

Chromalox[®]

PRECISION HEAT AND CONTROL

Comprehensive Thermal Solutions for Medical Equipment



MEDICAL EQUIPMENT

VALUE ADDED

THE CHROMALOX DIFFERENCE

Some companies build heaters and controls. Chromalox does more. We provide value-added heating solutions. The difference between these two approaches is the difference between uncertainty and assurance. It's the difference between having a supplier who just sells equipment and having a partner who can help you save time and money in the design and manufacture of your products by helping you to choose the best solution for your heating requirement and by providing reliable components that will help to ensure your products' trouble-free performance.



ASSURE YOUR PRODUCT QUALITY WITH CHROMALOX



Chromalox Is Your Best Choice for Heaters and Temperature Controls

The very nature of medical equipment demands accuracy and reliability. So when your application requires heaters and controls, choosing the right source for those components is all about finding products that are marked by precision and dependability, built by a manufacturer with the know-how and product selection to meet the demands of your application.

That source is Chromalox.

Experience

Chromalox has specialized in providing complete thermal solutions for technically demanding applications for more than 90 years, longer than anyone else, beginning with the introduction of the world's first metal-sheathed heating element. Our many years of accumulated experience and know-how, in addition to your Chromalox representative's extensive experience in helping to solve both ordinary and unusual heating requirements, provide an unsurpassed combination for solving your specific heating problems.

Selection

We offer many thousands of sizes, types, and ratings of dependable electric heating elements, temperature sensors, and controls perfectly suited for the exacting standards required by medical equipment manufacturers. Our broad range of heaters, sensors, and controls offers you a wide choice from which to select the best heating equipment for your application. And most can be modified to meet specific application requirements.

Service

Our field sales representatives are strategically located to give you prompt, on-the-spot, personal service. Our heating specialists are available and ready to help you integrate our products into your application with the engineering capabilities to design and supply products for the most difficult or unusual applications imaginable. Multiple manufacturing facilities worldwide help to ensure that you get what you need when you need it.

Reliability

Reliability is the hallmark of Chromalox heaters and controls. Computer-aided engineering and manufacturing help to ensure that the most optimum design parameters and the most efficient manufacturing processes are utilized. Detailed evaluations of incoming materials, continuous work-in-process inspections, and final inspection procedures to thoroughly test our products help to ensure the delivery of trouble-free products.

Our quest for reliability is never-ending. We continually search for and analyze new materials and manufacturing methods to further increase quality and efficiency. Ongoing product-life testing provides performance evaluations leading to design improvements where necessary.

Chromalox heaters and controls meet a variety of third-party approvals, recognition, and certifications, including UL, CSA, CE, and ASME.

THE CHROMALOX VALUE-ADDED DIFFERENCE

Enhanced Operating Performance

Chromalox thermal solutions employ standard or custom controllers along with the right heater and sensor to assure reliable accuracy for optimum performance with autoclaves, blood and fluid warmers, patient warming pads and blankets, and dialysis machines.

Exacting Manufacturing Capabilities

Medical equipment typically has stringent technical requirements for electric heating elements and sensors, ranging from precise dimensional and resistance tolerances to low current leakage and high insulation resistance readings. Chromalox understands these industry requirements, employing specific design criteria and manufacturing procedures to ensure that we meet your product specification. Our world-class manufacturing facilities utilize state-of-the-art production equipment and procedures to achieve outstanding product quality and value. All of our products follow rigorous in-process inspections and 100% final inspection, in accordance with the quality assurance parameters dictated by the end-use application needs.

Custom OEM Designs for Applications

Chromalox can design heating solutions for any unique requirement you might face. Our engineers will custom-design the right product to meet your application needs. If an element, sensor, control, or packaged system that we carry in stock doesn't exactly fit your needs, we'll custom-build it—either by expertly adapting an existing product or by designing and manufacturing a completely new one. We are responsive partners, eager to help you produce prototypes for new products and systems. With our experienced design engineers and extensive manufacturing capabilities, we'll work with you to develop innovative designs in the shortest possible turnaround times.

Precision Temperature and Power Control

Chromalox custom and standard controllers, temperature sensors, power controllers, SCRs, and proprietary software precisely sequence heaters, properly balance electrical loads, control soft starts, and correct power factors.

