

Circulation Heaters Selection Guidelines

Selecting a Circulation Heater

Selecting the proper circulation heater component requires critical engineering judgement and careful evaluation of the application. After determining the heat requirement for a specific heat application, the proper selection of the flange and vessel material, heating element sheath material, and correct watt density is critical to achieve long heater life. The ultimate selection of equipment is determined by the knowledge of the process and engineering acumen of the designer or plant engineer. Consult the Technical section of this catalog for circulation heater calculations and guidelines.

Application Factors

Heater selection is influenced by the following parameters.

- ① The heated medium, viscosity, specific heat, density and corrosive properties.
- ② The presence of contaminants in the medium.
- ③ The corrosion resistant properties of the heater sheath material.
- ④ The sheath watt density of the heating elements — the watts per square inch, and the flow rate of the heated medium.
- ⑤ The vessel design and material — pressure and temperature of the fluid being heated.

Corrosion Policy

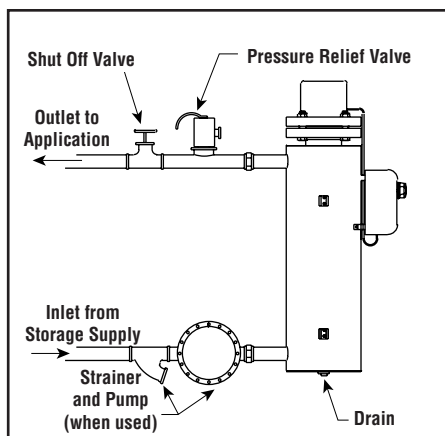
Chromalox will not warrant any electric heater against failure by sheath corrosion if such failure is the result of operating conditions beyond the control of the heater manufacturer. It is the responsibility of the purchaser to make the ultimate choice of sheath material based on his knowledge of the chemical composition of the corrosive solution, character of materials entering the solution, and controls by which he maintains the process.

Circulation Heaters — Selection Guidelines

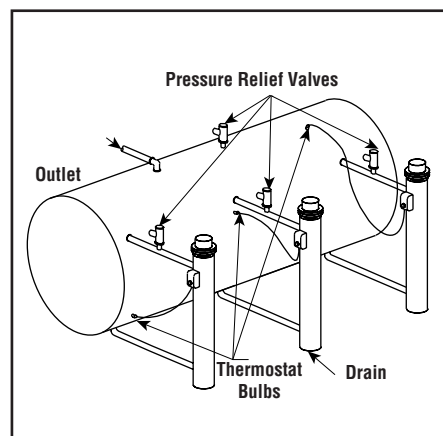
Application	①	②	③	④	⑤
	Solution or Heater Type	Alkaline or Acid Content (Est. % by Volume)	Sheath Material	Watt Density (W/In ²)	Vessel Material
Water	Clean Water	pH6 to pH8 (Neutral)	Copper	45 - 100	Galvanized Steel
Mild Solutions	Process Water and Very Weak Solutions Weak Solutions Demineralized, De-ionized or Pure Water	pH5 to pH9 (2 - 3%) 5 - 6% —	INCOLOY® INCOLOY® INCOLOY®	45 - 86 45 - 75 45 - 75	Stainless Steel Stainless Steel Stainless Steel
Corrosive & High Viscous Solutions	Mildly Corrosive Solutions More Severe Corrosive Solutions Severely Corrosive Solutions	5 - 15% 10 - 25% 30 - 60%	INCOLOY® INCOLOY® INCOLOY®	20 - 25 20 - 25 10 - 20	Stainless Steel Stainless Steel Stainless Steel
Oil	Low Viscosity Oils Medium Viscosity Oils High Viscosity Oils (Fuel Oil)	— — —	Steel Steel Steel	20 - 25 10 - 20 5 - 15	Steel Steel Steel
Air, Gases & Steam	Medium Temperatures to 750°F High Temperatures to 1400°F	— —	INCOLOY® INCOLOY®	20 - 25 10 - 20	Steel Stainless Steel

