



EXPANSION TANKS



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STROJIRENSKÝ KUSEBNÍ
ÚSTAV



Expansion tanks

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E x p a n s i o n t a n k s

Expansion tanks are devices designed to absorb the volume change of water or some other liquids, thus allowing the correct operation of a heating plant during all its operative phases.

Elbi produces closed expansion tanks composed by a tank in sheet steel and a bladder in synthetic material which separates the heating circuit from a chamber previously charged with air.

Expansion tanks with a bladder, which are available from 5 to 5.000 litres, are constructed by using quality sheet steels according to UNI-EN regulations and welded according to some strict qualitative standards; they are produced on automated lines, welded with procedures and approved weld materials, equipped with bladders in special rubber used against heat and ageing which are resistant up to 110° C (all of them are produced by ELBI); they are previously charged at a pressure of 0.5 – 1.0 – 1.5 bars according to the static height of the water column.

Once the construction has been completed, all the models are subjected to a hydraulic test with a pressure of 1.5 times higher than the designed one.

There are also some versions constructed according to the most important European regulations in force.

E l b i b l a d d e r s

Elbi produces all the bladders which mounts on its own equipment, as for the production it makes exclusive use of modern injection presses, the most advanced ones in this sector.

Dies designed by the Elbi technical department ensure the complete compatibility with tanks. All the bladders are tested by the company's quality control service at the end of the production run. Bladders which are used in the ERL series are constructed by applying an exclusive process which allows to obtain the exact dimensions corresponding to the tank's actual volume, thus eliminating every kind of mechanical stress during the operation.

Their mixing is the result of some studies and researches carried out directly by the Elbi technical department.

ER - CE series

2 to 24 litres



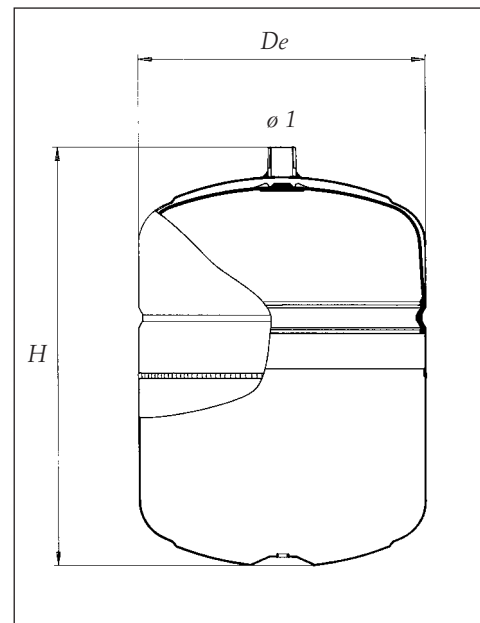
The available models from 2 to 24 litres are designed to be installed in different types of plant.

Besides, they are available in special versions, constructed according to the most important international regulations: CE, WRAS, UDT, etc.

4

Characteristics

- Working temperature: $-10^{\circ} \div +99^{\circ}\text{C}$
- Sturdy structure in high-quality steel, designed to endure for a long time.
- Painting with long life epoxy powders.
- Bladders in special rubber with those characteristics which ensure better performances and a longer life.
- In compliance with essential safety requirements of directive 97/23/EC.
- CE marking (type ER2 - ER5 without CE marking).



Model	Capacity litres	Maximum working pressure bar	Precharge pressure bar	De mm	H mm	ø1	Packaging mm
ER2	2	8	1,5	146	230	1/2"	150 x 150 x 240
ER5	5	8	1,5	205	225	3/4"	210 x 210 x 250
ER8 CE	8	8	1,5	205	300	3/4"	210 x 210 x 320
ER12 CE	12	8	1,5	270	300	3/4"	280 x 280 x 310
ER18 CE	18	8	1,5	270	410	3/4"	280 x 280 x 450
ER24 CE	24	8	1,5	320	355	3/4"	330 x 330 x 375

1MPa = 10 bar

Selection of the expansion tank

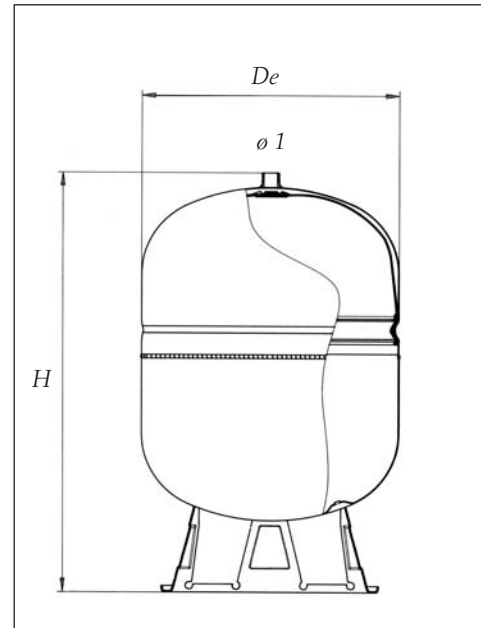
The table simplifies the choice of the ELBI expansion tank to be installed in hot water systems. The selection of the tank can be effectuated starting from the system's total capacity or from the plant's power, taking into consideration an average content of 12 litres per 1000 Kcal/h of power and a plant's maximum working pressure of 3 bars.

Model	Precharge pressure bar	Plant height meters m	Tank's volume acceptable litres	Tank's absorption capacity %	Temperature difference $\Delta T = (90 - 14)^\circ\text{C}$ Δ coefficient of expansion 0,035		
					Total water content in the plant litres	Heat-generator's power Kcal/h kW	
ER5	0,5	5	3,1	62	89	7.400	8,6
	1	10	2,5	50	71	5.900	6,86
ER8 CE	0,5	5	5	62	143	11.900	13,84
	1	10	4	50	114	9.500	11,4
ER12 CE	0,5	5	7,5	63	214	17.800	20,7
	1	10	6	50	171	14.250	16,57
ER18 CE	0,5	5	11,3	63	323	26.900	31,3
	1	10	9	50	257	24.100	28,2
	1,5	15	6,7	37	191	15.900	18,5
ER24 CE	0,5	5	15,5	65	443	36.900	43
	1	10	12	50	343	28.600	33,26
	1,5	15	9,3	39	266	22.200	25,82



The available models from 35 to 500 litres are designed to be installed in the different types of plant.

Besides, they are available in special versions, constructed according to the most important international regulations: CE, WRAS, UDT, etc.



Characteristics:

- Working temperature: $-10^{\circ}\div +99^{\circ}\text{C}$
- Sturdy structure in high-quality steel, designed to endure for a long time.
- Painting with long life epoxy powders.
- Bladders in special rubber with those characteristics which ensure better performances and a longer life.
- In compliance with essential safety requirements of directive 97/23/EC.
- CE marking.

Model	Capacity litres	Maximum working pressure bar	Precharge pressure bar	De mm	H mm	ø1	Packaging mm
ERCE 35*	35	10	1,5	400	390	3/4"	410 x 410 x 410
ERCE 50*	50	10	1,5	400	500	1"	410 x 410 x 535
ERCE 80	80	10	1,5	400	840	1"	410 x 410 x 860
ERCE 100	100	10	1,5	500	795	1"	510 x 510 x 830
ERCE 150	150	10	1,5	500	1.025	1"	510 x 510 x 1040
ERCE 200	200	10	1,5	600	1.100	1"	610 x 610 x 1100
ERCE 250	250	10	1,5	650	1.190	1"	660 x 660 x 1210
ERCE 300	300	10	1,5	650	1.265	1"	660 x 660 x 1290
ERCE 500	500	10	1,5	775	1.425	1" 1/4	785 x 785 x 1440

*Standard without base, upon request with feet.
1MPa = 10 bar

Selection of the expansion tank

The table simplifies the choice of the ELBI expansion tank to be installed in hot water systems. The selection of the tank can be effectuated starting from the system's total capacity or from the plant's power, taking into consideration an average content of 12 litres per 1000 Kcal/h of power.

Model	Precharge pressure bar	Plant's maximum working pressure bar	Plant height m	Tank's acceptable volume litri	Tank's absorption capacity %	Temperature difference $\Delta T = (90 - 14)^\circ\text{C}$ Δ coefficient of expansion 0,035		
						Total water content in the plant litres	Heat-generator's power Kcal/h kW	
ER CE 35	1	3	10	17,6	50	503	41.900	48,72093
	1,5		15	13,1	37	374	31.200	36,27907
	2		20	8,8	25	251	20.900	24,30233
ER CE 50	1	3	10	25	50	714	59.500	69,18605
	1,5		15	18,8	38	537	71.400	52,03488
	2		20	12,5	25	357	29.750	34,59302
ER CE 80	1	3	10	40	50	1.143	95.250	110,7558
	1,5		15	30	38	857	71.400	83,02326
	2		20	20	25	571	47.600	55,34884
ER CE 100	1	5	10	50	50	1.428	119.000	138,3721
	1,5		15	38	38	1.086	90.500	105,2326
	2		20	25	25	714	59.500	69,18605
ER CE 150	1	5	10	100	67	2.857	238.000	276,7442
	1,5		15	87	58	2.486	207.000	240,6977
	2		20	75	50	2.143	178.600	207,6744
ER CE 200	1	5	10	133	67	3.800	317.000	368,6047
	1,5		15	116	58	3.314	276.000	320,9302
	2		20	100	50	2.857	238.000	276,7442
	2,5		25	83	42	2.371	197.600	229,7674
	3		30	66	33	1.886	157.200	182,7907
ER CE 250	1	5	10	178	71	5.086	423.800	492,7907
	1,5		15	160	64	4.571	380.900	442,907
	2		20	143	57	4.086	340.500	395,9302
	2,5		25	125	50	3.571	297.600	346,0465
ER CE 300	3	6	30	107	43	3.057	254.800	296,2791
	1		10	214	71	6.114	509.500	592,4419
	1,5		15	193	64	5.514	459.500	534,3023
	2,5		25	171	57	4.886	407.000	473,2558
	3		30	150	50	4.286	357.200	415,3488
ER CE 500	3	6	30	128	43	3.657	304.800	354,4186
	1,5		15	321	64	9.171	764.300	888,7209
	2		20	285	57	8.143	678.600	789,0698
	2,5		25	250	50	7.143	595.300	692,2093
	3		30	215	43	6.143	512.000	595,3488
	3,5		35	178	36	5.086	427.000	496,5116



