AN EMPLOYEE OWNED COMPANY
ISO 9001:2000 REGISTERED

THICK FILM HEATING ELEMENTS
HEATRON THICK FILM HEATING ELEMENTS

ECA Electronics (ECAE), a Division of Heatron Inc., was the first company in the United States to produce heating elements using thick film technology on insulated metal substrates. Heatron uses the latest thick film materials to formulate dielectric, conductive, and resistive elements for production of high-performance heaters, resistors, and other components on steel, stainless steel, aluminum, and ceramic substrates.

Heatron uses its proprietary Elpor® system to electrically insulate metal substrates. The thick film heaters provide very fast temperature response and uniformity in a low-profile heater. Thick film heaters are ideal for applications where space is limited, where conventional heaters cannot be used, when heat output needs to be profiled across the surface, or in high watt-density applications.

Elpor® heated bowl for hospital food service carts: ECAE has produced hundreds of thousands of Elpor® bowls assembled into molded housings, as shown on the left.

Elpor® heated bowl and assembly, illustrating a continuous type heating element. ECAE’s high quality level enabled direct shipment to hundreds of hospitals across North America.

Medical heater (supplied with lead wires) makes life a little easier for those stricken with diabetes.

Elpor® Steel high-precision laser trimmed heater elements are matched within hunredths of a watt.

THICK FILM TECHNOLOGY

Thick film technology originated as hybrid circuits for military and automotive applications because of its high reliability. The term “thick film” relates to the circuit or heating element that is deposited via screen printing (0.0005” thick) on the substrate. Inks made by mixing ceramics and metals (known as Cermet inks) are used to make the resistors and conductors. Typically, these are metallic materials such as silver, gold, silver palladium, gold platinum, copper, and ruthenium. Ceramic inks are also used for the dielectric layer (glass under the circuit) and for encapsulates over the circuit layers. Cermet thick film materials and substrates vary, based on the customer’s application requirements.
WHY HEATRON FOR THICK FILM HEATERS?

♦ Experience: 20+ years - millions of products produced
♦ High volume or high mix capability
♦ Elpor® Steel, Stainless Steel, Aluminum, and Ceramic Substrates
♦ Economical cost
♦ Large sizes, custom shapes, and custom heat patterns
♦ Patented via-to-base metal to provide access for electrical ground
♦ Separate prototype line for small volume runs
♦ Laser trimming capability for tighter resistance tolerances
♦ Integral terminals
♦ Total heater design capability, from metal fabrication and material systems, to complete assembly of your finished product

New heater designs can be verified by Thermal Imaging. Heat distribution across the surface can be selective or perfectly uniform, depending on the application requirements.

Elpor® heater sizes and shapes vary as widely as their applications. Shown are smaller heaters used in law enforcement, appliance, and medical markets.

PRODUCT FEATURES

♦ High Watt-Density (up to 175 watts per in² or 72.125 watts cm²)
♦ High Operating Temperature 500°C (932°F)
♦ Low Thermal Mass
♦ Fast Ramp-Up to Operating Temperature
♦ Low Profile, Thin Substrate
♦ Excellent Control Over Heat Distribution
♦ Uniform Steady State
♦ Temperature sensors and controls can be incorporated into the design

The high-performance and fast response of Elpor® heaters “irons out” product design challenges.
APPLICATION BENEFITS

- Heat pattern can be precisely designed to profile the desired thermal gradient across the heated surface to meet the specific needs of the application (See thermal images on previous page)
- Better use of limited space due to higher watt densities and low profiles
- Faster response and ramp-up times
- Vibration and shock resistant
- Flexibility in size and shape
- Ideal for high volumes or specialized applications
- Multi-zoned wattage or voltage combination can be custom designed

AVAILABLE SUBSTRATE MATERIALS

See the application examples on the following pages. Contact Heatron’s application engineers and refer to the charts on page 7 for specific material characteristics. Heatron’s engineers will be able to guide you in choosing the most cost-effective solution for your application.

Homeland Security: Elpor® on Stainless Steel air analyzer saves lives by detecting explosives.

Transportation: Elpor® Stainless Steel Galley Coffee Warmer improves aircraft safety. Welded contact and mounting studs provide highly reliable electrical and mechanical connections.
HEATRON THICK FILM HEATING SUBSTRATES

ELPOR® INSULATED STEEL

- Heatron proprietary material system
- Single or multiple layers
- Total dielectric coverage of holes and edges
- Ideal for high volume, low cost
- Perfect for DC low voltage automotive applications
- Integral terminals
- Max operating temp of 350°C (662°F)
- 1250 VAC dielectric

Appliance Market:
Elpor® Steel clothes iron features rapid heat up and high watt-density.

Coffee Warmer with quick connect terminals for easy assembly in customer’s production line.

Large area Food Service heater features selective thermal distribution. Actual size of heater is 11.5” x 14”.

ELPOR® SS INSULATED STAINLESS STEEL

- Heatron proprietary material system
- 300 or 400 Series stainless steel
- Screen printed, multiple layers
- 2500 VAC/3500 VDC Dielectric
- Max operating temp of 550°C (1022°F)
- Primary heater substrate

Laboratory Equipment: Gas detector heats from 25°C to 300°C in less than 5 seconds.

