	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	800	800	500	500
1300	28,4	**38,2**	55,9	75,5	*28,4*	*38,2*	*55,9*	*75,5*	134,1	800	800	**500**	500
1400	28,4	38,2	55,9	74,7	*28,4*	*38,2*	*55,9*	75,5	134,1	1000	1000	600	500
1500	28,4	38,2	55,7	73,8	*28,4*	*38,2*	55,9	75,5	134,1	1000	1000	600	600
2000	28,4	38,2	51,2	68,6	*28,4*	*38,2*	55,9	75,5	134,1	1500	1500	800	600
2500	24,9	35,9	46,0	62,5	28,4	38,2	55,9	75,5	134,1	1500	1500	1000	1000
3000	20,6	31,4	40,0	55,6	28,4	38,2	55,6	73,6	134,1	2000	2000	1500	1500
3500	15,7	26,2	33,3	47,8	28,4	38,2	53,5	71,2	134,1	3000	3000	1500	1500
4000	10,2	20,2	25,8	39,1	28,4	38,2	51,2	68,5	134,1	3000	3000	2000	1500
4500		13,3	17,6	29,5	26,8	37,9	48,6	65,6	134,1	3000	3000	2000	2000
5000				19,0	24,9	35,9	45,9	62,5	134,1	3000	3000	2000	2000
5500					22,9	33,8	43,0	59,2	133,5	4000	4000	3000	2000
6000					20,6	31,4	39,9	55,8	124,4	4000	4000	3000	3000
6500					18,3	28,9	36,6	52,1	114,6	4000	4000	3000	3000
7000					15,7	26,2	33,1	48,2	104,1	5000	5000	3000	3000
8000					10,2	20,2	25,6	39,8	80,8	5000	5000	4000	3000
9000						13,6	17,3	30,7				4000	4000
10000								20,7				4000	4000

*) 50% output per pump, full redundancy in the framed area.

**) The value decreases with
TAZ = 105 °C by 2 m
TAZ = 110 °C by 4 m

Example
Q = 1300 kW
Flat radiators 90 | 70 °C
TAZ = 105 °C
Hst = 30 m
psv = 5 bar

Selected:
TexBox TPV 6.1
Primary vessel TU 500

Setting of BrainCube:
Hst = 30 m
TAZ = 105 °C

Check psv:
for TAZ = 105 °C
psv: 30/10 + 1,7 = 4,7 < 5 o.k.

Check Hst:
for TAZ = 105 °C
Hst: 38,2 - 2 = 36,2 > 30

Technical data:
Datasheet *Transfero*

Transfero= TecBox + Primary vessel + Secondary vessel (optional)
Secondary vessel. The nominal volume can be allocated to multiple vessels of the same size.

TecBox equipment

	T	TP	TV	TPV	TPV...P	TI
Precision pressure maintenance ± 0,2 bar	•	•	•	•	•*	•
+ fillsafe water make-up		•		•	•	
+ oxystop degassing			•	•	•	

*) Equipped with 2 buffer vessels for optimal pressure maintenance

Setting values
for TAZ, Hst and psv in the “Parameter” menu of the BrainCube.

		TAZ = 100 °C	**TAZ = 105 °C**	**TAZ = 110 °C**
Check psv:	for psv ≤ 5 bar	psv ≥ 0,1 · Hst + 1,5	psv ≥ 0,1 · Hst + 1,7	psv ≥ 0,1 · Hst + 1,9
	for psv > 5 bar	psv ≥ (0,1 · Hst + 1,0) · 1,11	psv ≥ (0,1 · Hst + 1,2) · 1,11	psv ≥ (0,1 · Hst + 1,4) · 1,11

The BrainCube determines the switching points and the minimum pressure p0.

Equipment

Buffer vessels
At least one Statico SD 35, required for T, TP, TV, TPV selection, for TPV...P, two buffer vessels are already mounted. For TI see selection table in “Installation instruction manual” on www.imi-hydronic.com. p0 of buffer vessel = p0 on BrainCube.

Expansion pipes
Transfero T_: table 6
Transfero TI: table 7

Lock shield valve DLV
Included in the scope of delivery.

Pleno
Water make-up as pressure maintenance monitoring device according to EN 12828 in combination with Transfero T or TV. The control is made through the BrainCube of the Transfero TecBox.

Zeparo
Air vent Zeparo ZUT, ZUTX or ZUP at each high point for venting during the filling and during the draining process. Separator for sludge and magnetite in each system in the main return to the heat generator. For microbubbles in the system flow, if possible, before the circulation pump. The condition is that no central degassing (e.g. Vento, Transfero) is installed.
The static height, Hst_m, according to the following table over micro bubble separators, must not be exceeded.

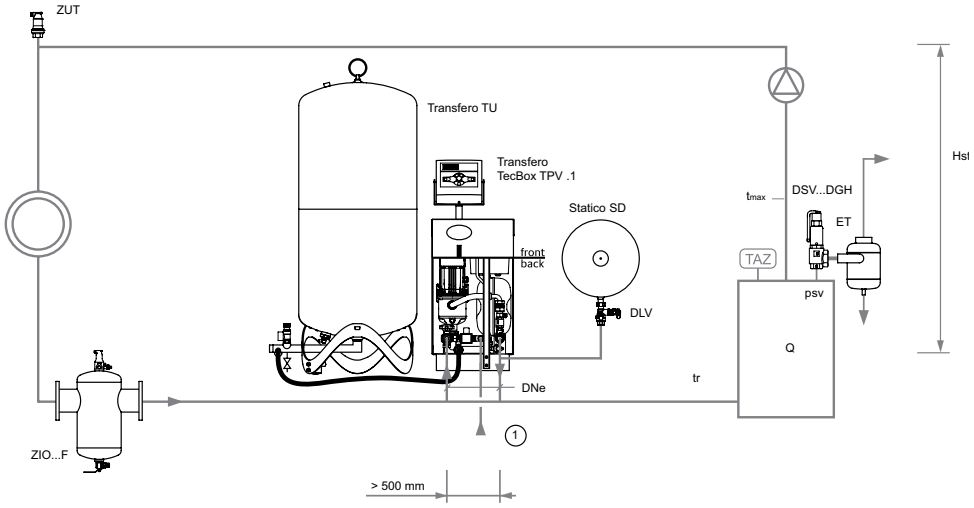
ts_{max} | °C	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**
Hst_m | mWs	15,0	13,4	11,7	10,0	8,4	6,7	5,0	3,3	1,7

Further accessories, product and selection details:
Datasheets *Pleno, Zeparo* and *Accessories.*

