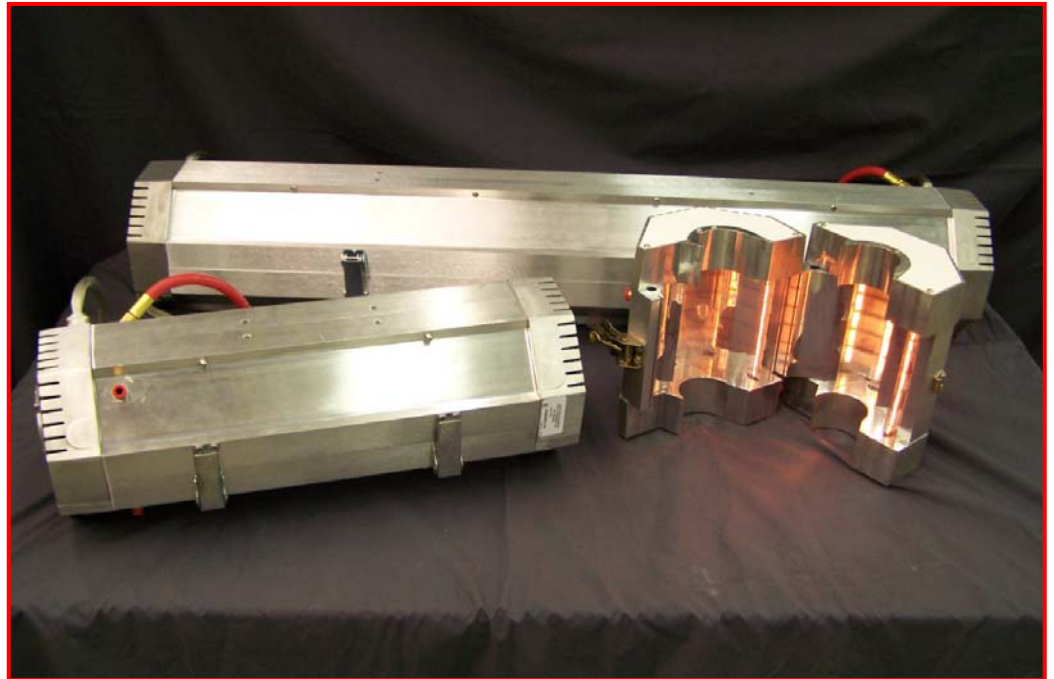




Instruction Manual

E4 ChamberIR Heater



Another quality product from:



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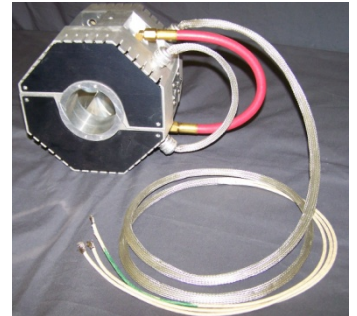
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Section 1

Introduction

The Model E4 elliptical chamber is designed for rapid heating of small size continuous materials such as tube, cable, and wire with an outer diameter from 0.25 to 0.125 inches in diameter. It may also be used as a high temperature furnace in test applications. The E4 is available in seven different lengths. Typical applications for these heaters include:

- Curing small-diameter silicone tubing
- Re-glossing small-diameter plastic tubing
- Burning lubricant off extruded wire
- Curing coatings or adhesives on wire or cable
- Drying water from wire or cable
- Preheat wire or cable



Description

The Model E4 focuses high-density infrared energy, generated by 'T3-style', halogen lamps, onto a cylindrically shaped target area. The heater is hinged so it can open and close in a clamshell style, for easy access.

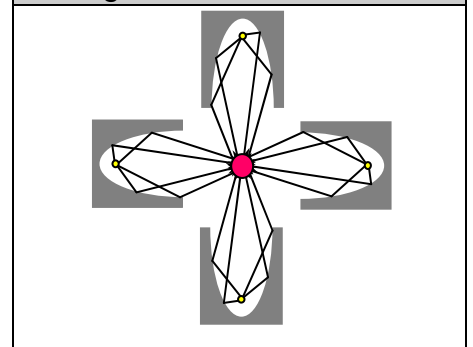
Reflectors

Four elliptical reflectors (see Figure 1) focus the infrared energy supplied by T3 lamps toward the heater center axis. The reflectors are constructed from aluminum polished to a specular finish and are available in heated lengths of 2, 5, 6, 10, 16, 25, and 38 inches (51, 127, 152, 254, 406, 635, and 965 mm).

