THERMAL ENERGY STORAGES

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Energy Storage Capacity of a Water Storage (calc)

$$Q_s = (m\ C_p)\ \Delta T$$

Q_s	total heat capacity of the storage tank	[kWh]
m	volume of the storage tank	[m^3]
C_p	heat capacity of water	[1.16 kWh/m^3K]
ΔT	temperature difference - hot water temperature and cold water temperature	[K]

Energy Storage Capacity of a Water Storage (calc)

1. Capacity of a domestic hot water storage?

2. Size of a seasonal storage for space heating?

Combi System for a Single Family House

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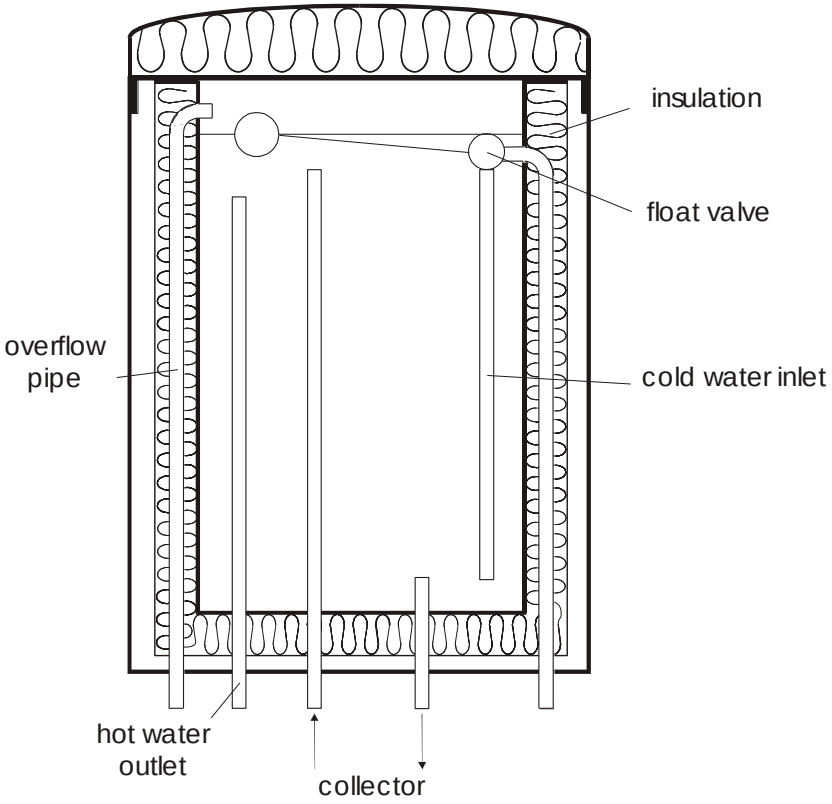
100% Solar Heated Houses

