

DATASHEET – High Temperature Heat Pipes

Thermacore's high temperature heat pipes are used in a wide variety of applications and service conditions from the ocean floor to geosynchronous orbit. These high temperature heat pipes have improved processes as mundane as glass making, as industrial as oil-shale extraction, and as high-tech as epitaxial deposition. With over 30 years of high temperature alkali metal heat pipe design, development and fabrication experience, Thermacore's liquid metal heat pipes have set new records for heat transfer in hardware developed for the National Aerospace Plane's leading edge, solved day to day problems in state of the art automobile spark plugs, and solar power Stirling engine receivers. If your product or process involves high temperature heat transfer, or involves high heat flux cooling, Thermacore has the design and fabrication experience required to provide the best thermal solution.



Figure 1. Isothermal Furnace Liner Heat Pipes

Applications

- Isothermal Furnace Liners (Standard & Custom)
 - » Thermocouple Calibration
 - » Crystal Growth
 - » Vapor Deposition
 - » Black Body Radiators
 - » Diffusion
 - » Annealing
 - » Temperature Calibration
 - » Thermophysical Property Characterization
 - » Materials Processing
- Energy Conversion
 - » Thermionic Converters
 - » Alkali Metal Thermal-to-Electric Converters (AMTEC)
 - » Stirling Engines Interfaces
- Solar Receivers
- Chemical Processing
- Engine Components
- Aerospace Leading Edges
- Rocket Nozzles
- High Temperature Space Radiators
- Magnetoplasmadynamic (MPD) Thrusters
- Isotope Separation
- Fusion Applications