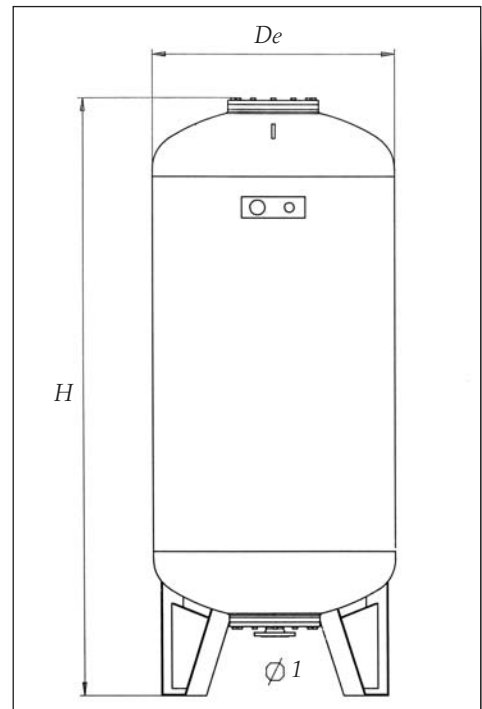
ERL - CE series

750 to 5000 litres



Thanks to an ELBI exclusive design, expansion tanks with an interchangeable bladder of the ERL series represent a valid solution for the installation in plants with high water contents which till now made us use traditional tanks without any bladders or install series of smaller tanks.

The ERL series is available in models from 750 to 5000 litres thanks to an exclusive designed bladder. The ERL series' bladders ensure a practically unlimited life, since they are produced in order to operate without any stretching. Besides, expansion tanks are available in special versions, constructed according to the most important international regulations: CE, UDT, CZ, etc.



Characteristics:

- Working temperature: $-10^{\circ}\div+99^{\circ}\text{C}$.
- Sturdy structure in high-quality steel, designed to endure for a long time.
- Painting with long life epoxy powders.
- Bladders in special rubber with those characteristics which ensure better performances and a longer life.
- In compliance with essential safety requirements of directive 97/23/EC.
- CE marking.

Model	Capacity litres	Maximum working pressure		Precharge pressure bar	De mm	H mm	ø1
		bar	bar				
ERL 750	750	10	16	no	800	1960	2" M
ERL 1000	980	10	16	no	800	2340	2" M
ERL 2000	2.000	10	16	no	1.100	2750	G 3"
ERL 3000	3.000	10	16	no	1.250	3100	G 3"
ERL 5000	5.000	10	-	no	1.550	3420	G 3"

1MPa = 10 bar

Selection of the expansion tank

The table simplifies the choice of the ELBI expansion tank to be installed in hot water systems. The selection of the tank can be effectuated starting from the system's total capacity or from the plant's power, taking into consideration an average content of 12 litres per 1000 Kcal/h of power and a plant's maximum working pressure of 6 bars.

Model	Precharge pressure bar	Plant height m	Tank's acceptable volume litres	Tank's absorption capacity %	Temperature difference $\Delta T = (90 - 14)^\circ\text{C}$ Δ coefficient of expansion 0,035		
					Total water content in the plant litres	Heat-generator's power Kcal/h kW	
ERL 750	1,5	15	482	64	13.771	1.148.000	1334,884
	2	20	430	57	12.286	1.024.000	1190,698
	2,5	25	375	50	10.714	893.000	1038,372
	3	30	321	43	9.171	765.000	889,5349
ERL 1000	3,5	35	268	36	7.657	638.000	741,8605
	2	20	571	57	16.314	1.360.000	1581,395
	2,5	25	500	50	14.286	1.190.000	1383,721
	3	30	430	43	12.286	1.024.000	1190,698
ERL 2000	3,5	35	357	35	10.200	850.000	988,3721
	4	40	286	28	8.171	681.000	791,8605
	2	20	1.142	57	32.628	2.719.000	3161,628
	2,5	25	1.000	50	28.571	2.380.000	2767,442
ERL 3000	3	30	857	43	24.486	2.040.000	2372,093
	3,5	35	714	35	20.400	1.700.000	1976,744
	4	40	571	28	16,314	1.359.000	1580,233
	2	20	1.714	57	48.970	4.080.000	4744,186
ERL 5000	2,5	25	1.500	50	42.857	3.571.000	4152,326
	3	30	1.285	43	36.714	3.059.000	3556,977
	3,5	35	1.071	35	30.600	2.550.000	2965,116
	4	40	857	28	2.485	2.040.000	2372,093
ERL 5000	2	20	2.857	57	81.628	6.802.000	7909,302
	2,5	25	2.500	50	71.428	5.952.000	6920,93
	3	30	2.142	43	61.200	5.100.000	5930,233
	3,5	35	1.785	35	51.000	4.250.000	4941,86
	4	40	1.428	28	40.800	3.400.000	3953,488



ERP series

6 to 24 litres

ERP tanks are available from 6 to 24 litres for a total number of 22 models.

The range of tanks proposed with the ERP series has been designed in order to ensure the greatest reliability. They are available in the TÜV and WRAS approved version.

Characteristics:

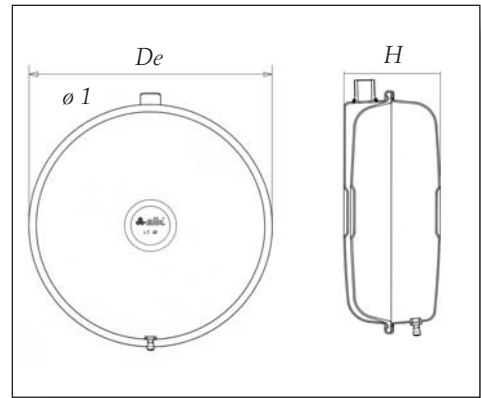
- Sturdy structure in high-quality steel, designed to endure for a long time.
- Painting with long life epoxy powders.
- Bladders in special rubber with those characteristics which ensure better performances and a longer life.
- Working temperature: $-10^{\circ}\div+90^{\circ}\text{C}$
- Precharge pressure: 1 bar
- In compliance with directive 97/23/EC (PED)

Model	Capacity litres	Maximum working pressure bar	Dimensions mm	De mm	H mm	ø1
ERP 320/6	6	3	/	320	94	3/4"
ERP 320/8	8	3	/	320	121	3/4"
ERP 320/10	10	3	/	320	131	3/4"
ERP 320/12	12	3	/	320	165	3/4"
ERP 385/7	7	3	/	385	83	3/4"
ERP 385/8	8	3	/	385	98	3/4"
ERP 385/10	10	3	/	385	108	3/4"
ERP 385/12	12	3	/	385	139	3/4"
ERP 385/14	14	3	/	385	146	3/4"
ERP 416/6	6	3	/	416	65	3/8"
ERP 416/8	8	3	/	416	75	3/8"
ERP 416/10	10	3	/	416	90	3/8"
ERP RET 6	6	3	516 x 196	/	95	3/4"
ERP RET 8	8	3	516 x 196	/	110	3/4"
ERP RET 10	10	3	516 x 196	/	124	3/4"
ERP RET 12	12	3	516 x 196	/	152	3/4"
ERP - Q 7	7	3	436 x 344	/	77	3/8"
ERP - Q 10	10	3	436 x 344	/	97	1/2"
ERP - Q 12	12	3	436 x 344	/	117	1/2"
ERP - Q 14	14	3	436 x 344	/	132	1/2"
ERP - Q 16	16	3	436 x 344	/	147	1/2"
ERP - Q 18	18	3	436 x 344	/	155	1/2"
ERP - Q 20	20	3	436 x 344	/	162	1/2"
ERP - Q 24	24	3	436 x 344	/	177	1/2"

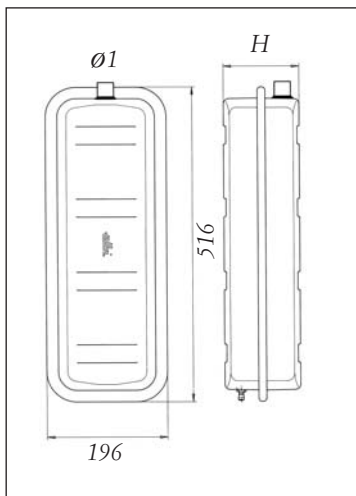
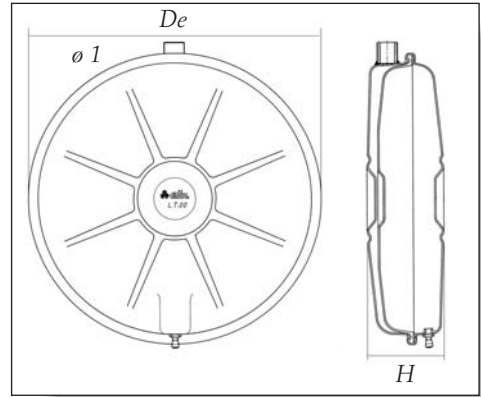
1MPa = 10 bar



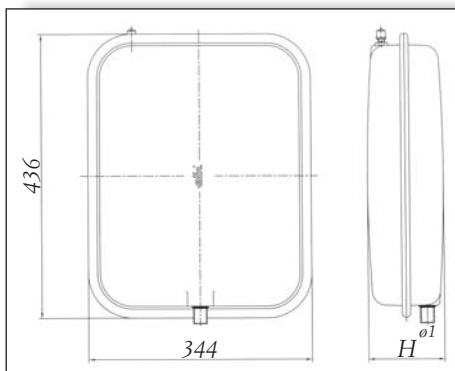
ERP 320
ERP 416



ERP 385



ERP RET



ERP - Q



Selection of the expansion tank ERP series

The table simplifies the choice of the ELBI expansion tank to be installed in hot water systems. The selection of the tank can be effectuated starting from the system's total capacity or from the plant's power, taking into consideration an average content of 8 litres per 1000 Kcal/h of power, a precharge pressure of 1 bar and a plant's maximum working pressure of 3 bars.