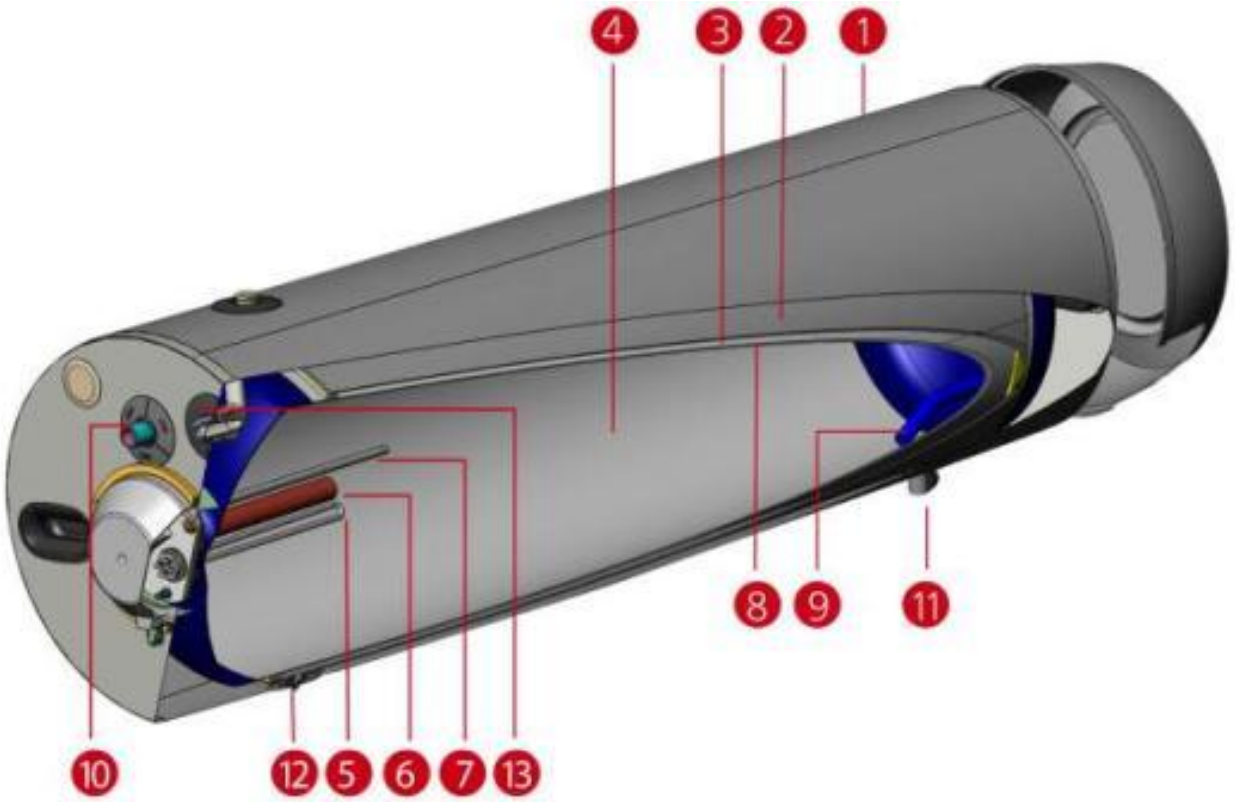
Multi family house Switzerland

Source: Jenni, CH

Storage tank for natural circulation systems



Pressurised Storage Tank



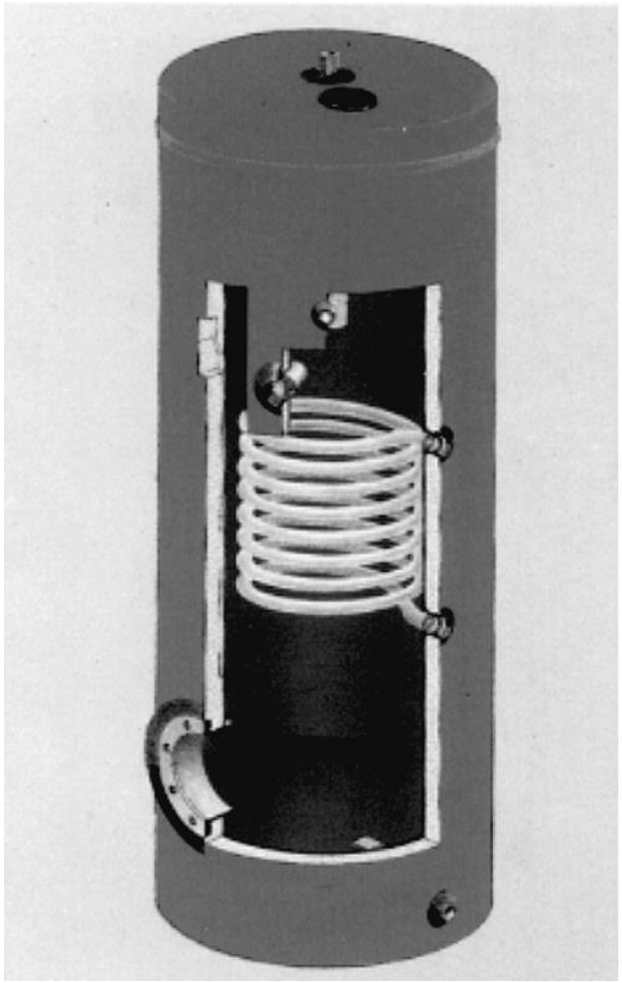
Source: Chromagen

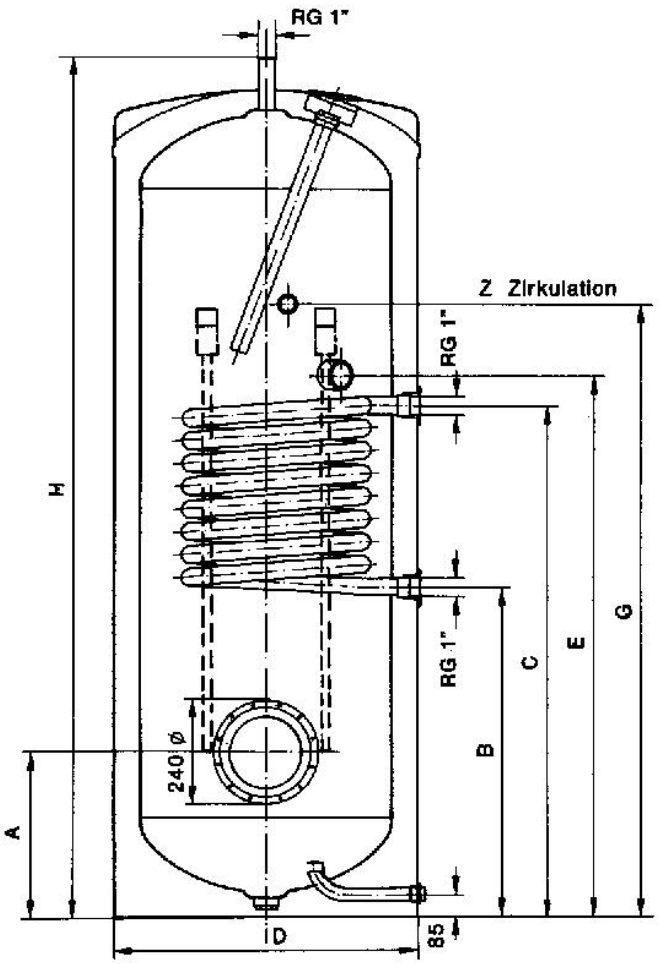
1. Coating
2. Insulation
3. Steel tank
4. Enamel coating
5. Electric heating element
6. Sacrificial anode
7. Thermostat
8. Double Jacket Heat Exchanger
9. Cold water inlet
10. Hot water to user
11. Heat exchanger inlet
12. Heat exchanger outlet
13. Heat Exchanger Safety Valve