Application examples

Transfero TPV .1
TecBox with 1 pump, precision pressure maintenance ± 0,2 bar with degassing and water make-up

For heating systems up to approx. 5 000 kW
(May require changes to meet local legislation)

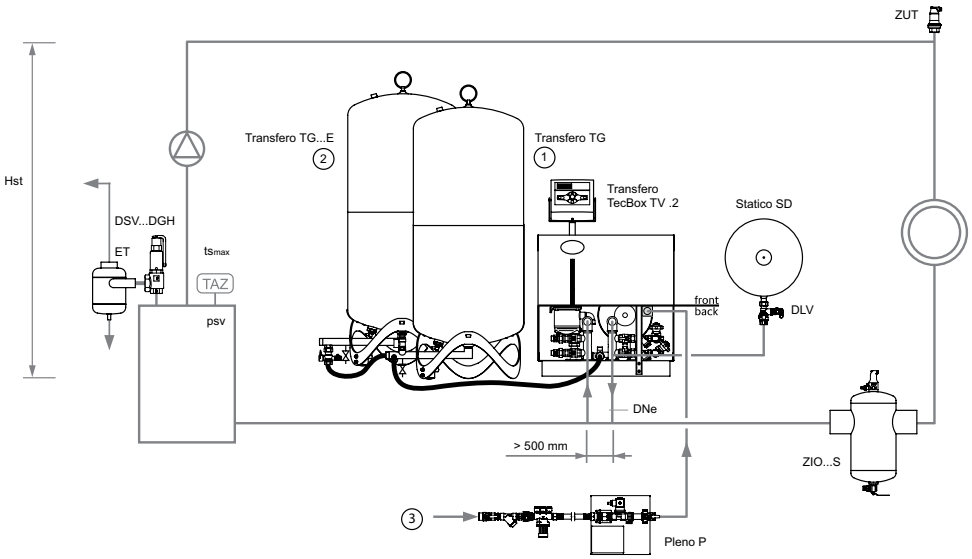


1. Water make-up connection, pw = min 2 bar, max. 10 bar

Zeparo ZIO...F for the central separation of sludge.
Zeparo ZUT for automatic venting during filling and during draining.
Further accessories, product and selection details, see: Datasheets *Zeparo ZU, Zeparo ZI/ZE* and *Accessories.*

Transfero TV .2
TecBox with 2 pumps, precision pressure maintenance ± 0,2 bar with degassing and Pleno P for the water make-up

For heating systems up to approx. 10 000 kW
(May require changes to meet local legislation)



1. Primary vessel
2. Secondary vessel
3. Water make-up connection, pw ≥ p0 + 1,9 bar (max. 10 bar)

Zeparo ZIO...S for the central separation of sludge.
Zeparo ZUT for automatic venting during filling and during draining.
Further accessories, product and selection details, see: Datasheet *Pleno*, *Zeparo ZU, Zeparo ZI/ZE* and *Accessories.*

Aquapresso
Pressure stabilisation for potable water

Aquapresso in potable hot water systems

Aquapresso saves valuable water in potable hot water systems. The expansion water is no longer lost through the safety valve but is temporarily stored by the Aquapresso. The correct setting of the pre set pressure is of importance for a faultless and reliable operation.

Calculation

For exact calculation please use software HySelect.

Preset pressure
p0 = pa - 0,3 bar
The preset pressure of the Aquapresso is set to at least 0,3 bar below the initial pressure pa

Initial pressure
pa = p_{FL}
The initial pressure corresponds to the flow presure p_{FL}. It should be kept at a constant level by means of the installation of a pressure regulating valve in the cold water line.

Safety valve
The non-operative pressure pR in the potable water network must not exceed 80 % of the response pressure safety valve.

$$psv = \frac{pR}{0,8}$$

Nominal volume
Vhs is the nominal volume of the potable water heater.
e (60 °C, table 1)

$$VN = Vhs \cdot e \cdot \frac{(psv + 0,5)\cdot(p0 + 1,3)}{(p0 + 1)\cdot(psv - p0 - 0,8)}$$

Quick selection

Heating-up from 10°C to 60°C

	p0 **4,0** bar | pa **4,3** bar				p0 **3,0** bar | pa **3,3** bar			
psv [bar]	**6**	**7**	**8**	**10**	**6**	**7**	**8**	**10**
Vhs [liter]	**Nominal volume VN** [liter]				**Nominal volume VN** [liter]			
50	8	8	8	8	8	8	8	8
80	8	8	8	8	8	8	8	8
100	12	8	8	8	8	8	8	8
150	18	12	8	8	8	8	8	8
180	18	12	12	8	8	8	8	8
200	25	12	12	8	12	8	8	**8**
250	25	18	12	12	12	12	8	8
300	35	18	18	12	18	12	12	12
400	50	25	25	18	18	18	12	18
500	50	35	25	25	25	18	18	25
600	80	50	35	25	35	25	18	25
700	80	50	35	35	35	25	25	25
800	80	50	50	35	35	35	25	25
900	140	80	50	35	50	35	35	35
1000	140	80	50	50	50	35	35	35

Example
Vhs = 200 litre
pa = 3,3 bar
psv = 10 bar

Selected:
Aquapresso ADF 8.10 with full flow-through
p0 = 3 bar
Reduce the factory set preset pressure from 4 bar to 3 bar!

Technical data:
Datasheet *Aquapresso*

Aquapresso in pressure-boosting systems

Aquapresso in pressure-boosting systems stabilize the potable water network and reduce the switching frequency. They can be installed at the low pressure and high pressure sides of a pressure-boosting system. Installation of an Aquapresso on the mains is always to be coordinated with the water supply company.

Approvals

Aquapresso is designed for potable water systems. As there are no uniform standards, please observe the local legislations for the individual countries with respect to the selection. These are decisive for the deployment of flowfresh fully flow-through or no flowthrough Aquapresso.

Aquapresso A...F with bypass

If the max. flow q_{max} is larger than the nominal flow qN for flowthrough Aquapresso A...F, the Aquapresso is to be installed with a bypass. The bypass is to be dimensioned for the flow difference with a flowspeed of 2 m/s. See Application example or instruction.

Calculation

Aquapresso on the suction side
Calculation according to 1988 T5

q_{max} | m³/h	VN | litre	qN Nominal flow
≤ 7	≥ 300	according to Datasheet
< 7 ≤ 15	≥ 500	
> 15	≥ 800	

Aquapresso for water hammering absorption
This topic is very complex and complicated. We recommend to have the calculation done by a specialized engineering office.