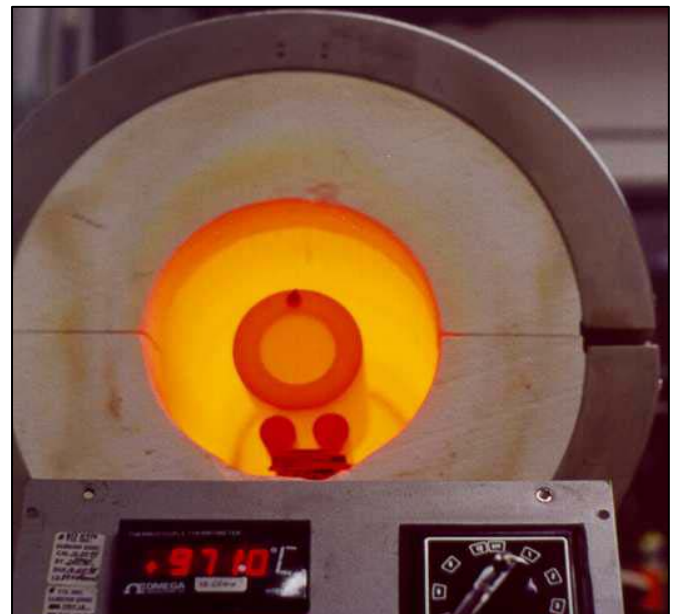


Figure 2. High Temperature Heat Pipe at 971°C

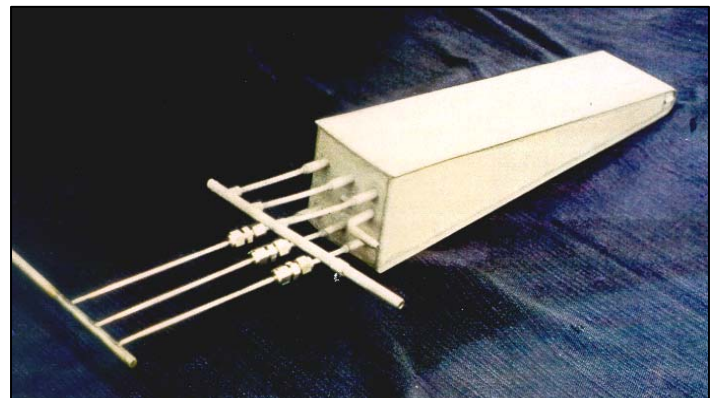


Figure 3. Hypersonic Vehicle Leading Edge Heat Pipe

Thermacore High Temperature Heat Pipe Advantages

- **Industry Leading Thermal Performance**
 - » High heat flux:
 - Lithium heat pipe operated at 126 kW/cm²
 - » Working Fluids Include:
 - Cesium: 300°C to 600°C
 - Potassium: 400°C to 1000°C
 - Sodium: 500°C to 1200°C
 - Lithium: 900°C to 1700°C
 - » Temperature Uniformity:
 - < 10mK Pressure-controlled IFL
- **High Temperature Materials**
 - » 300 Series Stainless Steels
 - » Incoloy 800 and Inconel 600, 601, 718, 625
 - » Haynes 230, 188, 214, Nickel, and Hastelloy C
 - » Titanium and Tantalum
 - » Molybdenum and TZM
 - » Rhenium, Niobium, & Tungsten
- **Operation, Life, Reliability**
 - » Thermacore High Temperature Heat Pipe Life Testing
 - Continuous Life Testing – longest continuous in the world
 - Sodium Heat Pipe Operating for over 15 years

Thermacore High Temperature Heat Pipes Enable

- High Power Heat Transfer Capabilities (>25kW)
- High Heat Flux Cooling Capability (>100 kW/cm²)
- High Precision Temperature Control and Rapid Temperature Recovery
- Isothermality at High Temperatures
- Uniform Material Crystal Growth
- Thermal to Electric Energy Conversion
- Energy Savings

Other References:

- Isothermal Furnace Liner Datasheet, Thermacore Web Site – www.thermacore.com.
- Chemical Processing Vessel Datasheet, Thermacore Web Site – www.thermacore.com.
- Pressure Controlled Heat Pipe (PCHP) Datasheet, Thermacore Web Site – www.thermacore.com.
- *Advances in Refractory Metal Heat Pipe Technology*, J. H. Rosenfeld and D. M. Ernst, Proc. 11th Int. Heat Pipe Conference, Pre-print Vol. 1, pp. 245-251, 1999.
- *Porous Media Heat Exchangers for Cooling of High Power Optical Components*, J. H. Rosenfeld and M. T. North, Optical Engineering, Vol. 35, No. 2, pp. 335-341, Feb. 1995.
- *Heat Pipe Applications for Improved Chemical Process Unit Operations*, J. H. Rosenfeld, P.C. Cologer, A. Duao, and P.M. Dussinger, 1997 Annual Meeting Houston, Texas, March 9-13, Unit Operations in Process Development.
- *Evaluation of Porous Media Heat Exchangers for Fusion Applications*, J. H. Rosenfeld, J.E. Lindemuth, and M.T. North of Thermacore, R.D. Watson and D.L. Youchison of Sandia National Laboratories, R.H. Goulding of Oak Ridge National Laboratory, December 6, 1995.
- *An Overview of Long Duration Sodium Heat Pipe Tests at Thermacore, Inc.*, John H. Rosenfeld¹, Donald M. Ernst¹, James E. Lindemuth¹, James L. Sanzi¹, Steven M Geng², and Jon Zuo³, STAIF Conference, 2004.
- *Advances in Refractory Metal Heat Pipe Technology*, John H. Rosenfeld and Donald M. Ernst, 11th Annual International Heat Pipe Conference, 1999.

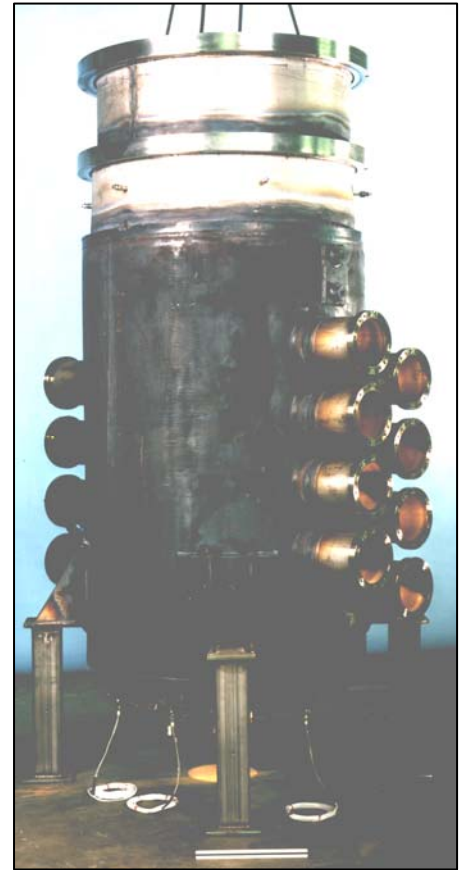


Figure 4. Chemical Reactor Thermal Control