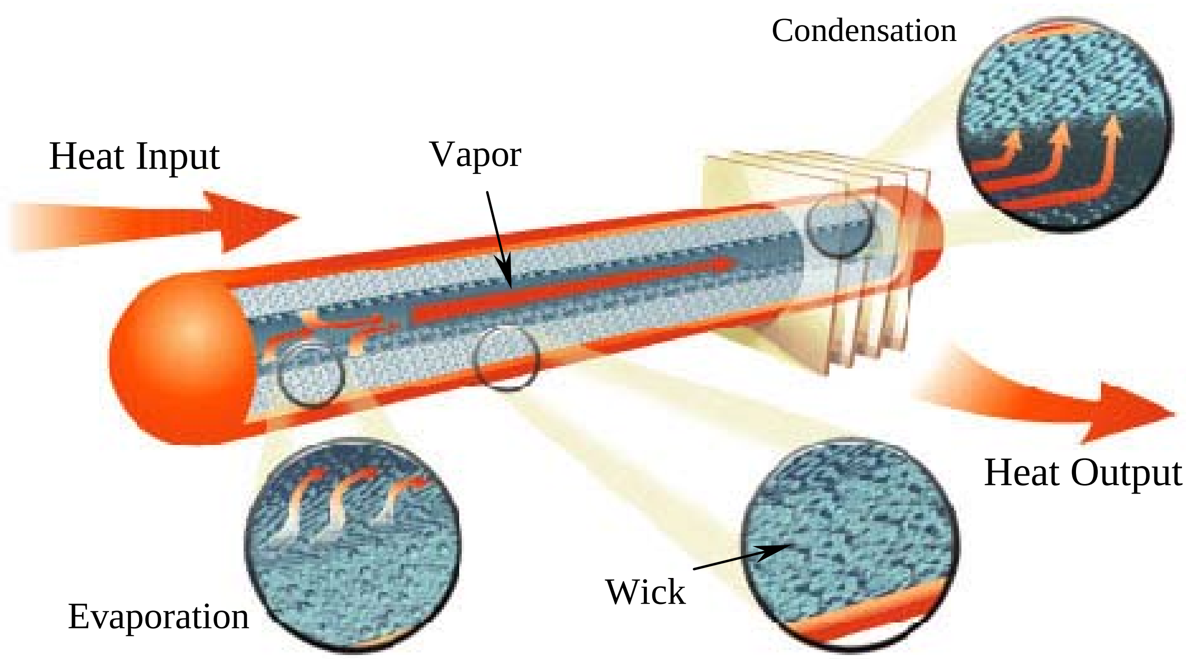
ISOTHERMAL FURNACE LINER

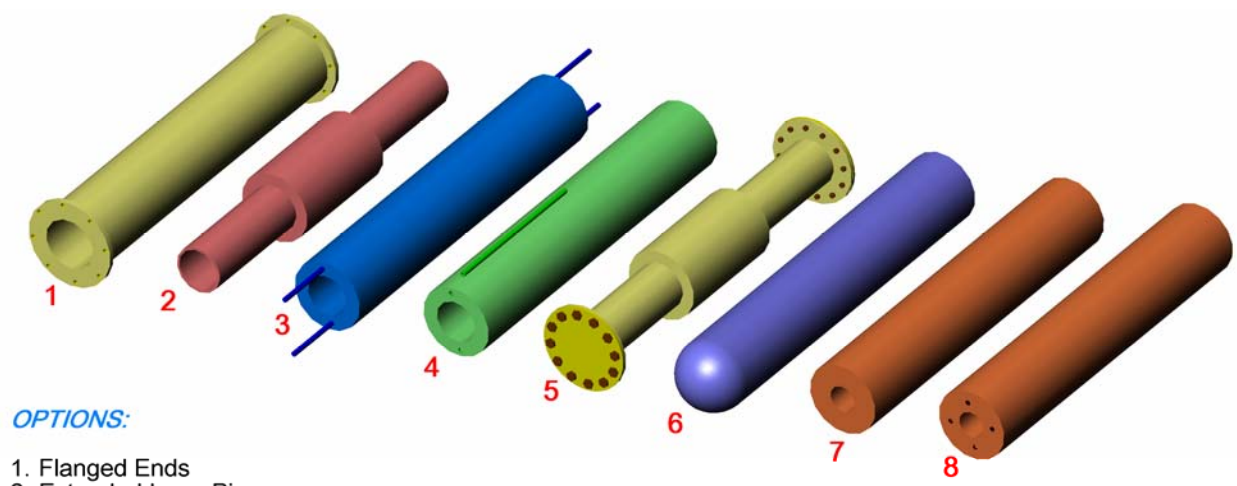
The Isothermal Furnace Liner (IFL) is an annular heat pipe. In its simplest form the heat pipe is a sealed tube containing a wicking material and a small amount of working fluid. As shown below, the wicking material is placed against the inner wall of the tube and serves to transport the condensed vapor from the location where heat is extracted to the location where heat is applied.