Aquapresso on the discharge side
VN calculation according to DIN 1988 T5 for the restriction of the switching frequency

$$VN = 0{,}33 \cdot q_{max} \cdot \frac{pa + 1}{(pa - pe) \cdot s \cdot n}$$

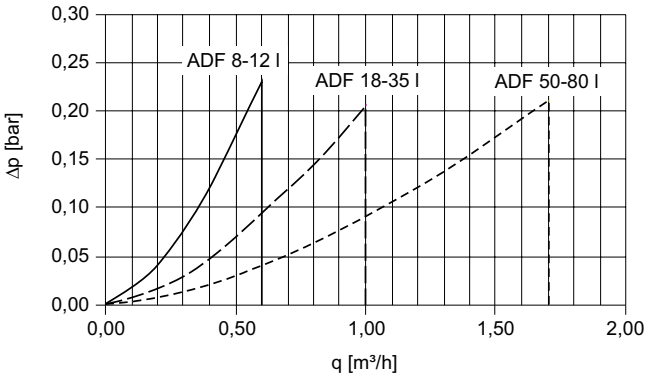
s Switching frequency | 1/h	Pump capacity | kW
20	≤ 4,0
15	≤ 7,5
10	> 7,5

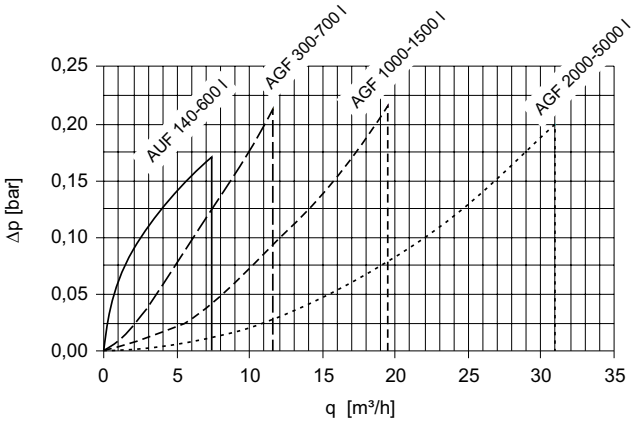
VN calculation by storage volume V between working pressure and turn-off pressure

$$VN = q \cdot \frac{(pe + 1) \cdot (pa + 1)}{(p0 + 1) \cdot (pa - pe)}$$

n = Number of pumps
pe = Working pressure
pa = Turn-off pressure
q_{max} = flow pump

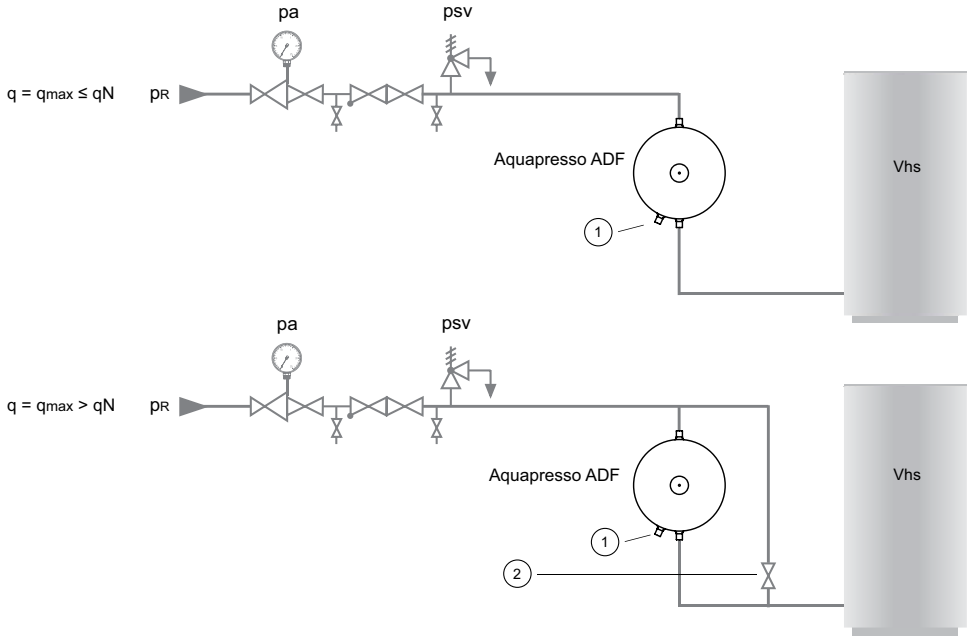
Aquapresso pressure losses





Application examples

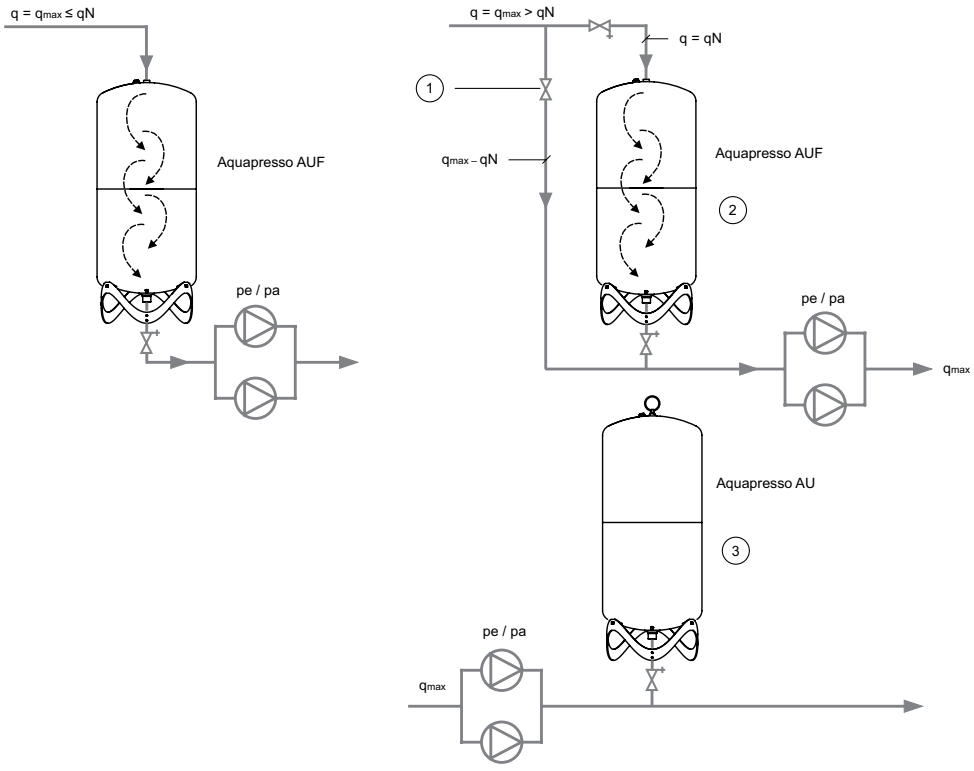
Aquapresso ADF
with flowfresh full flow-through in a potable water heating system
(May require changes to meet local legislation)



Aquapresso ADF
can be flow through from the top or from the bottom.

