



Thermal Solar Components, Systems and Sizing.

09th, October 2008

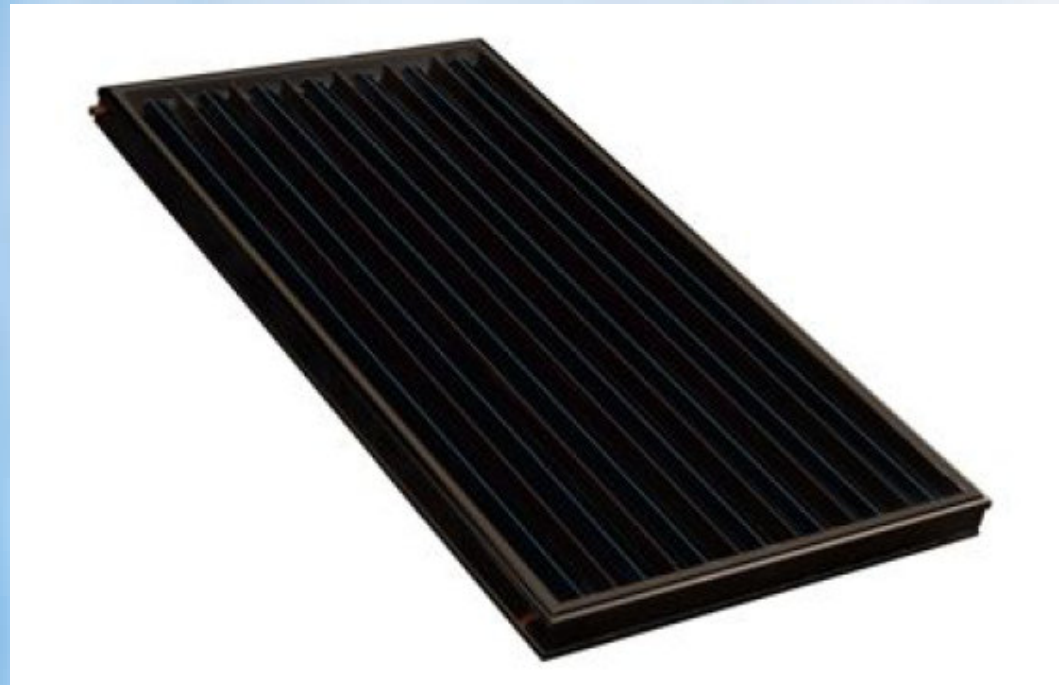
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Components

Solar Thermal Collector

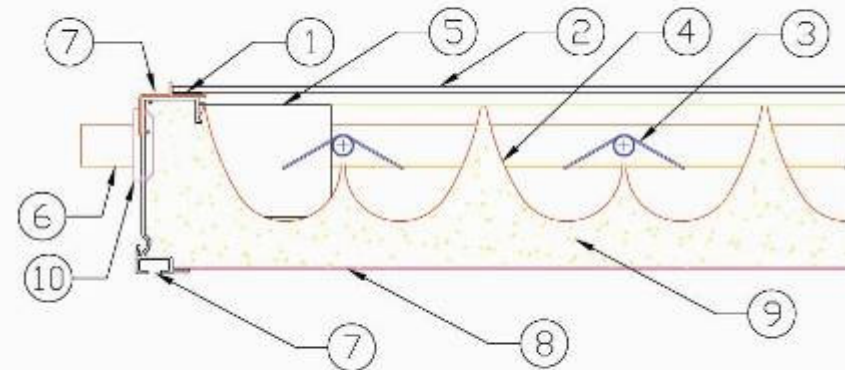
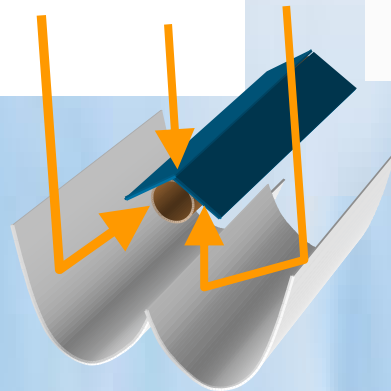
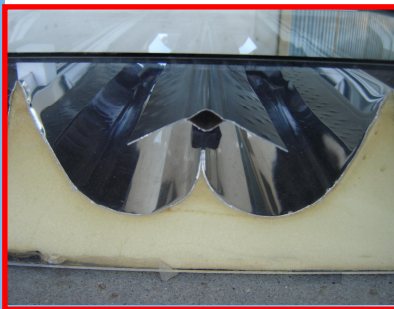
- Direct and reflective solar radiation collection;
- Water heating low/medium applications.

CPC 3E+



CPC Technology

CPC Collector (Compound Parabolic Concentrator)



1. Sealing tape;
2. Security glass/ 3 mm thickness;
3. Absorber;
4. Aluminum mirror;
5. Copper pipe \varnothing 22mm;
6. Aluminum anodized frame;
7. Polystyrene back cover;
8. Polyurethane insulation (CFCs free);
9. Rubber ring (E.P.D.M.).

CPC – Compound Parabolic Concentrator

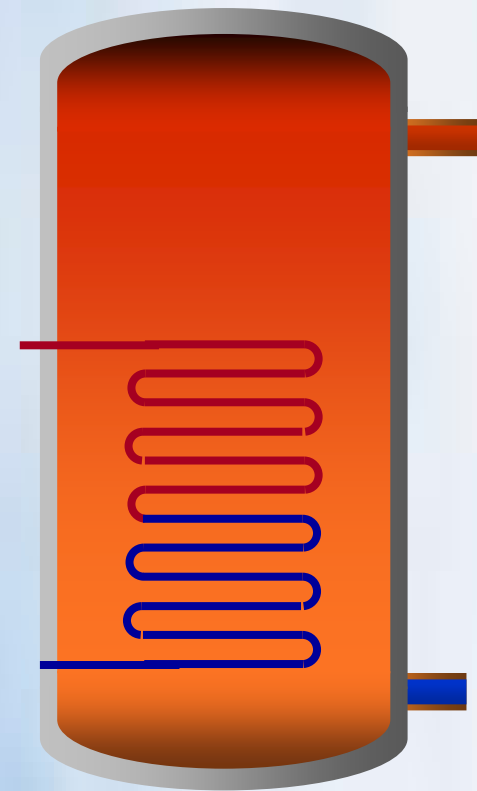
CPC advantages:

- Collecting direct and diffuse solar radiation;
- Smallest absorber area = low thermal losses;
- Applications for temperatures between 50° and 120°C;
- Stationary applications (dispense tracking).