Lamps

Included are four high intensity, short wave, 'T3-style', infrared lamps. The tungsten emitter in the lamps has an operating temperature of 2500 °K with a spectral energy peak wavelength of 1.15 microns. Each Model E4 requires four lamps to operate. The lamps are included with the Model E4.

Figure 1: E4 Reflector Configuration



Water Cooling

The Model E4 requires an external water-cooling supply to cool the reflectors. Refer to table 1 for flow rates depending upon model.

Benefits

Fast

T3 lamps heat up and cool down instantly in response to power control signals. They reach 90 percent of full operating temperature within three seconds from a cold start. The radiant energy

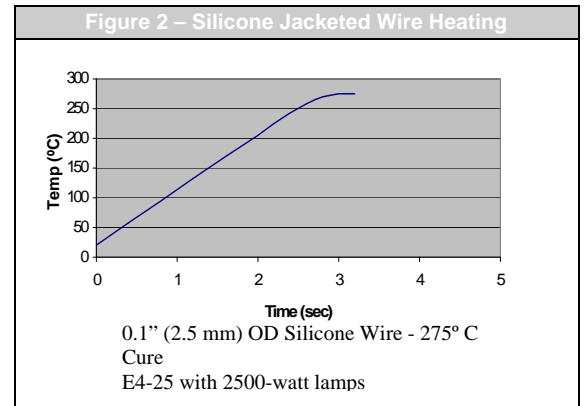
dissipates to ten percent within five seconds after power is removed. The instant on/off feature offers a great number of benefits to the user including reduced warm up and cool down times.

Focused -

T3 lamps have a small filament, which allows the energy to be focused towards a target. By focusing the IR, the concentration of heat is greatly increased, which allows small targets to see more thermal energy and allows higher process line speeds.

Controlled -

The ability to control the direction of the infrared heat, along with rapid response, allows higher heat transfer rates than with other infrared and convection systems. Figure 2 shows the heating of a silicone-jacketed wire. Using an E4, the wire is heated to curing temperature in several seconds, as compared to 2 to 5 times longer with other systems.



Applications

Low Temperature Applications-

Most pre- and post- plastics and rubber extrusion applications are low temperature (under 400 °C). Under these conditions, it is only necessary to provide water-cooling to the reflectors to allow the heaters to run continuously. The recommended maximum product diameter in these applications is 0.25 inch (6 mm). The heater will accommodate product size up to 2.5 inches in OD, however the heating will not be uniform around the circumference if the OD is greater than 0.25 inch (6 mm). Refer to the Model 4069 product data sheet for uniform heating of larger materials.

High Temperature Applications -

The Model E4 may also be operated as a high temperature furnace. Transient product temperatures to 2000°F (1100°C) and continuous product temperatures to 1500°F (815°C) can be achieved with the Model E4. Air-cooling options (A/AA) are recommended if operated in this mode.

Specimen Sizes -

The Chamber will accommodate specimens up to 2.50 inches in diameter. When operating at high heat flux outputs (lamp rated voltage or greater) the specimen should be no less than 1/8th inch in diameter and of a length equal to lamp lighted length, to prevent lamp damage.

Specimen Temperature -

Transient temperature up to 3000°F can be reached and higher specimen temperatures may be reached but at a risk of premature lamp failure. A continuous set point of up to 2000°F may be achieved. Shorter periods at constant temperature apply as specimen approaches maximum. For highest specimen temperatures and heating rates, specimen surface should be blackened to increase the absorptive characteristics.

Section 2

Specifications

General –

Refer to the table 2-1 below for general specifications and ratings on the various models of E4.