1. Hydrowatch
2. Bypass open, remove handwheel

Aquapresso AUF/AU
in a pressure-boosting system
(May require changes to meet local legislation)



Aquapresso AUF
at the low side; flow-through from the top to the bottom

Aquapresso AU
at the high pressure side; no flow-through

1. Bypass open, remove handwheel
2. p0 at least 0,5 bar below the minimum supply pressure
3. p0 = 0,9 working pressure of the peak load pump, at least 0,5 bar below the working pressure

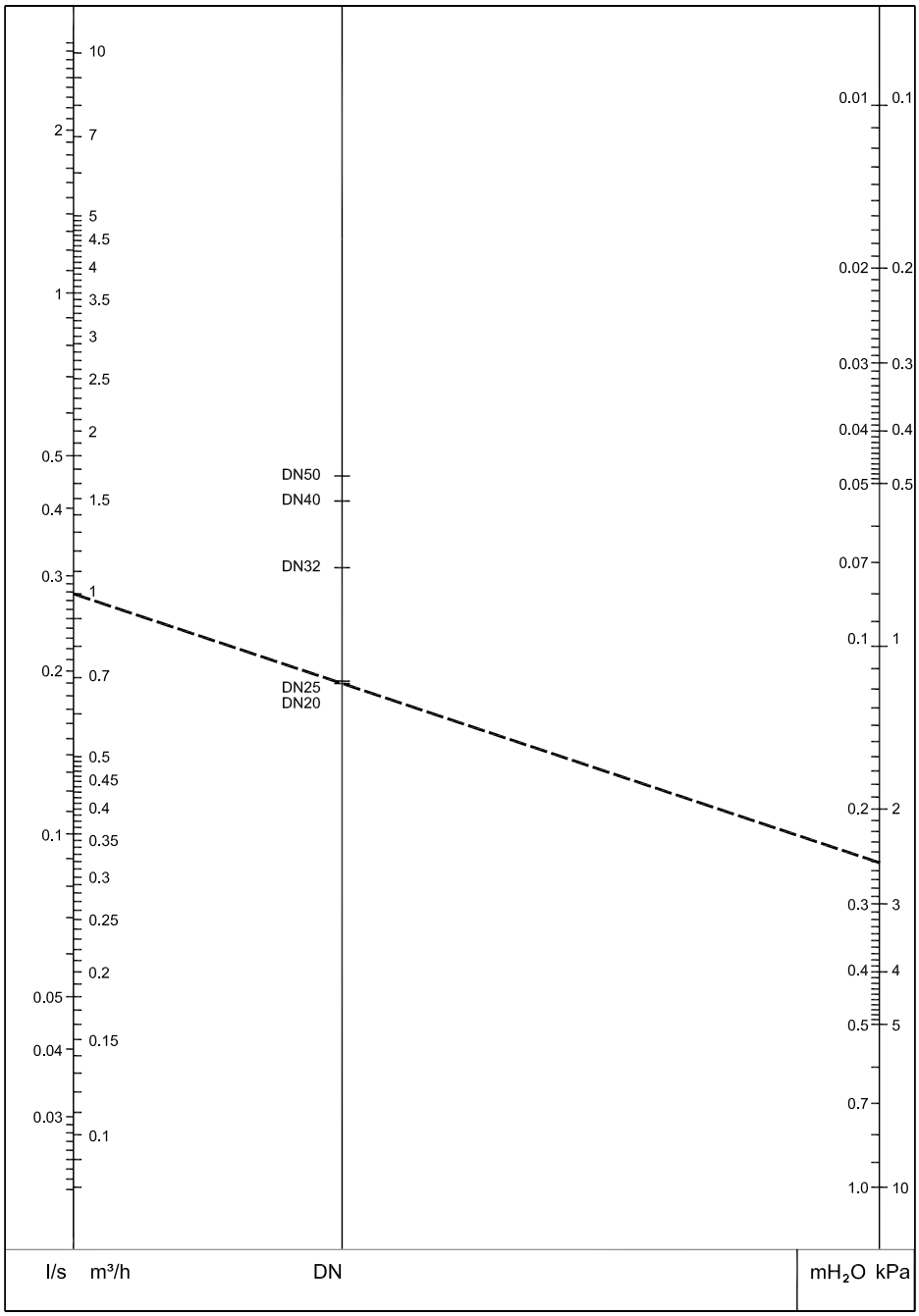
Zeparo Cyclone

Dirt separator with Cyclonic technology

Quick selection

Heating

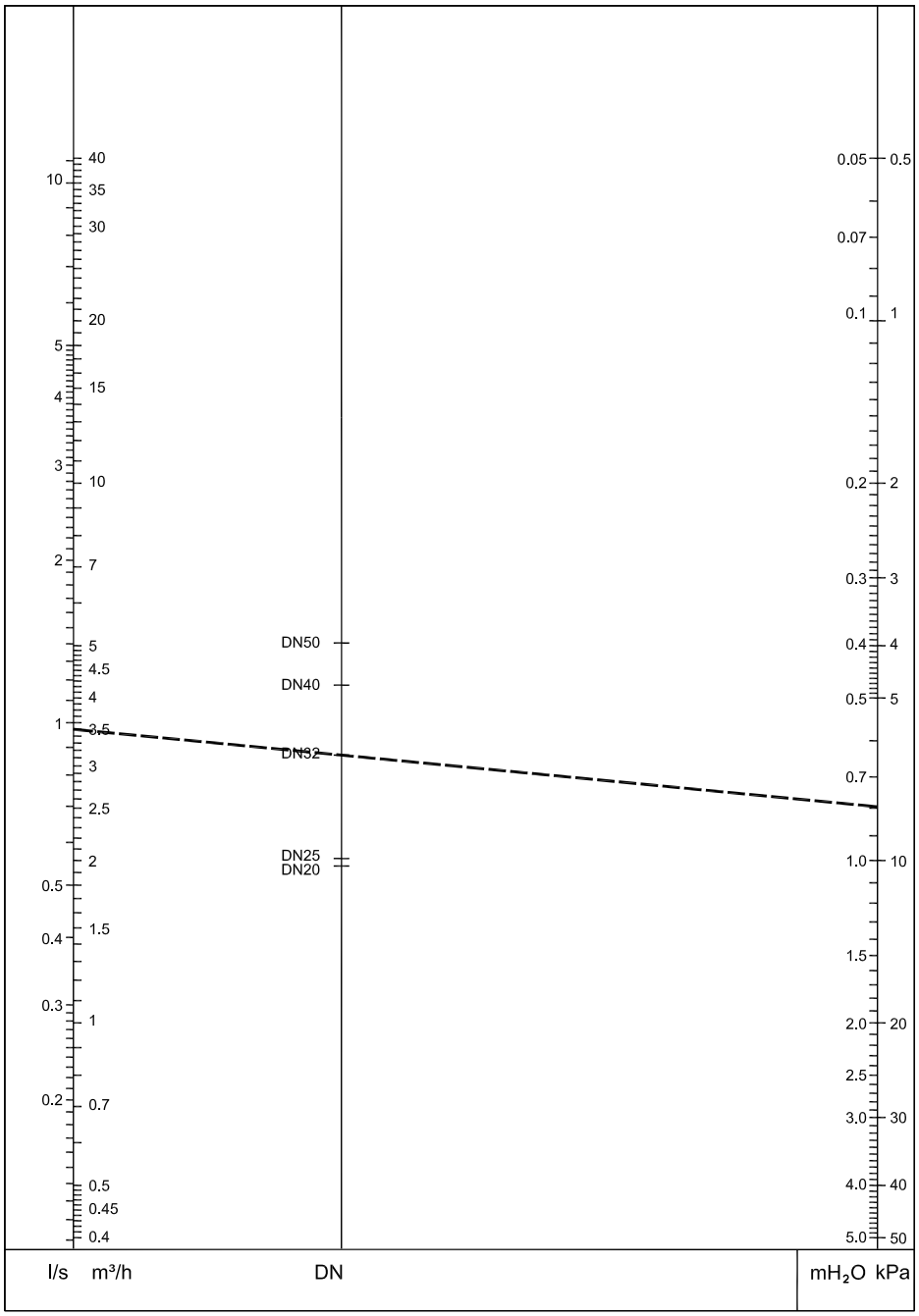
Example:
Heating system with a pipe DN 25 and 1000 l/h flow. Draw a line from the point 1000 l/h to required dimension DN20/25 and read on the line for pressure drop 2,5 kPa.