Tanks

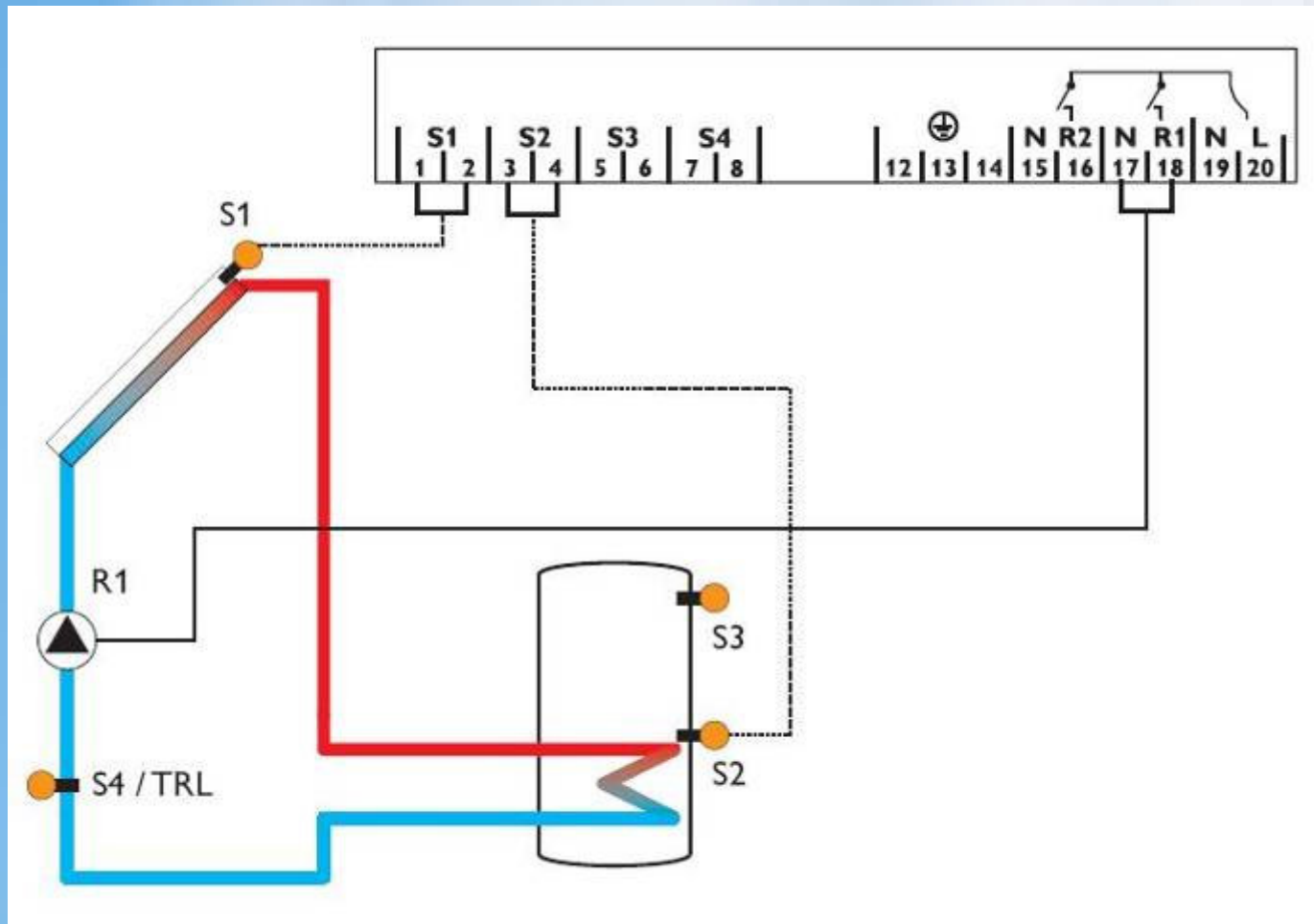
Due to variability of solar resource, normally is needed energy storages systems. Tanks and reservoir must have:

- Low thermal losses;
- Appropriated volume;
- Stratification;
- Temperature adequate;
- Fast response for energy demands;
- Long duration;
- Corrosion protection;
- Security devices .

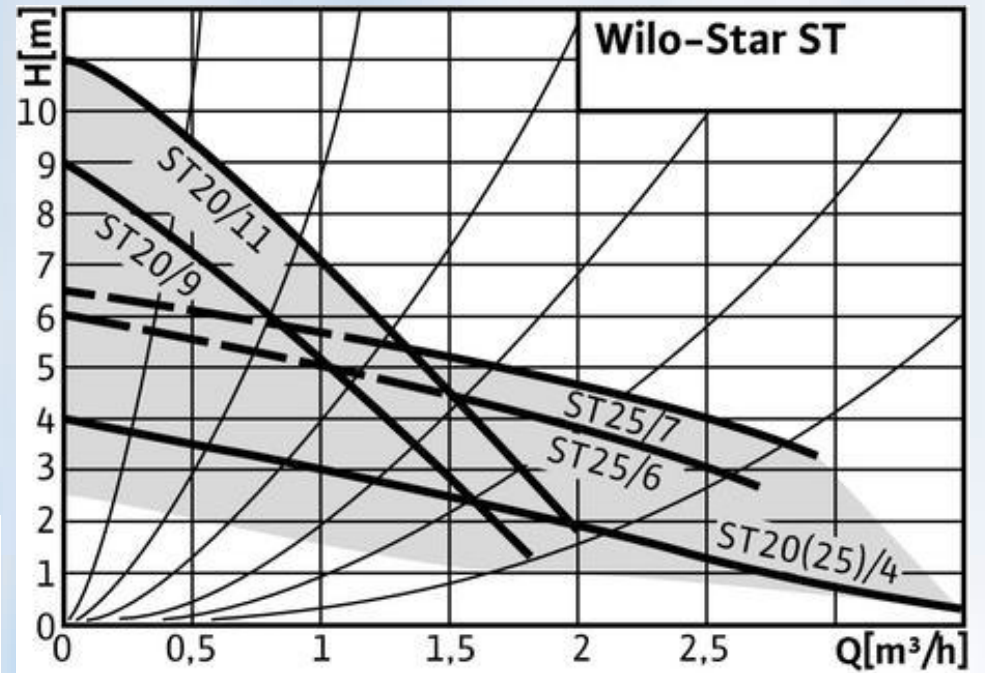


Differential Control

For control pump start/stop



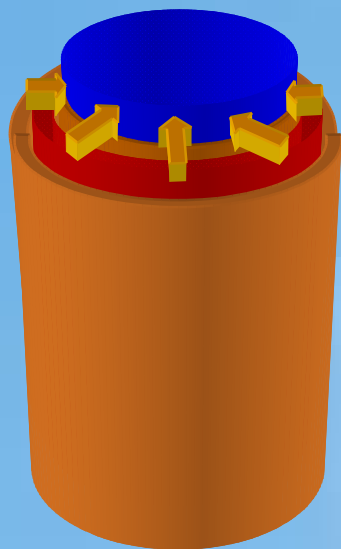
Circulation Pumps



Heat Exchangers

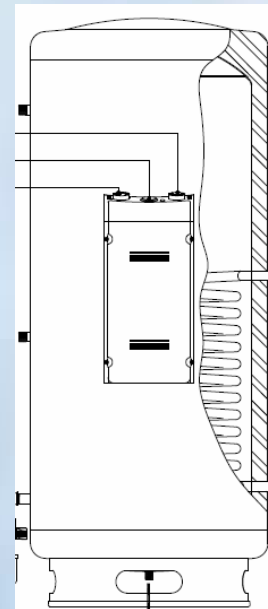
For solar applications, heat exchange sizing is designed for 700 W/m^2 .

Double chamber heat exchanger



- Low efficacy (0.35);
- For low volumes application.