Hot water storage tanks (left) for direct coupling of evacuated tube collectors

Source: Easy Solar, South Africa

Domestic hot water tank

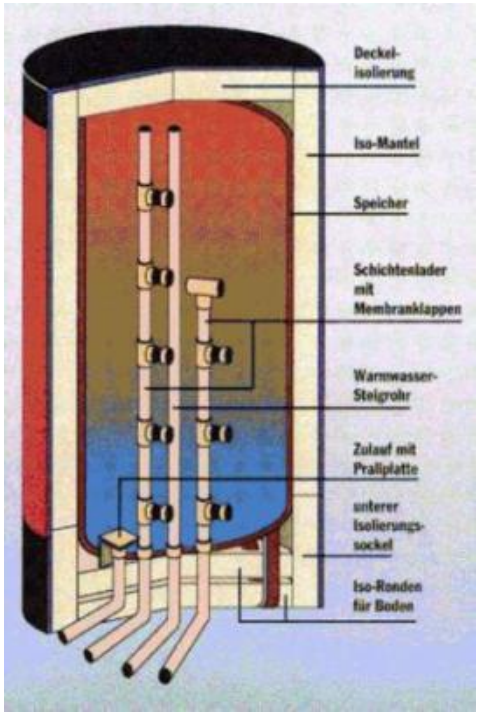




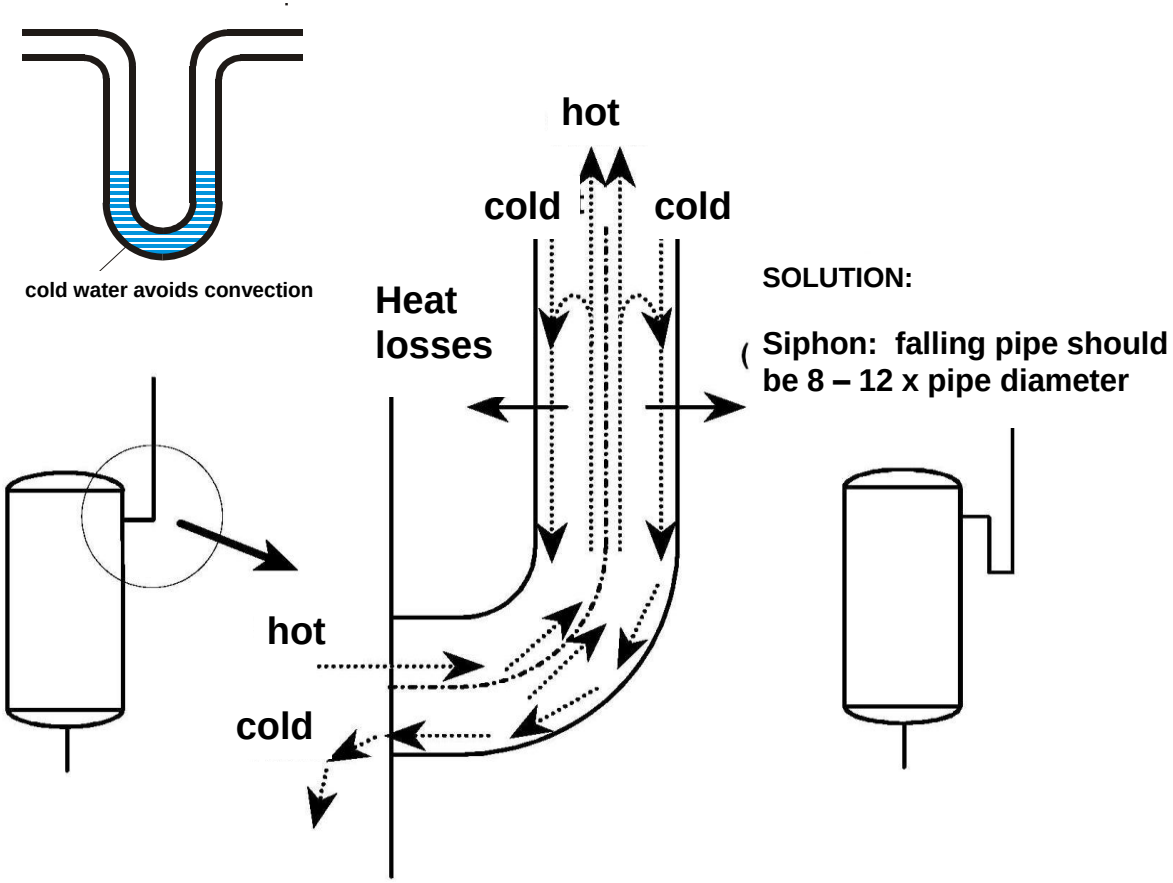
Source: AUSTRIA EMAIL

Different types of storage tanks

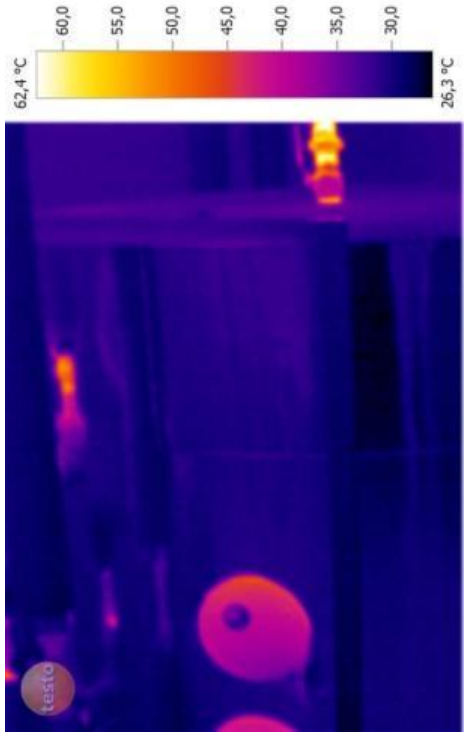
Storage tanks with stratification devices



