Chromalox®
PRECISION HEAT AND CONTROL

Building Precision Electric Heat and Control Systems For the Alternative Energy Industry

ALTERNATIVE ENERGY INDUSTRY

WE SERVE MORE INDUSTRIES

NO OTHER MANUFACTURER OF HEAT AND CONTROL PRODUCTS SERVES ALTERNATIVE ENERGY BETTER

With the broadest product line and experience unmatched in the industry, Chromalox provides precision heat and control systems for more processes throughout the world than anyone. We serve ethanol, biodiesel, biomass, solar, wind, methanol, LNG, LPG, and hydrogen fuel cells markets.

Precision Electric Heat and Control Designed with Our Alternative Energy Customers in Mind

In 1915, Chromalox introduced the world's first metal-sheathed heating element. Since then, we have grown from just a manufacturer of heating elements to a global force in the design and implementation of electric heat and control systems that meet the requirements, certifications, codes, and standards of process industries around the world.

The Chromalox Difference

Some companies simply build heaters and controls. Chromalox does more. We provide custom-engineered precision heating technologies for diverse process industries by designing equipment specifically for customers' needs. Chromalox is vertically integrated in manufacturing capabilities and offers full design and engineering for virtually any electric process heat and control application. We become a partner in helping you to save time and money before startup, a partner who works with you to maximize efficiency and minimize downtime, and a partner who provides the field service and technical support you need to get the job done.

No Other Manufacturer of Heat and Control Products Serves Alternative Energy Better

With the broadest product line and experience unmatched in the industry, Chromalox provides precision heat and control systems for more alternative energy processes and plants throughout the world than anyone. We serve the ethanol, biodiesel, biomass, solar, wind, methanol, LNG, LPG, and hydrogen fuel cells markets.

The Role of Electric Heat in "Green" Applications

As the drive to employ cleaner-burning sources of energy and energy production gains momentum, Chromalox is working shoulder to shoulder with energy suppliers to provide solutions that protect our environment. Here are just some of the ways Chromalox precision heat and control technologies are being employed.

Biodiesel Production Facilities

Biodiesel is a clean-burning alternative fuel produced from domestic, renewable resources. Chromalox circulation heaters, tank heaters, heat trace cable, and control panels are all used in the biodiesel production process. Each step requires critical temperature control that is able to be delivered through electric heat. The final biodiesel product contains no petroleum, is biodegradable and nontoxic, and can be used in conventional diesel engines with little to no modifications.

Ethanol Production Facilities

Ethanol is mainly known as an alternative fuel for gasoline-powered vehicles. Production involves the processing of various chemicals, water, and mixtures that must be held at exact temperatures, then pumped to processing stations. Chromalox heat trace cable, tank heaters, and controls are used to maintain tank and pipeline temperatures during production. Once completed, the ethanol product can then be shipped for final processing that may include beverages, gasoline, or industrial use.

Wind Turbines

Chromalox circulation heaters directly warm the hydraulic fluid used in the generation system. This helps increase the turbines' efficiency to produce pollution-free electricity. Flexible heaters are used for freeze protection in turbine blades, while loadbanks are utilized in load management.

Solar Power

The creation of polysilicon, CdTe, CIGs, and other active materials requires elevated process and environment temperatures. The production of solar cells, modules, and systems utilizes various deposition, lamination, and curing processes with tight temperature tolerances. Chromalox process heaters, heat transfer systems, and vaporizers are specifically engineered for these critical applications.Chromalox immersion heaters and heat trace cable are instrumental in the proper design and operation of solar concentration systems.

The Next Generation

Chromalox stands ready to assist in the development of emerging technologies such as hydrogen fuel cells, gas-to-liquids, biomass, and cellulosic ethanol . . . or to re-engineer existing green technologies like geothermal, hydroelectric, and total power generation.

SIGNIFICANT BENEFITS AND ADVANTAGES

Electric Heat Offers Significant Benefits and Advantages Over Oil- or Gas-Fired Systems

There are a lot more "green" reasons beyond environmental concerns to choose electric heat over oil- and gas-fired heat systems. Electric heat offers a number of advantages that can benefit manufacturers in saving or reducing manufacturing, installation, operating, maintenance, and capital costs. Improved safety and the ability to meet or exceed regulatory issues are important considerations, too.