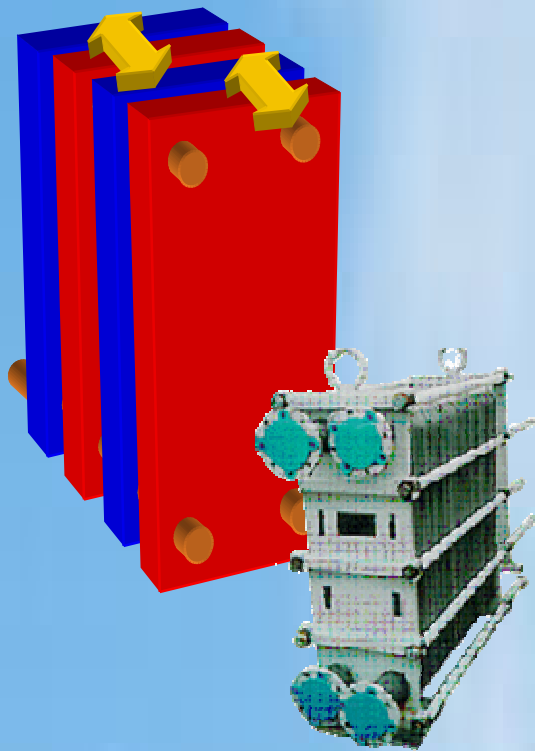
Coil heat exchanger



- Medium efficacy (0.55);
- For low/medium volumes application.

Heat Exchangers

Plate Heat exchanger



- + Best efficacy (0.75);
- + Adequate for median and big volume;
- + Modular upgrade;
- + Ideal for pool heating (with special metals alloys like Titanium);
- Insulation needed;
- Price;
- High pressure loss.

Accessories



Solar air vent



**stop valve for
air vent**



Balancing valve



**thermostatic
mixing valve**



Security valve



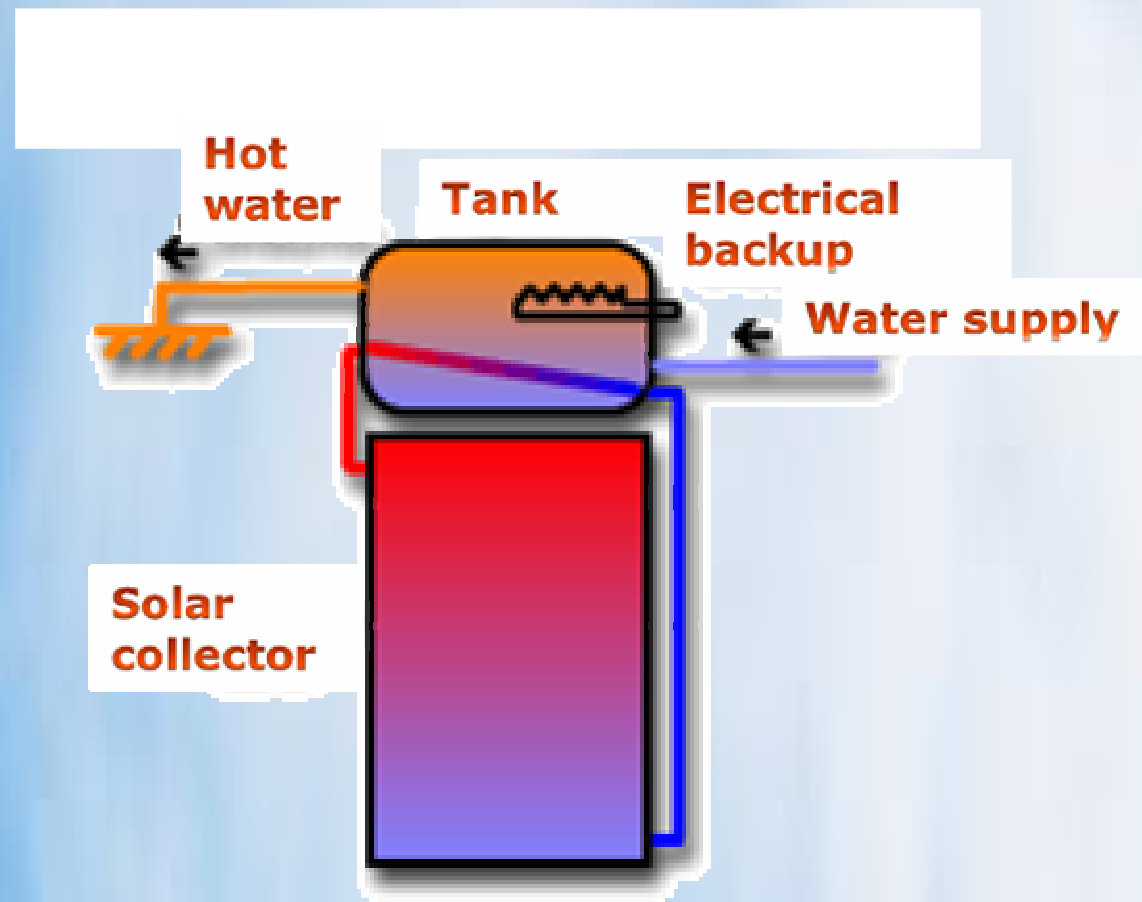
**Ball valve with built-in
check valve**



