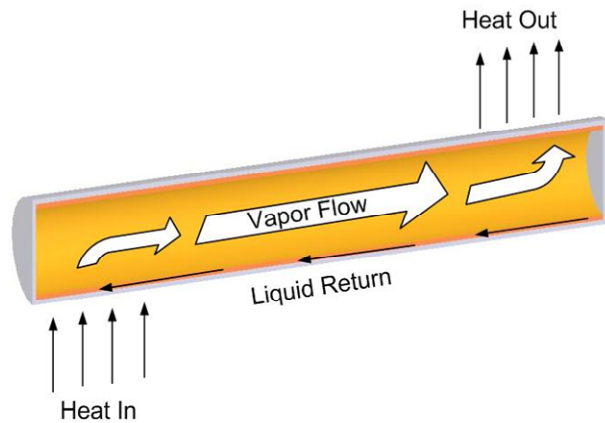


HEAT PIPES

The modern heat pipe technology was originated at the Los Alamos Scientific Laboratory in 1963. A good description of the early development history of the heat pipe technology can be found in an article published by Yale Eastman (currently a Director of ACT) in Scientific American in May 1968.

A typical tubular heat pipe is illustrated in the figure below. It is a vacuum tight device consisting of a working fluid and a wick structure. The heat input vaporizes the liquid inside the wick in the evaporator section. The vapor, carrying the latent heat of vaporization, flows towards the cooler condenser section. In the condenser, the vapor condenses and gives up its latent heat. The condensed liquid returns to the evaporator through the wick structure by capillary action. The phase change process and two-phase flow circulation continue as long as the temperature gradient between the evaporator and condenser is maintained.

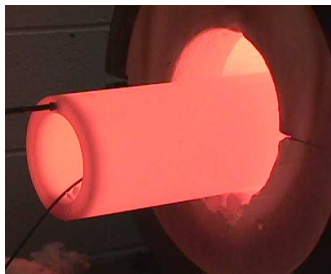


In addition to the common tubular form, heat pipes can be made into annular and planar configurations to fit each application. The most commonly used heat pipe working fluid today is water, which is suitable for temperatures between 20°C and 180°C (while recent developments of titanium/water heat pipes have pushed the temperature boundary to around 250°C). Heat pipes operating at lower temperatures use methanol, ammonia, propylene, ethane, nitrogen, oxygen and hydrogen as the working fluids. For higher temperature applications, alkali metals (also called liquid metals) such as cesium, potassium, sodium and lithium are used.

ACT has designed and manufactured heat pipes having various wicks, of various geometries including tubular, annular and planar, and operating at various temperatures from -150°C to 1,100°C. These heat pipes have been used in diverse applications including spacecraft thermal control, medical surgery temperature control, catalytic reactor cooling, and electronics thermal management. Below are sample photos of various heat pipes manufactured by ACT.



Tubular cryogenic heat pipes



Isothermal Furnace Liner



Heat pipes having various wicks