Model	Plant height m	Prech. press bar	Tank accept. vol lt	Tank absorb. cap. %	Plant Water content (lt)	Plant Power Kcal/h	Plant Power kW
ERP 320/6	10	1,0	3,0	50	86	10.700	12,44
ERP 320/8	10	1,0	4,0	50	114	14.300	16,63
ERP 320/10	10	1,0	5,0	50	143	17.900	20,80
ERP 320/12	10	1,0	6,0	50	172	21.500	25,00
ERP 385/7	10	1,0	3,5	50	100	12.500	14,53
ERP 385/8	10	1,0	4,0	50	114	14.300	16,63
ERP 385/10	10	1,0	5,0	50	143	17.900	20,81
ERP 385/12	10	1,0	6,0	50	172	21.500	25,00
ERP 385/14	10	1,0	7,0	50	200	25.000	29,10
ERP 416/8	10	1,0	4,0	50	114	14.300	16,63
ERP RET 6	10	1,0	3,0	50	86	10.700	12,44
ERP RET 8	10	1,0	4,0	50	114	14.300	16,63
ERP RET 10	10	1,0	5,0	50	143	17.900	20,81
ERP RET 12	10	1,0	6,0	50	172	21.500	25,00
ERP Q 7	10	1,0	3,5	50	100	12.500	14,53
ERP Q 10	10	1,0	5,0	50	143	17.900	20,81
ERP Q 12	10	1,0	6,0	50	172	21.500	25,00
ERP Q 14	10	1,0	7,0	50	200	25.000	29,10
ERP Q 16	10	1,0	8,0	50	228	28.500	33,14
ERP Q 18	10	1,0	9,0	50	258	32.200	37,44
ERP Q 20	10	1,0	10,0	50	286	35.800	41,63
ERP Q 24	10	1,0	12,0	50	343	42.900	49,88

1MPa = 10 bar

Max press.	3 bar
t max	90°C
t min	10°C



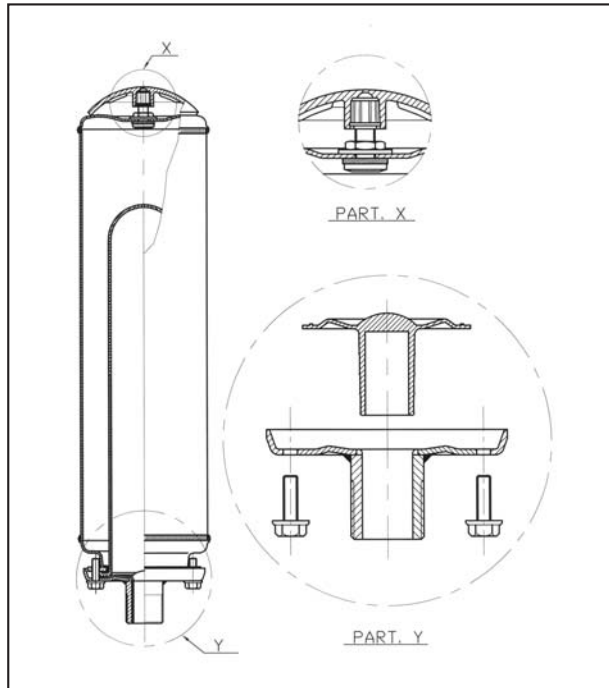
SANY series

0,5 to 4 litres

Replaceable butyl bladder slim type tanks

ELBI's New Slim type Tanks serve the double purpose of Shock Absorber and Domestic Hot Water storage vessel in wall hung and floor standing boilers.

The SANY product line has been developed by ELBI to respond to OEM's and contractors' demand for plumbing cushions that can be fitted in small and narrow spaces. The product design and appliance-finish paint render these vessels suitable for use in open/ visible spaces of the house as well.



Products specifications:

- Replaceable Butyl Bladder.
- White appliance- finish color.
- $\frac{3}{4}$ " GAS connection.
- Working temperature: $-10^{\circ}\text{C} \div +99^{\circ}\text{C}$.
- Plastic screen flange protection.

Model	Capacity litres	Diameter (mm)	Height (mm)	Spud length (mm)	Maximum working pressure (bar)	Precharge pressure (bar)	Packaging (mm)
SANY - 0,5	0,5	90	170	30	10	3	–
SANY - 1	1	90	240	30	10	3	–
SANY - 2	2	90	380	30	10	3	95 x 95 x 390
SANY - 3	3	90	530	30	10	3	95 x 95 x 540
SANY - 4	4	90	670	30	10	3	95 x 95 x 680

D - CE series

2 to 500 litres



Polifunctional sanitary vessels with bladder

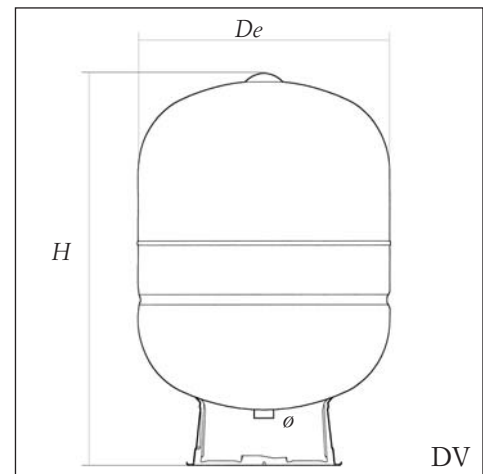
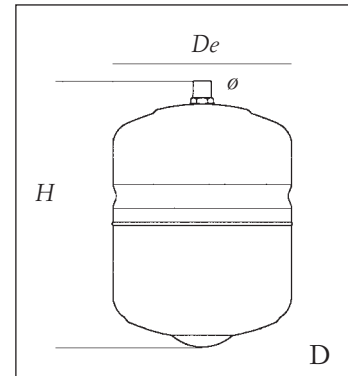
Polifunctional sanitary vessels with fixed bladder are designed to be fitted both into sanitary system as expansion tanks,

suitable to absorb the water expansion volume generated by a changing temperature, as well as tanks for cold water sanitary systems. Both applications are possible thanks to the exclusive Top-Pro® anti-corrosion treatment which ensures the protection against corrosion of the inner surface of the fitness of all parts in contact with water.

Installing a D series sanitary vessel considerably cuts down operating costs, while suppressing the discharge function of the safety valve.

Characteristics:

- Equipped with a fixed alimentary bladder in Butyl that ensures permanent isolation of the air cushion from the water;
- Internal protection of the water connection in Nylon 66;
- Guaranteed for 3 years (all the D series);
- In compliance with essential safety requirements of directive 97/23/EC;
- CE marking.



Model	Capacity litres	Max working pressure (bar)	Precharge pressure (bar)	ø	De mm	H mm	Packaging mm
D 2	2	10	3	1/2"	146	230	150 x 150 x 240
D 5	5	10	3	3/4"	205	225	210 x 210 x 250
D 8	8	10	3	3/4"	205	300	210 x 210 x 320
D 11	11	10	3	3/4"	270	300	280 x 280 x 310
D 18	18	10	3	3/4"	270	410	280 x 280 x 450
D 24	24	10	3	1"	320	355	330 x 330 x 375
D 35	35	10	3	1"	400	390	410 x 410 x 410
DV 50	50	10	3	1"	400	570	410 x 410 x 610
DV 80	80	10	3	1"	400	825	410 x 410 x 860
DV 100	100	10	3	1 1/4"	500	779	510 x 510 x 830
DV 150	150	10	3	1 1/4"	500	1.007	510 x 510 x 1040
DV 200	200	10	3	1 1/4"	600	1.076	610 x 610 x 1110
DV 300	300	10	3	1 1/4"	650	1.251	660 x 660 x 1290
DV 500	500	10	3	1 1/4"	775	1.410	785 x 785 x 1440

Method used for selecting the expansion tank

This table simplifies the choice of the ELBI expansion tank to be installed in the hot sanitary water circuits.

Model	Plant height m	Prech. press. bar	Tank accept. vol. lt	Tank absorbt. cap. %	Plant water content (lt)
D 2	30	3,0	0,9	45	80
	35	3,5	0,7	35	60
	40	4,0	0,6	30	50
D 8	30	3,0	3,4	43	290
	35	3,5	2,9	36	245
	40	4,0	2,3	28	195
D 11	30	3,0	4,7	43	400
	35	3,5	3,9	36	335
	40	4,0	3,2	28	270
D 18	30	3,0	7,7	43	660
	35	3,5	6,4	36	550
	40	4,0	5,1	28	440
D 24	30	3,0	10,3	43	880
	35	3,5	8,6	36	735
	40	4,0	6,9	28	590
D 35	30	3,0	15,0	43	1285
	35	3,5	12,5	36	1070
	40	4,0	10,0	28	860
DV 50	30	3,0	21,4	43	1835
	35	3,5	17,9	36	1530
	40	4,0	14,3	28	1225
DV 80	30	3,0	34,3	43	2935
	35	3,5	28,6	36	2445
	40	4,0	22,8	28	1955
DV 100	30	3,0	42,9	43	3670
	35	3,5	35,7	36	3060
	40	4,0	28,6	28	2445
DV 150	30	3,0	64,3	43	5505
	35	3,5	53,6	36	4585
	40	4,0	42,9	43	3670
DV 200	30	3,0	85,7	43	7340
	35	3,5	71,4	36	6115
	40	4,0	57,1	28	4890
DV 300	30	3,0	128,6	43	11010
	35	3,5	107,2	36	9175
	40	4,0	85,7	28	7340
DV 500	30	3,0	214,3	43	18345
	35	3,5	178,6	36	15290
	40	4,0	142,8	28	12230



Max press. =	6 bar
t inlet =	10°C
t outlet =	50°C

Sizing of an expansion tank with a fixed bladder

Technical data

The expansion tank's useful volume must be calculated according to a maximum working pressure (p_e), corresponding to the safety valve's adjustment pressure, diminished by a quantity equal to the difference value between the expansion tank and the safety valve, if the latter is situated downwards, otherwise increased if the safety valve is located upwards.

The expansion tank's useful volume must correspond to the expansion volume (V_e), in practice the maximum change of the water volume which can occur in the plant is the following one:

$$V_e = C \times (u_2 - u_1) \quad [\text{litres}]$$

where:

u_2 = water specific volume at the maximum operative temperature litres/kg.

u_1 = water specific volume at the minimum operative temperature litres/kg.

C = plant's total capacity (boiler, pipes, charges, etc.) kg.