Typical Applications

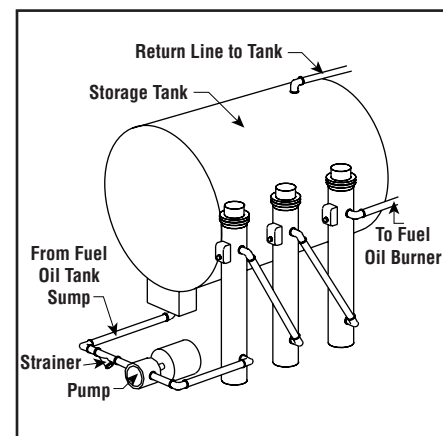
Inline Heating — Where demands for heated water or oil are nearly constant, circulation heaters may be installed directly in the fluid line, eliminating the need for storage tanks and their related heat losses.



Side Arm — Requirements of large storage tanks can be satisfied by using a number of circulation heaters, providing flexibility in temperature control and reducing power demand.



Closed-Loop Fuel Oil Heating — Requirements may be provided by a number of circulation units individually adjustable to temperature and fluid flow, reducing electrical demand on your utility bill.



Circulation Heaters Selection Guidelines (*cont'd.*)

Circulation Heaters — Selection Guidelines

Application	Heater/Vessel Material	kW Rating	Feature	Model	Page
Clean Water	Copper/Galv. Steel	3 - 18 6 - 500	Screw Plug Flanged	NWHMT NWH	C-8 C-9
	Copper/Steel or Brass	1.5 - 3	Booster	NWHJR	C-11
Clean Water & Oil	INCOLOY®/ Cast Iron or Galvanized	0.5 - 40	Field Adjustable	NWHSRG NWHOSR	C-12 C-12
Pure Water & Mildly Corrosive	Stainless/ Stainless	3 - 18	Screw Plug	NWHMTSS	C-31
Corrosive & High Viscous Solutions	INCOLOY®/ Stainless INCOLOY®/ CPVC	6 - 200	Flanged	NWHIS	C-32
		2 - 30 1.5 - 3	Reduced Watt Density Non-Metallic Body	NWHOIS CVCHS	C-33 C-14
Oil Light Medium Heavy	Steel/Steel	3 - 9	Screw Plug	NWHMTO	C-16
		1 - 9	Reduced Watt Density	NWHMTOR	C-17
		3 - 120	Flanged	NWHO	C-18
		30 - 120	Baffled	NWHOB	C-18
		3 - 120 20 - 70	Reduced Watt Density Baffled	NWHOR NWHORB	C-21 C-21
Steam, Air & Gas Med. Temp	INCOLOY®/ Steel	1 - 9	Screw Plug	GCHMTI	C-25
		1 - 9 3 - 350	Reduced Watt Density Flanged	GCHMTIR GCHI	C-26 C-27
High Temp	INCOLOY®/ Stainless	2 - 200	Flanged	GCHIS	C-34
		30 - 50	Baffled	GCHISB	C-34
		0.5 - 3.0	Low Flow	GCHCIS	C-36
Pre-engineered Packages — Wired & Skid Mounted					C-37
ASME & Custom Engineering Specifications (SDS)					C-38

Codes & Standards

ASME Certification to Sections I, IV and VIII, Division 1 — Chromalox is the leader in providing ASME (American Society of Mechanical Engineers) certification for pressure vessel applications.

Underwriters Laboratories — UL Listing available for many circulation heaters. Consult your Local Chromalox Sales office.

Canadian Standards Association — CSA certification available including NRTL/C.

National Electrical Code (NEC) — All Chromalox circulation heaters are built to allow NEC installation requirements.

Special Features

Kilowatt Ratings — Large kilowatt circulation heaters (500 kW and above) are available as single chambers or with multiple chambers in series. Skid mounting and integral control panels are also available.

Vessel Construction — Chamber size available in 10, 12, 14, 16, 18" and above for larger kilowatt capacities.

Pressure Ratings — 150, 300, 400, 600, 900, 1,500 and 2,500 Lb. Class.

Materials — 304, 316, 321, 347 Stainless Steel, INCONEL® and more.

Thermocouples can be provided on element sheath for overtemperature protection and/or mounted in the outlet nozzle for process control.

