

Pressure Controlled Heat Pipe Precision (PCHP) Furnace

The Pressure Controlled Heat Pipe (PCHP) Furnace is an electric tube furnace where the working space is enclosed by an Isothermal Furnace Liner (IFL), which provides temperature uniformity and consistency.

IFLs have been used for many years by the semiconductor industry and calibration laboratories to provide high temperature working spaces that are extremely isothermal. Spatial temperature uniformity better than 10 mK has been measured and, in many cases, is better than the available measurement techniques. The heat pipe achieves this uniformity by continuous evaporation and condensation of the working fluid sealed within the IFL. The size and geometry of the heat pipe and the furnace dimensions may be customized to meet special needs, such as providing black body sources for calibrating radiation sensors.

How the PHCP Furnace Works

Unlike a conventional IFL, the annular heat pipe in the PCHP Furnace is attached to a large buffer reservoir containing helium (Figure 1). When the furnace is in operation, vapor in the heat pipe sweeps the helium gas to the water-cooled condenser, where a stable vapor/helium interface is established. Power fluctuations by the furnace are absorbed through small movements of the vapor/helium interface. By adding or removing helium, an external control system maintains a nearly constant helium pressure in the system, which translates into constant vapor pressure inside the heat pipe, and ultimately into constant temperature. The relative precision of the temperature control is about ten times as high as that of the pressure control. The control system for the helium pressure consists of a sensitive pressure transducer, a helium supply bottle, and a vacuum pump.

The Control System

The actual control system is much more complex. Two pressure transducers cover a wide pressure range. A series of solenoid valves protects the

transducers from over-pressuring, and prevents vapor from entering the control system during set point changes. The power input to the furnace is controlled by a temperature controller, whose set point is coupled to the pressure control system. A computer equipped with the appropriate interface boards collects data and performs system monitoring.

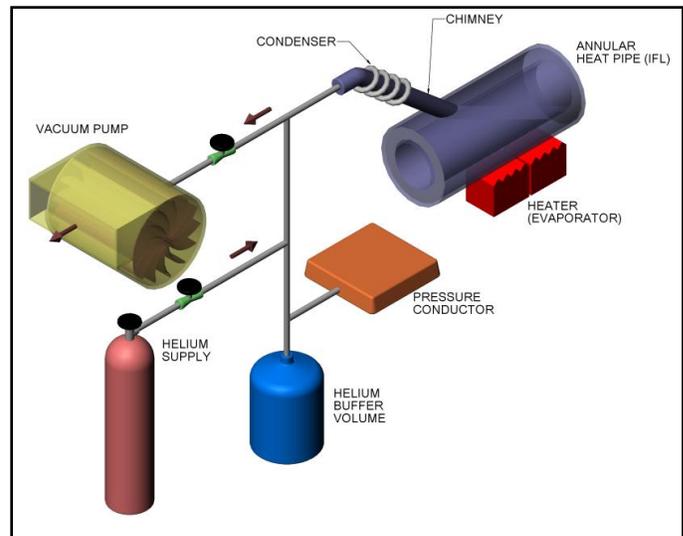


Figure 1 – PCHP Furnace Schematic

Critical Application Need

- ▶ Materials Processing
- ▶ Thermo-Physical Properties Characterization
- ▶ Temperature Calibration

PCHP Furnace Components

- ▶ Liquid Metal Heat Pipe
- ▶ Electric Tube Furnace
- ▶ Control Cabinet with Electronics and Pressure Monitoring System
- ▶ Computer