Expansion vessel

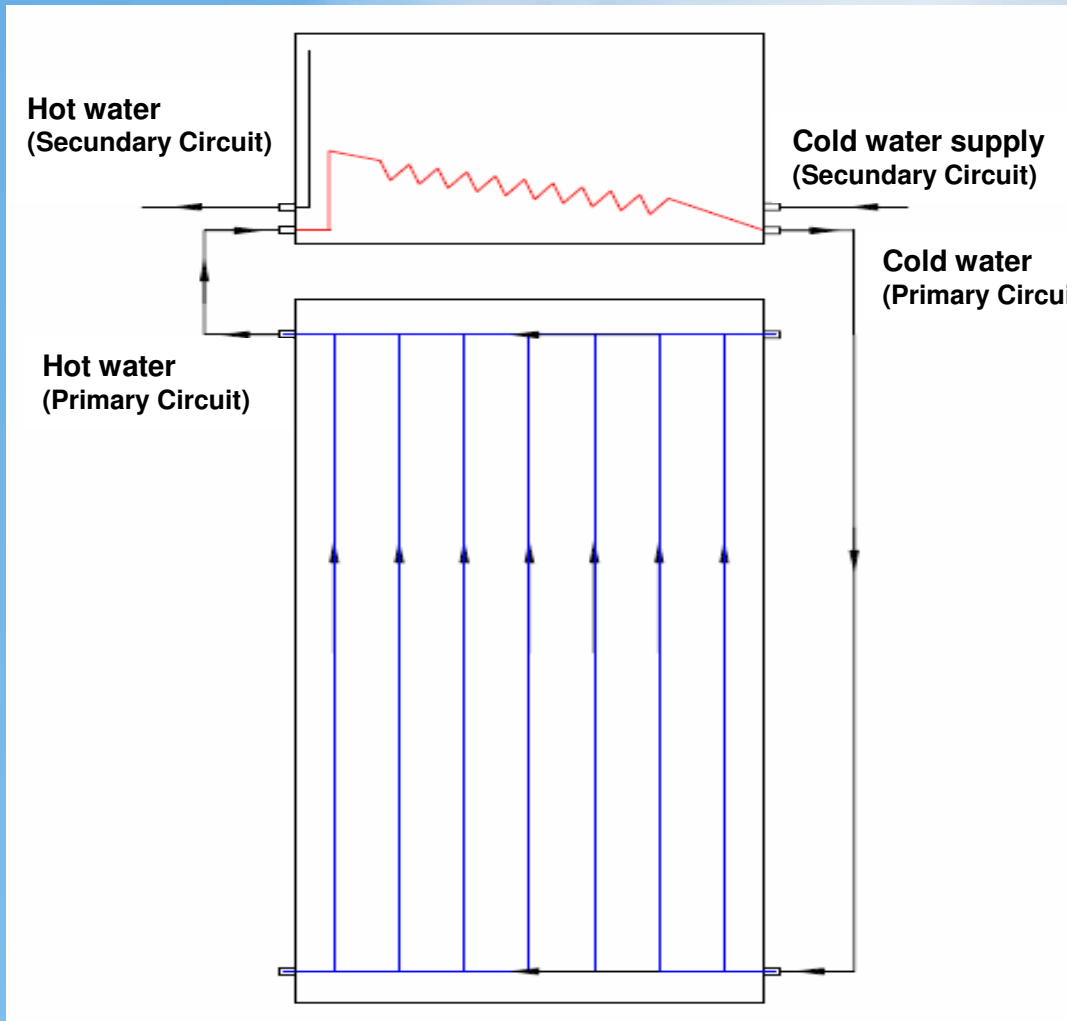
Thermal Solar Systems

Thermosiphon Systems



Thermosiphon Systems

Operation



- Primary circuit with natural circulation;
- Expansion vessel inside main storage tank;
- Intercooler with I&D AO SOL = higher efficiency in heat exchange;
- Copper tank (durability, higher thermal efficiency).

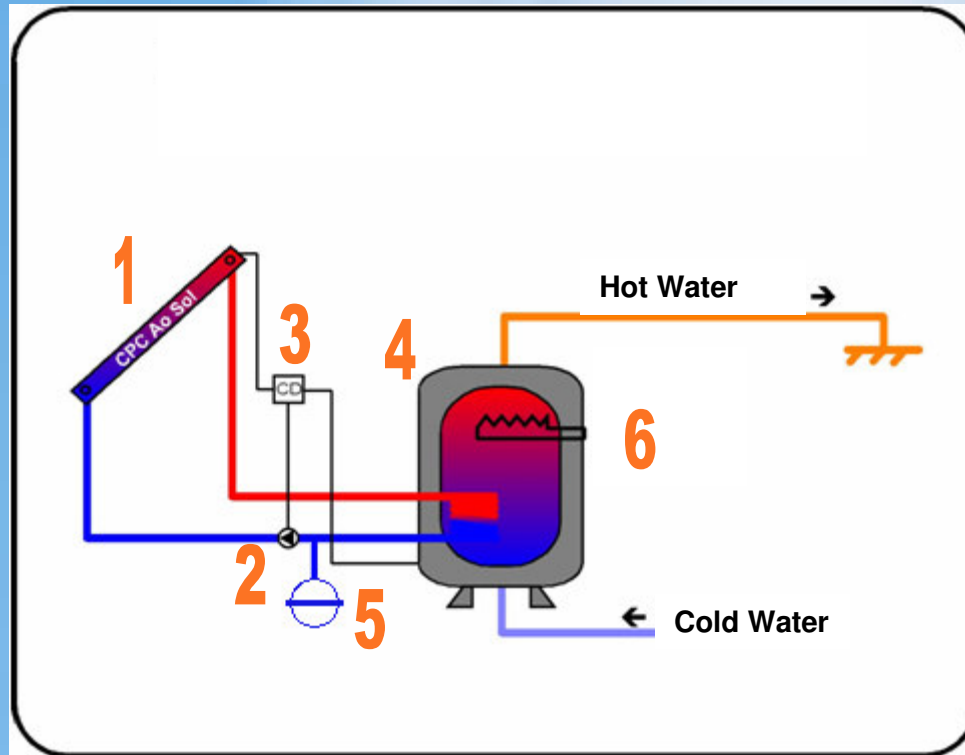
Thermosiphon Systems

Advantages

- Lower consumption of conventional energies;
- Easy installation;
- No need of solar control and pump;
- Reduce maintenance.

Forced Circulation Solar Systems

Medium and large systems



Main components:

1. Collector;
2. Pump;
3. Solar controller;
4. Tank;
5. Expansion vessel;
6. Backup system.

Forced Circulation Solar Systems

Advantages

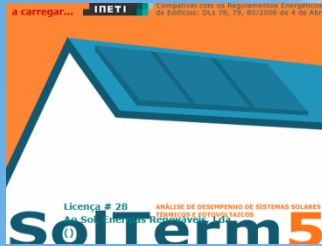
- Solar system with minor visual impact;
- Reduce thermal losses of storage tank;
- Best solution for medium and large systems.

Sizing

Inputs

- Climate data and Localization;
- Consume sizing:
 - N.º Bath;
 - Simultaneous;
 - Consuming volumes;
- Consume temperature (normally 60°C HW);
- Storage volume (50- 150 l/m²);
- Space for collector and tank collectors;
- P&I scheme.

Software Analysis: SOLTERM5.0 Inputs



- Solar thermal simulation;
- Select local and climate data;
- Select components characteristics;
- Energy demand inputs.

SolTerm 5.0 - Análise de desempenho e pré-dimensionamento de Sistemas Solares

Relatórios Editores Manual Outras informações Configuração Terminar

Clima e local Sistemas térmicos Sistemas fotovoltaicos Análise energética Análise económica Benefícios ambientais

Projectos

Lar Cabril

guardar apagar

configuração

sem depósito

com depósito

kit doméstico

multi

Schematic diagram showing a solar collector (10 x CPC AC SOLTE+ 1m0.08) connected to a pump (bomba), a heat exchanger (permutador), a tank (depósito 2500), a support (apoio), a gas meter (Gás Natural), a second tank (segunda a 2500), and a rejection point (rejeição). The diagram also shows a boiler (caldeira) and a hot water tap (água quente).