Inlet and Outlet Nozzles — Available with flanged or threaded connections, smaller or larger pipe sizes and different orientations.

Baffles mounted on element bundle inside chamber to increase fluid or gas velocity.

Terminal Standoffs in 4, 6 and 8" allow the terminal enclosure housing and the field wiring connection to operate at lower temperatures in high temperature heaters. Standoffs are frequently used in heat transfer and gas heating applications.

Mounting Saddles for horizontally mounted circulation heaters.

Weatherproof Insulation Jacket for outdoor unprotected installations.



More Information
is Available Online
on Tank Heating.

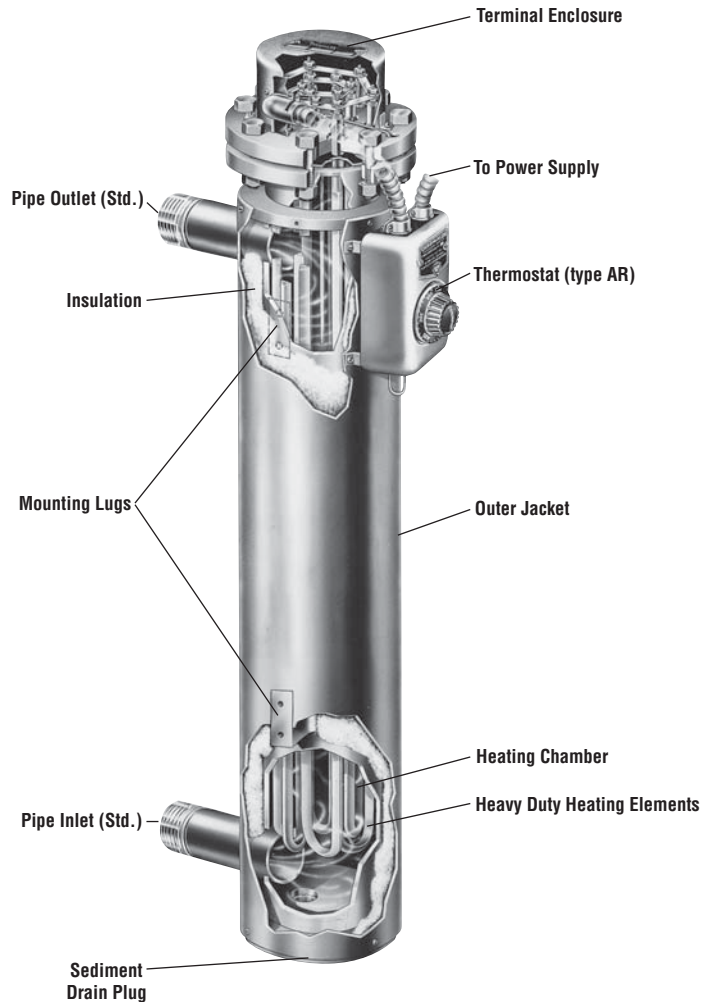
Bookmark Your Browser to
www.chromalox.com
and Select **Manuals**.

Circulation Heaters

Features

- Kilowatt Ratings from 0.5 kW (500 W) to Over 500 kW (500,000 W)
- Voltage Ratings to 600V
- Pressure Ratings from 150 - 2,500 psig
- Temperatures to 1500°F (815°C)
- Pipe Chambers 1 - 18" NPS (or Larger)
- Quality Heating Elements in Screw Plugs or Flanges for Ease of Replacement
- Sheath Materials include Copper, Steel, Stainless, INCOLOY® and INCONEL® to Suit Most Operating or Corrosive Environments
- Vessel Materials include Carbon Steel, 304 or 316 Stainless Steel, Non Ferrous Alloys and High Temperature Plastics
- Terminal Enclosures for General Purpose, Moisture Resistant and Explosion Resistant Applications
- Thermocouples and RTD Sensors for Process and Overtemperature Control
- Wide Range of Mechanical and Solid State Electronic Controls including Temperature Controllers
- Contactor or SCR Power Panels for Close Temperature Control (see Controls Section)
- Vertical or Horizontal Mounting with Mounting Lugs or Saddle Supports
- Available with High Temperature Standoffs and Internal Element Baffles
- Custom Designed Skid Mounting, Multiple Chambers and Integral Control Panels
- ASME Certification Section I, IV or VIII, Division 1
- UL, CSA and Other Third Party Approval, Listing or Certification Available on Many Models

Basic Construction



Basic Construction

Terminal Enclosures — E1 General Purpose, sheet metal, painted with red enamel, E2 Moisture Resistant/Explosion Resistant, E3 Explosion Resistant, E4 Moisture Resistant.