Table 2-1						
Model No:	E4-2		E4-5	E4-6	E4-10	
Weight (lbs)	13		18	22	27	
Lamp P/N	057550-002	057550-003	057541-001	057550-004	057544-002	057544-005
Lighted Length (in)	2.37		5.0	6.75	10.00	
Lamp Rated Voltage	120	120	120	240	240	240
Current (Amps)	16.67	33.33	16.67	25.00	16.67	33.33
Rated Power (KW)	2.0	4.0	2.0	6.0	4.0	8.0
Water Flow (gpm)	.25	.49	.25	.74	.49	.98
Operating Voltage	240	240	240	240	240	240

Model No:	E4-16		E4-25		E4-38
Weight (lbs)	38		54		77
Lamp P/N	057541-004	057541-008*	057549-001	057544-008*	057549-002
Lighted Length (in)	16.0		25.0		38.0
Lamp Rated Voltage	240	240	480	600	570
Current (Amps)	26.67	50.0	20.83	33.33 (29.55 @ 480V)	26.67 (24.30 @ 480V)
Rated Power (KW)	6.4	12.0	10.0	20.0 (14.18 @ 480V)	15.2 (11.67 @ 480V)
Water Flow (gpm)	.79	1.47	1.23	1.74	1.43
Operating Voltage	240	240	480	480	480

* Indicates Horizontal Operation Only

Options and Accessories

Lamps -

Lamps for the Model E4 are included with the heater. Table 2-2 displays available lamps for replacement ordering.

Table 2-2: Lamps				
Model (P/N)	Heated Length	Volts	Watts	Lamp Description
057550-002	2 Inches	120	500	Q500T3/CL
057550-003	2 Inches	120	1000	Q1000T3/4CL (*)
057541-001	5 Inches	120	500	500T3/CL (*)
057550-004	6 Inches	120	1500	Q1500T3/CL (*)
057544-002	10 Inches	240	1000	1000/T3/2CL/HT
057544-005	10 Inches	240	2000	2000/T3/CL/HT (*)
057541-004	16 Inches	240	1600	1600T3/CL
057541-008	16 Inches	240	3000	3000T3/CL (*) (**)
057541-005	25 Inches	480	2500	2500T3/CL (**)
057549-001	25 Inches	480	2500	2500T3/VB/CL (*)
057544-008	25 Inches	600	5000	5MT3/1CL/HT (**)
057541-006	38 Inches	570	3800	3800T3/CL (**)
057549-002	38 Inches	570	3800	3800T3/VB/CL (*)

(*) Standard lamp that ships in heater

(**) Lamps are for Horizontal Operation Only

Quartz Liner -

A quartz liner can be provided to protect the reflectors in the heater from contaminants, to maintain the reflectors at their maximum efficiency. It has a 2.24 inch (57 mm) outer diameter and a 2.09 inch (53 mm) inner diameter.

Observation Window -

A 0.5 inch diameter window (W) with a quartz cover can be provided in the center of the chamber side wall, to permit product viewing. With the quartz cover removed, product temperature can be measured with a suitable optical pyrometer. The observation window is not available on models ordered with four purging ports. See Figure 3 for Window placement.

