MINCO

BULLETIN SEMI-1
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Minco solutions for
The Semiconductor Industry

600°C
500°C
400°C
300°C
200°C
100°C
0°C

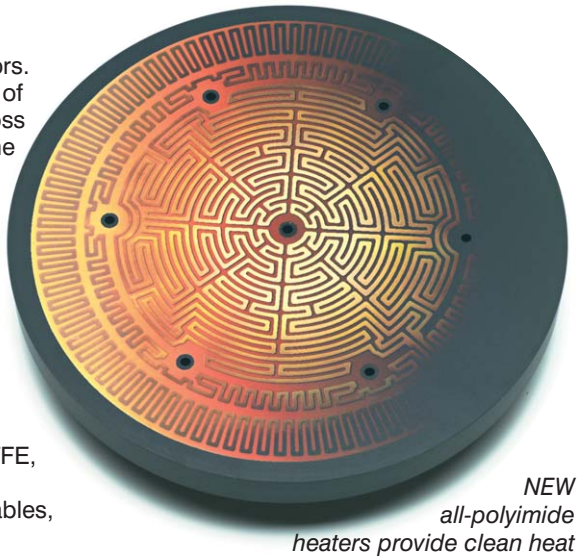
Uniform, responsive, reliable heat

Heat is a critical factor in processing and testing of semiconductors. A high level of available heat allows faster throughput. Reduction of temperature gradients across a heater means less variability across a wafer and thus higher yields. A heating element that's less prone to failure cuts the risk of downtime. All these translate to productivity and profits.

Minco Thermofoil™ heater technology helps you achieve your thermal design goals.

A Thermofoil heater consists of an etched-foil element laminated between flat or flexible insulating layers. In comparison to traditional tubular or cast-in heaters, the Thermofoil construction provides more surface area for heat output. As a result, the element runs cooler even at high watt densities.

Minco offers heaters with Kapton® polyimide, silicone rubber, PTFE, and mica insulations for temperatures up to 600°C. We can also manufacture complete thermal subassemblies with heat sinks, cables, connectors, temperature sensors, thermostats, or fuses.



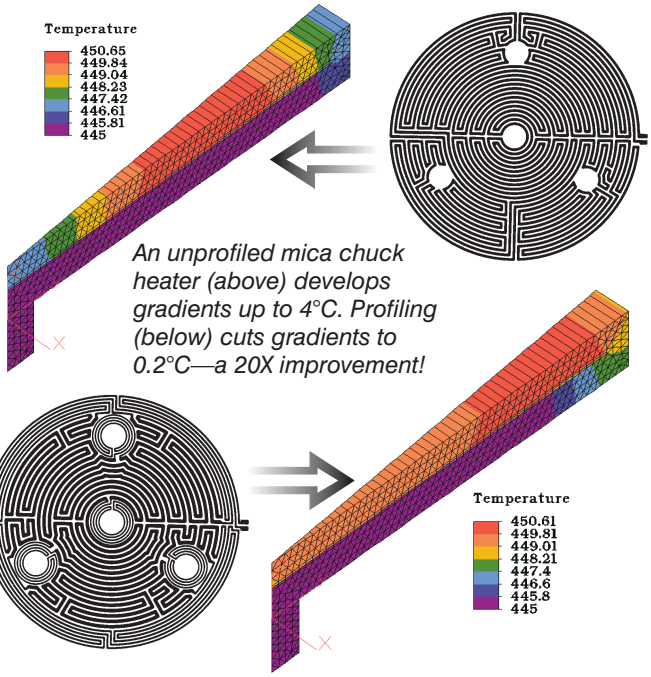
NEW all-polyimide heaters provide clean heat with low outgassing to

Exceptional temperature control through profiling

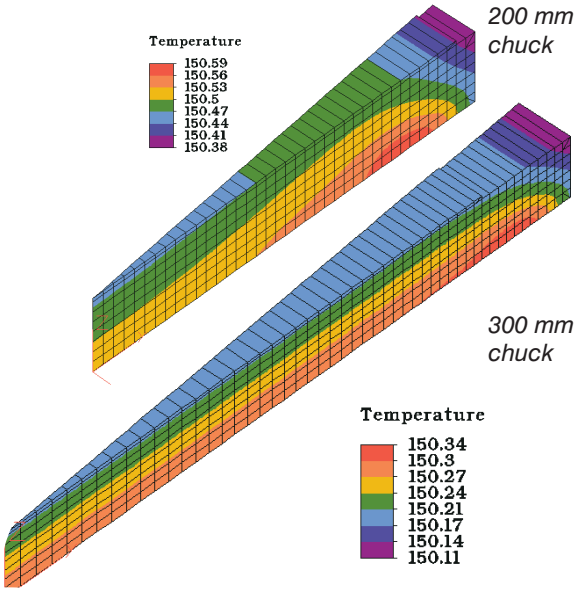
The electrical element of a standard Thermofoil heater is laid out to uniformly distribute heat across its surface. If heat losses are also uniform across the surface, so are resulting temperatures.