Controls — Stock and assembly stock NWH, NWHO and GCH circulation heaters, models -MT, -3 and -6 are provided with a thermostat mounted on the heater.

Mounting — Small units supported by inlet and outlet piping; larger units provided with mounting lugs for support.

Outer Jacket — Constructed of heavy gauge painted steel sleeving which contains high temperature thermal insulation to reduce heat losses from heating chamber.

Heating Chamber — Pipe chambers (150 Lb welded construction, standard) have a flanged

or threaded end to receive heater assembly and are closed at the opposite end. Larger units have drain connections to allow sludge removal. Inlet and outlet nozzles are provided for circulation of fluid or gas through heater chamber. Chamber material available in Steel, Galvanized Steel or Stainless Steel depending on the application.

Heating Elements — Flange or screw plug mounted tubular type heating elements offered in Stainless Steel, Copper, Steel or INCOLOY® sheath to suit corrosive resistance requirements.

Wiring Connections — All Chromalox circulation heaters are provided with internal wiring and power connections that are sized in accordance with wiring tables in the National Electrical Code. For safe operation of the heaters, all external wiring should also be in accordance with NEC, state and local codes.

Circulation Heaters

Terminal Enclosures

- **E1 General Purpose**
- **E2 Moisture Resistant/Explosion Resistant**
- **E3 Explosion Resistant**
- **E4 Moisture Resistant**
- **Conduit Openings Matched to the Number of Circuits**

Applications

The versatility of electric heaters permits them to be used in almost any conceivable location indoors or outdoors, exposed to the weather. Chromalox provides a variety of electrical terminal enclosures to match the unique requirements of virtually any environment.

Features

E1 General Purpose Enclosure — Suitable for most indoor or protected commercial and industrial applications.

E2 Combination Moisture Resistant and Explosion Resistant and E3 Explosion Resistant Enclosures — Type E2 and E3 explosion resistant terminal enclosures are intended for use in hazardous locations including:

- Class I Groups C & D, Div. 1 & 2
- Class I Group B¹, Div. 1 & 2
- Class II Groups E, F & G, Div. 1 & 2
- Class III, Div. 1 & 2.

Type E2 terminal enclosures are provided with gaskets and are suitable for outdoor or wet locations as well as hazardous areas.

E4 Moisture Resistant Enclosure — Suitable for outdoor or wet locations. The terminal covers are provided with water-tight gaskets to seal the electrical terminals and connections from the environment.

Special Requirements for Electric Heaters & Terminal Enclosures in Hazardous Locations:

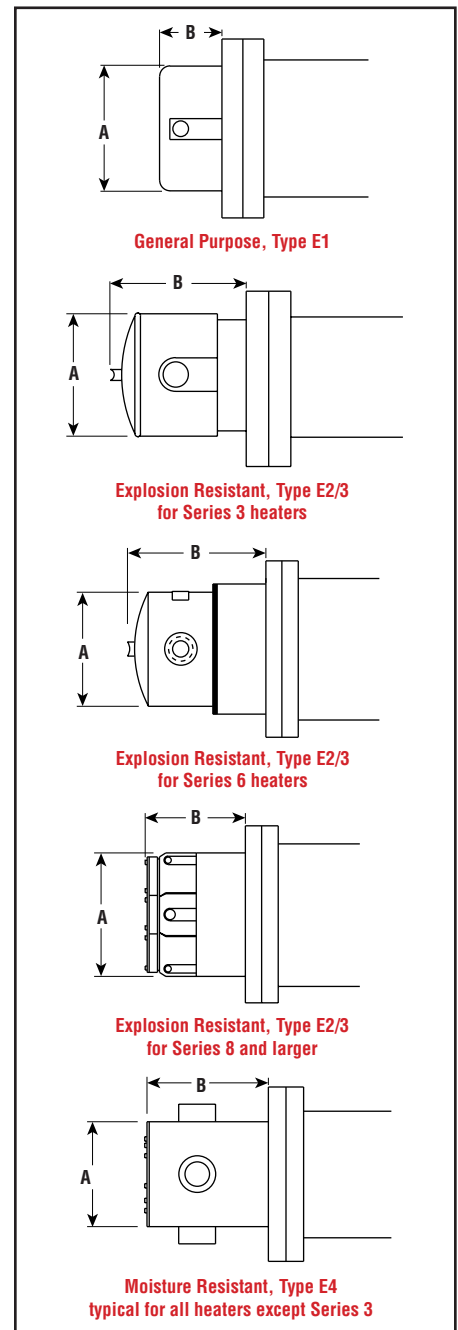
Wiring — The proper use of Type E2 and E3 terminal enclosures on electric heaters located in hazardous areas requires that all electrical wiring comply with National Electrical Code (NEC) requirements for hazardous locations.

Maximum Temperatures — Safe operation in a hazardous location requires the maximum operating temperatures of all exposed surfaces of the heater including temperatures on the outside of the vessel, piping, flanges, screw plugs, enclosures and other heat conducting parts be limited. The maximum surface temperature permitted in any hazardous location is determined by the flammable liquids, vapors or gases present. The end user or purchaser of the electric heating equipment is responsible for determining the proper classification of an area and for providing Chromalox with hazardous area specifications and requirements for proper equipment design. (NEC Articles 500 and 501 provide guidelines for evaluating and classifying hazardous locations.)

Safety Devices — Approved pressure and/or temperature limiting controls must be used on electric heaters and heating elements to ensure safe operation in the event of system malfunctions.

Note 1 — Class I Group B locations include Hydrogen gas. These areas require additional conduit seals and thread engagement. Contact your Local Chromalox Sales office for heaters and terminal enclosures suitable for Class I Group B hazardous locations.

Typical Terminal Enclosures



Terminal Enclosure — Dimensions (Inches)

Series	No. Elements	Dimensions (In.)					
		E1 General Purpose		E2/3 Moist./Explos. Resistant		E4 Moisture Resistant	
		A	B	A	B	A	B
3	3	4	3-1/2	4-1/4	5-3/8	4-1/4	5-3/8
6	6	6-11/16	3-1/2	5-3/4	6-15/16	6-3/4	3-9/16
18	18	9-13/16	5-3/8	9-1/2	10	10	5-11/16
27	27	11-3/16	6-9/16	10-1/2	9-1/8	12	5-11/16
36	36	13-3/16	6-9/16	12	9-1/8	12	6-5/16
45	45	15-3/16	6-9/16	14	9-1/8	14	6-5/16
72	72	17-3/16	6-9/16	18	10-1/8	18	7
108	108	19-3/16	7-7/8	20	10-1/8	20	7

Circulation Heaters

Mechanical & Electronic Control Options

- **Wide Range of Mechanical and Electronic Control Options**
- **NEMA 1, 4, 7 and 12 Enclosures**
- **Process Controllers - Integral or Remote with the Sensor in the Heater Thermowell (AR Control) or in the Heater Outlet**
- **High Limit Controllers - Integral or Remote, Sensor in the Heater Thermowell (AR Control) or Welded to Element Sheath**
- **Type J or K Thermocouples (Std.) RTD's and Other Type Thermocouples Available**
- **Mechanical and Electronic Controls can be Combined**
- **Magnetic Contactors for Multiple Circuits and High Amperages**

Applications

Mechanical and Electronic Controls & Thermal Sensors can be provided for all circulation heaters for overtemperature protection for the heater and fluid medium and/or for process control.

