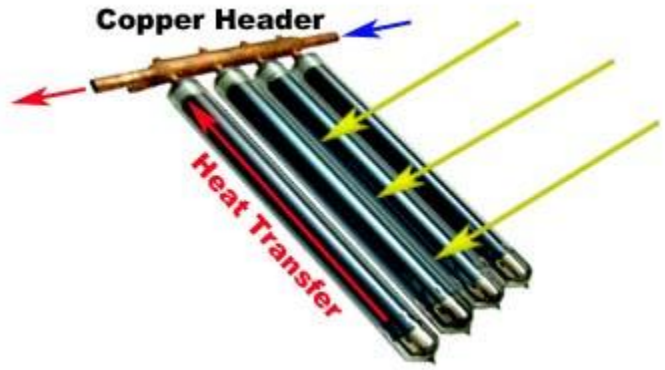
Thermal Collectors: Heat Pipes & Evacuated Tube Technology by Solar Panels Plus

The operation of the solar collector is as follows:

1. **Solar Absorption:** Solar thermal energy is absorbed within the evacuated tubes and is converted into usable concentrated heat.

2. **Solar Thermal Transfer:** Copper heat pipes transfer the thermal energy from within the solar tube into the copper header.

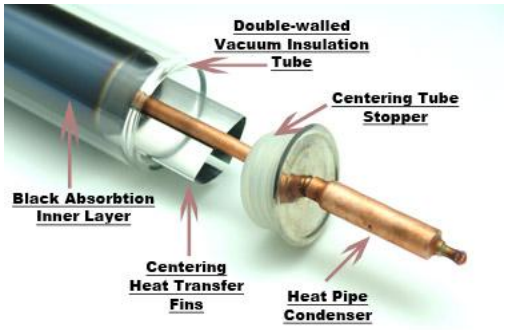
3. **Solar Thermal Storage:** A thermal transfer solution (water or glycol mixture) is pumped through the copper header. As the solution circulates through the copper header the temperature is raised by 5-10 °C / 9-18 °F.

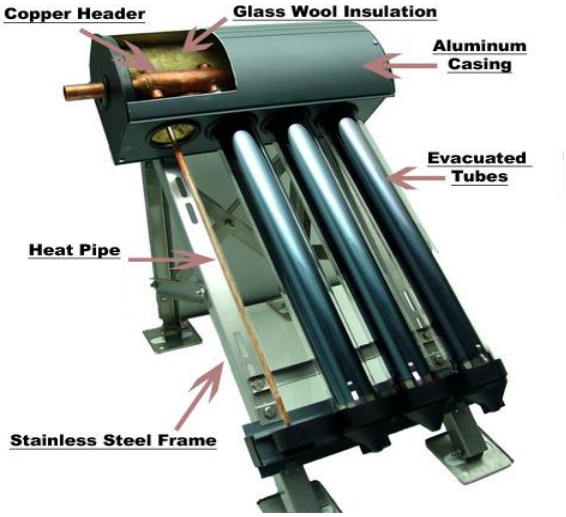


Evacuated Tubes: The most efficient thermal collector on the market, the glass tubes absorb solar thermal energy for use in water heating. The tubes have a double wall, the area between the inner and outer layers of the wall are evacuated (a vacuum). This acts as a thermos to keep heat from escaping into the atmosphere.

The evacuated tubes are glass tubes manufactured from strengthened borosilicate glass. The tubes have a double outer layer; the outer layer is fully transparent to allow solar energy to pass

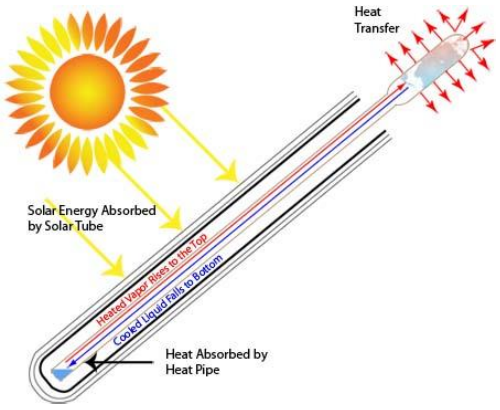
through unimpeded. The inner layer is treated with a selective optical coating which causes energy absorption without reflection. The inner and outer layer are fused at high temperatures at the end leaving an empty space between the inner and outer layers. All air is pumped out of the space between the two layers (evacuation process) creating the thermos effect which stops conductive and convective transfer of heat which might otherwise escape into the atmosphere. Heat loss is further reduced by the low-emissivity nature of the type of glass that is used