Broadest Third-Party Approval

With manufacturing locations in the U.S. and Europe, Chromalox has earned approvals and certifications including, but not limited to, CE, NEC, UL, VDE, cUL, FM, CSA, MSHA, BASEEFA, Cenelec, ASME, PED, ATEX, GOST, and ISO9000.



**LOCAL
TECHNICAL SUPPORT,
CUSTOM DESIGN**

The industry's largest and most experienced team of engineers are right there in the field with you. The majority of our 300+ field sales representatives are degreed engineers, and all are experienced with Chromalox heating products and applications. Our innovative design engineers are ready to work with your local Chromalox representative to custom-build a precision heating and control system for any application need you have.

PRECISE HEAT AND CONTROL FOR ACCURACY AND RELIABILITY

Nothing is more critical for a heater and its control in a medical equipment application than reliable accuracy and performance. Indeed, a patient's life may depend on it. And for many applications, the heater and control are the essential components. Chromalox heaters and controls are engineered and manufactured to provide precise heat and control to help ensure the accuracy and reliability that is expected of your equipment.

Tubular Heating Elements

These elements are versatile and transfer heat exceptionally well by convection or radiant heat for patient warming, and by heat conduction in ultrasonic heaters, labware washers, dialysis machines, hematology analyzers, blood warmers, and temperature therapy units. Round, triangular, flat press, and formed bends are made to customer requirements. Many sheath materials are available as well as more than 20 terminations and many stocked accessories. See product details on page 6.