After the heat pipe is evacuated of all noncondensible gases, it is charged with a small amount of liquid. The internal pressure of the heat pipe is determined by the vapor pressure of the working fluid at the operating temperature. The liquid is evaporated at the location where heat is applied and condensed in thin films at the location where heat is extracted. Under these conditions, evaporation and condensation occur at aproximately the same temperature.

The IFL, as an annular heat pipe, achieves a nearly isothermal wall temperature by virtue of the continuous evaporation and condensation of the working fluid. The internal heat transfer coefficient of the wick and wall is on the order of 6 kW/m^2-ºC. Radiation dominates heat transfer between the walls of the liner and anything inserted into the cavity. At 800ºC, the corresponding radiation coefficient is only 280 W/m^2-ºC which is about 20 times lower than the internal liner coefficient. As a result, the furnace liner is very effective in isothermalizing its wall temperature and providing an isothermal environment. A probe may experience the same uniformity, but depends on the heat transfer paths between the probe and the surrounding walls and between the probe and the outside environment.

IFLs are used for process tubes and laboratory furnaces and provide better temperature uniformity than possible with any conventional control technique. A flat temperature profile is inherent to the liner. In most applications, temperature uniformity is within 0.1ºC over the liner length. When a single uniform temperature zone is required, the IFL can provide this zone with a single heater and controller. Temperature adjustment is a simple one-step process and frequent profile measurements are not necessary. Energy can be saved and productivity increased, because usable reaction zone length in a given furnace becomes equal to or larger than the active heater length. Two or more IFLs may be used in series to create multiple individually-controlled zones for special effects such as step changes in temperature profile.



OPTIONS:

1. Flanged Ends
2. Extended Inner Pipe
3. IFL with Support Rods
4. IFL with Thermo Wells
   (External, Internal or within Heat Pipe)
5. Vacuum Retort
6. Hemispherical Dome End
7. Small Diameter Cavity
8. Calibration Wells

Standard IFLs for operation to 1600ºC are available in a range of sizes to fit conventional furnace bores for horizontal or vertical application. Custom IFLs can be fabricated for sub-ambient and cryogenic operation. The size and geometry of the IFL can be customized to meet specific requirements.

Phone: 717.569.6551 780 Eden Road, Lancaster, PA 17601 USA FAX: 717.569.4797
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Specifications:

Standard Furnace Liners may be specified by using the following designations:

IFL-XX-YY-ZZ

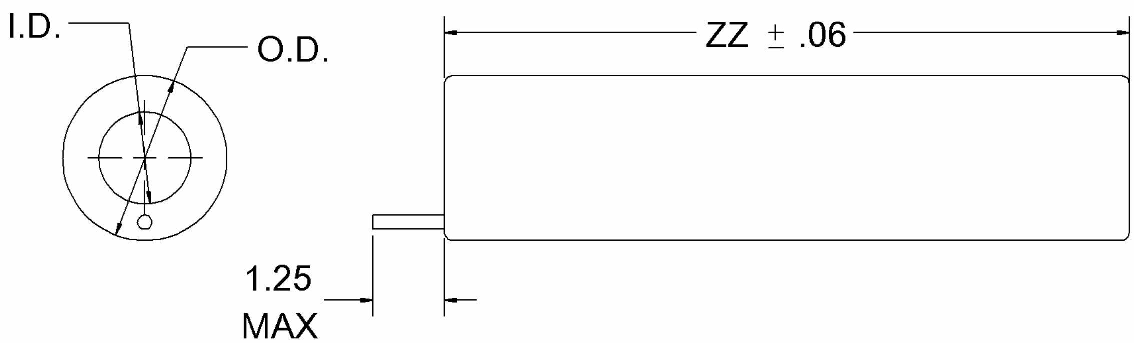
Series Designation
IFL

Operating Range (°C)			
XX	Operating Fluid	Range Minimum	Range Maximum
2	Water	20	300
6	Cesium	300	600
10	Potassium	400	1000
11	Sodium	500	1100
16	Lithium	900	1600

Nominal Diameter ± 0.06 in (1.5 mm)				
YY	I.D. (in)	I.D. (mm)	O.D. (in)	O.D. (mm)
14	1.38	35	2.38	61
16	1.61	41	2.88	73
20	2.06	52	3.50	89
25	2.46	62	4.00	102
30	3.07	78	4.50	114
35	3.55	90	5.00	127
*† 40	4.02	102	5.56	141
*† 50	5.04	128	6.64	169

Nominal Length ‡		
ZZ	L (in)	L (mm)
6	6.0	152
12	12.0	305
18	18.0	457
21	24.0	610
36	36.0	914
42	42.0	1,067

* Potassium IFL-10 restricted to 950°C.
† Sodium IFL-11 restricted to 1000°C.
‡ For IFL-10 and -11, allow 0.13 in (3.3 mm) clearance for each 6.0 in (152 mm) of length for thermal expansion.



Benefits:

- Simplified Temperature Control
- Rapid Temperature Recovery
- Increased Productivity
- Energy Savings
- Sub-Ambient and Cryogenic Options

Applications:

- Thermocouple Calibration
- Black Body Radiators
- Crystal Growing
- Vapor Deposition
- Diffusion
- Annealing
- Chemical Reaction
- Vapor Pressure Measurement

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