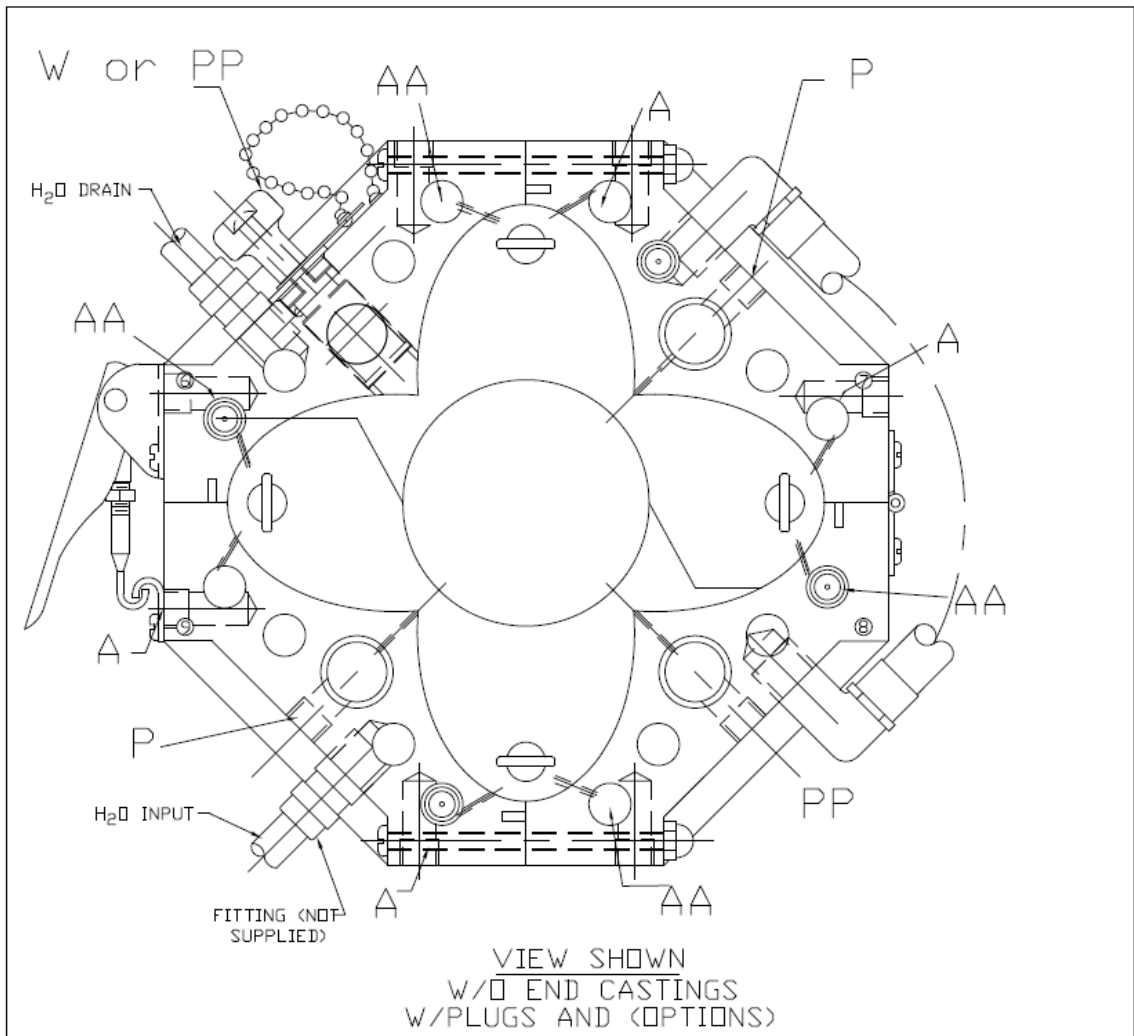
Purging Ports -

Purging ports can be provided on two (P) or four (PP) opposing sides of the chamber wall. This feature allows the heating environment to be force-cooled or inert gas-purged. Purging ports will not function with a quartz liner installed. See Figure 3 for purge port placement.

Air Cooling -

Cooling ports provide added cooling to enhance lamp life. Four (A) or eight (AA) air-cooling ports can be provided along the length of the lamps. Clean, dry shop air should be used with the air-cooling ports. See Figure 3 for air cooling port placement.

Figure 3 Option Location



Option Codes (additional machining required)	
A	Four port Air Cooling (lamp cooling)
AA	Eight port Air Cooling (lamp cooling)
P	Two port purge (process cooling/atmosphere)
PP	Four port purge (process cooling/atmosphere)
W	Observation Window (Pyrometer port, ½" diameter)

Safety

General

The E4 ChamberIR Heater is designed for safe operation. Nevertheless, installation, maintenance and operation of the heater can be dangerous for a careless operator or maintenance person. For your safety and the safety of others, please read the instructions in this INSTRUCTION MANUAL and follow these safety practices that will help to prevent accident or injury.

Infrared Radiation -

!CAUTION!

Continuous exposure to high intensity infrared radiation at close proximity could be harmful to eyes or skin. Although infrared lamps are not emitting ultra violet electromagnetic radiation, harmful burns could still result if an operator is in close contact with lamps being operated at high intensity.

Because of the brilliant light emitted by infrared lamps at full intensity, it is recommended that the eyes be shielded from the glare if observing the lamps or radiant heat chamber for an extended period of time. Use suitable shaded lenses or dark glasses.

High Temperatures -

Parts of the heater may exceed 500°F (260°C). Contact with the lamps, reflectors, or metal parts near the lamps may cause severe BURNS.

!WARNING!