The V_t total volume of the closed expansion tank with a bladder is calculated according to the following formula:

$$V_t = \frac{V_e}{1 - \frac{P_p}{P_e}} \quad [\text{litres}]$$

In order to avoid calculating $1 - \frac{P_p}{P_e}$ the table 2 reporting the results of these calculations has P_e been drawn up.

where:

V_e = plant's expansion volume litres

P_p = precharge pressure of the expansion tank bar (absolute pressure)

P_e = plant's maximum working pressure or adjustment pressure of the safety valve bar (absolute pressure)

The precharge pressure must correspond to the hydrostatic pressure in the tank's installation place, whereas the difference between the cut in pressure of the safety valve (p_v) and the working pressure (p_e) is usually 10% of the cut in pressure.

A tolerance of 10% of the plant's total volume is allowed in the choice of the tank to be installed.

“water specific volume at different temperatures”

Table 1

T °C	v litres/Kg	T °C	v litres/Kg	T °C	v litres/Kg	T °C	v litres/Kg
- 10	1,00186	16	1,00103	36	1,00632	80	1,0290
- 5	1,00070	18	1,00138	38	1,00706	85	1,0324
0	1,00013	20	1,00177	40	1,0078	90	1,0359
2	1,00003	22	1,00221	45	1,0099	95	1,0396
4	1,00000	24	1,00268	50	1,0121	100	1,0434
6	1,00003	26	1,00320	55	1,0145	110	1,0515
8	1,00012	28	1,00375	60	1,0171	120	1,0600
10	1,00027	30	1,00435	65	1,0198	130	1,0795
12	1,00048	32	1,00497	70	1,0227	140	1,0795
14	1,00073	34	1,00563	75	1,0258	150	1,0903

Table 2 a

Max working pressure	precharge pressure (bar)								
	1	1,5	2	2,5	3	3,5	4	4,5	5
1,5	0,2								
2	0,333	0,167							
2,5	0,429	0,286	0,143						
3	0,5	0,375	0,25	0,125					
3,5	0,556	0,444	0,333	0,222	0,111				
4	0,6	0,5	0,400	0,3	0,2	0,1			
4,5	0,636	0,545	0,455	0,364	0,273	0,182	0,091		
5	0,667	0,583	0,5	0,417	0,333	0,25	0,167	0,083	
5,5	0,692	0,615	0,538	0,462	0,385	0,308	0,231	0,154	0,07
6	0,714	0,643	0,571	0,5	0,429	0,357	0,286	0,21	0,14
6,5	0,733	0,667	0,60	0,533	0,467	0,4	0,333	0,26	0,2
7	0,75	0,688	0,625	0,563	0,5	0,438	0,375	0,31	0,25
7,5	0,765	0,706	0,647	0,588	0,529	0,471	0,412	0,35	0,29
8	0,778	0,722	0,667	0,611	0,556	0,5	0,444	0,38	0,33
8,5	0,789	0,737	0,684	0,632	0,579	0,526	0,474	0,42	0,36
9	0,8	0,75	0,7	0,65	0,6	0,55	0,5	0,45	0,4
9,5	0,81	0,762	0,714	0,667	0,619	0,571	0,524	0,47	0,43
10	0,818	0,773	0,727	0,682	0,636	0,591	0,545	0,5	0,45

Table 2 b

Max working pressure	precharge pressure (bar)								
	5,5	6	6,5	7	7,5	8	8,5	9	9,5
6	0,07								
6,5	0,13	0,06							
7	0,18	0,12	0,06						
7,5	0,23	0,17	0,11	0,06					
8	0,28	0,22	0,16	0,11	0,06				
8,5	0,31	0,26	0,21	0,16	0,1	0,05			
9	0,35	0,3	0,25	0,21	0,15	0,1	0,05		
9,5	0,38	0,33	0,28	0,24	0,19	0,14	0,1	0,05	
10	0,41	0,36	0,32	0,27	0,23	0,18	0,14	0,09	0,045

ERL-DAC series

300 to 5000 litres



Auto-pressurized expansion tanks

FUNCTION

Traditional expansion tanks are used in heating plants in order to limit overpressures which are generated by the liquid's volume variation inside the closed circuit whenever temperature changes. In fact, the air cushion of the expansion tank serves as a "lung" according to a ratio established by Boyle law.

The DAC (Dynamic Air Cushion) system has been designed to solve in a simple, safe and economically advantageous way the problems that can occur to the designer of a heating plant in the following cases.

- *Exceptionally high water volume in the plant.*
- *Limited dimensions of the boiler room.*
- *Very reduced differences between the plant's min./max. pressures.*

In these cases, the possibility to exploit completely the tank's volume as a water reserve allows to save considerably both in the installation costs and in the management and maintenance ones.

The groups of the ERL/DAC series allow to achieve this aim, since the expansion tank's sizing is not calculated according to the maximum value of water acceptance in the tank (Boyle law), but only according to the total expansion volume of the water contained in the plant. The pressurisation level is constantly checked by the electronic control panel according to the set min./max. pressure data.

CHARACTERISTICS OF THE STRUCTURE

The ERL/DAC system is composed by:

- An expansion tank of the ERL-D series CE approved.
- A control unit with a microprocessor (MCP) and an incorporated compressor CE approved.

EXPANSION TANKS OF THE ERL-D SERIES

They are constructed in high-quality sheet steel and they are available from 300 to 5000 litres. The models from 750 to 5000 litres are equipped with a bladder of the "all volume" type, whose dimensions ensure a practically unlimited life of the bladder itself, thus allowing to work under nearly null conditions of mechanical stress. They are traditionally available in the Export version at 10 bars max working pressure. Upon request they can be manufactured with different pressure more than 10 bar according to the most important international standards (TÜV, ASME, BS).



MCP control unit

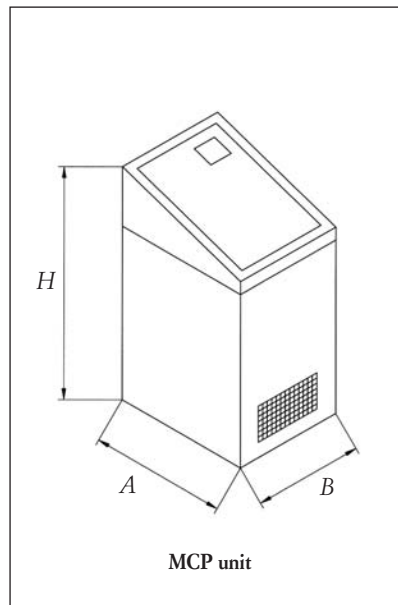
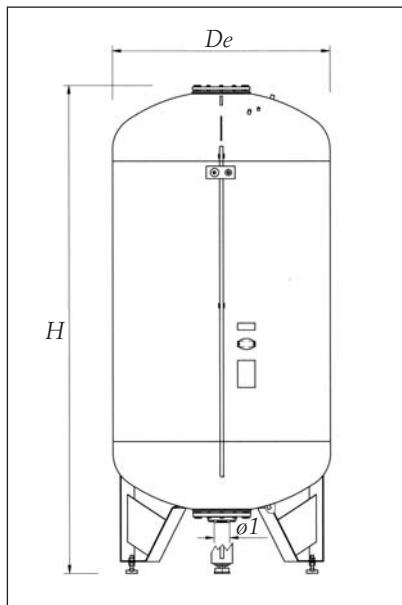
DIMENSIONAL DATA ERL-D tanks

Model	Capacity lt	De mm	H mm	ø 1	Maximum pressure bar
ERL-300 D	300	650	1.310	1" 1/4 M	10
ERL-500 D	500	775	1.485	1" 1/4 M	10
ERL-750 D	750	800	2.025	2" M	10
ERL-1000 D	1.000	800	2.355	2" M	10
ERL-2000 D	2.000	1.100	2.820	G 3"	10
ERL-3000 D	3.000	1.250	3.170	G 3"	10
ERL-5000 D	5.000	1.550	3.490	G 3"	10

Working temperature: -10°C + 99°C

MCP control unit

Model	Suction capacity lt/min	A mm	B mm	H mm
MCP1	114	610	490	900
MCP3	300	610	490	900
MCP5	650	660	560	935
MCP7	1.050	800	665	1.080



- The tanks 750, 1000, 2000, 3000 and 5000 litres are endowed with an upper and lower flanged opening.
- All the compressors are equipped with a IP-54 type protection.
The compressor's maximum pressure:
MCP1 = 8 bars, the other ones = 10 bars.
- The compressors mounted on the MCP1 unit are single-phase, all the others are three-phase.

MCP unit – Technical characteristics

Model	Electric power (HP/KW)	Voltage (V)	Noise (db)	Capacity Compressor (lit/min.)
MCP1 220/50	1 / 0,75	220	65	114
MCP1 220/60	1 / 0,75	220	65	114
MCP1 110/60	1 / 0,75	220	65	114
MCP3 380/50/60	2,5 / 1,8	380	65	300
MCP5 380/50	5,5 / 4	380	70	650
MCP5 380/60	5,5 / 4	380	70	650
MCP7 380/50	10 / 7,5	380	70	1.050
MCP7 380/60	10 / 7,5	380	70	1.050

“MCP” CONTROL UNIT

The MCP unit is equipped with an analogue microprocessor and it is endowed with a compressor, a liquid crystals display, some solenoid valves and some filters for the air outlet and inlet in the tank. The MC unit controls the system operation, by keeping under control the set minimum and maximum pressure data, the compressor and solenoid valves operation. There are four versions in order to satisfy the different types of the compressors' current and power supply.

- MCP1 – with a compressor of 0.75 kW **single-phase**
- MCP3 – with a compressor of 1.8 kW **three-phase**
- MCP5 – with a compressor of 4 kW **three-phase**
- MCP7 – with a compressor of 7.5 kW **three-phase**

The MCP1 unit is available with single-phase supply (110/220V 50/60 Hz); whereas the other models are endowed with a three-phase supply at 380 V.

Description of the system operation

PHASE 1

When the system is off, therefore with the water at ambient temperature, the boiler is switched off, the compressor is in the OFF position as well as the solenoid valves and EV-2, the plant is in the static phase as well as the pressure inside the expansion tank.