Heat Losses

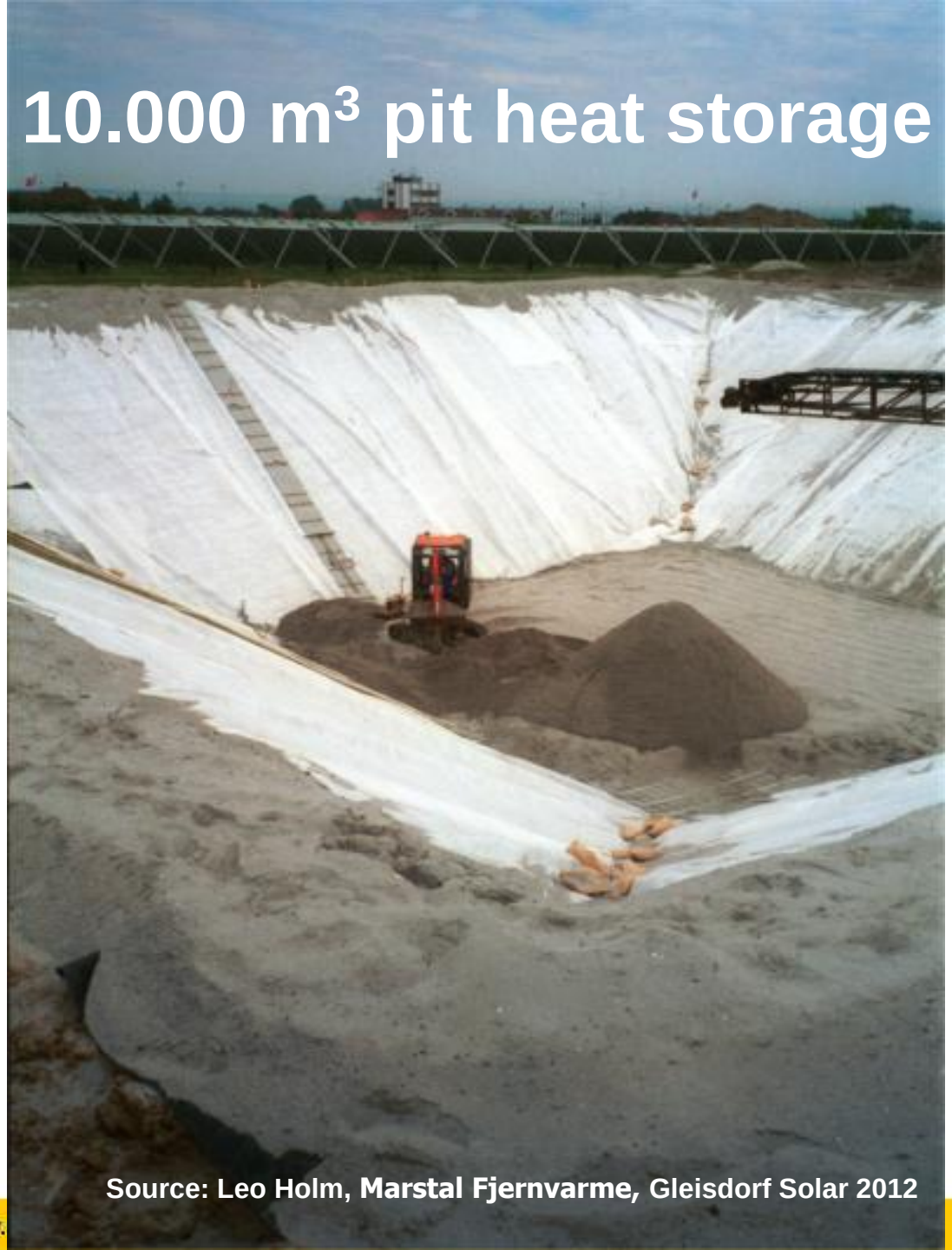

cold water avoids convection
hot
cold
cold
Heat
losses
SOLUTION:
Siphon: falling pipe should
be 8 – 12 x pipe diameter
hot
cold