Consistent Pricing

Electric utility prices have been very consistent, averaging only four percent yearly increases. This allows customers to accurately determine operating cost without gambling on the volatile prices of gas or oil. Gas and oil prices tend to be erratic, with prices surging every winter.

Clean-Running Operation

With electric heat there is no additional expense of installing exhaust piping, fuel or gas inlet lines, storage tanks for fuel oil, or air inlet lines–not to mention the factory space lost to accommodate such a system.

No Pollution

Electric converts 100 percent of the power input into heat energy with no pollutants generated. Fuel- and gas-fired systems produce pollutants that must be monitored and controlled in accordance with EPA regulations.

Quiet Operation

Electric heaters have no combustion noise and minimal moving parts. This greatly reduces concerns over meeting OSHA noise regulations.

Reduced Footprint and Envelope Size

Compared to some similar oil and gas heating systems of similar outputs, electric heaters are typically one-quarter to one-half the size. This saves valuable plant floor space.

Minimal Maintenance

Due to the simpler operation of electric heaters (i.e., no combustion controls) very little maintenance is needed. In addition, electric elements can be easily replaced by service personnel.

Lower Operating Cost

Due to the complexity of controlling a fuel/air mixture in a fuel or gas system, a full-time, trained technician may be needed for its operation. In addition, without continual tuning, gas and oil units can have reduced efficiencies.

Safety Concerns

Electric heaters have no open flames. Flame-operated systems may require installation away from any potentially combustible areas.

Large Turndown / Precise Control

With multiple staging or an SCR power control, electric heaters can respond rapidly and precisely to varying process conditions for operating cost savings. The large turndown ratios possible with electric heat drop operating costs proportionally, while turndown ratios of other heat technologies, e.g. steam, deliver a diminishing return of operating cost reduction.

Chromalox Understands the Challenges of Alternative Energy Production

Chromalox Understands Every Facet of the Process and the Plant

From large tank and process heaters to self-regulating heat trace and controls. From explosion-proof heaters for freeze protection to comfort heaters. Our expertise, combined with the most stringent material and manufacturing standards you'll find in the industry, provides you with an array of products you can count on to perform at each critical process phase.

Chromalox Meets Your Specific Challenges

With that kind of experience behind us, Chromalox understands the unique challenges that alternative energy plant builders, managers, and maintenance personnel face. And we have the knowledge, experience base, local support, and technical skills to meet those challenges with you.

Broadest Third-Party Approvals

Chromalox is the only manufacturer with extensive systems manufacturing in the U.S. and Europe. Approvals and global certifications include, but are not limited to, CE, NEC, UL, VDE, cUL, FM, CSA, MSHA, BASEEFA, Cenelec, ASME, PED, ATEX, GOST, and ISO9000.

LONG HISTORY OF INNOVATION

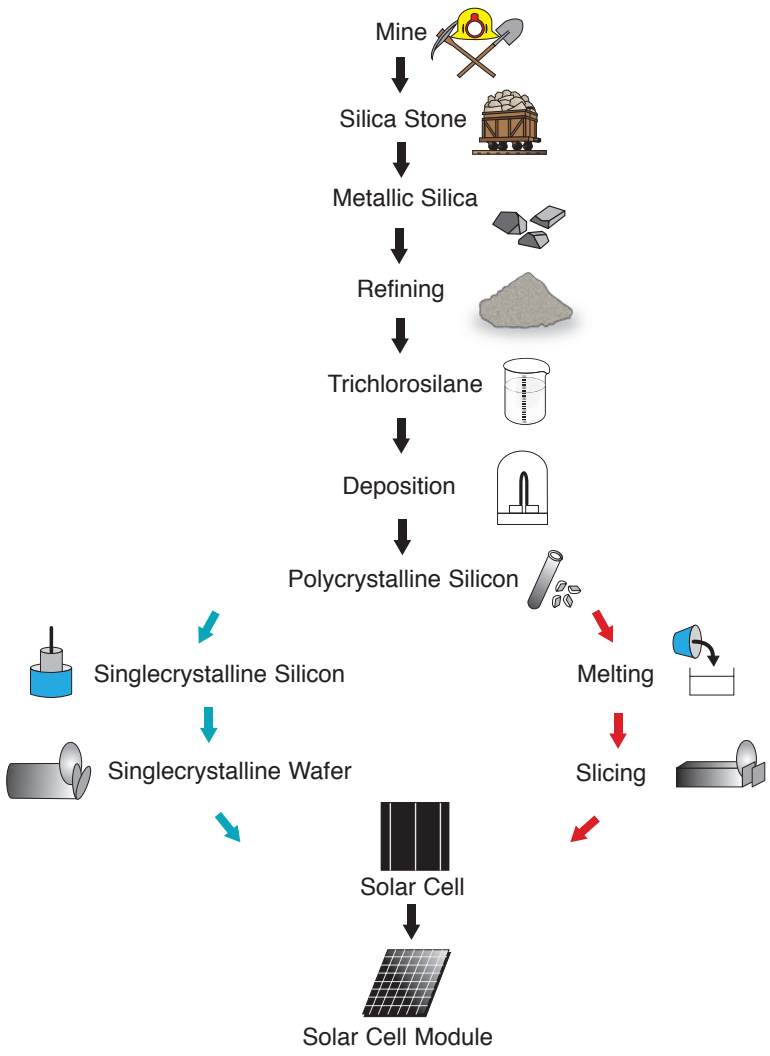
CHROMALOX HAS A LONG HISTORY OF INNOVATION IN THE POWER, ENERGY, AND FUEL MARKETS