PHASE 2

The boiler becomes operative, the water volume inside the plant increases with the consequent pressure increase of the air cushion inside the expansion tank. When the maximum pressure reaches the set value, the EV-2 solenoid valve opens with the consequent air outlet through the SIL-1 silencer; the temperature reaches the designed maximum value and the boiler is switched off.

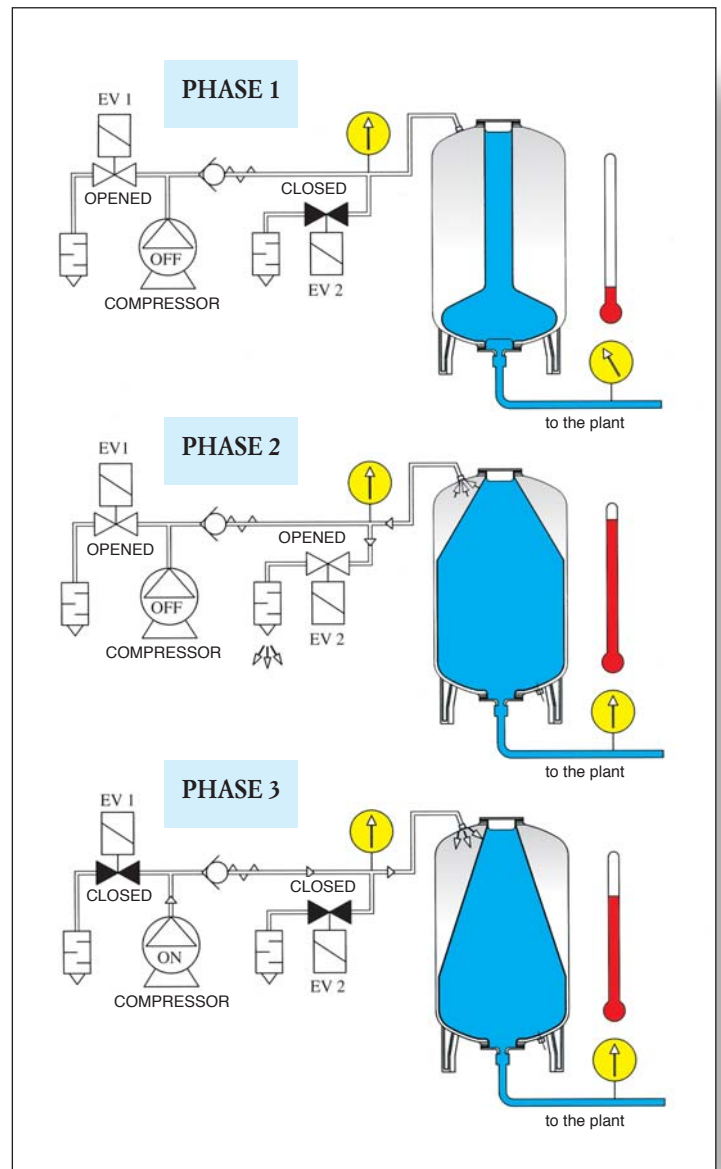
PHASE 3

The boiler is still off for the provided temperature difference, the plant slowly cools and therefore the water volume diminishes with the consequent pressure decrease of the air cushion inside the tank. When the pressure reaches the set minimum value, the compressor becomes operative by letting air in the tank until reaching the set maximum pressure. When the compressor is switched off, the solenoid valve opens by discharging the compressor's head (thus allowing a subsequent soft start without any efforts by the motor).

COMPRESSORS – Technical data

The usually mounted compressors are provided, already inside the unit, with preliminary controls. Four models with powers from 0.75 to 7.5 kW are provided in order to satisfy the most installation requirements. In the event it is necessary to use a compressor with a higher working pressure or with a higher suction index, which is not provided in traditional models, consult the company for getting a suitable model to the plant's requirements.

On request, some versions with tropicalised motor are available.



Sizing of an auto-pressurised expansion tank

Technical data

Tank's sizing

The sizing of the expansion tank is calculated only according to the total expansion volume of the water contained in the plant, increased by 20% in order to leave a margin of working and safety to the air cushion. The air cushion pressure is selected according to the static height (h), which corresponds to the difference expressed in meters between the highest point of the plant and the water inlet coupling in the expansion tank, plus a margin of 3 m for the deaeration.

Example

Plant's data		
Boiler's power	Qk	= 3200 kW
Static height	h	= 18 m
Delivery maximum temperature	TM	= 90 °C
Water inlet temperature	Ti	= 10 °C

If the water contents is 13L/KW, the water volume of the plant will be:

$$Vi = 3200 \times 13 = 41600 \text{ L}$$

From the table concerning the coefficients of the water expansion we will get:

$$\text{Expansion \% of the water at } 90^{\circ}\text{C} \quad n = 3,59 \%$$

$$\text{Expansion \% of the water at } 10^{\circ}\text{C} \quad n2 = 0,04 \%$$

(Tab. 2)

The Ke coefficient of expansion will be:

$$Ke = \frac{3,59 - 0,04}{100}$$

Therefore, the total water expansion will be:

$$Ve = 41600 \times 0,0355 = 1477 \text{ litri}$$

Therefore, the tank's optimum capacity for the involved plant will be:

$$1,477 + 20\% = 1,772 \text{ litres.}$$

The model with a higher capacity, that is the ERL 2000 model, must be selected.

As 1 bar corresponds to 10 meters of the water column and the static height is 18 m, the water column's height will be 21 m (taking into consideration 3 meters for the deaeration), to which corresponds a pressure of 2.1 bars. According to the pressure – heat power diagram (fig.1), the CP-1 single-phase compressor corresponds to the 2.1 bar pressure and to the 3200 kW heat power. The suitable supply and control unit is MCP1. Therefore, the system will be the following one: ERL-2000D coupled with a MCP1 unit.

Choice of the compressor – Calculation of the flow index

Introduction

The total water volume in a heating plant is proportional to the generator's heat power. In a modern heating system, there are on average 13 litres of water per 1000 Kcal/h.

$$(1) \quad Vs = 13 \text{ L}/1000 \text{ Kcal} / b$$

Calculation of the TS expansion time

$$(2) \quad Ts = Vs \times W \times C \times Dt$$

where $Vs = 13 \text{ L} / 1000 \text{ Kcal} / b$

$W = \text{water volume at the designed maximum temperature Kg/L}$

$C = \text{specific heat Kcal/Kg} \times ^{\circ}\text{C}$

$Dt = \text{temperature increase } ^{\circ}\text{C}$

Calculation of the VD water expansion volume relevant to the DT temperature increase

$$(3) \quad Vd = Vi \times K$$

where $Vi = \text{water volume in the plant}$

$K = \text{coefficient of the water expansion according to the DT temperature increase}$

Calculation of the If flow index

$$(4) \quad If = Ve / Ts$$

where $If = \text{If-flow index in 1./min.}$

Calculation of the actual suction index of the compressor (CFM)

$$(5) \quad \text{CFM} = If \times Kr$$

where $Kr = 1.1$ is a coefficient under the worst suction conditions, at the suction temperature of 30°C and relative humidity of 100%.

Example for calculating the suction index

(valid for most plants)

plant's water volume	Vi	= 28169 L
minimum temperature	Tm	= 80 °C
maximum temperature	TM	= 90 °C
temperature increase	Dt	= 10 °C
water inlet temperature	Ti	= 10 °C
specific heat	C	= 1 Kcal / Kg x °C
water volume at 90°	CW	= 0,965 Kg/L (tab.)

$$Ts = \frac{13 \times 0,965 \times 1 \times 10 \times 60}{100}$$

$$Vd = Vi \times K$$

from the table about the coefficients of expansion (table 2) we can get:

expansion % of the water at 90°C $n = 3,59\%$

expansion % of the water at 80°C $n1 = 2,90\%$

$$K = \frac{(n - n1)}{100}$$

$$K = \frac{(3,59 - 2,90)}{100} = 0,0069$$

$$Vd = 28169 \times 0,0069 = 194,36 \text{ L}$$

$$If = \frac{194,36}{7,53} = 25,81 \text{ L} / \text{min.}$$

$$\text{CFM} = 25,81 \times 1,1 = 28,39 = 28,4 \text{ L} / \text{min.}$$

L'espansione totale dell'acqua nell'impianto è

$$Ve = 28169 \times Ke$$

$$\text{total water expansion at } 90^{\circ}\text{C} \quad n = 3,59\%$$

$$\text{total water expansion at } 10^{\circ}\text{C} \quad n2 = 0,04\%$$

$$Ke = \frac{(n - n2)}{100}$$

$$Ke = \frac{(3,59 - 0,04)}{100} = 0,0355$$

$$Ve = 28169 \times 0,0355 = 1000 \text{ L}$$

Therefore, it is possible to affirm that in the most plants it is necessary to use a compressor with a suction index of CFM = 28.4 L/min. per 1,000 L of expanded water at the atmospheric pressure.

In order to size correctly the compressor, it is necessary to compare the suction index with the designed pressure of the expansion tank, taking into consideration that the result "Pressure multiplied by Volume" is a constant value when the pressure is absolute. Therefore, if the pressure in the expansion tank must be kept at 2.5 Bars, remembering that the atmospheric pressure is about 1 Bar, we will get:

$$\text{CFM} = \frac{1 + 2,5}{1} \times 28,4 = 99,4 \text{ L} / \text{min.}$$

In that case, it is necessary to select a compressor with a CFM suction index which is higher than 99.4 L/min.

As for heating plants with current parameters that vary from 11 to 14 litres per kW, use the diagram reported below for selecting the type of compressor.

For pressures which are higher than 10 bars, consult the company.

