HEAT DISSIPATION FOR SOLAR WATER HEATERS

Anyone can make a solar water heater. It is as simple as running water through a black hose laid out in the sun. If the water isn't hot enough, a sheet of glass or clear plastic can be used to cover the hose and reduce heat loss.

But on hot days this may cause the hose to melt or become weak. To avoid this, metal tubes can be used in place of the hose. If, during cooler weather, the water still isn't hot enough, the tubes can be coated with a special ("selective") black surface to reduce heat loss and absorb more solar energy.

But on very hot days this may cause the water in the tubes to boil. The "art" to building a solar water heater is not just in making hot water. It is achieving a balance between summer over-heating and winter under-heating.

This Fact File describes some ways of doing this and in particular explains how the Solahart Heat Dissipation Pipe works.

Do All Solar Water Heaters Dissipate Heat?

All solar and conventional water heaters do dissipate heat and in so doing cool down the water held in the storage tank. Most of the dissipated heat is lost through the insulation that surrounds the storage tank.

Heat dissipation occurs whenever the temperature of the water in the storage tank is higher than that of the surrounding air. This dissipation is seen as a reduction over time of the storage water temperature.

If energy is not added to the stored water eventually the water temperature will return to equal that of the surrounding air. When the sun is heating the solar collectors, most of the solar energy is transferred into the storage tank to heat the water in it.

The balance is lost or dissipated back to the surrounding air. The ratio between the amount of heat transferred and amount dissipated depends on the design and the temperature of the solar collectors.

Heat is not dissipated from the solar collectors when the sun is unable to provide any heating. At these times, the solar collectors cool to a temperature below that of the water in the storage tank and do not contribute to any heat dissipation.

After extended periods of hot and sunny weather and during which there has been negligible hot water use, a solar water heater can "stagnate". Under stagnation conditions, the temperature of the water in the storage tank is hot and stable.

This happens because the amount of heat dissipated through the storage tank insulation is equal to the amount of solar energy transferred into the storage tank water from the solar collectors. The temperature at which stagnation occurs ("the stagnation temperature") is a critical design parameter for a solar water heater.

What If Heat Dissipation Is Too Slow?

If the rate of heat dissipation is low, then the stagnation temperature is higher than with faster rates of heat dissipation. An overly slow rate of heat dissipation actually means that the stagnation temperature is too high.

It is important that solar water heaters are not allowed to stagnate at temperatures close to the boiling point of water (100˚C). If 100˚C stagnation temperatures are experienced, high pressures arise.

This means that either the storage tank is subject to excessive stress or too much reliance is placed on the safety relief valves. This is where science must overtake art.

The performance of the solar collectors must be matched to the characteristics of the total system to ensure that even during periods of very high solar radiation and no hot water usage, the storage tank water temperature remains within safe limits.

How Does a Solahart Control Heat Dissipation?

A Solahart solar water heater has a number of characteristics that help to control the rate of heat dissipation. First, the "asymmetric" thermal insulation around the storage tank is thicker over the top of the tank than under the bottom.

This means that if the storage tank water is hot throughout, the lower, less insulated part of the tank will rapidly dissipate heat and the water temperature will stabilise or fall. If the storage tank water is hot near the top only, minimal heat will be dissipated and the water temperature will continue to rise.

Second, the absorber surface of the solar collector will re-radiate (dissipate) as much heat as it collects once the surface temperature approaches a critical level. For black paint collectors (‘L’ and ‘J’ type), this critical temperature is below 100˚C.

This means that ‘L’ and ‘J’ collectors, when used in conjunction with a Solahart storage tank, will self-limit the storage tank water temperature to below 100˚C. For selective surface collectors (‘K&M’ type), this critical temperature is above 100˚C.

This means that ‘K&M’ collectors can drive the storage tank water temperature close to the critical boiling point. In areas that are prone to very hot weather or high solar radiation, Solahart solar water heaters can be fitted with an additional Heat Dissipation Pipe.

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What Is The Solahart Heat Dissipation Pipe?