For exact calculation please use software HySelect.

Cooling

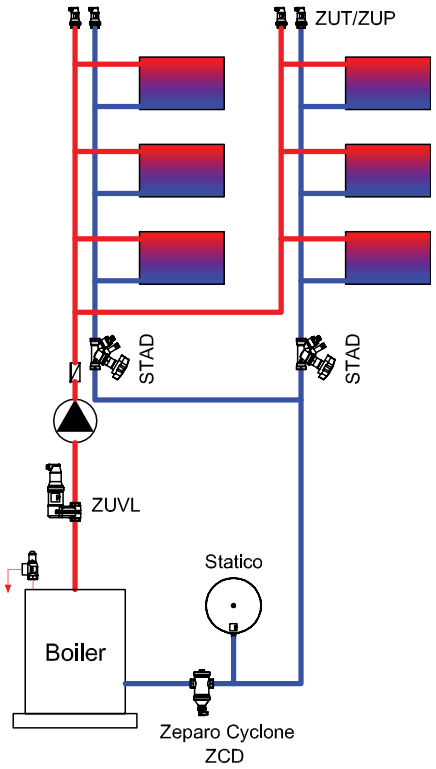
Example:
Cooling system with a pipe DN 32 and 3,5 m^3/h flow. Draw a line from the point 3,5 m^3/h to required dimension DN32 and read on the line for pressure drop 8 kPa.



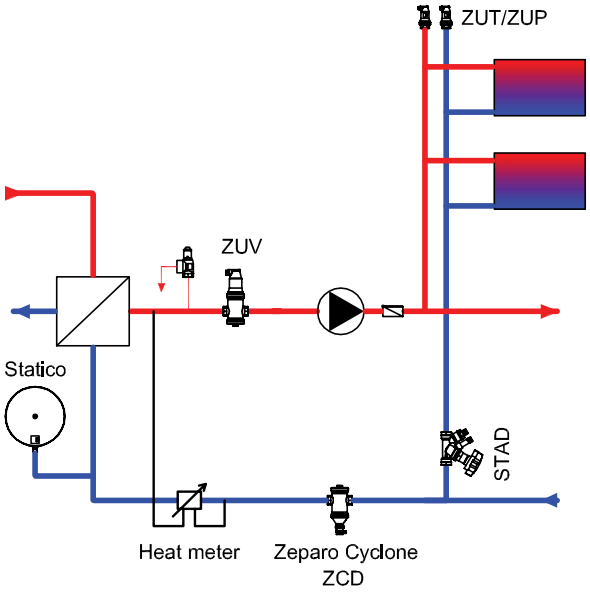
For exact calculation please use software HySelect.

Application examples

System with boiler



System with heat exchanger



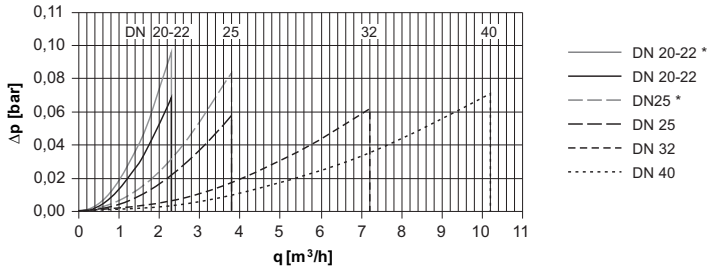
The Zeparo Cyclone dirt separator should be mounted either on the return in front of the unit to be protected or directly in front of the energy source.
There is no minimum distance required to pipe bends etc. before or after the Zeparo Cyclone.