TAB. 2

Coefficients of the water expansion expressed in % (with or without addition of anti-freeze glycol)

Temperature °C	Only water	Anti-freeze 10%	Anti-freeze 20%	Anti-freeze 30%	Anti-freeze 40%	Anti-freeze 50%
10	0,04	0,32	0,64	0,96	1,28	1,60
15	0,11	0,43	0,75	1,07	1,39	1,71
20	0,18	0,50	0,82	1,14	1,46	1,78
25	0,31	0,63	0,95	1,27	1,59	1,91
30	0,44	0,76	1,08	1,40	1,72	2,04
35	0,62	0,94	1,26	1,58	1,90	2,22
40	0,79	1,11	1,43	1,75	2,07	2,39
45	1,00	1,32	1,64	1,96	2,28	2,60
50	1,21	1,53	1,85	2,17	2,49	2,81
55	1,46	1,78	2,10	2,42	2,74	3,06
60	1,71	2,03	2,35	2,67	2,99	3,31
65	2,01	2,33	2,65	2,97	3,29	3,61
70	2,28	2,60	2,92	3,24	3,56	3,88
75	2,59	2,91	3,23	3,55	3,87	4,19
80	2,90	3,22	3,54	3,86	4,18	4,50
85	3,21	3,53	3,85	4,17	4,49	4,81
90	3,59	3,91	4,23	4,55	4,87	5,19
95	3,96	4,29	4,61	4,93	5,25	5,57
100	4,35	4,67	4,99	5,31	5,63	5,95

TAB. 3

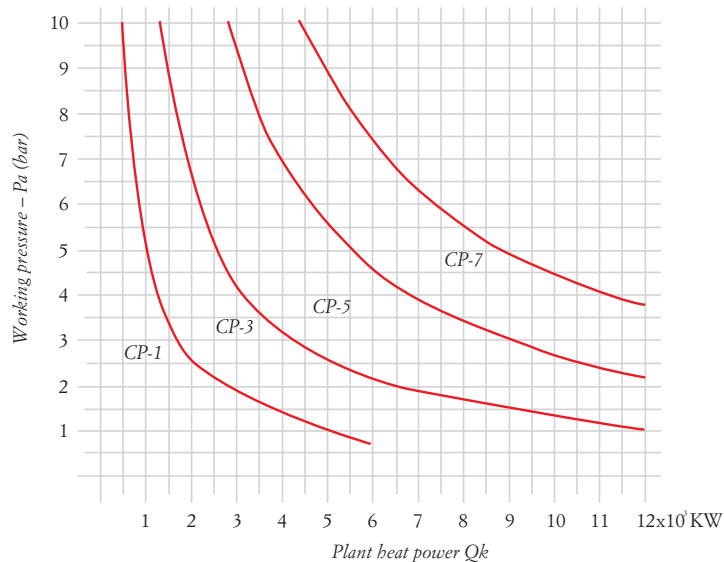
Water volume

Temperature °C	Density Kg/l.
10	0,99975
15	0,99915
20	0,99820
25	0,99711
30	0,99576
35	0,99421
40	0,99224
45	0,99025
50	0,98807
55	0,98573
60	0,98324
65	0,98059
70	0,97811
75	0,97849
80	0,97183
85	0,96865
90	0,96534
95	0,96192
100	0,95838

TAB. 4 TYPE OF TANK ACCORDING TO THE PLANT'S WATER VOLUME (m³) AND THE MAXIMUM WORKING TEMPERATURE (°C)

ERL type	Volume m³ 70°C	Volume m³ 80°C	Volume m³ 90°C	Volume m³ 100°C	Expansion (litres)
300	11	9	7	6	250
500	19	15	12	10	430
750	28	22	18	15	640
1000	38	30	24	20	850
2000	76	59	48	39	1.700
3000	114	89	72	59	2.550
5000	190	149	118	99	4.250

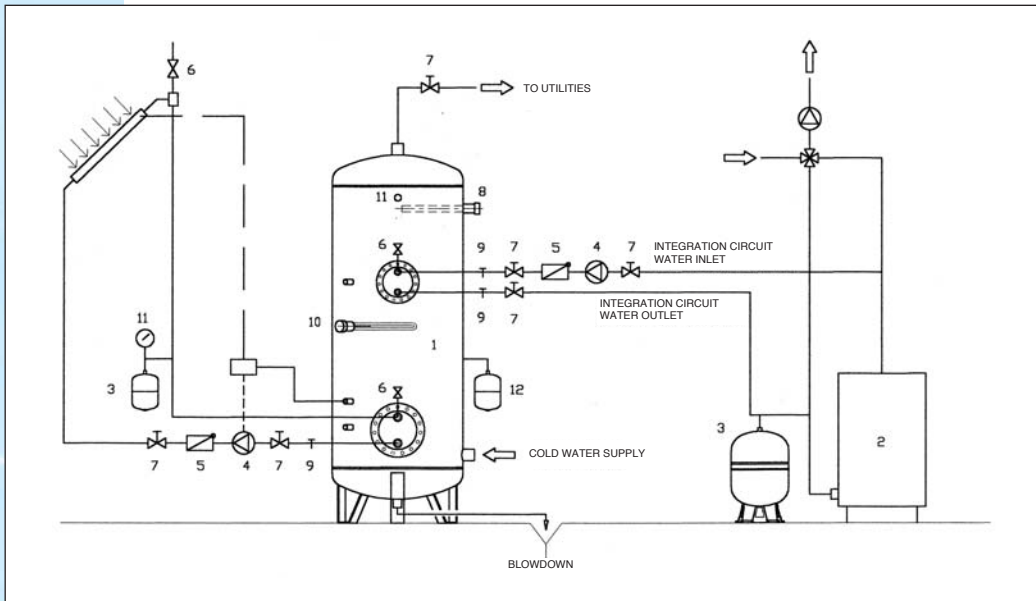
Diagram used for selecting the type of compressor





Some examples of installation

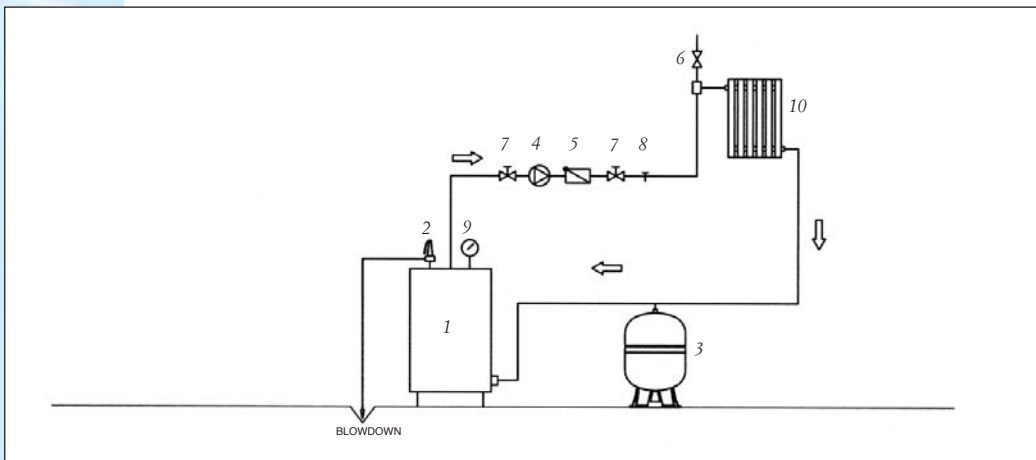
Traditional installation with solar integration



LEGEND

- 1-ELBI water heater
- 2-Boiler
- 3-D expansion tank
- 4-Circulation pump
- 5-Clapet check valve
- 6-Air valve
- 7-Gate valve
- 8-Magnesium anode
- 9-Thermometer
- 10-Resistor
- 11-Pressure gauge
- 12-D expansion tank

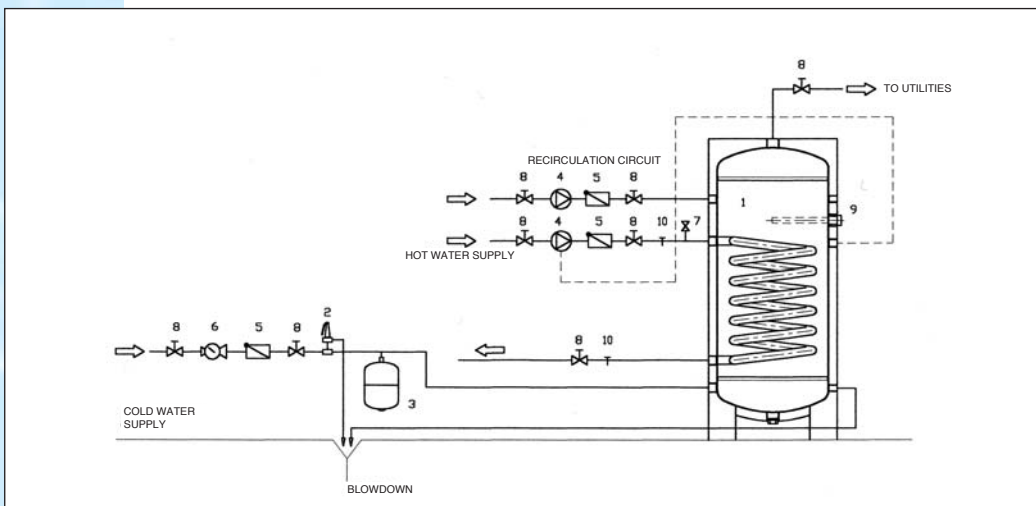
ERE installation



LEGEND

- 1-Boiler
- 2-Safety valve
- 3-ERE expansion tank
- 4-Circulation pump
- 5-Clapet check valve
- 6-Air valve
- 7-Gate valve
- 8-Thermometer
- 9-Pressure gauge
- 10-Radiator