Control Selection Guidelines

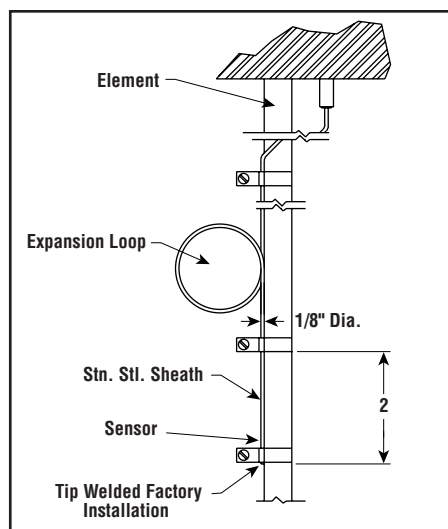
AR Controls — Type AR bulb and capillary controls are standard on many stock heaters with temperature ranges as indicated in the product descriptions. These rugged non-indicating controls are suitable for most applications. Optional temperature ranges are available. Consult the Controls Section for details.

Electronic Controls — Electronic process controls provide greater control accuracy and operating system flexibility than is available with mechanical controls. Consult the Controls Section for details.

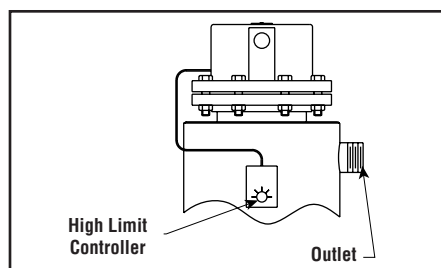
Control Panels — Integral or remote mounted control panels with electronic controls and solid state (SCR) or contactor power controllers can be provided using virtually any combination of control devices. Consult the Controls Section for details.

Overtemperature Protection — De-energizing the heating elements when sheath temperatures exceed recommended limits can prevent element damage and extend the life of the heater. A thermal sensor can be attached to the element sheath for overheat protection. Properly connected to a solid state high limit controller, the sensor will turn the heater off in the event of a low-flow or no-flow condition. Type J thermocouples are recommended for liquid and type K for gas applications.

Remote Mounted Electronic Control

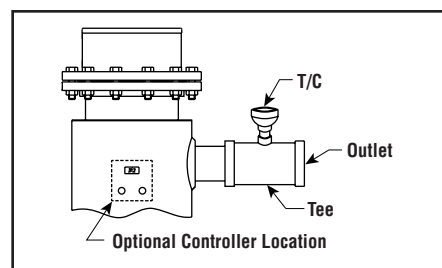


High Limit Controls — Electronic high limit controls can be mounted on the heater chamber with an overheat thermocouple welded to heating element sheath inside the chamber. This arrangement provides protection by shutting down the heater at a predetermined element sheath temperature. Option also available with thermocouple only, welded or clamped to heater element sheath as shown above.



Magnetic Contactors — Heaters utilizing two or more circuits or with amperage draw that exceeds the thermostat rating will require a contactor(s). Contactors are ordered separately and mounted remote from the heater. Consult the Controls Section for details.

Electronic Process Control Thermocouples — Thermal sensors can be mounted in a tee on the heater outlet nozzle. Electronic controller is remote mounted. Option also available with process controller mounted on the heater insulation jacket.



Ordering Information — To order circulation heaters with electronic controls, specify model, volts, kW and provide the following information.

Electronic Control Check List

Overtemperature thermocouple:	Yes / No /
High temperature limit controller:	Yes / No /
Controller Model No.	_____
Mounting:	/ Integral / Remote
Process control thermocouple:	Yes / No /
Type:	_____
Location:	_____
Process controller:	Yes / No /
Controller Model No.	_____
Mounting:	/ Integral / Remote

Assembly Stock Delivery — Where heaters are listed as **Stock (S)** or Assembly Stock (AS), electronic control options are available as assembly stock delivery. When heaters are listed with a standard mechanical Type AR thermostat, the thermostat will be provided on the heater unless otherwise stated.

Note — Circulation heaters with a screw plug header - Series NWHSSMT, NWHMT, NWHMTO and GCHMT are not available as assembly stock with a thermocouple welded to the element sheath.