The Solahart Heat Dissipation Pipe is a ‘U’ shaped pipe that consists of two main sections: the absorber and the dissipater. The pipe contains a small quantity of water and is sealed to hold a partial vacuum.

The absorber is inserted into the centre of the storage tank and takes heat from water in the lower section of the storage tank. There is sufficient water in the pipe to fill the absorber section only.

The dissipater is mounted higher than the absorber and behind the storage tank. It dissipates heat transferred to it from the absorber within the storage tank.

To help increase the rate of dissipation, the dissipater is fitted with radiator fins. The Dissipater, Absorber and Storage tank in the Heat Dissipation Pipe System are separated by insulating tubes which prevent electrical connection between the tank and the absorber section located within the storage tank.

This insulation prevents galvanic action of the anode on to the copper absorber tube.

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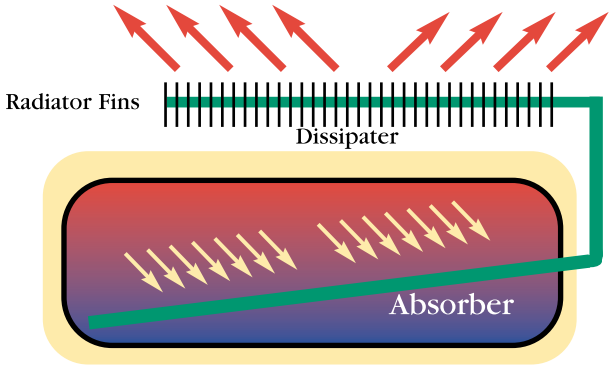
How Does The Heat Dissipation Pipe Work?

The Solahart Heat Dissipation Pipe relies upon two important physical properties of fluids. First, a liquid will boil at a lower temperature when it is held in a partial vacuum. Second, a liquid will transfer heat way from its surface at a faster rate if it is boiling.



The partial vacuum inside the Heat Dissipation Pipe causes the water in the absorber to boil at about 75˚C. Because the absorber is immersed in the lower section of the storage tank it senses the lowest water temperature.

If the storage tank lower section temperature is below 75˚C then the system is considered to be away from critical conditions. At this temperature the water in the absorber is stable and it does not transfer heat to the dissipater.

If the storage tank mid-point temperature approaches 75˚C, the system is considered to be nearing critical conditions and some additional heat dissipation is desirable. At 75˚C, the absorber water boils and the associated vapour quickly moves up into the dissipater.

The dissipater and the attached fins are then heated. Because the fins are hotter than the surrounding air they rapidly dissipate heat.

This in turn cools the dissipater and the vapour. The cooling vapour condenses to liquid, falls back to the absorber, and repeats the process until the storage tank mid-point temperature has fallen to below 75˚C.

The heat dissipation pipe self regulates its dissipation rate to match the temperature of the storage water. If the temperature continues to rise the vapour created by the boiling process within the tube is driven further into the finned area of the dissipater which increases the rate of dissipation.

How Does The Heat Dissipation Pipe Work?

The Solahart Heat Dissipation Pipe is maintenance free. It is sealed for the life of the water heater and never needs replacing or refilling.

Unlike open-circuit relief valve or isolation valve systems, the closed-circuit Heat Dissipation Pipe does not suffer problems of clogging or corrosion. Because the exposed dissipater section does not contain any liquid, it will not freeze even in the coldest of weather.

There is no need to insulate any part of the Heat Dissipation Pipe.

Are There Different Sizes of eat Dissipation Pipe?

There are two sizes of Heat Dissipation Pipe. One is suitable for 180 and 200 litre Solahart storage tanks and the other is for 300 and 400 litre tanks. They are made only for use with Solahart ‘J’ and & ‘K’ type closed circuit tanks.

Technical Specifications

Model	180/220	300/440
Length	1185 mm	2005 mm
Width	75 mm	75 mm
Pipe Diameter	19 mm	19 mm
Weight	6.0 kg	9.5 kg
Tube Material	Copper	Copper
Fin Material	Aluminium	Aluminium
Heat Output	0.35 kW	0.70 kW

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