D installation

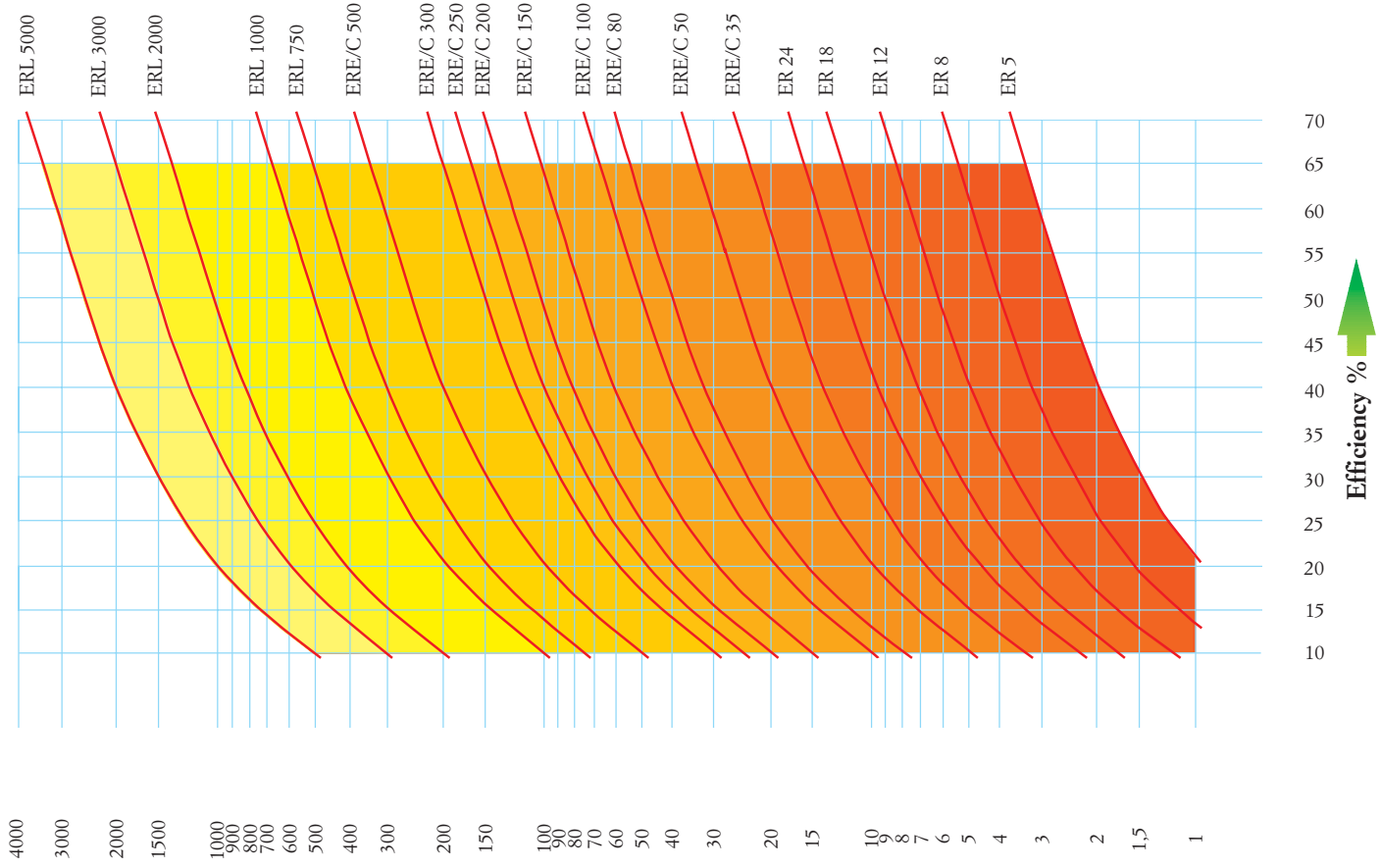


LEGEND

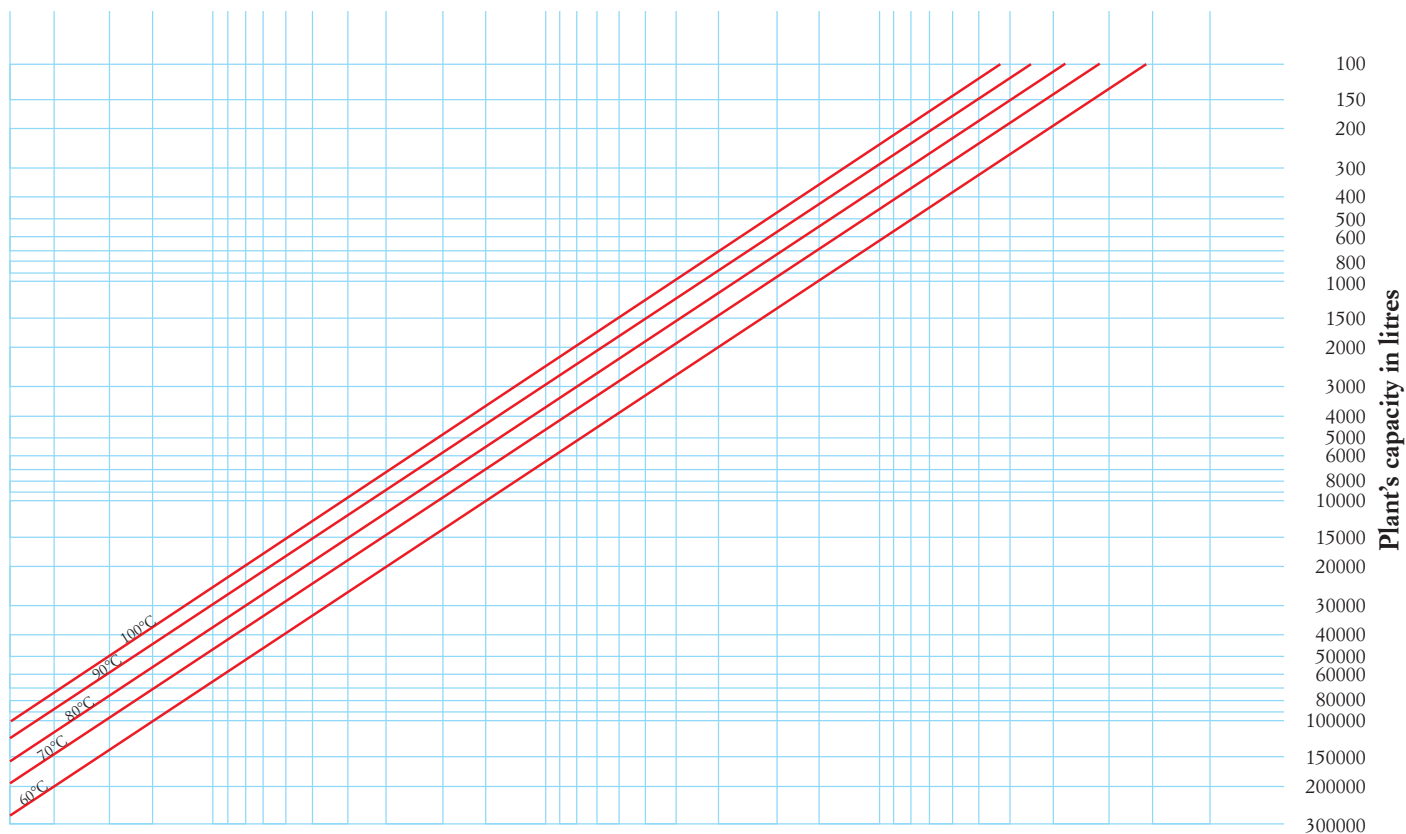
- 1-ELBI water heater
- 2-Safety valve
- 3-D expansion tank
- 4-Circulation pump
- 5-Clapet check valve
- 6-Pressure reducer
- 7-Air valve
- 8-Gate valve
- 9-Magnesium anode
- 10-Thermometer

