

High Temperature Heat Pipes

Aavid, Thermal Division of Boyd Corporation's high temperature heat pipes (Figure 1) are used in a wide variety of applications and service conditions, from the ocean floor to geosynchronous orbit. These heat pipes have improved processes as mundane as glass making, as industrial as oil-shale extraction, and as high-tech as epitaxial deposition (Figure 2).

With over 40 years of high temperature alkali metal heat pipe design, development and fabrication experience, Aavid's liquid metal heat pipes have set new records for heat transfer in hardware developed for the National Aerospace Planes leading edge (Figure 3), solved day to day problems in state-of-the-art automobile spark plugs, and solar-powered Stirling engine receivers.

If a product or process involves high temperature heat transfer, or high heat flux cooling, Aavid has the design and fabrication experience required to provide the best thermal solution.

Critical Application Need

- ▶ Isothermal Furnace Liner (IFL) (Standard & Custom):
 - » Thermocouple and Temperature Calibration
 - » Crystal Growth and Vapor Deposition
 - » Diffusion and Annealing
 - » Thermo-Physical Property Characterization
 - » Materials Processing
 - » Chemical Processing
- ▶ Energy Conversion:
 - » Thermionic Converters
 - » Alkali Metal Thermal-to-Electric Converters
 - » Solar-Powered Stirling Engine Receivers
- ▶ Aircraft/Spacecraft Applications
 - » Leading Edges and Engine Components
 - » Rocket Nozzles and Space Radiators
 - » Magnetoplasmadynamic (MPD) Thrusters
- ▶ Isotope Separation for Nuclear Power Stations
- ▶ Fusion Applications



Figure 1 – High Temperature Heat Pipes

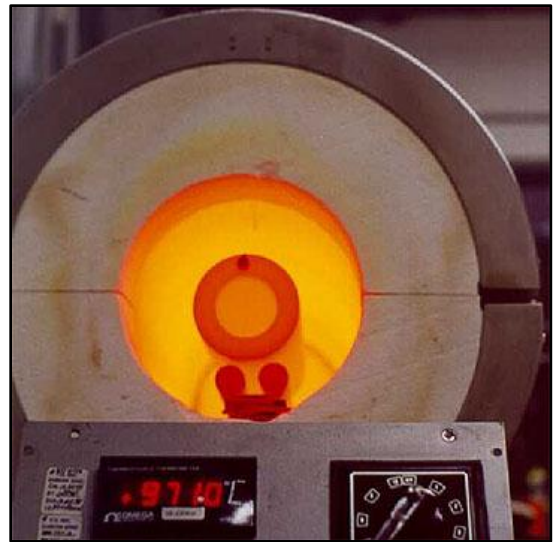


Figure 2 – High Temperature Heat Pipe at 971° C

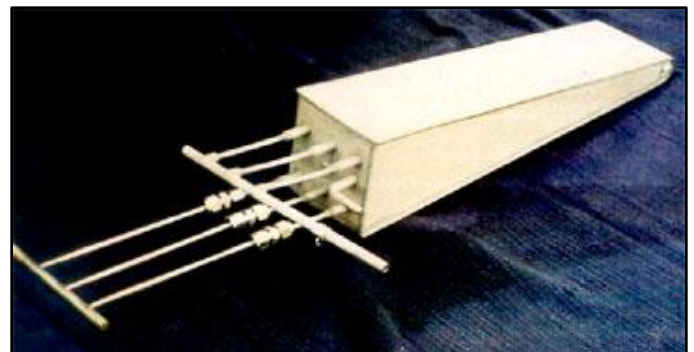


Figure 3 – Leading Edge Heat Pipe

Key Features and Benefits

- ▶ 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: <10 mK 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, Tantalum, Rhenium, Niobium, and Tungsten
 - » Molybdenum and TZM
- ▶ Operation, Life, and Reliability
 - » Continuous Heat Pipe Life Testing: Longest continuous in the world
 - » Sodium Heat Pipe Operating for Over 20 years

High Temperature Heat Pipes Enable:

- ▶ High Power Heat Transfer Capabilities (>25 kW)
- ▶ 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



Isothermal Processing Vessel That Uses High Temperature Heat Pipes