

Heat Pipe Basics

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What is a heat pipe?

A heat pipe is a very efficient heat conductor. A typical heat pipe consists of a vessel in which its inner walls are lined with a wick structure. The vessel is first vacuumed, then charged with a working fluid, and hermetically sealed. When the heat pipe is heated at one end, the working fluid evaporates from liquid to vapor (phase change). The vapor travels through the hollow core to the other end of the heat pipe at near sonic speed, where heat energy is being removed by a heat sink or other means. Here, the vapor condenses back to liquid and releases heat at the same time. The liquid then travels back to the original end via the wick by capillary action. The energy required to change phase from liquid to gas is called the *latent heat of evaporation*. For example, the latent heat of evaporation for water is 539 cal/g. The sensible heat of water is 1 cal/g°C. Therefore, the working fluid in a heat pipe can transport a very large amount of heat and makes heat pipes 100's to 1000's times better than a solid copper rod. Fig 1 is a schematic of a heat pipe.

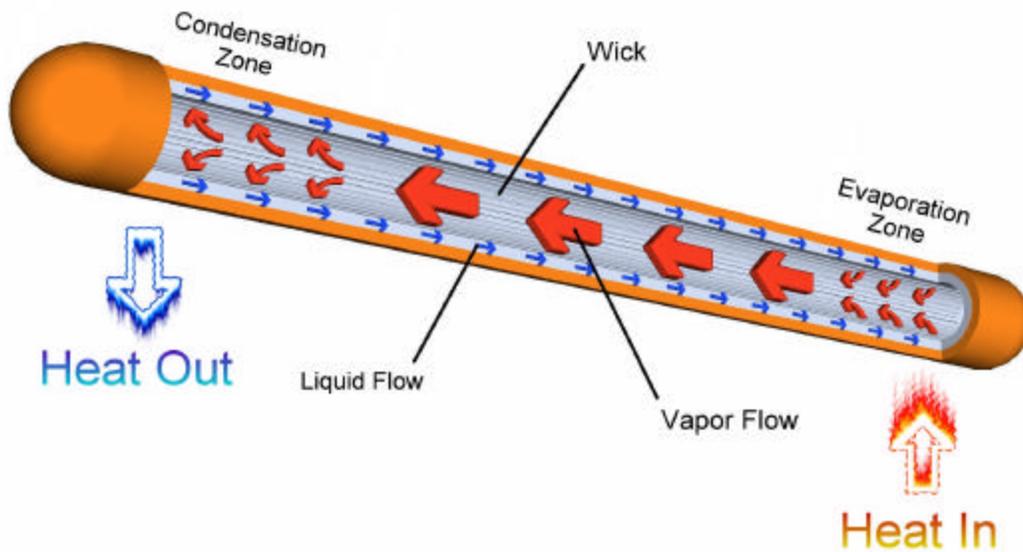


Fig 1. The schematic of a heat pipe

When to consider a heat pipe?

There are three thermal conditions that may lead to the use of heat pipe:

- 1) *To act as a primary heat conductive path.*

When a heat source and heat sink need to be placed apart, a heat pipe can be a very effective heat conduction path for heat transportation from the heat source to the heat sink.

- 2) *To aid heat conducting of a solid.*

Heat pipe can add the efficiency and transport capacity of a thermal shunt.

- 3) *To aid heat spreading across the plane.*

Heat pipes can be used to increase the heat spreading across a large heat sink base, thereby effectively increasing the base thermal conductivity. The effect of this is the decrease of the temperature gradient across the base (increase in efficiency), thereby lowering the heat source temperature.