Heat Pipe: Inside the glass tube is the copper heat pipe. It is a sealed hollow copper tube that contains a small amount of proprietary liquid, which under low pressure boils at a very low temperature. In fact the liquid contained in the heat pipe boils at only 86 °F (30

This heat pipe rapidly and efficiently transfers the captured thermal energy through the evacuated tube and delivers it to the manifold (header) as the liquid boils and rises. As the heat is removed from the heat pipe by the copper header, the liquid condenses and gravity returns it to the base of the heat pipe so that the process is continually repeated.



Because the evacuated tubes are round, they serve as a passive tracking solar collector, maximizing their performance.

PASSIVE SOLAR TRACKING

Passive Solar Tracking

Having the maximum amount of absorber area directly facing the sun causes superior solar collector performance. Because of their round design, Solar Panels Plus evacuated tube collectors are able to passively track the sun, meaning that they are always pointed directly at the sun and can absorb solar thermal energy evenly all day long.

This is important, particularly if the heat is needed throughout the day without using a large thermal storage system. Evacuated tube solar collectors are great for everything from making plain old hot water, to solar heating, solar air conditioning, commercial water heating or manufacturing process heat.

By tracking the sun from early morning until late afternoon, more heat is generated by the collector which means that your existing energy source will be used less, saving money and helping conserve precious non-renewable resources

Flat-plate collectors, on the other hand, only directly face the sun during midday which decreases their maximum daily heat output, lowers the heat available during morning and afternoon, and, causes the need for larger storage in many applications.

It's no wonder that evacuated tubes are quickly becoming the solar collector of choice for commercial and residential users throughout the world.

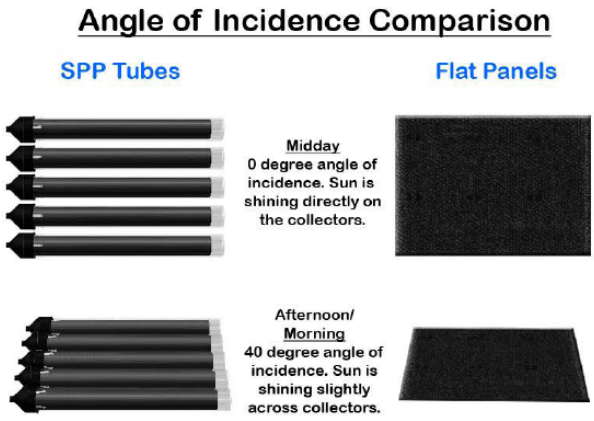
Incidence Angle Modifier (IAM)

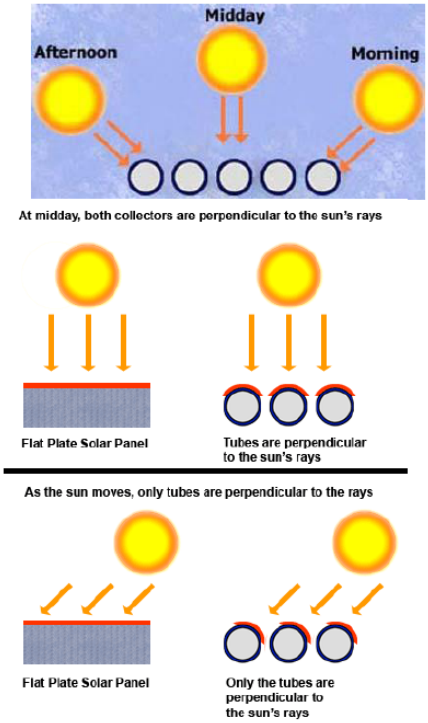
IAM is the variance in output performance of a solar collector as the angle of the sun changes in relation to the surface of the collector.Solar Panels Plus evacuated tubes provide an important and measurable increase in efficiency in the morning and afternoon when the sun's angle is between 40 and 80 degrees from perpendicular. The result is constant heat output for the better part of the day.

When solar energy is absorbed by a collector at an angle other than perpendicular, the performance of that collector changes and measuring the IAM provides an angle based performance factor. When the collector is perpendicular to the sun, a maximum value of 1 is achieved as the collector is receiving the maximum amount of radiation possible.