But in most cases heat dissipates faster at the edges of objects than the center. Mounting structures also sink away heat. Cool spots appear and uniformity suffers.

A Minco profiled heater design puts more replacement heat where it's needed: at edges and other loss points. This makes it possible to reduce gradients by 10 times or more. And because profiling is determined by a master artwork in the photo etching process, it's repeatable from heater to heater and adds nothing to unit cost.



An unprofiled mica chuck heater (above) develops gradients up to 4°C. Profiling (below) cuts gradients to 0.2°C—a 20X improvement!



Tight profiling produces temperature uniformity within 0.25°C, even across a 300 mm wafer chuck.

Heaters for every need

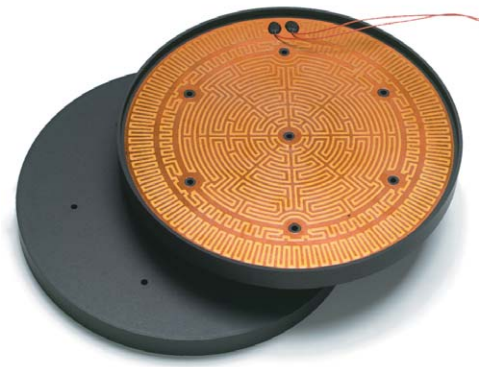
All-polyimide (AP) 260°C

Polyimide insulation and polyimide internal adhesive give these heaters outstanding temperature capability along with high dielectric strength to 1000 VRMS. The heater measures only 0.3 mm (0.012") thick and can be factory mounted directly to chucks or clamped with backing plates. Heat output can range up to 80 watts per square inch (12 W/square cm).

Vacuum performance is excellent with outgassing less than 0.01% CVCM. The heater will resist most process chemicals (contact Minco with questions about specific compounds).

Applications:

- High wattage/fast warmup
- Heated chucks for vacuum environments
- Chemical exposure
-



Mica 600°C

Mica insulated Thermofoil heaters combine extreme heat with exact control like no other heater. High heat flux up to 110 watts/square inch (17 W/square cm) in combination with low mass gives rapid warmup and recovery.

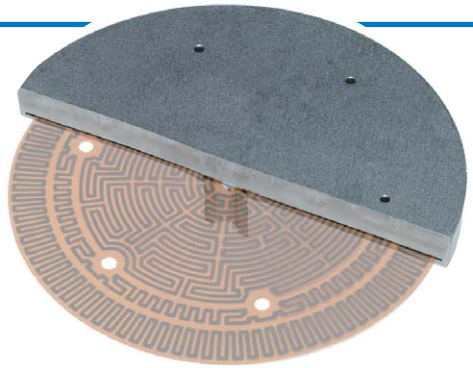
Mica heaters are clamped to heat sinks with rigid backing plates and are suitable for vacuum after initial burn-in.

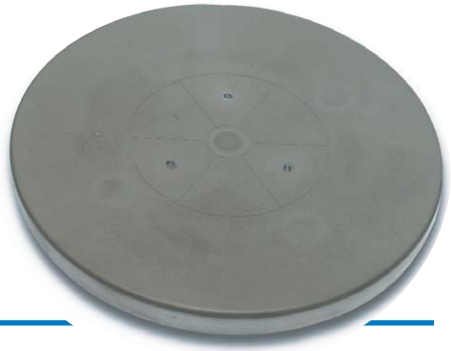
Applications:

- High wattage/fast warmup
- Heated chucks
- Elevated temperature testing
- Solder operations

Encapsulated heaters

Either mica or AP heaters can be sealed inside a welded metal enclosure. This barrier protects heaters from aggressive chemicals and isolates heater materials from ultra-pure processes. The flat Thermofoil internal element gives more precise temperature control than cast-in heaters. Minco can provide hermetic feedthroughs for leadwire exits and plating, anodizing, or other coatings on the metal surface.





Silicone rubber 235°C

Blanket heaters with etched-foil or wirewound elements are easily installed on process tanks or platens for reliable heating. Minco has hundreds of sizes available from stock or can custom design for your needs.

