

Solar Thermal: Solar Collectors

Types of Solar Collectors

Solar collectors collect heat from the sun's radiation. They are usually located on the roofs of houses but can also be sited on walls or the ground. Roof panels are typically more economical for small installations.

For optimum performance the collectors should be sited in a shade free area, facing south at an angle of 35° to the horizontal. However orientating those somewhere between south east and south west, and at an angle of $30-45^\circ$ to the horizontal would not significantly affect the system's performance over the course of a year. Where the collector is to be mounted on a pitched roof the choice of angle is usually determined by the roof pitch. However on a flat roof the collector is usually supported by a purpose built frame, allowing it to be inclined at the optimum angle.

There are two main types of collector:

1. Flat plate collectors
2. Evacuated tube collectors

Flat Plate Collectors

We want to collect as much radiation as possible so dark colours and matt surfaces are preferred to rather than light polished surfaces. The coating can be non-selective or selective. The non-selective surfaces are good absorbers, absorbing 90-95% of solar radiation, but lose 90% by radiating back out from the collector.

Selective coatings are good absorbers, absorbing 90-95% of solar radiation and only losing 6-12% by radiating back out from the collector.

Flat plate collectors comprise of a dark metal plate within an insulated box, with a glass or durable plastic cover. Heat transfer fluid circulating inside the plate absorbs the solar radiation. The plate is usually coated with a selective coating which ensures high absorption and low heat loss.

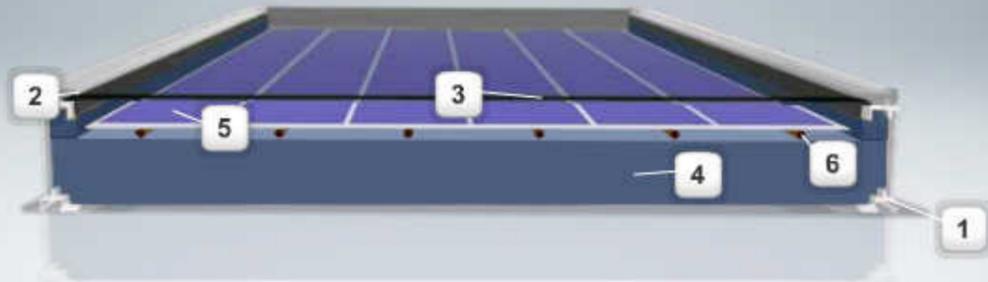
Glazing materials need to let the maximum solar energy through to the absorber and a minimum to be transformed back to the atmosphere; they can be made from:

- Acrylic - transmission rate of 89%
- Glass - transmission rate of 91-95%
- Plastic - transmission rate of 90-95%