Zeparo
Automatic air vents and separators

Quick selection

Approx. pressure loss (Δp) – Separator

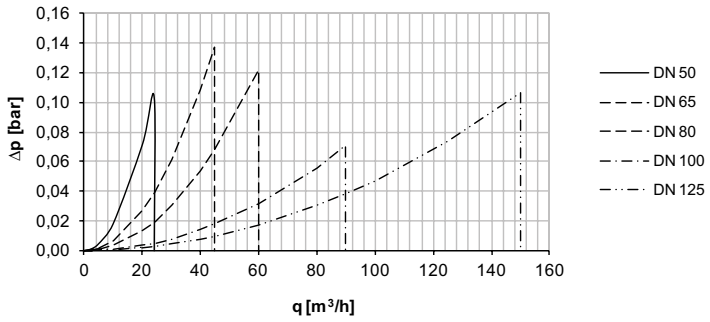
Zeparo DN 20-40
ZUV, ZUVL, ZUD, ZUDL, ZUM, ZUML, ZUK, ZUKM, ZUR, ZUC, ZUCM



Zeparo DN 20-40 must operate within the limits ≤ qN.

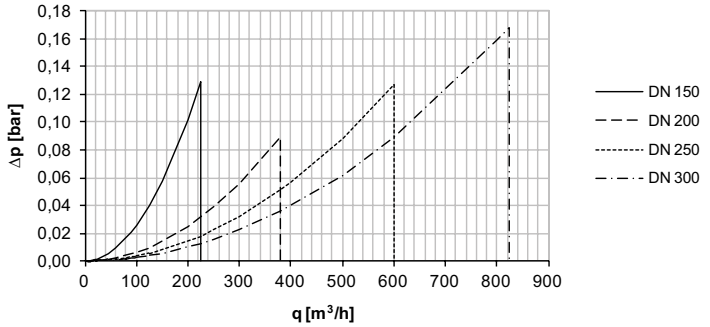
*) Lateral

Zeparo ZIO, ZIK, ZEK
DN 50 – DN 125



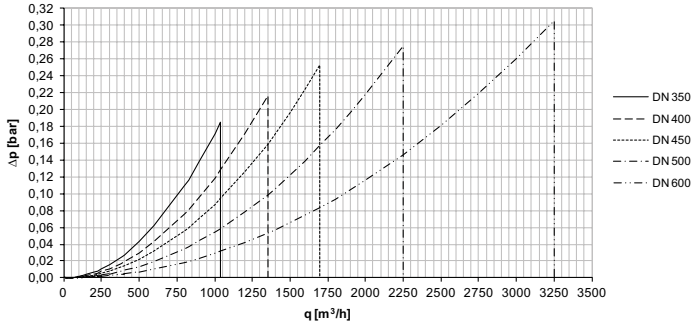
Zeparo DN 50-300 operation is limited to:
Continous flow ≤ qN
Intermittant flow ≤ qN_{max}

Zeparo ZIO, ZIK, ZEK
DN 150 – DN 300



Zeparo DN 50-300 operation is limited to:
Continous flow ≤ qN
Intermittant flow ≤ qN_{max}

Zeparo ZIO, ZIK, ZEK
DN 350 – DN 600



Zeparo DN 50 – DN 600 operation is limited to:
Continous flow ≤ qN
Intermittant flow ≤ qN_{max}

Zeparo Collect

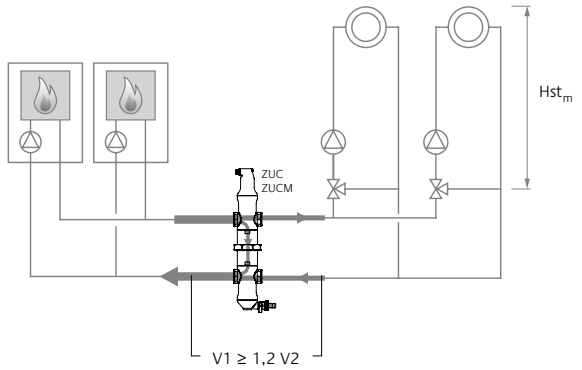
A low loss header suitable for the hydraulic coupling of primary and secondary heating circuits complete with deaeration and dirt separation. They are installed between the heat generator and the heating sircuits. Effective deaeration is only given if the maximum static height Hst_m is not exceeded, see table.

ts_{max} | °C	90	80	70	60	50	40	30	20	10
Hst_m | mWs	15,0	13,4	11,7	10,0	8,4	6,7	5,0	3,3	1,7

It is important that the volumetric flow rates between V1 and V2 are suitably adjusted.

Application examples

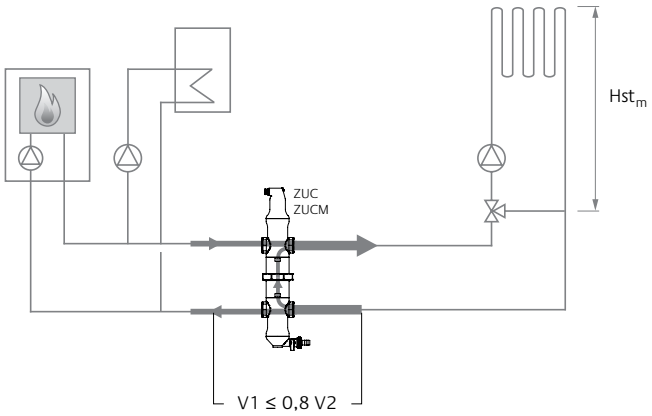
Example A: Primary flow rate q1 bigger than secondary flow rate q2
To be used where the secondary flow rates q2 are reduced through mixing of the return water so that the boiler can no longer be regulated. Not suitable for condensing boilers (example B).



Example A: q1 > q2

ZUC | ZUCM	q1 | m³/h
20	≤ 1,25
22	≤ 1,25
25	≤ 2
32	≤ 3,7
40	≤ 5

Example B: Primary flow rate q1 less than secondary flow rate q2
Use with condensing boilers and under floor heating systems. The secondary flow rate q2 of the under floor heating circuit is bigger than the flow rate through the condensing boiler q1. Hot water circuits should be connected on the primary side of the low loss header.