Food Service soup heater: Thick film allows rapid thermal transfer and excellent temperature uniformity.
Automotive heater reduces pollution. Underhood heater removes ice crystals and accelerates warm up to improve reliability and fuel economy. Shown here is the heater element in various stages of manufacture and the insert-molded finished product.

ELPOR® AL INSULATED ALUMINUM

- Heatron proprietary material system
- Screen printed, multiple layers
- 1250 VAC Dielectric
- Max operating temp of 250°C (482°F)

ALUMINA OR ALUMINUM NITRIDE

- Laser cut or pressed
- Custom shapes and heat patterns
- Maximum operating temp of 500°C (932°F)
- More fragile than Elpor® metal substrates
- 5000 VAC dielectric

1.8” x 2.5” high watt density laboratory equipment heater.

Medical heater assembly with thermistor: thick film applied to alumina bonded to aluminum.

Automotive underhood heater shown to actual size.

Medical: High watt density thick film ceramic heater for hospital fluid warmer.
## OPERATING TEMPERATURE RANGE (deg C)

<table>
<thead>
<tr>
<th>Material</th>
<th>Steel</th>
<th>Stainless Steel</th>
<th>Aluminum</th>
<th>Ceramic</th>
<th>Ceramic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Max Temperature</strong></td>
<td>350°C  662°F</td>
<td>550°C  1022°F</td>
<td>250°C  482°F</td>
<td>500°C  932°F</td>
<td>300°C  572°F</td>
</tr>
<tr>
<td><strong>Watt Density (w/in²)</strong></td>
<td>150</td>
<td>175</td>
<td>n/a</td>
<td>23</td>
<td>150</td>
</tr>
<tr>
<td><strong>Watt Density (w/cm²)</strong></td>
<td>23.3</td>
<td>27.1</td>
<td>n/a</td>
<td>3.6</td>
<td>23.3</td>
</tr>
<tr>
<td><strong>Dielectric Strength</strong></td>
<td>1250 VAC</td>
<td>2500 VAC 3500 VDC</td>
<td>1250 VAC</td>
<td>5000 VAC</td>
<td>5000 VAC</td>
</tr>
<tr>
<td><strong>Dielectric Constant</strong></td>
<td>6.6</td>
<td>n/a</td>
<td>n/a</td>
<td>9.5</td>
<td>8.9</td>
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<tr>
<td><strong>Thermal Conductivity (W/mK)</strong></td>
<td>55</td>
<td>15</td>
<td>230</td>
<td>20</td>
<td>170</td>
</tr>
<tr>
<td><strong>Coefficient Of Thermal Expansion (x 10⁻⁶/°C)</strong></td>
<td>13.3</td>
<td>12-15</td>
<td>25</td>
<td>7</td>
<td>4.6</td>
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</table>
Heatron specializes in providing engineered solutions for customers in a broad variety of industries. Heatron, Inc. is an industry leader and technological innovator in the manufacture of electric heating elements, thick film and custom resistors, metal core circuit boards, and LED light engines and assemblies for OEMs.

Heatron is a private employee-owned company that employs approximately 250 associates within four production facilities, totaling more than 100,000 square feet. In 2002, Heatron acquired ECA Electronics in Erie, Pennsylvania. ECA Electronics manufactures a variety of high volume and high mix Thick Film products and assemblies.

Heatron serves over 30 markets, the largest being medical equipment, followed by automotive resistors and sensors, food service equipment, laboratory and instrumentation equipment. Heatron has been ISO 9001 registered since 1994 and is now ISO 9001:2000 registered (Registrar: Underwriters Laboratories). Many products are, or can be, safety agency recognized or certified to UL, CE, CSA, TUV, or other standards. A number of products comply with customers’ FDA, Telcordia™ (formerly Bellcore), and Mil Spec requirements.

**ABOUT HEATRON**

**FLEXIBLE HEATERS AND TEMPERATURE SENSORS**

Heatflex Silicone Rubber, Kapton™, Etched Mica or Polyester heaters
Clearview Optically Clear/Transparent heaters, Thermotron Polymer Thick Film heaters
Combination Heater/Sensors, RTD fine wire temperature sensors
Heaters bonded to metal or custom assemblies, lead attachment, cable, and flex circuit assemblies

**OTHER THICK FILM PRODUCTS**

♦ ELPOR® LED Light Engines for thermal management
♦ ELPOR® Metal Core Circuit Boards
♦ ELPOR® High Temp Burn-In Boards
♦ Laser trimming and high volume capability

**ENGINEERED PRODUCTS**

♦ CAST IN Heaters (Aluminum or Bronze)
♦ Sand or Permanent Mold foundry processes
♦ Non-Heated Castings to customer specifications
♦ HEATROD Cartridge heaters, NON-STICK patented Cartridge heaters
♦ Value added assemblies, heaters, and temperature sensors to customer specifications
♦ Mica Strip, Band, and Custom Heaters

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For Technical & Sales Inquiries:

Heatron, Inc.
3000 Wilson Avenue
Leavenworth, KS 66048
www.heatron.com
e-mail: Heatron1@heatron.com

ECA Electronics
8135 Nathan Circle
Erie, PA 16509
(For more information, call Heatron: 1-913-651-4420)