Chromalox has been developing better means of applying electric heat for process industries since 1915. That year, we introduced the world's first metal-sheathed heating element.

ALTERNATIVE ENERGY PROCESSING

Two Examples of Where Chromalox Products and Systems Are Used in Alternative Energy Production

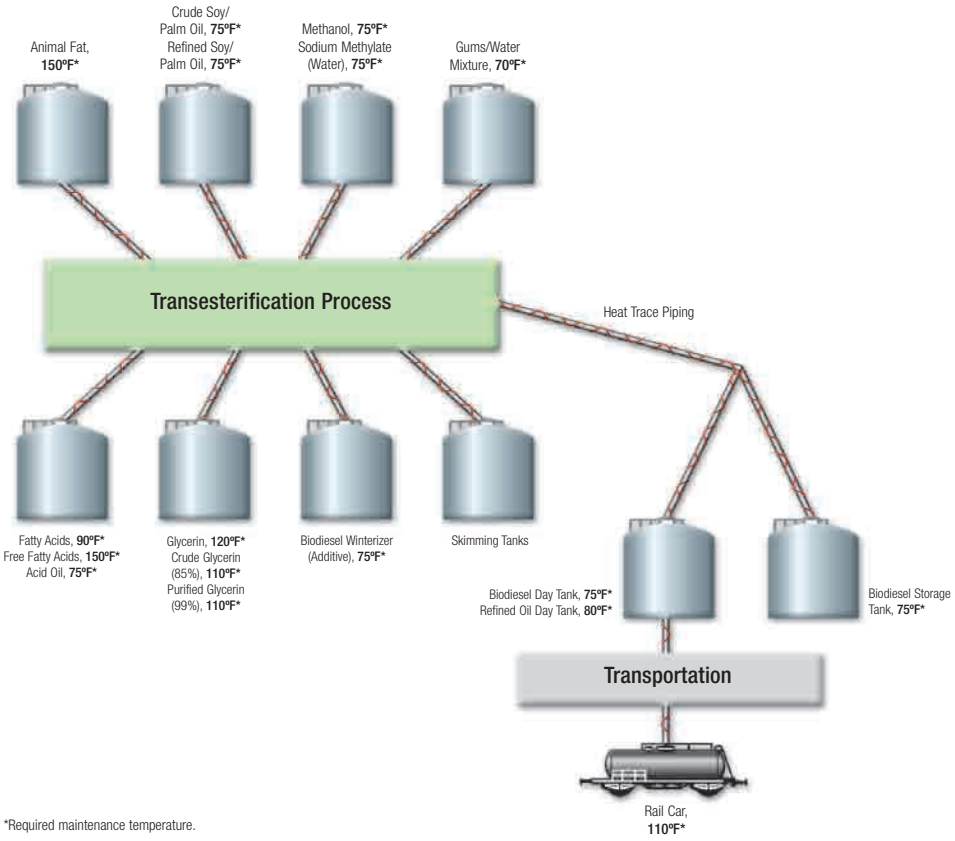
Silicon Solar Cell Module Production



Chromalox Product/System	Application
Circulation Heaters	• Hydrogen Heating • STC Superheating • Ammonia and Dopant Gas Heating
Immersion Heaters	• Deposition Chamber Heating • Furnaces and Ovens
Vaporizers	• STC Vaporizers • Ammonia Vaporizers • High-Temperature Thermal Fluid Transfer
Heat Transfer Systems	• Lamination Equipment • Drying and Curing Applications • Batch Ovens and Kettles