Montagem | sombreamento: 5% (por default)

Depósitos / Permutadores

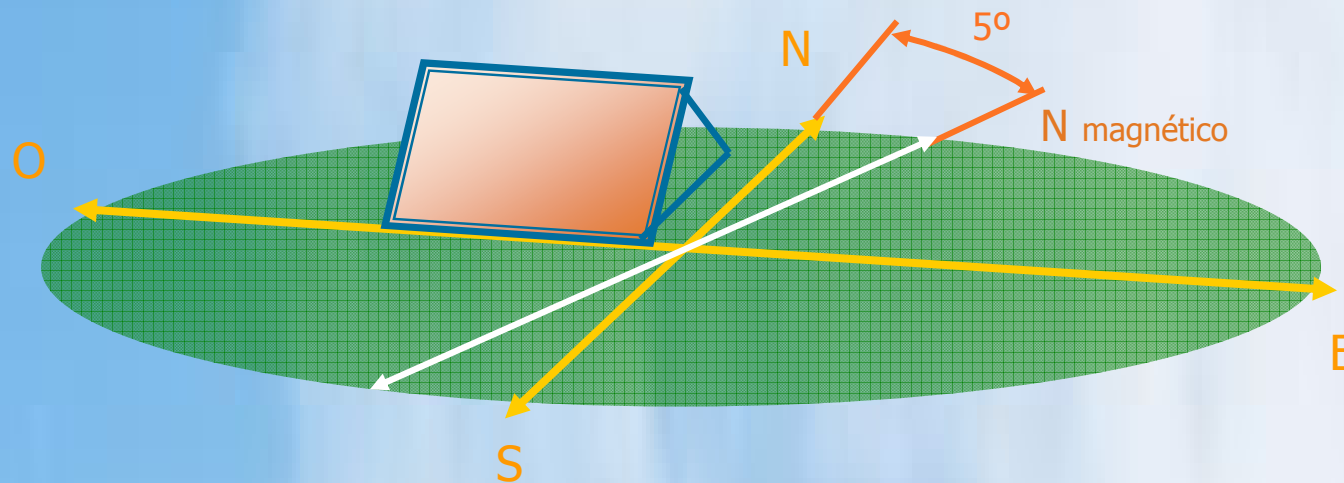
2500

1 conjunto depósito/permutador
Volume = 2500 l
Área externa = 14,97 m²
Perdas térmicas = 15,0 W/K

Permutador interno, tipo serpentina.
Eficiência do permutador 55%.
Depósito colocado no exterior.
Posição vertical.

Collector Orientation

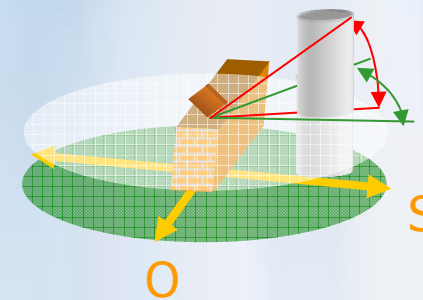
- Geographical South oriented;
- For CPC EW position preference;
- +/- 30° deviations acceptable (penalization < 10%).



Collector Orientation

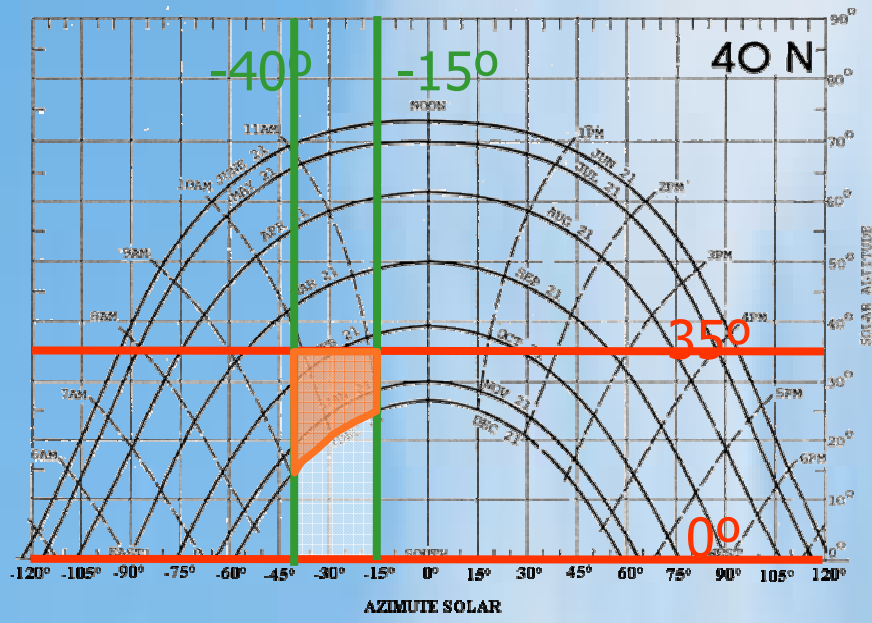
- Shadows prevision;
- Stereographical determination;
- Software (SOLTERM5.0) preview and simulation.

Lisboa: lat aprox. 40°

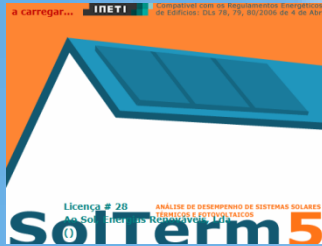


$$h < 35^\circ$$

$$-40^\circ < a_s < -15^\circ$$



Software Analysis: SOLTERM5.0 Outputs



- Energy analysis;
- Iterative process;
- Productivity (kWh/m²) and output (kWh) maximization (for Lisbon > 850 kWh/m²);
- Global system efficiency normally > 40%.

SolTerm 5.0 - Análise de desempenho e pré-dimensionamento de Sistemas Solares

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Lisboa
Projecto: TOTAL | Lisboa

Desempenho do sistema térmico

	Rad. Horiz. kWh/m ²	Rad. Incl. lin. kWh/m ²	Desperdiçado kWh	Fornecido kWh	Carga kWh	Apoio kWh
Janeiro	83	109	.	3908	8651	4713
Fevereiro	81	118	.	4056	7651	3595
Março	110	144	.	4045	8291	3445
Abril	156	161	.	5310	7674	2365
Mai	197	180	.	5865	7750	1885
Junho	200	177	.	5006	7326	1519
Julho	228	200	.	6779	7750	971
Agosto	210	206	.	7061	7930	866
Setembro	148	172	.	6230	8023	1793
Outubro	107	149	.	5066	8291	2925
Novembro	73	122	.	4353	8198	3845
Dezembro	60	108	.	3514	8651	4737
Anual	1640	1947	.	63496	96705	32609

Rendimento global anual do sistema: 49% Fração solar: 68.0%
 Produtividade: 912 kWh/[m² colector]

Optimização sob critérios energéticos

aumentar a fração solar
 reduzir o fornecimento de energia de apoio
 optimizar a orientação dos colectores