Example B: q1 < q2

ZUC | ZUCM	q2 | m³/h
20	≤ 1,25
22	≤ 1,25
25	≤ 2
32	≤ 3,7
40	≤ 5

Safety technology

Devices for sealed heating systems according to EN 12828 with TAZ ≤ 110°C

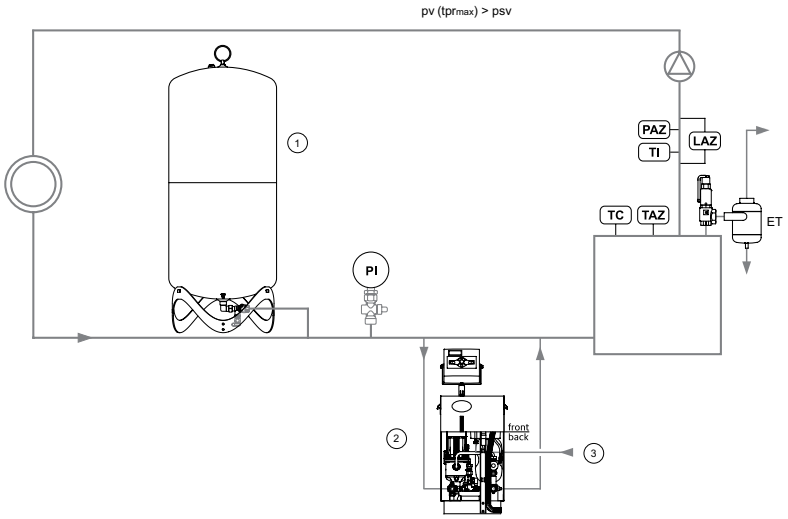
	Heated directly *with oil, gas, electricity, solid fuels*	**Heated indirectly** *heat exchanger with vapour or liquids*	**Datasheet**
General requirements			
TI Thermometer, display range ≥ 20 % above TAZ	•	•	Accessories
TAZ Temperature limiter according to EN 60730-2-9	•	• 1)	Accessories
TC Temperature controller	•	•	
LAZ Low-water protection 2) for roof top installations	•	–	Accessories
PI Manometer, display range ≥ 50 % above PSV	•	•	Accessories
SV Safety valve, EN 4126 for vapour emission	•	• 3)	Accessories
Pressure maintenance, e.g. Statico, Compresso, Transfero	•	•	Statico, Compresso, Transfero
Pressure maintenance monitoring device 4), e.g. Pleno	•	•	Pleno
Additional requirements for Q > 300 kW / heat generator			
LAZ Low-water protection 2)	•	–	Accessories
ET Blow tank 5)	•	• 6)	Accessories
PAZ Pressure limiter	•	–	
Additional requirements with slow-action heating			
Emergency cooling through thermal discharge protection or safety heat consumer, e.g. with solid fuel boilers	•	–	

1) Temperature controller sufficient according to standard, but not recommended.
2) Minimum pressure or flow limiters can be used as an alternative. For central roof units above 300 kW not additionally, 1 low-water protection is sufficient.
3) Dimensioning for water discharge with 1 litre/kWh possible if the primary temperature does not exceed the evaporation temperature with the safety valve opening pressure psv.
4) Automatic water make-up device (e.g. Pleno) or minimum pressure limiter.
5) Substitution with additional TAZ and PAZ possible. EN 12828 does not contain constructive specifications. We recommend to proceed according to the known state of the art of the countries, e.g. SWKI 93-1 in Switzerland or DIN 4751-2 in Germany.
6) Only if the vapour pressure pv at flow temperature tpr_{max} is bigger than safety valve opening pressure psv.

Application examples

Safety equipment according to EN 12828
(May require changes to meet local legislation)

Directly heated system
Q > 300 kW



1. Pressure maintenance e.g. Statico SU
2. Pressure maintenance monitoring device. Degassing with built-in water make-up, e.g. Vento VP...E
3. Water make-up connection

Terminology

General terms

BrainCube	Name of the new Pneumatex controls in Compresso, Transfero, Pleno and Vento.
TecBox	Name for Pneumatex compact control units consisting of hydraulic part and BrainCube control.
Quality features	airproof, silentrun, dynaflex, oxystop, vacusplit, helistill, leakfree, fillsafe, secuguard, flowfresh

Geometry

D	**Diameter** Characteristic diameter of the device.
H	**Height** (H, H1, H2, …) Characteristic overall height of the device.
h	**Installation dimensions** (h, h1, h2, …)
B	**Width** Characteristic overall width of the device.
l	**Depth** Characteristic overall width of the device
L	**Length** Characteristic overall length of the device or the fixture
si	**Insulation thickness**
m	**Empty weight** of the device at the time of delivery without the packaging.
S	**Connection** Characteristic dimension for the device connection.
S_{in}	**Connection in** Characteristic dimension for the device connection for streaming in media.
S_{out}	**Connection out** Characteristic dimension for the device connection for streaming off media.
Sv	**Connection vessel** Characteristic dimension for the device connection to the vessel.
Swm	**Connection water make-up** Characteristic dimension for the water make-up connection.
Sw	**Connection dewatering** Characteristic dimension for evacuation, dewatering operations.
R	**Male thread, conical**, ISO 7-1
Rp	**Female thread, cylindrical,** ISO 7-1
G	**Female tread, male thread, cylindrical**, ISO 228
DN	**Nominal diameter** Numeric size specifications for tube dimensions according to the pressure device directive.
PU	**Packaging unit** Standard packaging quantity in a box or pallet. For articles with the specifications of the PU please coordinate order quantities smaller than the PU with the sales office. Items within a PU always provide of a functional separate packaging.