Heat losses due to poor and missing insulation



Source: Leo Holm, **Marstal Fjernvarme,** Gleisdorf Solar 2012

10.000 m³ pit heat storage



Source: Leo Holm, **Marstal Fjernvarme,** Gleisdorf Solar 2012

10.000 m^3 pit heat storage

Source: Leo Holm, **Marstal Fjernvarme,** Gleisdorf Solar 2012

75.000 m^3 pit heat storage


18/11/2011 12:29

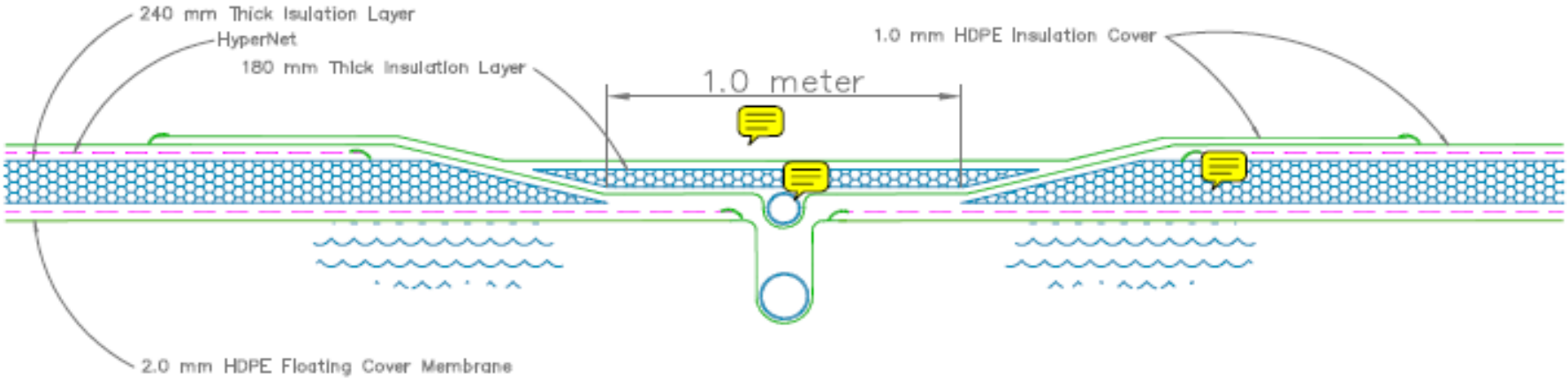

01/24/2012


04/24/2012


06/11/2012


06/11/2012

Source: Leo Holm, **Marstal Fjernvarme,** Gleisdorf Solar 2012



Typical Section Thru Float at Berm

Not to scale

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Houston, Texas 77073-3598
(800)435-2008 / (281)443-8564

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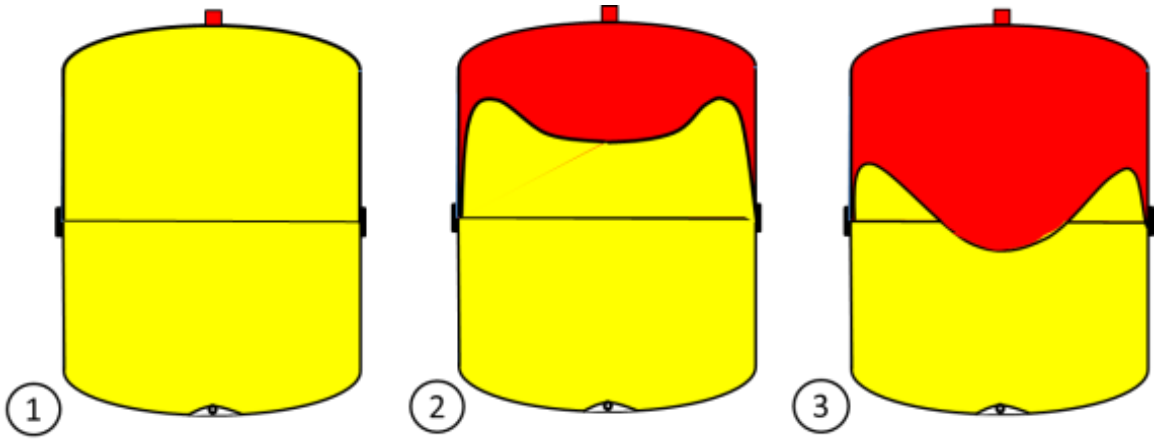
DRAWN	EJT	DATE	13/3/2012	REVISION	18/3/2012	DWG. NO.	Marstal Flc-08

Source: Leo Holm, **Marstal Fjernvarme,** Gleisdorf Solar 2012

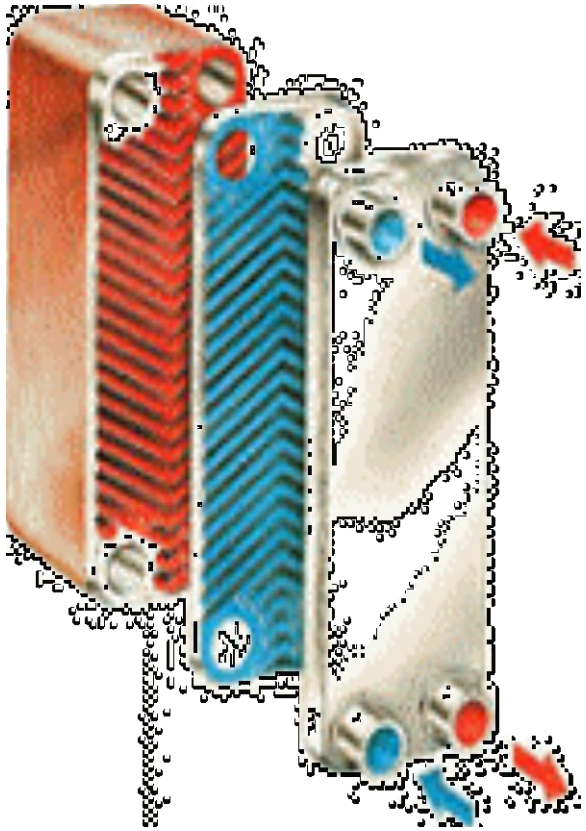
Source: Leo Holm, **Marstal Fjernvarme,** Gleisdorf Solar 2012