constrangimentos
 manter o azimute

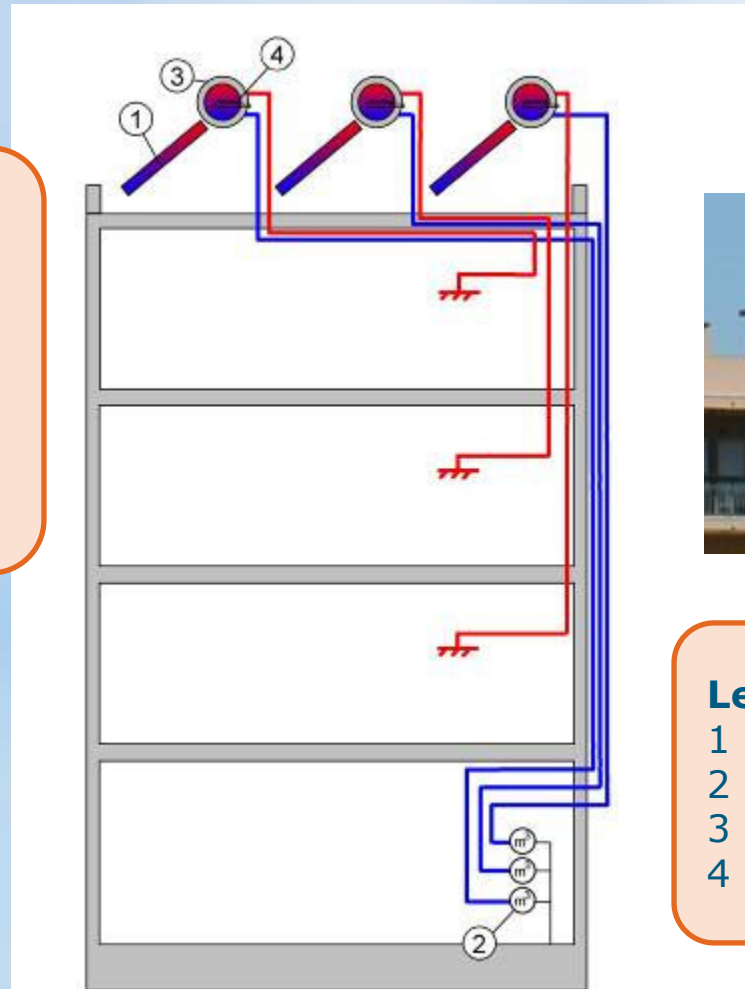
Optimizar
 (35 módulos)
 69.65 m²
 Inclinação 15°
 Azimute Sul
 Armazenamento de 3000 l

N.B. Num Projecto de AQS padronizado segundo o RCCTE (DL 80/06 de 4 Abril) "E solar" é o valor anual de "Fornecido"

Collective Systems

MULTI KT1 Solar System

**Individual
Collection and
Accumulation
(Decentralized)**

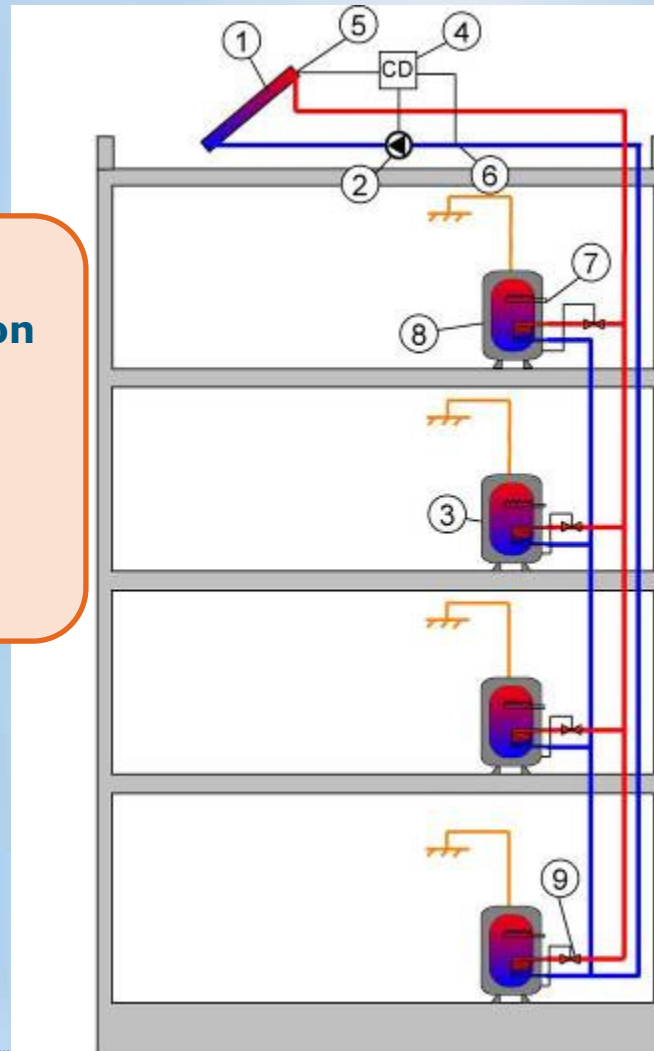


Legend

- 1 - Kits collectors;
- 2 - Cold water meter;
- 3 - Kits tanks;
- 4 - Electrical backup.

MULTI CF1 Solar System

**Collective Collection
(Centralized) and
Individual
Accumulation
(Decentralized)**

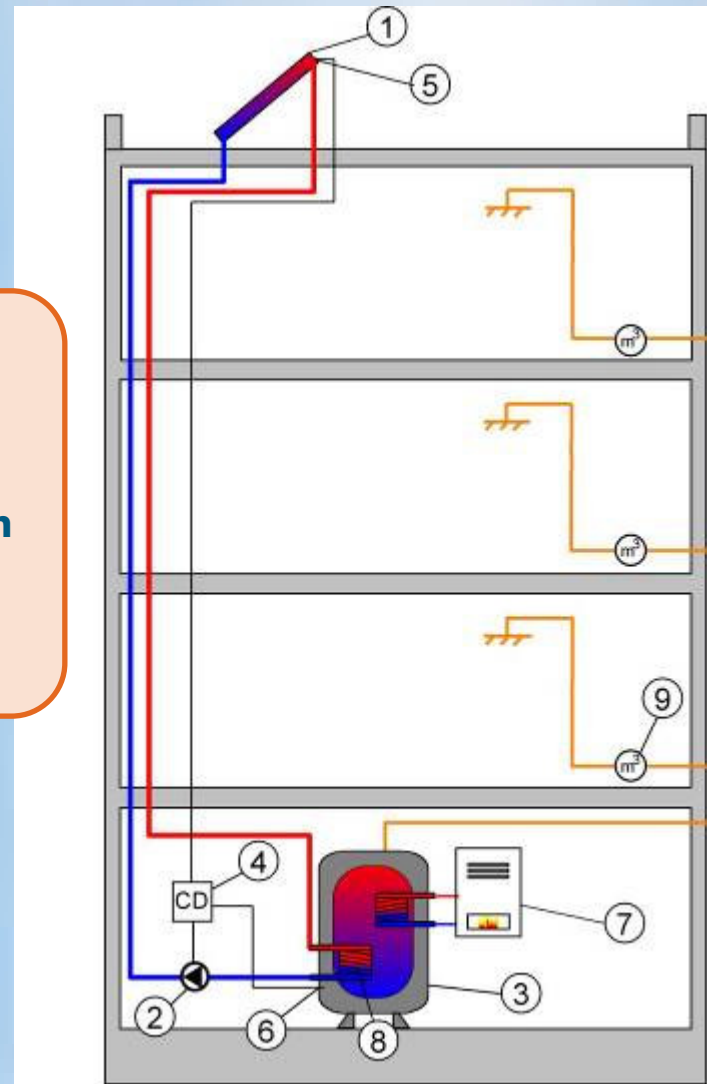


Legend:

- 1 - Collectors;
- 2 - Pump;
- 3 - Tanks;
- 4 - Differential controller;
- 5 - Collector temp. sensor;
- 6 - Return temp. sensor;
- 7 - Backup;
- 8 - Heat exchanger;
- 9 - Automatic stop valve.

MULTI CF4 Solar System

**Collective
Collection and
Accumulation with
Central Backup**



Legend:

- 1 - Collectors;
- 2 - Pump;
- 3 - Tank;
- 4 - Differential controller;
- 5 - Collector temp. sensor;
- 6 - Tank temp. sensor;
- 7 - Backup;
- 8 - Heat exchanger;
- 9 - Hot water meter.