Silicone rubber heaters operate to 60 watts/square inch (9 W/square cm) and have UL component recognition. They install with self-adhesive backing or liquid cements, or can be factory vulcanized to heat sinks.

Applications:

- Tanks
- Thermal stress testing
- Prevent condensation in cabinets

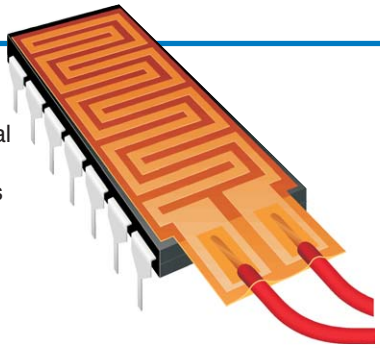
Component heaters 200°C

Miniature Kapton® heaters fit directly on electronic components for precise localized application of heat.

Available in stock and custom dimensions down to 0.25” x 0.25” (6.4 x 6.4 mm), they can be clamped or adhered to flat or curved components.

Applications:

- Thermal stress testing
- Heat source simulation for thermal prototyping
- Stabilization in cold environments

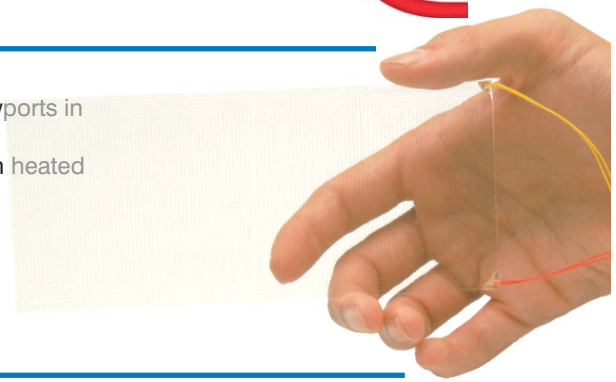


Thermal-Clear™ heaters 100°C

Transparent heaters with fine-wire elements give precise heat without obstructing light.

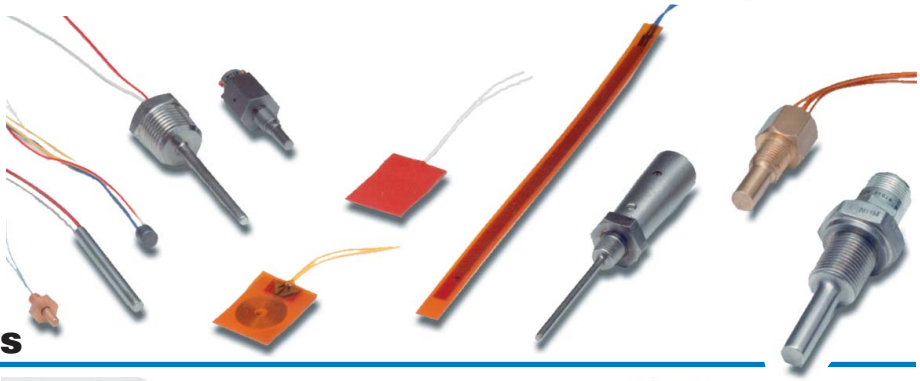
Applications:

- Defog windows and viewports in process equipment
- Reduce radiant loss from heated chambers



Temperature sensors

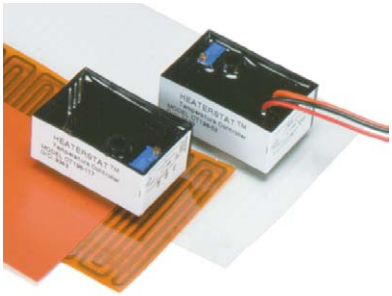
Minco high precision RTD’s remain stable within 0.05°C/year at temperatures up to 850°C. Sensors are available with a variety of case materials, or in flexible packages for surface sensing. Minco stocks more than 2000 sensor variations for immediate needs, and has tailored more than 6000 custom sensors to unique applications.



Temperature controllers

Minco offers standard 1/16 DIN programmable temperature controllers with RTD or thermocouple input to complete your thermal system.