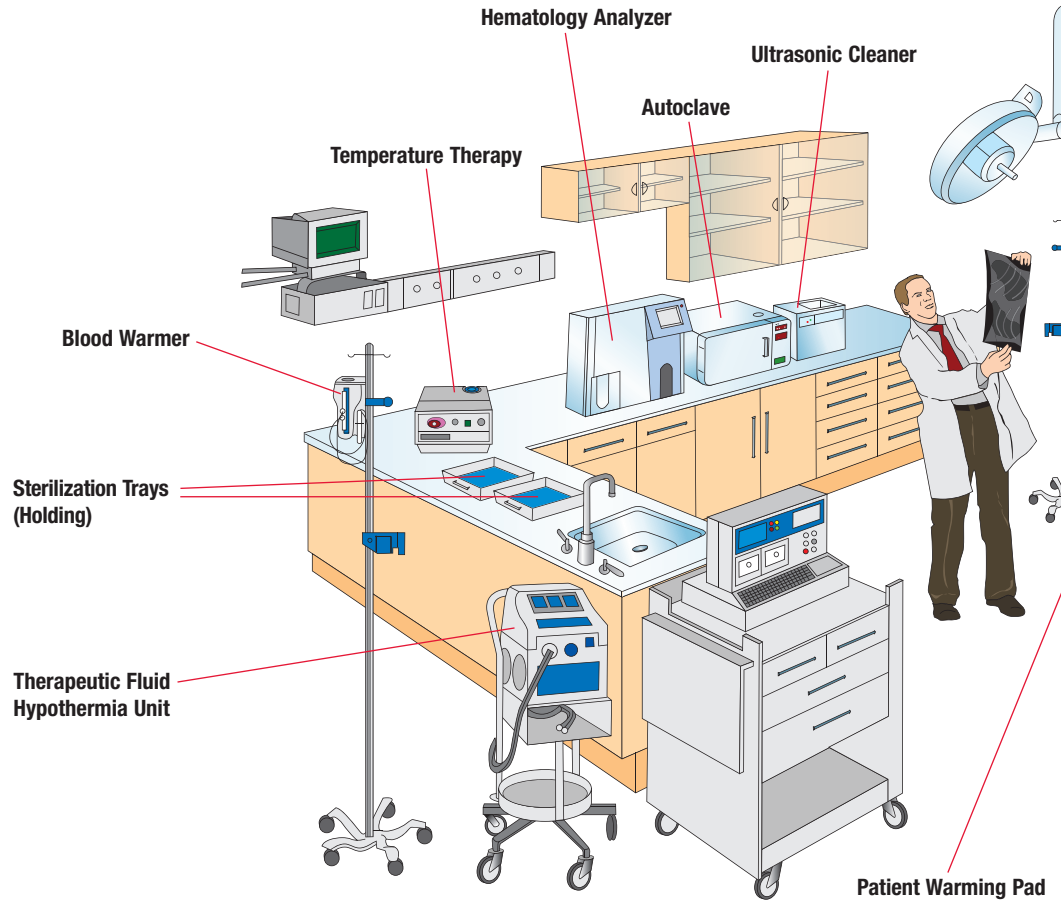
Cartridge Heaters

Blood warmers, ultrasonic cleaners, temperature therapy, and therapeutic fluid hypothermia units are among the medical equipment applications where these long-life, high-efficiency performance heaters can be found. Their patented construction results in maximum heat transfer at reduced power consumption for economical performance. See product details on page 6.



Finned Tubular Heating Elements

Chromalox Fintube® heating elements are ideal for heating air in applications like radiant or convective patient warmers because the fins greatly increase surface area for faster heat transfer. They are superior to open-coil elements because the heating coil is completely encased in a metal sheath, minimizing shock hazard and hot spots. They can be bent to provide higher concentrations of installed kilowatts for a given area. See product details on page 6.



Silicone Laminate/Flexible Heating Elements

Versatile Chromalox silicone laminate/flexible heating elements find use in a variety of medical equipment applications—from blood warmers, fluid warmers, and therapeutic fluid hypothermia units to patient warming pads and blankets, blanket warmers, syringe heaters, sterilization holding trays, and lotion warmers—requiring low to medium temperatures. Rugged construction of lightweight material provides chemical and moisture resistance. A variety of electrical, shape, and contour fittings meets a broad range of specifications. See product details on page 6.



Immersion Heaters

The stainless steel sheath elements and thermowells in our flanged and screw plug immersion heaters are ideal for heating water in hydrotherapy units, ultrasonic cleaners, labware washers, and autoclaves. A wide variety of ANSI and customized flanges and element lengths is available. A patented 360° rotatable housing is available on most models of our screw plug models to facilitate easy conduit connections. See product details on page 8.



Circulation Heaters

Chromalox circulation heaters afford high-energy efficiency, fast heating, and uniform heat distribution for applications such as therapeutic fluid hypothermia units and hydrotherapy equipment. They provide high turn-down capability, tight outlet temperature control, and variable flow rates. A variety of electrical terminal enclosures is available to meet the requirements of your application. See product details on page 8.



Strip Heaters

These easy-to-install heating elements heat surfaces by conduction or convection. Many sheath materials, termination styles, operating temperatures, sizes, voltages, wattage ratings, and mountings are available. These are often used for applications such as sterilization holding trays, autoclaves, convective patient warmers, and warming blanket cabinets. See product details on page 7.