02/08/2012

Different states of a membrane expansion vessel

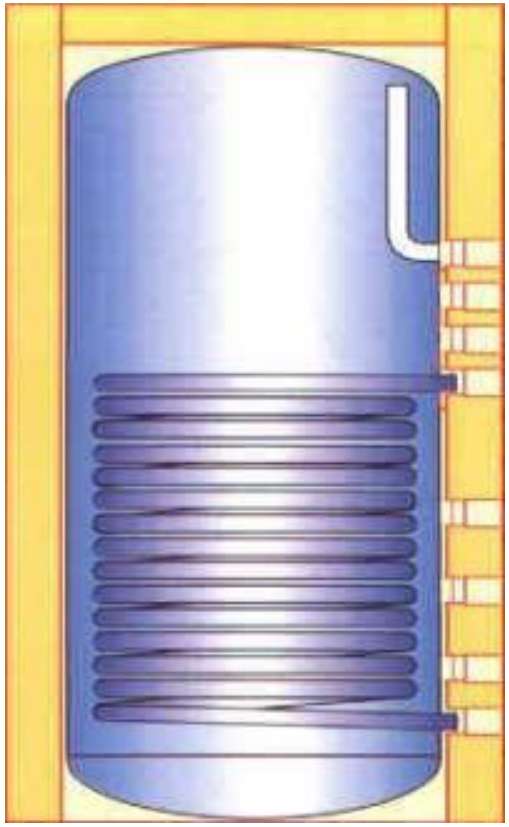


Corded-tube heat exchanger (left) plate heat exchanger (right)



Coil heat exchangers

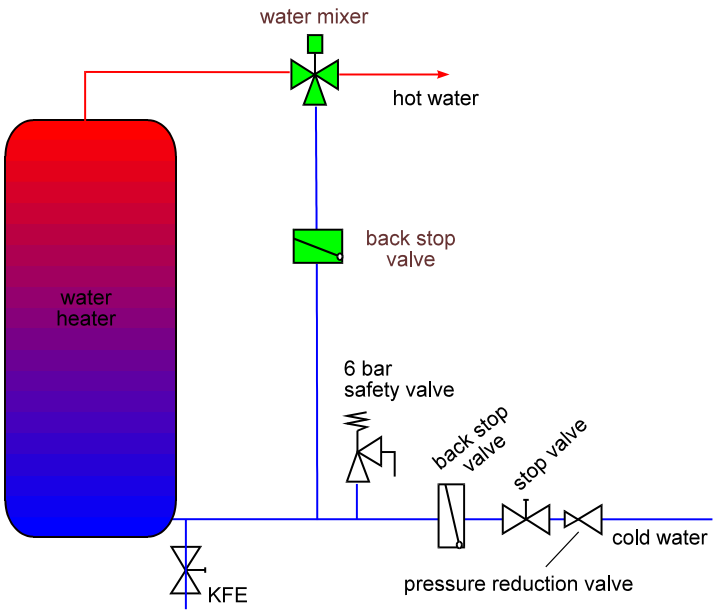
Corded tube heat exchanger (top); smooth tube heat exchanger (bottom)

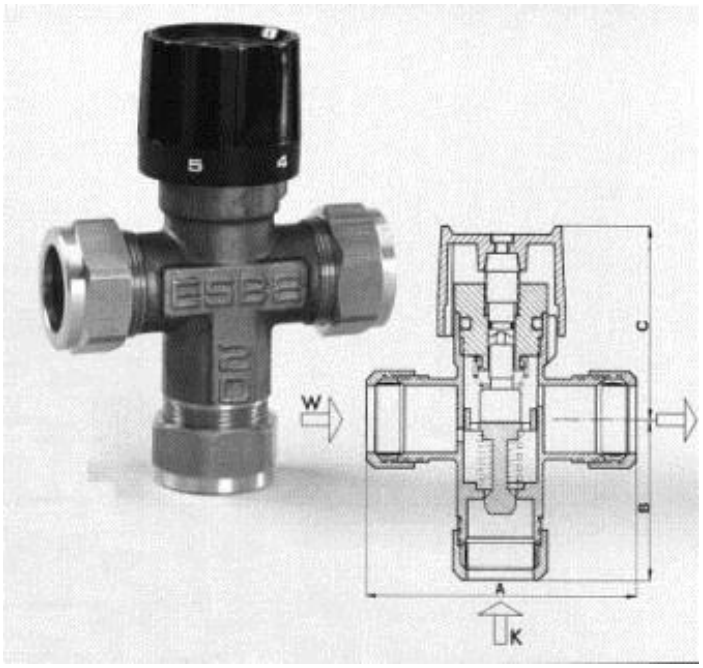


Smooth tube heat exchanger integrated in a domestic hot water storage

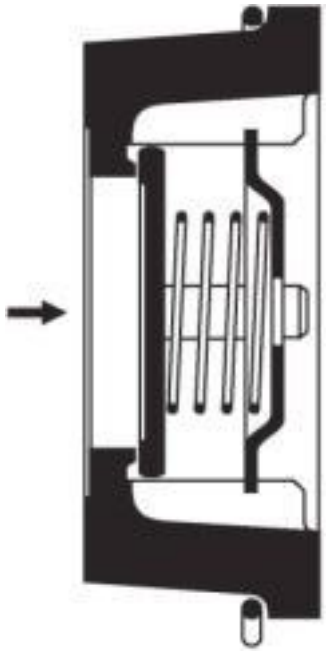
Calcification at a heat exchanger (left picture) and at pipes (middle and right picture)