Universal diagram used for selecting the tank

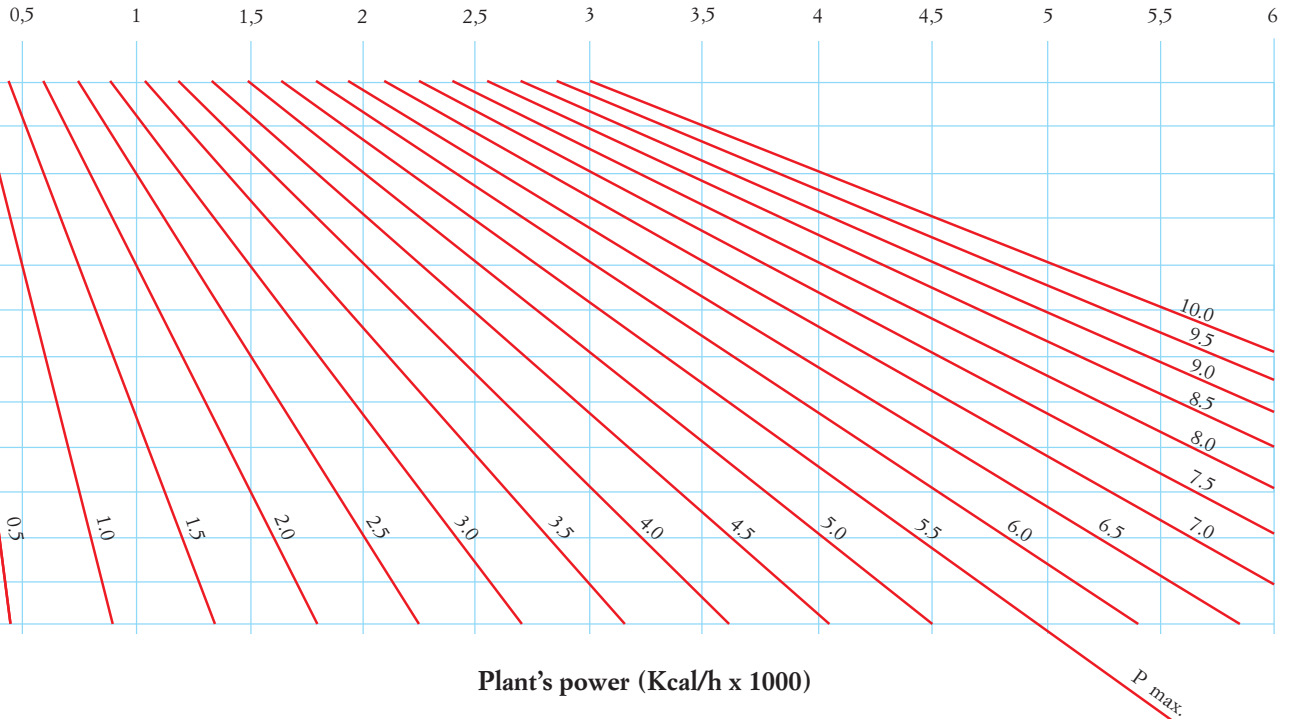
ELBI expansion tanks



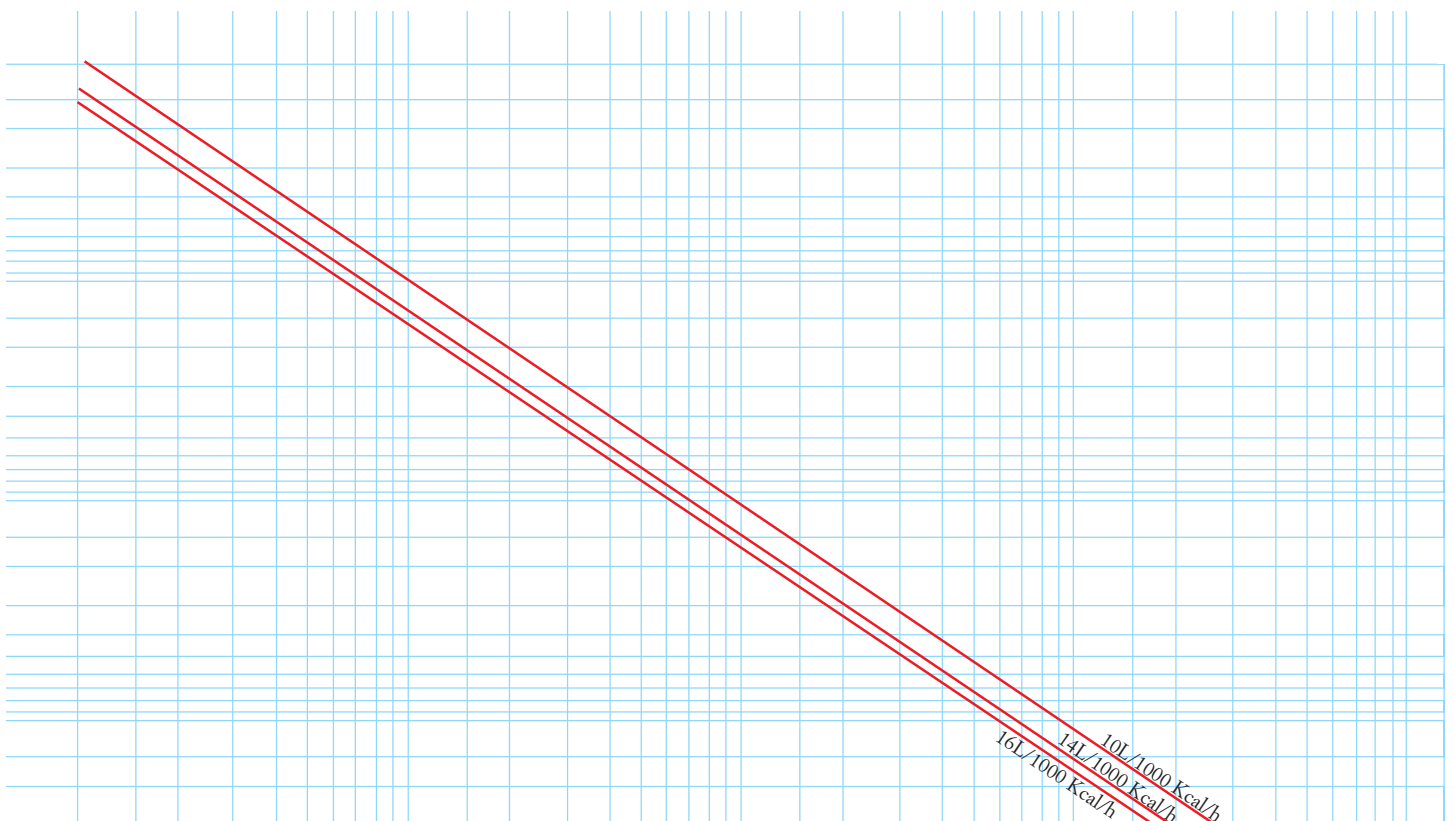
Expansion volume expressed in litres



Precharge pressure (bar)

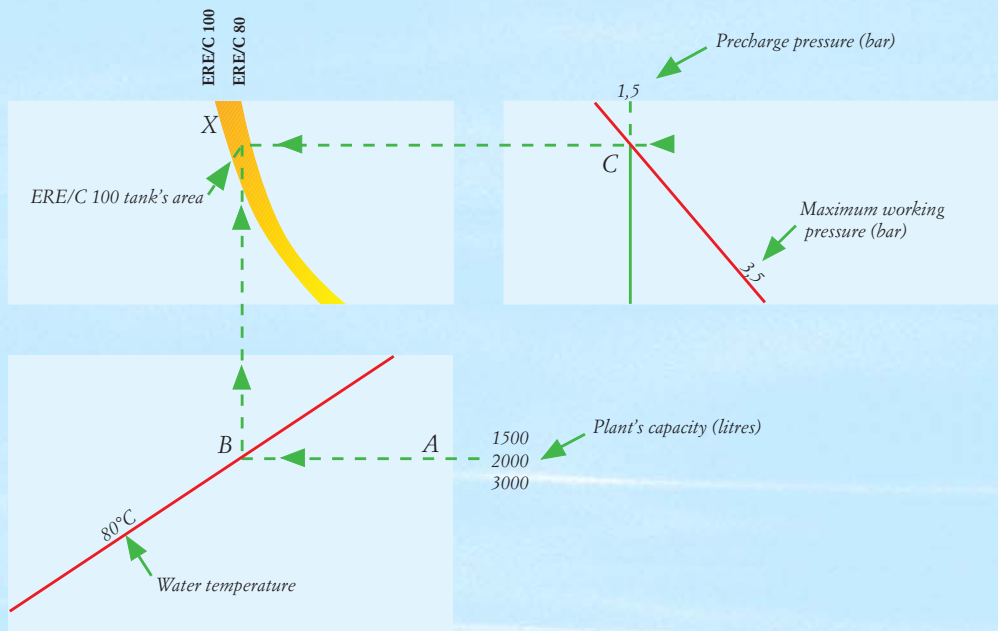


Kcal/h x 1000	kW
10	11,628
15	17,442
20	23,256
30	34,884
40	46,512
50	58,140
60	69,767
70	81,395
80	93,023
90	104,651
100	116,279
150	174,419
200	232,558
300	348,837
400	465,116
500	581,395
600	697,674
700	813,953
800	930,233
900	1046,512
1000	1162,791
1500	1744,186
2000	2325,581
3000	3488,372
4000	4651,163
5000	5813,953
6000	6976,744
7000	8139,535
8000	9302,326
9000	10465,116
10000	11627,907
15000	17441,860
20000	23255,814
30000	34883,721
40000	46511,628
50000	58139,535
60000	69767,442
70000	81395,349
80000	93023,256
90000	104651,163
100000	116279,070



16L/1000 KCal/h: Plant equipped with radiators
 14L/1000 KCal/h: plant equipped with convectors (or radiating panels with steel pipes)
 10L/1000 Kcal/h: plant equipped with radiating panels and copper pipes

How to use the universal diagram



Determination of the expansion tank according to the plant's water content

The initial data used to determine the expansion tank's capacity are the following ones, namely:

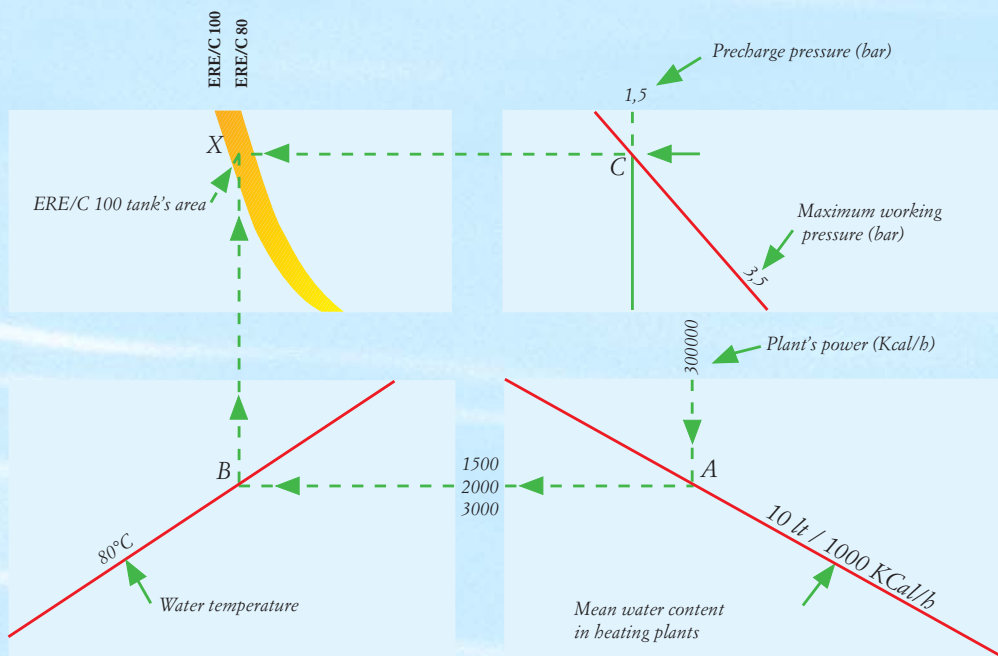
- plant's static pressure or precharge pressure (absolute pressure);
- maximum working pressure of the plant (absolute pressure);
- water mean temperature;
- plant's capacity.

As you know already the plant's capacity, draw a horizontal line until intersecting the water mean temperature line "A-B".

From the point "B", draw a vertical line up to the above graph.

Since you know already the precharge pressure and the plant's maximum pressure, it is necessary to find the intersection point of the two right lines "C" and, starting from this one, draw a horizontal line until reaching the graph on the side.

In the intersection point of these two right lines "X" you find the expansion tank necessary for the plant.



Determination of the expansion tank according to the plant's power

The initial data used to determine the expansion tank's capacity are the following ones, namely:

- plant's static pressure or precharge pressure (absolute pressure);
- maximum working pressure of the plant (absolute pressure);
- water mean temperature;
- plant's power.

Since you know already the power, draw a vertical line until intersecting the right line relevant to the mean water content of the plant "A". Starting from the point "A", draw a horizontal line until intersecting the water mean temperature line "A-B".

From the point "B", draw a vertical line up to the above graph.

Since you know already the precharge pressure and the plant's maximum pressure, it is necessary to find the intersection point of the two right lines "C" and, starting from this one, draw a horizontal line until reaching the graph on the side.

In the intersection point of these two right lines "X" you find the expansion tank necessary for the plant.



Elbi S.p.A. *via Buccia, 9 - 35010 Limena (Padova) tel. 049 88 40 677 - fax 049 88 41 610*
Internet <http://www.elbi.it> • e-mail: vendite@elbi.it