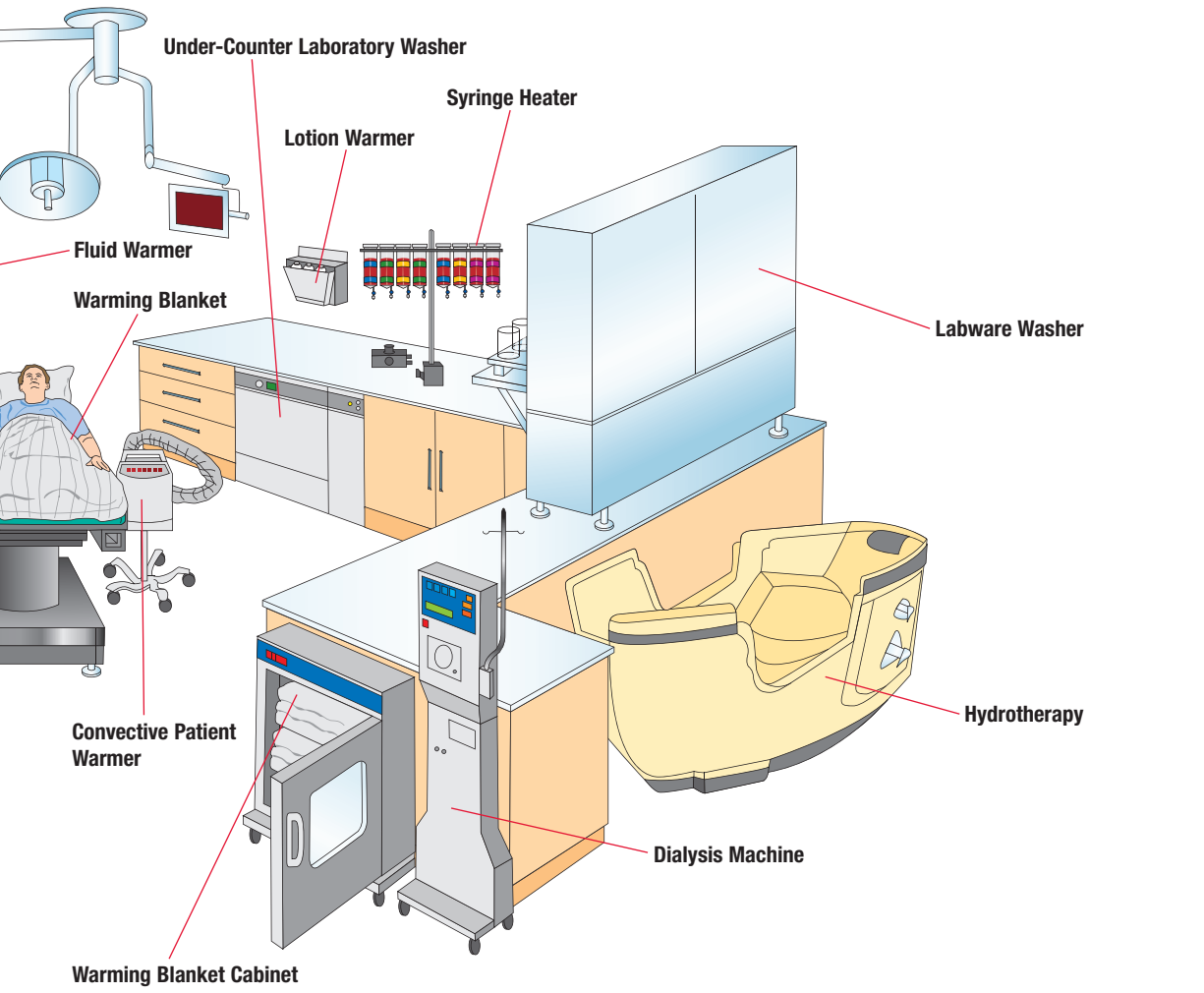
Band Heaters

Any application requiring uniform, conductive heat transfer to a cylindrical surface is a candidate for band heaters. Medical equipment where band heaters are used includes blood warmers, therapeutic fluid hypothermia units, lotion warmers, syringe heaters, and hydrotherapy heaters, and hydrotherapy units. See product details on page 7.



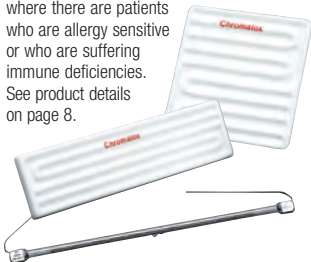
Thick Film Heaters

Chromalox thick film heaters apply heat directly to an application by surface contact, ensuring optimum transfer and fast thermal response for excellent operating efficiency. Their low-profile, compact design makes them ideal for use where space is tight and around obstacles such as notches, posts, and mounting holes and brackets. See product details on page 7.



Infrared Radiant Heaters

Infrared radiant heaters are ideal for use where moving air, which can carry entrained particulate matter, is not acceptable, such as where recovering burn patients are located or areas where there are patients who are allergy sensitive or who are suffering immune deficiencies. See product details on page 8.



Custom and Standard Controls, Sensors

From basic, low-cost temperature and process controllers, to monitors and overtemperature controls, to more sophisticated control systems, Chromalox has the controls, sensors, and accessories you need for use in a variety of medical equipment. Choose from our line of standard components, or let Chromalox custom-design the right control solution for your application's needs. We are the only heating element supplier offering a complete line of controls, control panels, sensors, and accessories. See product details on pages 9 and 10.



RELIABILITY. THE HALLMARK OF CHROMALOX HEATERS AND HEATER CONTROLS

Computer-aided engineering and manufacturing guarantees utilizing the optimum design parameters and the most efficient manufacturing process. Detailed evaluations of incoming materials, continuous work-in-process inspections, and final inspection procedures that thoroughly test every item produced help ensure delivery of trouble-free products. We continually search for and analyze new materials and manufacturing methods to further increase quality and efficiency, while ongoing product-life testing provides performance evaluations leading to design improvements where necessary.