Domestic hot water-mixing valve



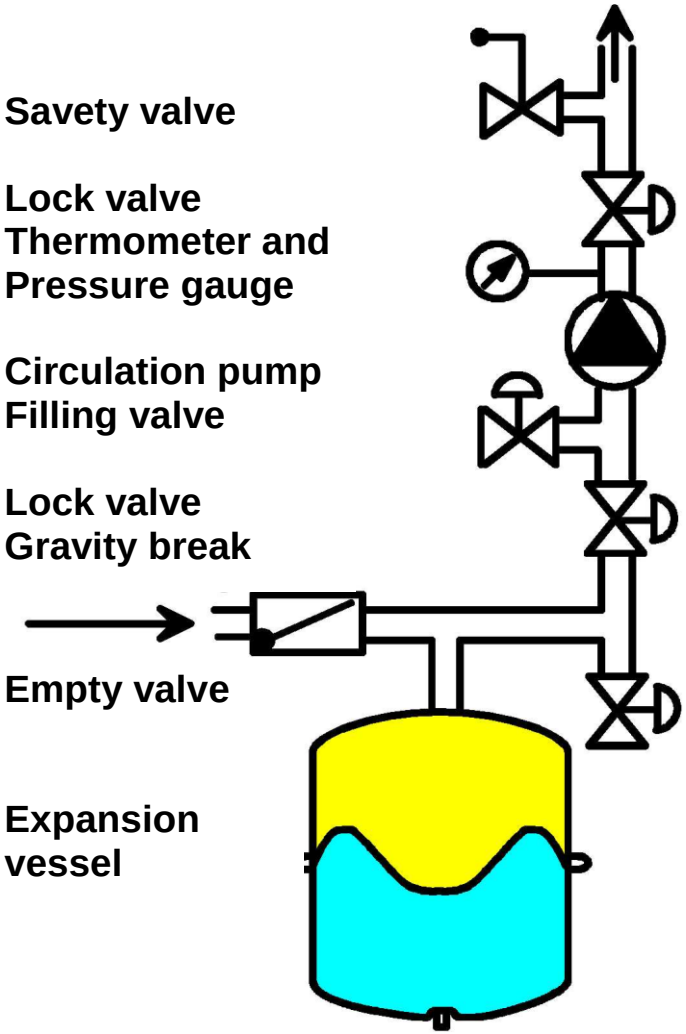


Gravity break



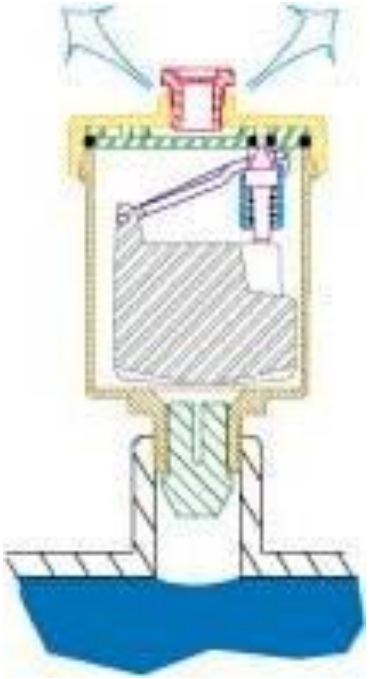
Source: Gestra GmbH, Bremen

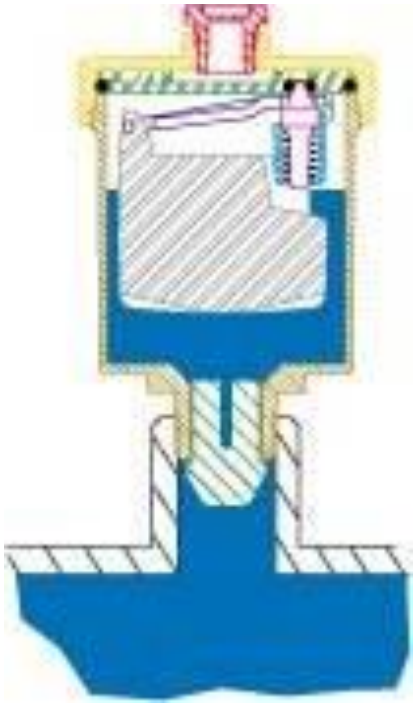
Position of the different components in the return line of the collector loop