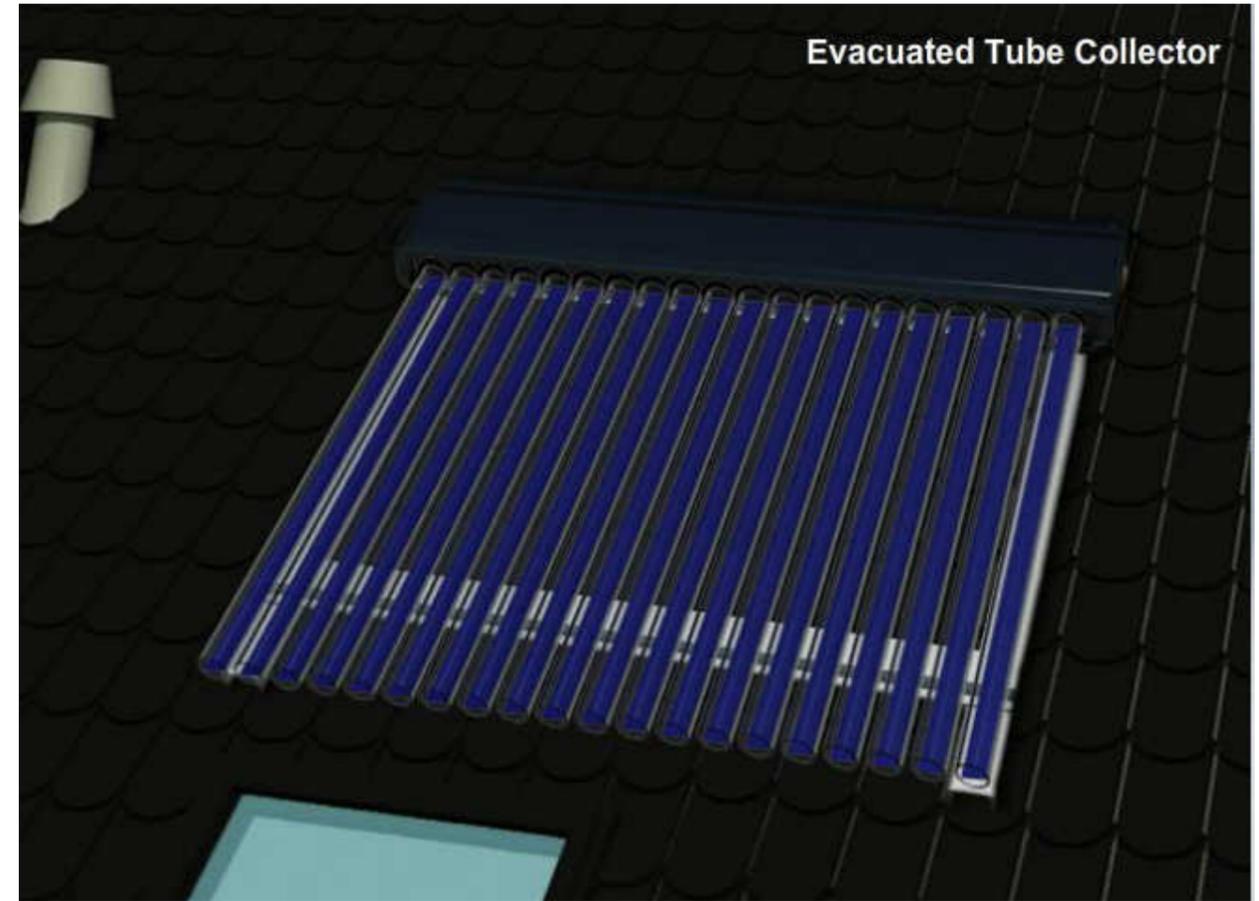


Flat Plate Solar Collectors

1. Casing
2. Seal
3. Transparent Cover
4. Thermal Insulant
5. Absorber Plate
6. Tube



Evacuated Tube Collector



Evacuated Tube Collector

Evacuated tube collectors comprise of a series of metal strips collectors within a row of glass vacuum tubes. The vacuum greatly reduces heat loss from convection and conduction. Each pipe is a sealed unit with a large heat transfer plug at the top. Heat transfer liquid is heated and rises within the tube, which releases heat energy at the condensing tip transfers the heat to a condenser located in the manifold of the solar system. The condensed liquid then flows back down the tube to repeat the cycle.

Available in assembly units of 20-30 tubes connected to a manifold, stagnation temperature range from 210-250° C.

The efficiency of the evacuate tubes collectors is usually higher than that of a flat plate collector. The evacuated tube collector can also be lighter in weight but cannot be integrated within the roof covering due to its form.



Absorption of Energy Efficiency of Collectors

Efficiency of a solar collector is measured as the ratio of energy obtained by the heat transfer fluid to the total energy falling on the total collector surface.

Collector efficiency is not the same as absorber or apparent efficiency; absorber and aperture efficiency are based on absorber area and aperture area respectively.

The relative temperature between ambient temperatures of the collector is known as Delta T.

Efficiency Comparison at Irradiation of 1,000 W/m²k

KEY

-  Selective surface evacuated tube
-  Selective surface flat plate
-  Non-selective surface flat plate
-  Unglazed non-selective surface flat plate