Pressures

Hst	**Static height** Water column between the highest point of the system and the connecting branch of the expansion vessel, for water-controlled pressure-maintaining systems with pump (Transfero) referred to the suction joint of the pump.
Hst_m	**Maximum static height for the deployment of bubble separators** It depends on the temperature conditions at the place of installation of the separator.
p0	**Minimum pressure** Lower limit value for the pressure maintenance. It is mainly defined by the static height Hst and the vapour pressure pv. If the value is fallen short of the function of the pressure maintenance cannot be ensured. For large systems and temperature limits above 100°C the pressure limiting devices are triggered. *Statico, Aquapresso*: Pre set pressure to be set at the gas side. Be careful with respect to Aquapresso in drinking water systems! If the drinking water pressure falls short of the pre set pressure this may lead to pressure blows and to an increased bubble wear (Initial pressure pa). *Transfero, Compresso, Vento, Pleno:* The minimum pressure p0 is calculated by the BrainCube control from the static height Hst and the vapour pressure pv (TAZ).
pz_{min}	**Minimum required equipment pressure** e.g. NPSH requirement for pumps or boilers
pv	**Vapour pressure** According to EN 12828 the excess pressure towards the atmosphere to prevent evaporation.
pa	**Initial pressure** Lower threshold for an optimum pressure maintenance. During the operation it must always be above the minimum pressure. We recommend at least 0,3 bar. For systems with minimum pressure limiters this value must be selected such that the triggering of the limiters is prevented in all operating modes. With respect to Pneumatex devices with BrainCube control the initial pressure is calculated internally by the control. *Statico*: Pressure with minimum system temperature after feeding the water reserve. Water makeup devices in the sense of a pressure maintenance monitoring device according to EN 12828 must be triggered if the value is fallen short of. If the filling temperature is equal to the lowest system temperature the initial pressure corresponds to the filling pressure. e.g. heating systems: lowest system temperature ~ filling temperature ~ 10 °C. *Compresso, Transfero*: Pressure at which the pump or the compressor must be triggered. *Aquapresso*: Pressure of the drinking water network before the Aquapresso. It must also always be greater than the pre set pressure at flow conditions.
pe	**Final pressure** Upper threshold for an optimum pressure maintenance. It must be at least 0,5 bar below the safety valve response pressure. For systems with maximum pressure limiters it must be selected such that the triggering of the limiters is prevented in all operating modes. *Statico*: The highest pressure to be assumed after the max. system temperature has been achieved. *Compresso, Transfero:* The pressure at which the spill device must open at the latest. *Aquapresso:* The highest pressure to be assumed after the absorption of the drinking water to bestored.
psv	**Response pressure safety valve** According to EN ISO 4126-0 the pressure at which the safety valve at the heat generator begins to open.
psv_c	**Closing pressure tolerance** Difference between response pressure and closing pressure for safety valves | EN ISO 4126-1.
psv_o	**Opening pressure tolerance** Difference between response pressure and opening pressure for safety valves | EN ISO 4126-1.
PS	**Maximum admissible pressure** According to the pressure device directive the maximum pressure for which the pressure device has been dimensioned according to the manufacturer's specification.
PS_{CH}	**Maximum admissible pressure Switzerland** Pressure up to which the expansion vessel does not require an approval according to the Swiss directive SWKI 93-1 (PS · VN ≤ 3000 bar · litre).
PF	**Pressure factor** Ratio between the required nominal volume VN and the water absorption volume Ve + Vwr for expansion vessels.
pw	**Fresh water pressure** Flow pressure of the fresh water network, e.g. drinking water network, that is available before the water make-up device.
dpu	**Working pressure range** Pressure range for which a water make-up or degassing device has been designed. It must be adjusted to the working pressure of the system.
dpqN	**Pressure loss with nominal flow** Pressure loss referred to the nominal flow capacity of a device, e.g. Aquapresso or Zeparo.

Volumes

e	**Expansion coefficient** According to EN 12828 the factor for the calculation of the expansion volume from the water capacity. In this case, referred to the solidification point.
Vs	**Overall system water capacity** According to EN 12828 the overall water capacity of the heating system that is involved in the volume expansion.
vs	**Specific overall system water capacity** Overall water capacity of the heating system that is involved in the volume expansion, referred to the installed heating surface output.
VN	**Nominal volume** According to the pressure device directive the entire internal volume of the pressure compartment of the expansion vessel.
VNd	**Water capacity for which a device is rated** Characteristic performance parameter that describes up to which water capacity the device, e.g. Vento, can be used.
Vg	**Water content collector panels** For solar systems to ENV 12977-1 the collector volume which can phase change to steam has to be added to the connecting pipes volume.
Ve	**Expansion volume** According to EN 12828 the volume expansion of the water capacity of the heating system between the min. and max. system temperature.
Vwr	**Water reserve** According to EN 12828 the water quantity in the expansion vessel for the compensation of water losses caused by the system.

Temperatures

ts_{max}	**Maximum system temperature** Maximum temperature for the calculation of the volume expansion. For heating systems the dimensioned flow temperature at which a heating system is to be operated with the lowest outside temperature to be assumed (standard outside temperature according to EN 12828). For cooling systems the max. temperature that is achieved due to the operation mode or standstill, for solar systems the temperature up to which an evaporation is to be avoided.
ts_{min}	**Lowest system temperature** Lowest temperature for calculating expansion volumes. The lowest system temperature is equal to the freezing point. It is dependant on the percentage of antifreeze additives. For water without additives $ts_{min} = 0$.
t_{pr}	**Primary flow temperature** Maximum flow temperature in primary circuit of heat exchangers (indirect fired).
t_r	**Return temperature** Return temperature of the heating system with the lowest outside temperature to be assumed (standard outside temperature according to EN 12828).
TV	**Maximum flow temperature** Maximum flow temperature for which a device is equipped according to the normative and safetyrelated requirements. TV may be greater than TS if the device is installed at a place with $t \leq TS$, e.g. in the system return.
TAZ	**Safety temperature limiter | Safety temperature controller | Temperature limit** Safety device according to EN 12828 for the temperature protection of heat generators. If the set temperature limit is exceeded the heating is turned off. Limiters are locked, controllers automatically release the heat supply if the set temperature is fallen short of. Setting value for systems according to EN 12828 ≤ 110 °C.
TS	**Maximum admissible temperature** According to the pressure device directive the maximum temperature for which the pressure device or the fixture has been dimensioned according to the manufacturer's specification.
TS_{min}	**Minimum admissible temperature** According to the pressure device directive the minimum temperature for which the pressure device or the fixture has been dimensioned according to the manufacturer's specification.
TWM	**Maximum admissible temperature for water make up** The highest admissible temperature for make up units as part of a pressurisation or degassing system. This only applies if TWM < TS.
TB	**Maximum admissible bag temperature** Maximum admissible permanent temperature for the butyl bag.
TB_{min}	**Minimum admissible bag temperature** Minimum admissible permanent temperature for the butyl bag.
TA	**Maximum admissible ambient temperature** Maximum ambient temperature for the installation of a device.

Capacities

Q	**Heat capacity** Blowing-off capacity of a safety valve referred to the vapour emission according to the component inspection.
QNsv	**Heat capacity** Blow off capacity of a safety valve referred to the vapour emission according to the component inspection.
$QNsv_W$	**Heat capacity** Blow off capacity of a safety valve for water flow according to specification, related the to heat output of the heat generator, 1 kW = 1 l/h.
qN	**Flow rate, Nominal flow** Nominal throughput of a device, e.g. Aquapresso, Zeparo or nominal flow rate of a compressor or pump.
qN_{max}	**Maximum flow** Maximum throughput of a device, e.g. Zeparo.
Kvs	**Flow parameter** Throughput of a device with a differential pressure of 1 bar.
qNwm	**Water make-up capacity** Nominal capacity of a water make-up device.
U	**Voltage** Nominal voltage for an electric device.
I	**Electric current** Admissible current load for a device.
Pel	**Electric load** Load for an electric device.
SPL	**Sound pressure level** Sound pressure level dB(A) – effective perceived.
IP	**Code for protection against moisture and physical contact** according to EN 60529.

Additional information

System design: calculation software HySelect

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