Specifiers: Solar Thermal Collector Types

From RVR

Solar thermal collectors convert sunlight into heat and then transfer this heat to a solar fluid which moves the heat into the downstream system. There are many types of collector available but we are mainly concerned with two principal types; Flat panel collectors and Vacuum tube collectors.

Collector Terminology

Gross Area

The gross area is the actual area occupied by the collector. It is determined by it's external dimensions.

Aperture Area

The aperture area is the area through which light enters the collector. This determines the maximum amount of energy which the collector can absorb. The aperture area can be quite significantly smaller than the gross area.

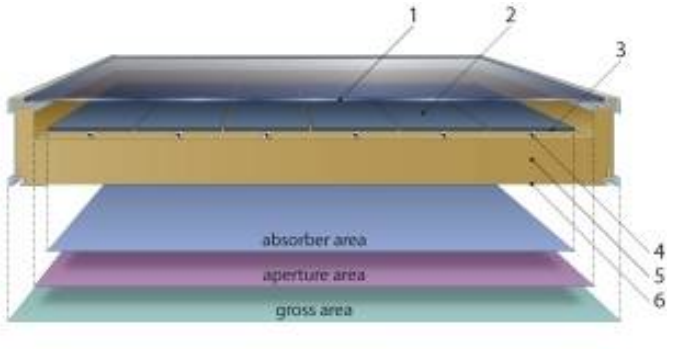
Absorber Area

The absorber area is the area of the actual absorbing surface. This is usually smaller than the aperture area.

When comparing collectors, it is essential that they are compared on the basis of aperture area. Efficiency figures, based on aperture area, are available for all collectors which have been tested to EN12975.

Flat Panel Solar Collectors

The graphic below shows the main components of a Flat Panel Solar collector.



1. The solar glass is a special tough glass designed to optimise transmission of solar energy.
2. There is an air space between the glass and absorber.
3. The absorber is made from copper or aluminium and coated with a special 'selective' material to ensure maximum absorption of solar heat. The selective coating is designed to maximise energy absorption but minimise re-radiation of heat.
4. Copper tubes are welded to the absorber to ensure that the heat is transferred to the solar fluid.
5. A thick layer of polyeurethane or rockwool insulation is mounted behind the absorber in order to minimise heat loss from the back of the solar panel.

Flat panel collectors can have gross areas ranging from $2m^2$ - $18m^2$ in a single collector.

RVR supplies flat panel collectors from the Austrian company TiSun. For more information click on the FM-S TiSun Solar Collectors (http://www.rvr.ie/default.aspx?subj=catalog/ProductDescription&catIdPath=0_70_75_71&productId=SOL551) product page.

Vacuum Tube Collectors

Vacuum Tube Panels on a roof

In this type of collector, the absorber is surrounded by a vacuum. The incoming radiant energy passes through the vacuum unimpeded, but it cannot be transferred outwards from the absorber by convection or conduction.

The vacuum tube consists of two concentric glass cylinders. The vacuum is contained between the cylinders. The selective absorber is normally applied to the outer surface of the inner glass cylinder.

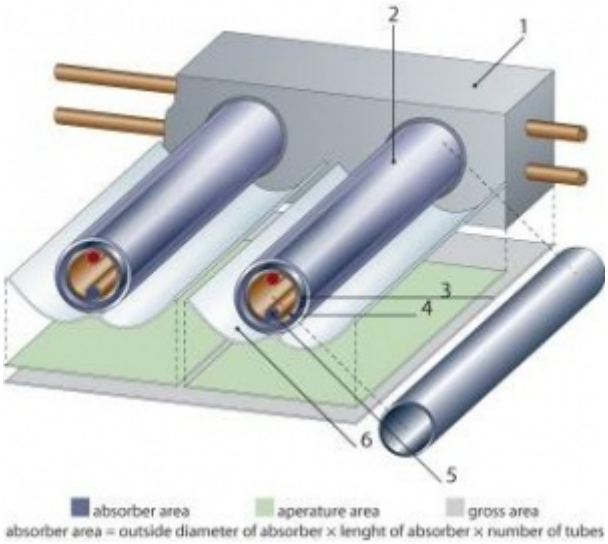
The incoming solar energy passes through the outer glass tube. It then passes through the vacuum and is absorbed by the coating on the inner glass tube. The inner glass tube becomes hot and transfers it's energy by conduction to the internal heat exchange surface of the collector. The vacuum is very effective at preventing the transfer of heat outwards from the absorber. Even with an absorber temperature of 120°C or more, the outer glass remains cold.