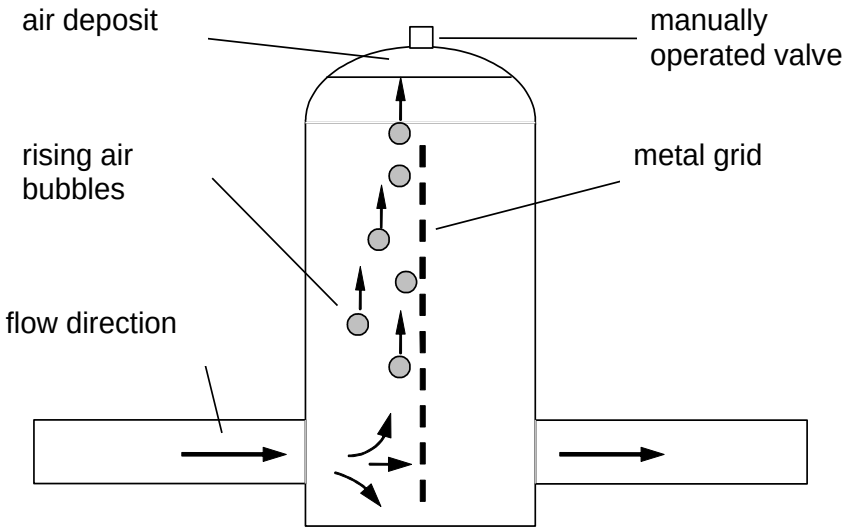
Source: Streicher, W.: Sonnenenergienutzung, Graz, 2003

Automatic air eliminators





Sources: Giacomini S.p.A, San Maurizio d'Opaglio, Italy and VOSS Holding GmbH + Co. KG, Germany

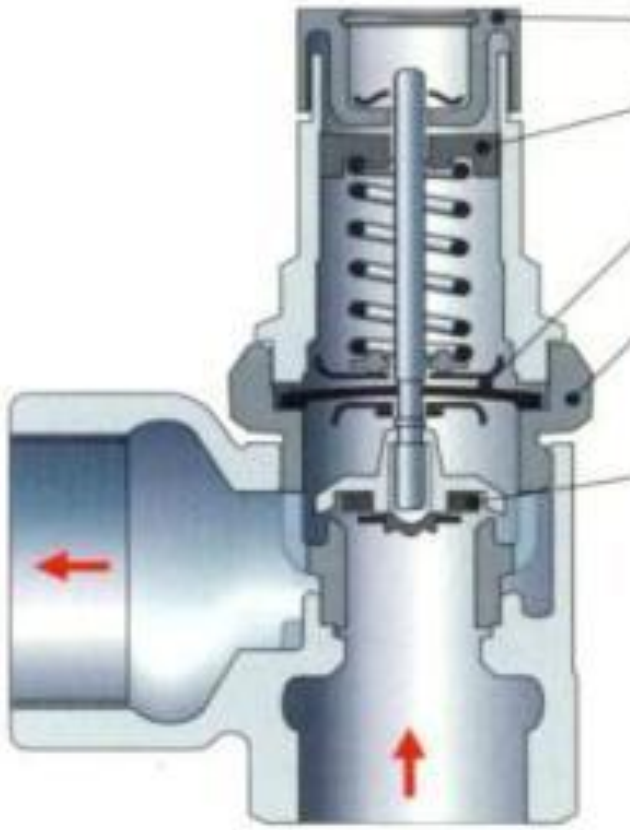


Manually operated air eliminator (left); Cyclone air eliminator (right)

Pumps, safety valves, controller

Source: WILO, Hanazeder Electronic GmbH, PKP Prozesstechnik GmbH

Safety valve



plug

valve spring clip

membrane

application with valve seating

seal

Source: Deutsche Gesellschaft für Sonnenenergie: Solarthermische Anlagen, Berlin 2000

DIMENSIONING OF DOMESTIC HOT WATER SYSTEMS
Hot water demand

		Low demand (litres)	Medium demand (litres)	High demand (litres)
Residential buildings	per person and day	30	50	60
Sport facilities	per shower	20	30	50
Accommodation	per bed	20	40	60

Tilt angle for different latitudes and seasons

Latitude [degree]	Best collector tilt in:					
	June	Orientation	**Sept./March**	Orientation	**December**	Orientation
50 N	26.5	S	50	S	73.5	S
40 N	16.5	S	40	S	63.5	S
30 N	6.5	S	30	S	53.5	S
20 N	3.5	N	20	S	43.5	S
15 N	8.5	N	15	S	38.5	S
10 N	13.5	N	10	S	33.5	S
Equator = 0	**23.5**	**N**	**0**	**-**	**23.5**	**S**
10 S	33.5	N	10	N	13.5	S
15 S	38.5	N	15	N	8.5	S
20 S	43.5	N	20	N	3.5	S
30 S	53.5	N	30	N	6.5	N
40 S	63.5	N	40	N	16.5	N
50 S	73.5	N	50	N	26.5	N

Dimensioning of domestic hot water solar systems for Central European and Southern African conditions

Daily hot water demand [litres]	Solar storage capacity [litres]	Collector area* SC [m^2]
100	200	4
200	400	6
300	500 – 750	8 - 12
500	750 - 1000	12 - 16

Daily hot water demand [litres]	Solar storage capacity [litres]	Collector area* SV [m^2]	Collector area* SC [m^2]
50	50 – 75	1.0 – 1.5	0.9 – 1.3
100	100 – 150	2.0 – 3.0	1.5 – 2.5
200	200 – 300	3.5 – 4.5	3.0 – 4.0
300	300 – 450	4.5 – 6.0	4.0 – 5.0
500	500 - 750	7.5 - 10	6.0 – 8.5

*) depending on the required solar fraction
SV ... coating of solar varnish
SC ... selective coating