CPC Projects

Ao Sol CPC Projects: Gestiretalho

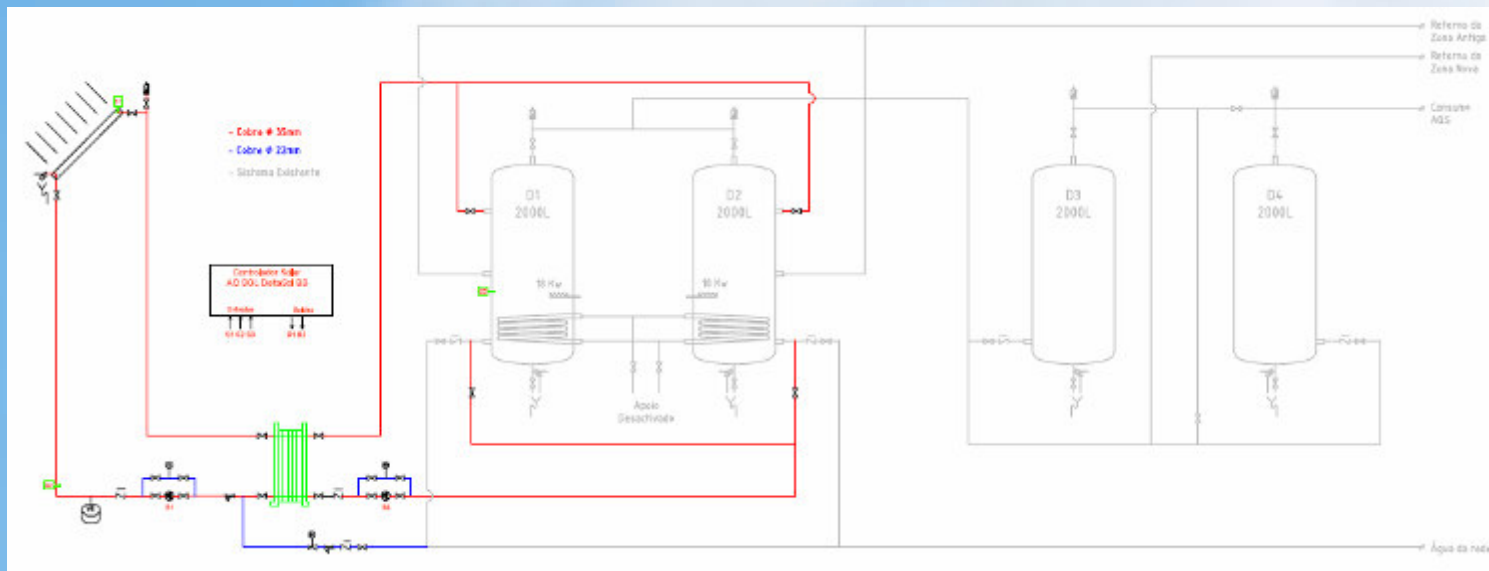


Project: Gestiretalho

Local: Carregado

Objective: Water heating (8.000 lt.) for baths

Solution: System with 36 CPC 3E+ collectors and 2 tanks 2.000 lt. each (parallel)



Ao Sol CPC Projects: Centro de Interpretação Ambiental do Alviela

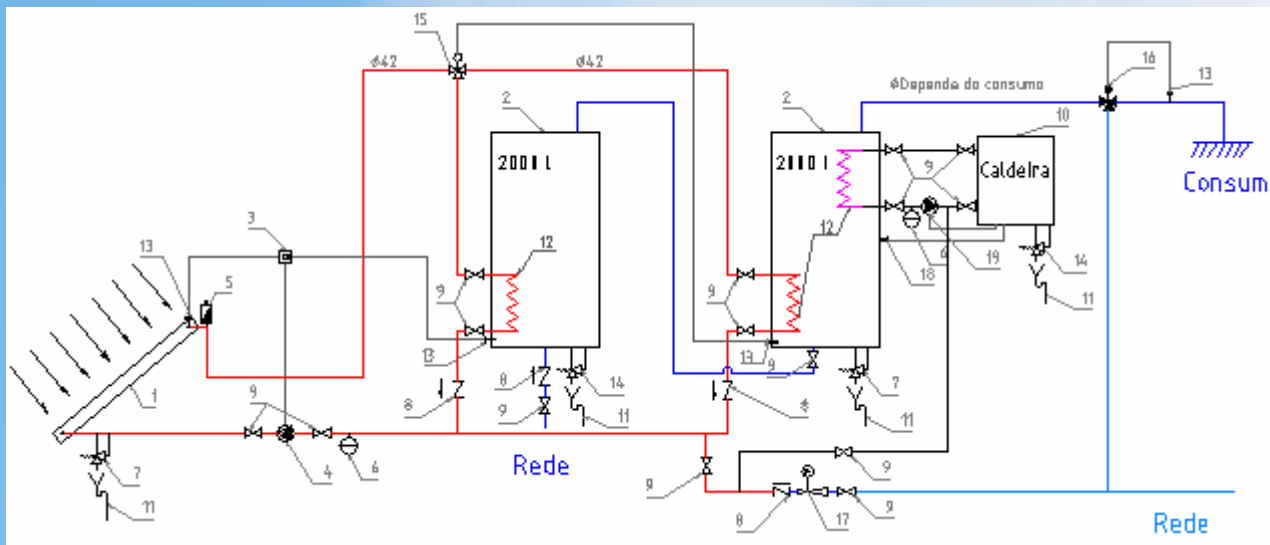


Project: Centro de Interpretação Ambiental do Alviela

Local: Olhos d'Água, Alviela, Alcanena

Objective: Water heating (4.000 lt.) for baths

Solution: Solar system with 24 CPC AO SOL collectors and 2 tanks 2.000 lt. each (serial)



Ao Sol CPC Projects: Piscina Municipal de Vale Fundão

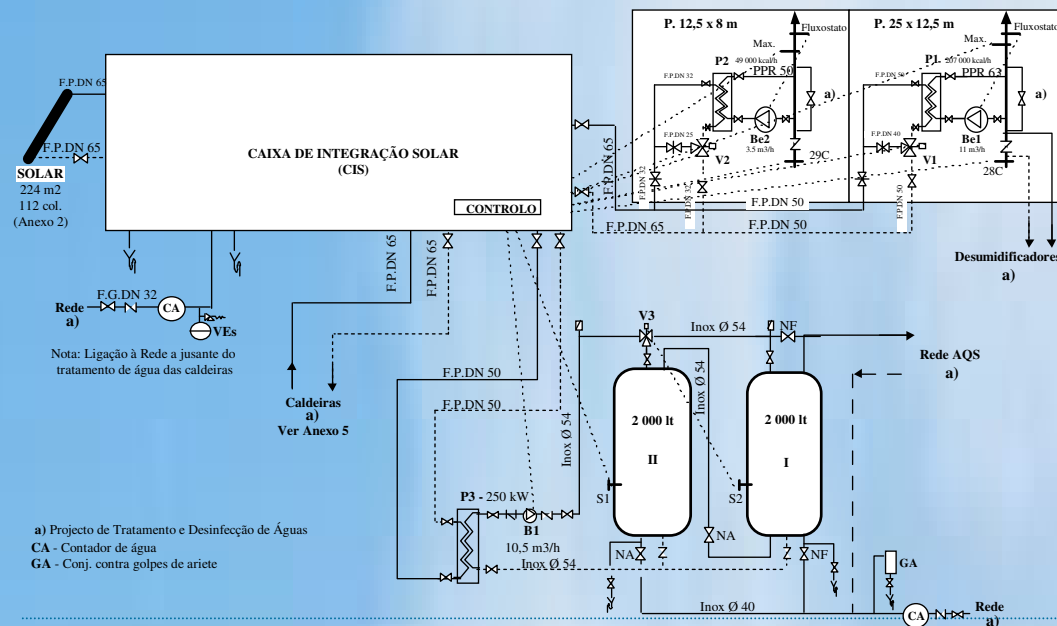


Project: Piscina Municipal de Vale Fundão

Local: Lisboa

Objective: Swimming pool heating (2 pools) and water heating (4.000 lt.)