In the instance of flat-plate collectors, the maximum value of 1 is achieved at midday and is quite less during the morning and afternoon. The chart at the bottom of the page clearly shows this.

Our evacuated tube solar collectors, on the other hand, often provide performance values in excess of 1 during the morning and afternoon based on their cylindrical design, which allows the panels to reflect onto each other which can boost performance.





The diagram to the left further demonstrates the passive tracking of the sun by Solar Panels Plus evacuated tubes.

In the first picture (0 deg), the sun is directly perpendicular to the collector and is allowing the collector to absorb the maximum amount of sunlight available. The gaps in between the tubes do let some sunlight pass through but the collector still produces an IAM of 1.

In the next picture (40 deg), the sun is approximately 2 hours and 40 minutes before/after midday. The are no gaps in between the tubes and the sun is still perpendicular to the collector, allowing for the maximum amount of sunlight to be absorbed and reflected onto neighboring tubes, producing an IAM values of greater than 1 (peak performance). As the angle of the sun increases beyond 40 deg the evacuated tubes begin to overlap and are exposed to less solar radiation. The surface area of the collector is still absorbing sunlight but performance is reduced due to the overlapping of the tubes. This has minimal effect on the overall daily performance of the collector because only a small percentage of sunlight falls beyond the optimal angle of 40 degrees (very early morning/very late afternoon)

The result of the IAM effect equates to approximately a 25% increase in heat output performance compared to flat-plate collectors with the same absorber area and under the same operating conditions. The IAM is extremely important to consider when comparing heat output of different solar collectors – especially when comparing flat-plate collectors to evacuated tube collectors.

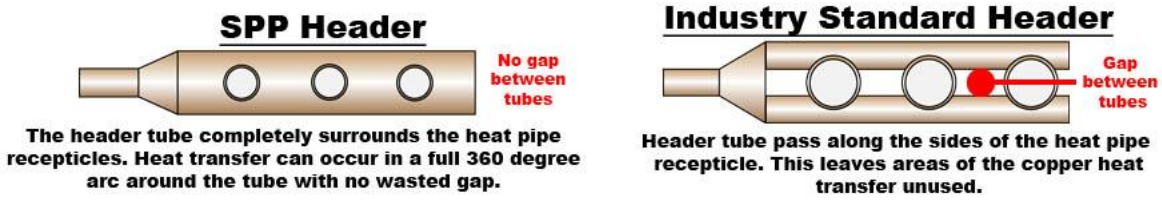
DESIGN IMPROVEMENTS TO THE SPP-30 EVACUATED TUBE COLLECTOR

NEW OPTICAL COATING

SPP started with a better performing selective optical coating formula to absorb more sunshine (even on cloudy days) and reflect less solar energy.

HEADER REDESIGN

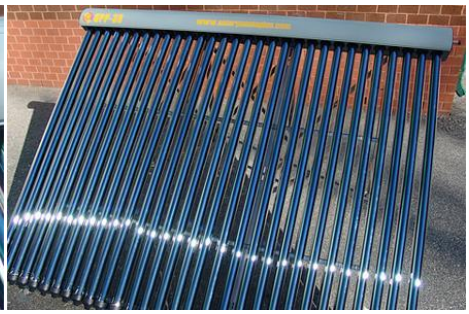
A new header design was developed with more heat exchange surface area inside the manifold (360º contact with heat transfer fluid).



CONDENSER BULB REDESIGN

SPP made the condenser bulb (and receiver) longer and thinner which allows it to be inserted into a single piece header instead of welding the receiver to a split header (see above diagrams). In the process, they gave the bulb a larger heat exchange surface area.The heat pipe was centered in the tube instead of having it run down one side of the tube for better passive solar tracking. Also, the end of the tube was sealed where it plugs into the manifold with a thermal cap, instead of leaving it exposed.

SPP-30 AWARDED ONE OF THE SRCC's* HIGHEST RATINGS



So what makes the SPP-30 the world's best and most efficient solar water heater collector? The dedication of the people at SPP to make the most advanced solar thermal collector in the world. The goal was to make a more durable, less costly, and easier to install collector that would outperform the competition in their solar thermal collection efficiency. SPP succeeded!

* The Solar Rating and Certification Corporation currently administers a certification, rating, and labeling program for solar collectors and a similar program for complete solar water heating systems. SRCC rating is required by federal and state governments for equipment to qualify for tax rebate programs.