QUALITY MANUFACTURING

COMPONENT HEATERS

Tubular, high-density, cartridge heaters, finned tubular heating elements, strip heaters, band heaters, silicone laminate/flexible heaters, and thick film heaters—all are component heaters. Component heaters meet many heating needs in medical equipment applications. Shape and size are the determining factor in most applications.

Chromalox carries the widest selection of standard component heaters in many shapes, sizes, and wattages.

COMPONENT HEATERS

Silicone Laminate/Flexible Heaters

Chromalox silicone laminate/flexible heaters are thin and extremely pliable, making them the perfect heating solution for virtually any geometry or complex shape. They feature low mass and minimal thickness to deliver extremely responsive heat-up and cool-down for low to medium-temperature applications. They are ruggedly constructed by laminating wire or etched-foil heating circuits between plies of silicone rubber insulating material for flexibility and strength. Terminal connections are made internally at any point on the surface of the heater or projected from any edge with internal or mounted strain reliefs used to help ensure durability. A wide range of mounted or free-standing thermostats, thermocouples, RTS, thermal fuses, and thermistors is available for control. These heaters can be mounted by using adhesives, vulcanized bonding, eyelets, mounting bars, hooks, springs or spring clasps, and pre-formed clasps.



- Maximum temperature: 390°F
- Voltage: up to 600

Tubular Heating Elements

These highly adaptable heating elements are an extremely versatile heat source. They perform exceptional heat transfer by conduction, convection, or radiation, applying the exact amount of required heat to liquids, air, and surfaces. Element design configurations vary—round, triangular, flat press, and formed bends. Bends are made to customer requirements. A multitude of sheath materials is available as are more than 20 optional terminations and many stocked accessories.



- Wattage: 75 to 10,000
- Voltage: 120, 240, 280
- Watt density: 3 to 53 W/in.²
- Maximum sheath temperature: up to 1,600°F

High-Density Cartridge Heaters

The patented construction of Chromalox high-density cartridge heaters results in unmatched, high-efficiency performance characteristics and a superior life rating. No other swaged cartridge heater is compacted to the extent of Chromalox high-density cartridge heaters. The tightly compacted refractory insulation provides excellent heat transfer to the heavy-wall INCOLOY* sheath. This means that the resistance wire runs at a lower temperature than competitive units with loose-fill insulation. Uniform winding of the wire, and close and even spacing between the wire and the inside of the sheath produce even temperature throughout the heater's length.



- Diameters: 1/4, 3/8, 1/2, 5/8, and 3/4 in.
- Voltage: 120 and 240
- Wattage: 50 to 5,000
- Watt densities: from 25 to 200 W/in.²

Fintube® Heating Elements

Superior to open-coil elements, the heating coil is completely encased in a metal sheath, minimizing a shock hazard due to accidental contact with the heater. The metal sheath minimizes hot spots and electrical shorting likely with open coil elements. Plus, bending configurations can be achieved to provide higher concentrations of installed kilowatts for a given area. An aluminum-painted steel sheath and furnace-brazed fins are the standard. Stainless steel or Monel* sheath and fins are also available for corrosive environments.



- Dimensions: 0.315- and 0.475-in. sheaths are standard with 2-in.-wide fins
- Voltage: 120 and 240, single phase
- Maximum work temperature: 225° to 565°F
- Wattage: 250 to 4,150

Strip Heaters

Chromalox offers a variety of strip heaters and accessories for convection-type air heating and clamp-on installations. They are ruggedly constructed for efficient heat transfer and long, dependable service. High-quality, coiled, alloy resistor wire, embedded in specially formulated, high-grade refractory material is uniformly spaced over the width and length of the heater for even heat distribution. The rock-hard, high-density refractory material both insulates the resistor and maximizes and transfers heat rapidly from the coil to the sheath. A variety of sheath materials is available, including rust-resisting iron, MONEL*, chrome steel, and INCOLOY*— all with a high-emissivity black oxide finish for maximum heat transfer. Chromalox clamping devices and mounting tabs speed installation. Many choices of terminal locations simplify layout between elements and power lines. Hundreds of models are in stock and available for immediate shipment. Special ratings and sizes can be readily manufactured.