Solution: Solar system with 112 CPC AO SOL collectors and CIS control (Integration Solar Box)



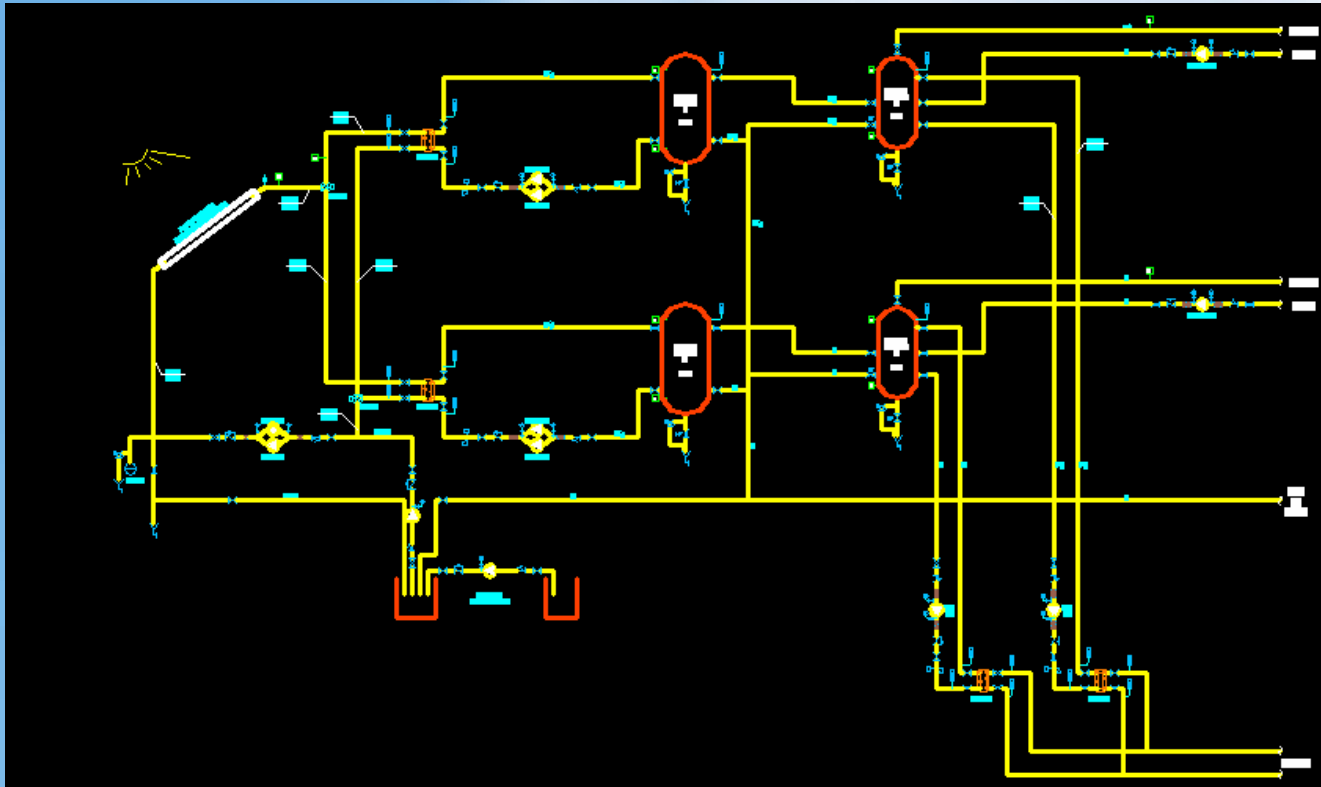
Ao Sol CPC Projects: Hotel Tivoli Marinotel

Project: Hotel Tivoli Marinotel

Local: Vilamoura - Algarve

Objective: Water heating (12.000 lt.)

Solution: Solar system with 138
CPC 3E+



Ao Sol CPC Projects: Presidência da República

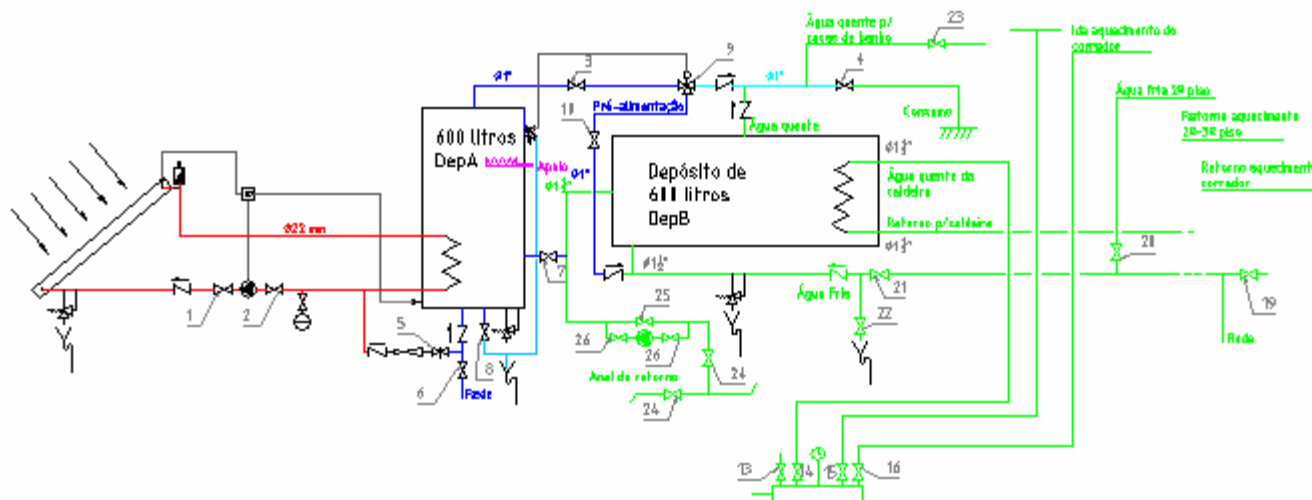


Project: Presidência da República, Palácio de Belém

Local: Belém

Objective: DHW (600 lt.)

Solution: Solar system with 4 CPC AOSOL and 600 lt tank



END