Chromalox Product/System	Application
Pipe Heat Trace and Controls	• High-Temperature Process Lines • Water and Steam Lines • Gas Lines
Component Heaters	• Deposition Chamber Heating • Furnaces and Ovens • Lamination Equipment • Drying and Curing Applications
Control Systems	• Precise SCR Control Systems for Tight Process Requirements • Integrated Control Systems for Plant Control and Automation Systems
Tank Heaters	• Freeze Protection • Temperature Maintenance of Bulk Liquids

Biodiesel Production Facility



*Required maintenance temperature.

Chromalox Product/System	Application
Tank Heaters and Controls	• B100 Tanks • Skimming Tanks • Fatty Acid Tanks • Glycerin Tanks • Distribution Points • Wastewater Treatment
Circulation Heaters and Controls	• Scrubbers • Water Wash System • Process • Soy and Vegetable Oil Heating
Pipe Heat Trace and Controls	• Processing Line Temperature Maintenance • Storage Tank Line Temperature Maintenance and Freeze Protection • Rack System Temperature Maintenance and Freeze Protection • Distribution Point Temperature Maintenance and Freeze Protection
Comfort Heaters	• Warehouse • Shipping/Receiving • Distribution • Manufacturing Area
Steam Boiler System	• Rail Car

DESIGN, ENGINEERING AND MANUFACTURING

Unrivaled Design, Engineering and Manufacturing Capabilities Focused on Your Custom Alternative Energy Process

Front-End Engineering Design Assistance

Chromalox has more experience in process design than anyone else in the industry. Prior to construction, let us put that experience to work for you.

Accurate planning and sound engineering are keys to any process. Our engineering support staff can help to properly specify equipment that will get the job done right the first time so when you enter the construction phase, you can be sure that the specified equipment will operate as desired

Comprehensive Engineering Capabilities

From heater assemblies and skid fabrication to integration with controls and sensors, our complete engineered systems reduce installation labor, reduce startup time, and ensure proper operation to specification. Chromalox provides engineering assistance with integrating our products into your application, offering a full range of engineering capabilities.

Our in-house engineering and software capabilities allow us to design simple operator interfaces. These advanced designs can reduce your business' training time and expense, as well as increase repeatable operation. In addition, Chromalox has training tools and resources to assist you with installation, startup and operation.

Manfacturing That Leads the Industry

Chromalox maintains state-of-the-art manufacturing plants–nine in all–throughout the United States, Mexico, and Europe. In the U.S., Chromalox has more than 250,000 square feet of manufacturing capability in Utah with additional manufacturing in Tennessee, Pennsylvania, and Wisconsin.Our manufacturing capability features computer- controlled, automated machinery to help quality. With ASME welding capability in-house since 1953, Chromalox has gained more in-plant experience than any other electric heater manufacturer to perform welding correctly. Our high-unit-volume ASME production of large, high-pressure systems gives Chromalox the experience base to perform ASME welding at a level of excellence unsurpassed in our industry.

Comprehensive On-Site Engineering Service and Support

Chromalox will provide highly qualified personnel for site commissioning and operational servicing anywhere in the world. Our engineers have been comprehensively trained and possess the required medical and safety certificates. If necessary, they are available to commission the mechanical, electrical, instrumentation, and control equipment for any system we have built.

Custom Design for Special Needs

Chromalox can design heating solutions for any unique requirement. 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. Chromalox will help you produce prototypes for new products and systems, developing an innovative design in the shortest possible turn-around time.

Chromalox Has the Heating Technology and Controls for Your Alternative Energy Applications

Packaged Systems

Chromalox packaged systems are safe, versatile, and easy-to-use heating systems for alternative energy production. These systems are pre-engineered and constructed with carefully matched components for easy installation and trouble-free operation in your application.