- Wattage: up to 3,000
- Voltage: 120 to 400
- Watt density: up to 38 W/in.²
- Maximum temperature: up to 1,500°F



Band Heaters

Band heaters grip tightly to cylindrical surfaces to supply uniform heat transfer. Chromalox band heaters are flexible and come in one- or two-piece construction for easy installation and removal. They accommodate diameters as small as 15/16 in. to as large as 20 in. and are capable of reaching sheath temperatures up to 1,500°F. Stainless steel braids and conduit protect terminations and resist contamination.

- Maximum temperature: 1,500°F
- Watt density: up to 50 W/in.²



Thick Film Heaters

Chromalox thick film heaters can be used for applications where desired temperatures are higher than can be achieved with flexible silicone laminate heaters. They are designed to provide relentless, dependable, and round-the-clock service week-in and week-out for years. Thick film heaters are constructed of a substrate, a base dielectric material, and a resistor. A variety of substrate materials may be used. Termination points are fused directly to the resistor circuit for strong, trouble-free connections. Thick film heaters are corrosion resistant, contributing to their long service life. Thermal profiles can be maintained to within $\pm 1^\circ\text{F}$ and are distinguished by fast thermal response for excellent operating efficiency. By varying the density of the heater circuit, thick film heaters can be designed to vary heat output across the surface.

- Operating temperatures: up to 932°F
- Watt densities: up to 500 W/in.²



* INCOLOY and MONEL are the registered trademarks of Huntington Alloys Corporation.

IMMERSION, CIRCULATION, AND INFRARED HEATERS

Immersion Heaters

These are hairpin-bent tubular elements welded or brazed into a flange or a threaded hex plug. They heat liquids, viscous fluids, forced air, and gases by direct contact for virtually 100 percent efficiency. They can be provided with electrical enclosures, and some models are provided with a thermowell for temperature control. Most units are UL listed and CSA certified.

- Screw plug size: ½", ¾", 1", 1¼", 2", and 2½" NPT
- Screw plug power rating: up to 40 kW
- Flanged heater power rating: up to 2,000 kW
- Screw plug and flanged heating element material: brass, steel, or stainless steel
- Sheath material: copper, steel, stainless steel, or INCOLOY*



Circulation Heaters

Chromalox circulation heaters are packaged units consisting of a screwplug or flanged immersion heater mounted in a thermally insulated heating chamber for efficient heating of a flowing medium. Thermocouple sensors can be provided to connect to most any controller. Many terminal enclosures, sheath and vessel materials, flanged connections, and controls are available.

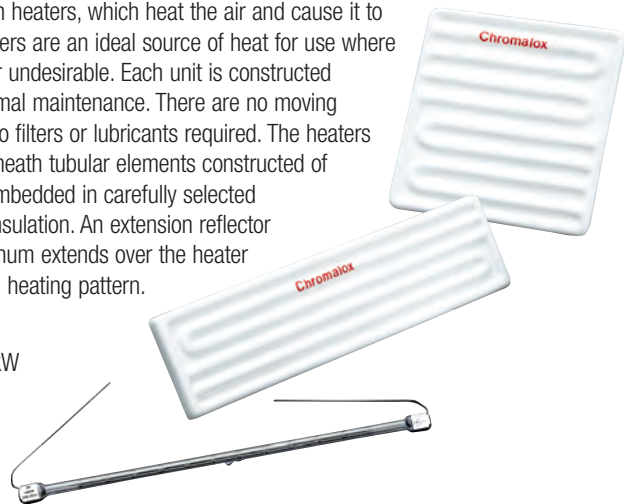
- Pressure resistance: up to 5,000 psi
- Maximum temperature: up to 1,200°F
- Power rating: up to 2,000 kW



Radiant Infrared Heaters

Like heat from the sun, Chromalox® ChromaStar® infrared heaters create invisible electromagnetic waves that travel through space and are absorbed by people and objects in their path. Unlike convection heaters, which heat the air and cause it to circulate, infrared radiant heaters are an ideal source of heat for use where air movement is impractical or undesirable. Each unit is constructed for long life and requires minimal maintenance. There are no moving parts or motors to wear out, no filters or lubricants required. The heaters consist of hairpin-bent alloy sheath tubular elements constructed of high-quality resistance wire embedded in carefully selected magnesium oxide refractory insulation. An extension reflector constructed of mirrored aluminum extends over the heater assembly to provide a uniform heating pattern.