There are two main types of vacuum collector technology available:

Fluid Type

In a fluid type vacuum collector, a solar fluid passes through a U-Tube in each of the solar tubes, absorbing the solar energy directly.

The graphic below shows how a Fluid type / U-Tube type collector works.



1. The collector header contains the flow and return pipes. These are insulated to minimise heat loss.
2. The solar energy is collected by the Vacuum Tube. This traps the energy inside like a thermos flask.
3. The inner tube with it's selective coating gets hot.
4. An aluminum fin is in contact with the inner glass surface. Heat is conducted from the glass into the aluminium. The aluminium fin surrounds the copper U Tube. Heat is conducted from the fin into the copper tube.
5. The solar fluid circulates through the copper U tube. The solar heat is transferred to the fluid.
6. A parabolic "CPC" reflector ensures maximum aperture area as it gathers the suns rays, no matter which direction they come from.

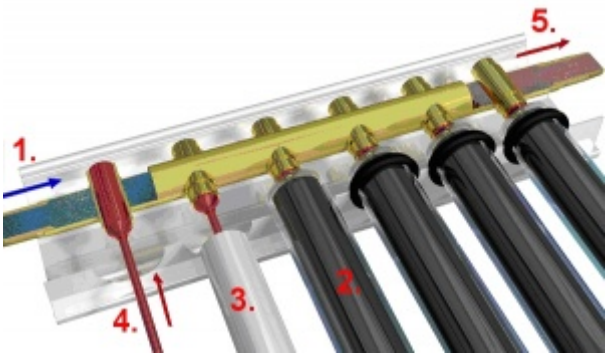
Some collectors are supplied with a CPC "Compound Parabolic Reflector" behind the tubes. A collector without a CPC reflector will have a much smaller aperture area than one which has a reflector.

RVR supply the VTN range of vacuum collectors from Calpak. Further information is on the Calpak 12VTN (http://www.rvr.ie/default.aspx?subj=catalog/ProductDescription&catIdPath=0_70_75_71&productId=SOL001) product page.

Heat Pipe

The structure of the vacuum tube for a heat pipe collector is very similar to the fluid type collector. In a heat pipe vacuum collector, the solar fluid does not absorb the energy directly. Instead, there is a refrigerant in the tubes that indirectly heats the solar fluid.

The graphic below shows how a Heat Pipe type collector works.



1. The solar fluid is circulated up around the panel from left to right.
2. The solar energy is collected by the Vacuum Tube. This traps the energy inside like a thermos flask.
3. The inner tube with it's selective coating gets hot. An aluminum fin is in contact with the inner glass surface. Heat is conducted from the glass into the aluminium. The aluminium fin surrounds the copper heat pipe. Heat is conducted from the fin into the copper heat pipe.
4. Inside the copper pipe there is a refrigerant which evaporates. When it evaporates, it rises to the top of the pipe by convection. It comes into contact with a copper bulb which transfers the heat into the solar fluid which circulates in the header. The refrigerant cools, condenses and flows by gravity back down the heat pipe until it is heated again.
5. The solar fluid, having been heated by 20+ tubes, leaves the collector and is circulated to the external system. The process begins again at step #1.

Heat Pipe type vacuum collectors are convenient and very easy to transport. Handling is easy as the tubes can be disconnected from the manifold of the collector and fitted after installation.

Heat pipes must be installed at a minimum angle of 15° to the horizontal to ensure that the recirculation of the refrigerant within the heat pipes can occur.

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RVR Supply a range of heat pipe vacuum tube collectors. Further information is on the RVR Solar HP20 model (http://www.rvr.ie/default.aspx?subj=catalog/ProductDescription&catIdPath=0_70_75_71&productId=SOL401) and HP30 model (http://www.rvr.ie/default.aspx?subj=catalog/ProductDescription&catIdPath=0_70_75_71&productId=SOL402) product pages.

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