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ADVANCED COOLING TECHNOLOGIES, INC.

Innovations in Action

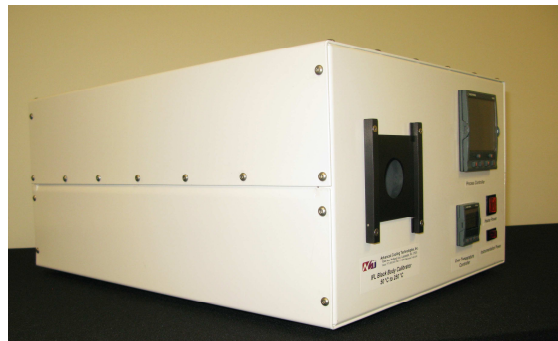
Water Isothermal Furnace Liners and Heat Pipe Blackbody Cavities

Water Isothermal Furnace Liners (IFLs) and Water Heat Pipe Blackbody Cavities (HPBCs) are used for precise temperature uniformity and control in the temperature range of 50 to 250°C. These IFLs and HPBCs are manufactured in an annular geometry. The working space within the inner tube is where the calibration, testing or materials processing is performed. The outer tube surface is heated or cooled to increase or decrease the operating set point. The space between the inner and outer tubes is where the heat pipe wick structure and the water working fluid are contained. Depending on the specific application, the IFL or HPBC can be manufactured with both ends open or with one end closed. The closed end can be in a hemispherical or conical shape. Thermocouple wells and grounding straps or studs can also be added for custom designs.

Water IFLs and HPBCs are manufactured using Monel® as the heat pipe material. ACT has extensive test data demonstrating the long term compatibility of water and Monel® at high temperatures. Life test heat pipes have been operated in excess of 30,000 hours at greater than 250°C with no sign of incompatibility or physical deformation. During manufacturing and processing, ACT oxidizes the Monel® at temperatures significantly greater than 250°C to form a stable, uniform, high emissivity coating useful for blackbody cavity calibration instruments.

The internal vapor pressure is the saturation pressure at the operating temperature, which is 600 psia at 250°C. The pressure increases rapidly as the temperature increases. For example, the internal pressure is nearly 1,000 psia at 280°C. Therefore, water IFLs and HPBCs are typically constructed using Schedule 40 pipe sizes, which can safely contain the high pressure at these elevated temperatures. A pressure relief rupture disk is installed on each unit to safely vent the internal pressure should the pipe be accidentally put into an over temperature condition.

ACT manufactures both stand alone IFLs or HPBCs and custom designed turnkey systems including the IFL or HPBC, heating or cooling mechanisms, temperature and fluid controls, and safety measures. Custom features, such as thermocouple wells, grounding studs and mounting flanges, are easily accommodated and can be incorporated to achieve a significant increase in value. Examples of some custom turnkey systems are shown in the pictures below.



Water HPBCs installed in an enclosure with controls, temperature sensor wells, and selectable aperture plates.