- 5,118 to 46,062 BTU/hr
- Power rating: 1.5 to 13.5 kW
- Voltage: up to 600
- UL listed, CSA certified



* INCOLOY and MONEL are the registered trademarks of Huntington Alloys Corporation.

CUSTOM CONTROLS

Custom Controller/Timer

The Chromalox custom controller/timer provides reliable, accurate temperature control in a unit that fits inside compact equipment. It uses a “SMART” auto-tuning PID algorithm for accurate control that automatically calculates the PID parameters suited for a specific process. Its integral timer function provides timed control of a heating cycle. The custom controller/timer is designed for simple software and hardware modification to enable different button or timing functions. It comes without an overlay, so that one may be customized, whether it is provided by the customer or by Chromalox. It can cover just the custom controller/timer or the customer’s entire control display and include the customer’s branding. The dual PCB board assembly can be mounted in spaces as shallow as 2 inches—even 1 inch if the assembly’s two boards are mounted side by side.



- Process timing from 1 to 999 minutes
- Alarm with relay or built-in buzzer option
- Configuration port for saving and downloading set-up parameters
- Independent over-temperature option provides an inexpensive independent circuit and eliminates the need for additional space and/or mounting of a separate component

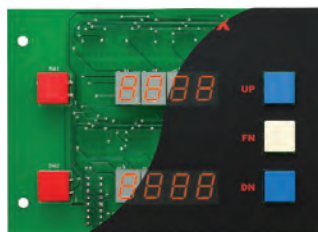
OEM Custom Control Platform

Developing a custom temperature controller for your OEM application quickly and easily can result in reduced costs and faster response-to-market. This is the idea behind the Chromalox OEM custom control platform.

Here’s how it works:

1. Prototyping is accomplished with a system board that accepts plug-in input and output cards of standard types that can be mixed and matched for each application
2. When the design is finalized for production, the modules are quickly repackaged into a single-board solution

Basic operational capabilities include support for a variety of temperature sensor types, temperature control for up to four channels, hi/low temperature alarms, basic timer functions, and one- or two-number hour/minute displays. The Chromalox OEM custom control panel platform can be panel-mounted with either an overlay or membrane switch. Use a Chromalox control overlay or use your own to make the control unique to your product.



Additional features:

- Quick and simple set-up and programming using direct manual input to configure setpoint and timer functions
- Additional parameter adjustments may be included for field use or factory configured to your requirements
- Control modes include on/off with a dead band, PI, and PID
- Alarm types include process, high or low
- Advanced custom operator interface is available for remote-control parameter viewing and configuring, and for downloading programs or uploading information for advanced diagnostics by PDA or PC, wirelessly or via Ethernet



CUSTOM CONTROLS

Drawing on more than 90 years of experience, Chromalox offers its expertise in control products that are truly customizable to your OEM application. We offer choices that can provide the exact degree of product sophistication, or simplicity, that you want.

This is what makes *our* solution *your* solution.

STANDARD CONTROLS AND SENSORS

Chromalox offers an extensive line of standard controls to meet a variety of demands. And as your single source for the essential control elements, Chromalox stocks all the accessories you need to complete your application.

STANDARD CONTROLS AND SENSORS

Standard Controls

Temperature Controls

From basic electromechanical thermostats to single- and multi-loop, microprocessor-based temperature controllers, Chromalox temperature controllers provide precise, economical process control. Advanced models feature PID operating modes for heating and/or cooling; fuzzy logic control; dual output/dual alarm protection; NEMA 4X front panels; ramp/soak programming; and digital communications and software. Available panel cutouts (DIN) range from 1/32 to 1/2. Front panels can be customized to include your brand.



Monitors and Overtemperature Controllers

Our monitors and overtemperature controllers are designed to protect expensive process equipment with models offering alarm relay outputs; DIN rail mounting; digital LED displays; thermocouple and RTD inputs; NEMA 4X front panels; and digital communications. UL-, cUL-, and FM-approved models are available.