Large-Tank Heating Systems

Chromalox packaged large-tank heating systems are uniquely designed to heat large storage tanks located above or below ground and containing highly viscous fluids or heat-sensitive materials.

Impedance Heating Systems

Impedance heating systems employ the "Joule Effect" to produce and directly transfer heat from the entire circumference and length of pipe to the material being heated. It can be used for proper temperature maintenance as well as to raise fluid temperature. Utilizing the pipe itself and minimum equipment, installation is simple. Temperature control is highly accurate (to within ±1ºF) and higher watt densities (up to 190 W/in.^{2}) can be used due to increased velocities with lower pressure drops.

Heat-Transfer Systems

Chromalox packaged heat-transfer systems come complete with integral controls and can be used to heat and pump hot oil. They include temperature and power controls, expansion tanks, heat exchangers, pumps, valves, gauges, and all necessary piping, eliminating component selection and assembly. Chromalox horizontal electric vaporizers are designed for use with Dowtherm,* Therminol,* and other organic fluids to transfer heat at high temperatures and low pressures. They are pre-engineered, prewired, and pre-piped packages designed for flexible, dependable, and efficient operation.

Process Heaters

Heat processing applications vary widely from industry to industry. Chromalox has a process heating solution for nearly every application: immersion heaters that can apply heat at virtually 100% efficiency to water, oils, viscous materials, solvents, process solutions, and gases; circulation heaters that are designed to heat a flowing medium using in-line or side-arm piping configurations; process air heaters that can apply heat not only by electrically heated air, but even special atmospheres such as argon or nitrogen; and process radiant heaters that transfer energy through space, without the presence of a medium, for maximum efficiency.

*Dowtherm is a registered trademark of The Dow Chemical Company.
Therminol is a registered trademark of Monsanto Company.

PACKAGED SYSTEMS
PROCESS HEATERS

COMFORT, HEAT TRACE, CONTROL SYSTEMS

Industrial Comfort Heaters

Chromalox electric comfort heaters provide efficient, economical heat for a variety of applications. Convection, forced-air, and radiant heaters provide safe, clean, fast heat. Their heavy-duty construction affords long, dependable service.

Typical applications include:

- Heating industrial work areas
- Machinery freeze protection
- Heating warehouse and storage areas
- Pipe thawing
- Spot heating

Control Systems

From multi-loop electronic controls to stock and custom control panels, Chromalox can design the right system for your plant's needs. We are the only heating element supplier offering a complete line of process and electronic heat trace controls and control panels from basic, low-cost temperature controllers to more sophisticated control systems like the Chromalox® intelliPANEL™ 3-phase SCR power control panel featuring unique color touchscreen technology.

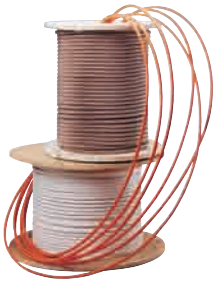
Typical applications include:

- Process temperature maintenance
- Freeze protection
- Resistive and inductive heating

Heat Trace and Controls

Heat trace is used to counteract the heat loss from process equipment and piping through its insulation. Chromalox offers a variety of heat trace systems for temperature maintenance and freeze protection, and to prevent solution precipitation and the increase of viscosity or solidification of product.

We offer a variety of heat trace cable to suit a variety of application requirements: from self-regulating, low-temperature cable to constant-wattage and mineral-insulated cable.



Chromalox offers heat trace temperature control, monitoring, and power management in one, modular package. Other available accessories include all of the necessary components needed to complete your installation, such as splices, power connection boxes, and water-resistant end-seal terminations.

Typical applications include:

- Cooling water lines
- Steam or condensate return lines
- Compressed air lines
- Fire protection lines
- Storage tanks
- Valves

Why Choose Electric Heat?

- Consistent pricing
- Clean-running operation
- No pollution
- Quiet operation
- Reduced footprint and envelope size
- Minimal maintenance
- Low operating cost
- Safety
- Large turndown / precise control

Why Choose Chromalox?

- Broadest product line and experience unmatched in the industry
- Precision-engineered heat and control systems for more alternative energy processes throughout the world than anyone
- Vertical integration in manufacturing capabilities
- Full design and engineering for virtually any electric process heat and control application

Chromalox Value-Added Products and Services Are Available Worldwide

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