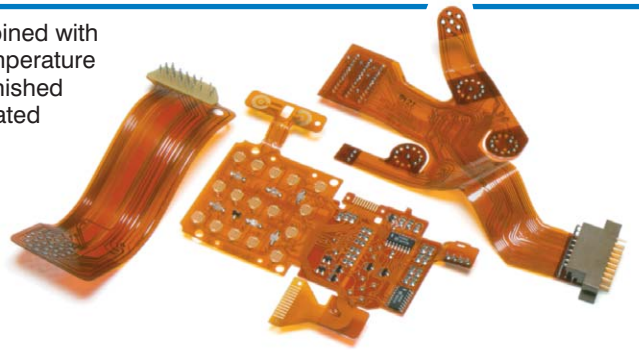
We also manufacture the Heaterstat™ sensorless DC controller. It uses temperature feedback from the heating element itself as a control input.



Flex-circuits

Minco manufactures high precision flex-circuits from single layer to 16-layer rigid-flex. Lines and traces down to 0.003” (0.07 mm) allow high density interconnection. We can assist with design strategies for control of impedance and RFI in high frequency signal traces.

Flex-circuits can be combined with heating elements and temperature sensors. They can be furnished with connectors or populated with components.



Design resources

Minco wants to make the thermal design process as easy as possible. Listed below are some of the aids available to you.

Literature

Bulletin HS-201: Minco's standard product catalog for Kapton, rubber, and mica heaters. It lists more than 1800 standard sizes and resistances of rectangular and round models, plus gives custom design tips.

Bulletin HAP-1: All-polyimide (AP) heaters.

Bulletin HR-2: Wirewound silicone rubber heaters.

Bulletin HS-2: Thermal-Clear™ transparent heaters.

Bulletin TF-6: Small heaters for electronic components.

Bulletin CT-2: 1/16 DIN temperature controllers.

Bulletin CT198: Heaterstat™ sensorless controller.

Application Aid #25: Prototyping techniques for Thermofoil heaters.

Bulletin TS-102: Temperature sensors and instruments.

Application Aid #24: Flex-circuit design guide.

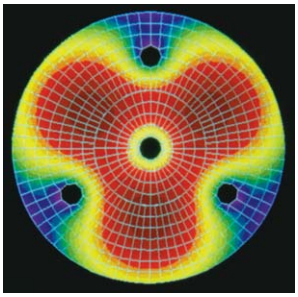
To obtain copies of this literature contact Minco or go to our web site at www.minco.com/semicon.

Wattage estimation

Minco's Application Aid #21 and companion software "Thermal Calc" present simplified methods for estimating total power required for a heating application. They take into account material warmup requirements plus losses to convection, conduction, and radiation. Available at no cost from Minco.

Finite Elements Analysis (FEA)

Minco offers complete FEA consultation for predictive modeling of thermal systems. FEA can simulate both steady state and transient conditions. It shows the effects from heat losses at edges and other points, making it particularly useful for initial determination of heater profiling patterns.



FEA does not completely eliminate the need for empirical testing but it can reduce the design iterations required.

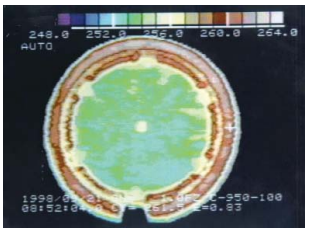
Thermographs on page 1 were generated by FEA.

SensArray™ testing

Minco can test chuck temperatures using multipoint instrumented wafers.

Thermal imaging

Minco's infrared imaging camera opens a window into thermal processes. You can see thermal gradients develop as parts heat up, and record events to videotape for later analysis. There are no heat sink effects from sensors to cause errors.



Thermal imaging does require line-of-sight access to heaters, which may not be possible under actual use conditions. Nevertheless, it is a valuable addition to the thermal designer's toolkit.

Catalog models

Although numerical methods such as FEA can shorten design cycles, the complexity of thermal design makes experimentation essential. At some point you must test your system with actual heaters.

Only Minco offers thousands of catalog heater models to assist with prototyping. Choose from Kapton, silicone rubber, transparent and mica heaters in a wide assortment of round and rectangular shapes, with several resistance values to achieve desired watt ratings. Most are available from stock in moderate quantities.

Many custom heater designs can be proven at the prototype stage with one or more catalog heaters. You can even test profiling by independently powering separate heater elements, and adjusting power levels until gradients subside.

Minco sales organization

Personal, expert assistance at all stages of your design is available from:

- Factory sales engineers.
- Factory trained independent sales representatives.
- Regional applications engineering offices.

About Minco

Minco was founded in 1956 and developed flexible temperature sensors and the first etched-foil heaters by 1960. Flex-circuits followed in 1974. Minco currently has annual sales over $50 million and employs 700 at its 250,000 square foot Minneapolis headquarters. Additional manufacturing facilities are located near Toulouse, France.

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ISO 9001

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