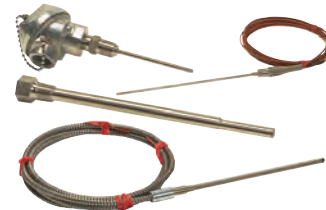
SCR Power Control Components

SCR power control components are easily integrated into electric resistance heating applications and deliver high-precision power modulation and smooth power output. Zero-crossover and phase-angle-fired configurations are available that drive single- and three-phase loads to 1,600 kW. Features include current limiting, over-current trip, LED status indicators, I2T fusing, and shorted SCR detection. Models are UL-, cUL-, CE-, and DEMKO-approved.



Sensors and Accessories

Sensors range from bare thermocouples and RTDs to the most sophisticated infrared non-contact sensors that directly, consistently, and accurately measure product temperature. Stock accessories include thermowells, wiring, indicating meters, timers, and recorders in addition to electro-mechanical contactors, thermostats, and thermostats.



CHROMALOX ADDS VALUE WITH SERVICE AND SUPPORT

Prompt Customer Service with Quick Parts Replacement

Chromalox maintains vast inventories of repair and replacement parts for immediate shipment and same-day or next-day delivery. Call our toll-free service line at **1-800-368-2493** and we'll help you select the right component quickly and get your order on its way.

Technical Assistance 24 Hours a Day, 7 Days a Week on the Internet at www.chromalox.com

This website offers product specs, design wizards, training manuals, and technical documentation day or night. You can find answers to questions about anything from electronic temperature controllers, heaters, and heating elements to material compatibility, corrosion, and wire sizing. And more . . .

- Quickly check the availability of all stocked and assembly-stocked parts by part or model number
- Search our ever-expanding resource of application solutions in the Chromalox KnowledgeBase by typing in your application to see how we have solved the application in the past
- Download our design guides, specification sheets, instruction manuals, catalog pages, and installation guides to quickly provide submittals and information to your customer base

Field Technical Service

In addition to information available in product literature and at our website, factory and local engineers can offer answers that return your equipment to service quickly. Factory-trained engineers or technicians will visit your site to evaluate your problem and define the best solution. Call **1-800-443-2640** for the representative closest to you. Or visit chromalox.com.

Chromalox Products and People Cover the Globe

Our modern and efficient manufacturing and distribution facilities are strategically located to get products to you globally when you need them, wherever you are around the world. Our worldwide positioning includes engineering and sales support available in most countries on every continent. This makes Chromalox truly a global thermal solutions provider.



VALUE ADDED

**UNMATCHED STOCK,
RAPID DELIVERY**

Chromalox maintains an inventory of nearly one million items. We also operate the fastest delivery system in the business. We can ship any component or system we stock within 24 hours through our chromalox.com electronic direct order entry system. Same-day delivery is available for many items. In addition, factory offices, stocking representatives, and over 2,000 authorized distributors carry Chromalox systems and components for same-day pickup.

Chromalox Value-Added Products and Services Are Available Worldwide



Chromalox[®] PRECISION HEAT AND CONTROL

103 Gamma Drive
Pittsburgh, PA 15238
USA

Phone: (412) 967-3800
Fax: (412) 967-5148
Toll-Free: 1-800-443-2640

email: sales@chromalox.com
www.chromalox.com

Chromalox-UK
Unit 122, Lombard House
2 Purley Way
Croydon, Surrey, CR0 3JP, UK

Tel: +44 (0)20 8665 8900
Fax: +44 (0)20 8689 0571

email: uksales@chromalox.com
www.chromalox.co.uk

Chromalox-France
Route de Château-Thierry
Noyant et Aconin
F-02203 SOISSONS Cedex, France

Tel: +33 (0)3 23 74 39 39
Fax: +33 (0)3 23 74 39 00

email: etirexchromalox@wanadoo.fr
www.chromalox.fr

Chromalox-China
Chromalox (Shanghai) Precision Heat
and Control Co., Ltd.
Suite A2, 4th Floor, Fenggu Building
88 Taigu Road
Waigaoqiao Free Trade Zone
Shanghai 200131
People's Republic of China

Tel: +86 (0)21 5866-8802
Fax: +86 (0)21 5866-8803

email: shanghai.office@chromalox.com
www.chromalox.cn