NEVER place hands under the heating elements.

ALWAYS allow heating element to cool at least 5 minutes before touching the lamps or adjacent parts.

Electrical Safety -

There is danger of electrical shock when servicing the heater.

!CAUTION!

Observe that all applicable local and national electrical codes are met and a safe electrical ground system is installed before attempting to operate the heater. Refer to the Section 4 for proper installation procedures.

ALWAYS disconnect the external power lines prior to servicing the heater.
ALWAYS disconnect the power lines **AND** any optional interlock circuits before installing or changing lamps.
NEVER operate the heater with the heater end covers removed.

Fire Safety -

1. Obey the same fire-safety rules you observe when you work with hot plates, high intensity infrared heaters, propane or acetylene torches, soldering irons, and other equipment that operates at high temperatures.
2. Remove all solids, liquids, and gases that burn easily from the area around the heater.
3. Know where the nearest fire extinguisher is located and how to use it.
4. Know how to put out fire from all the types of material near the Model E4 Heater.

Section 4

Installation

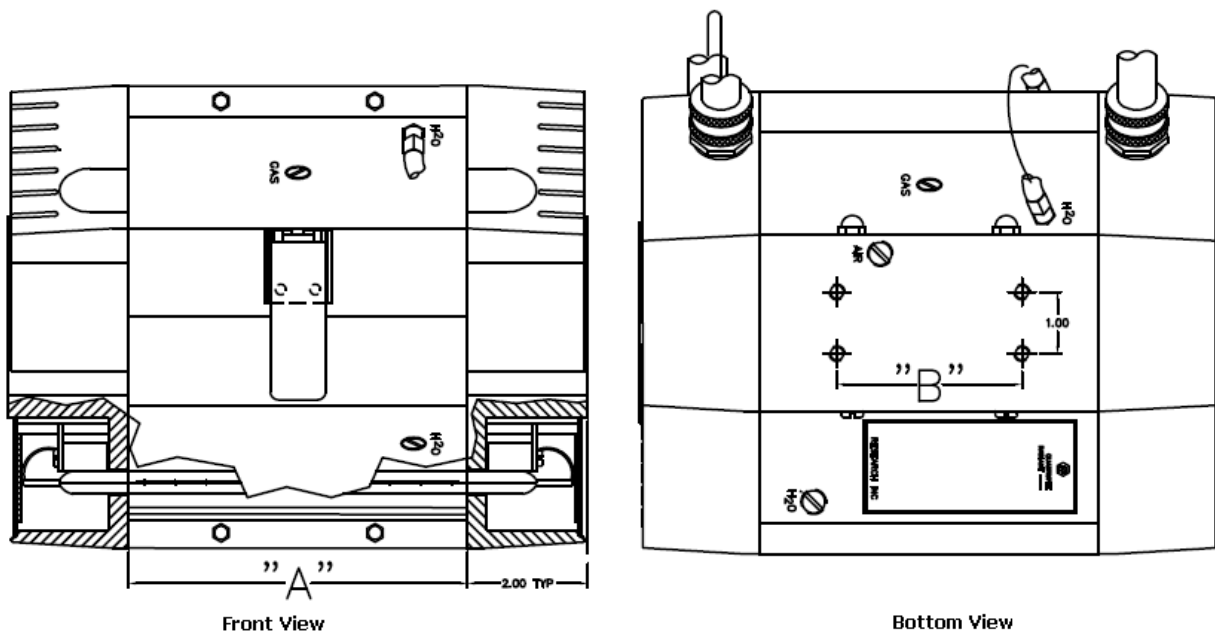
The following paragraphs describe mounting information, power connections, cooling water connections and lamp installation.

Mounting Information -

Fasten the Model E4 to a sturdy support bracket via the 4 ¼-20NC x .37 inch deep threaded holes on the side of the reflector block. Center the unit so that specimens will be located in the focal axis. Physical dimensions for all units are listed in table 4-1, Dimensions A and B.

Model Number	Dimension A (inches)	Dimension B (inches)
E4-2	2.50	---
E4-5	5.50	3.0
E4-6	7.40	3.0
E4-10	10.50	5.0
E4-16	16.50 </td <td>5.0</td>	5.0
E4-25	25.50	5.0

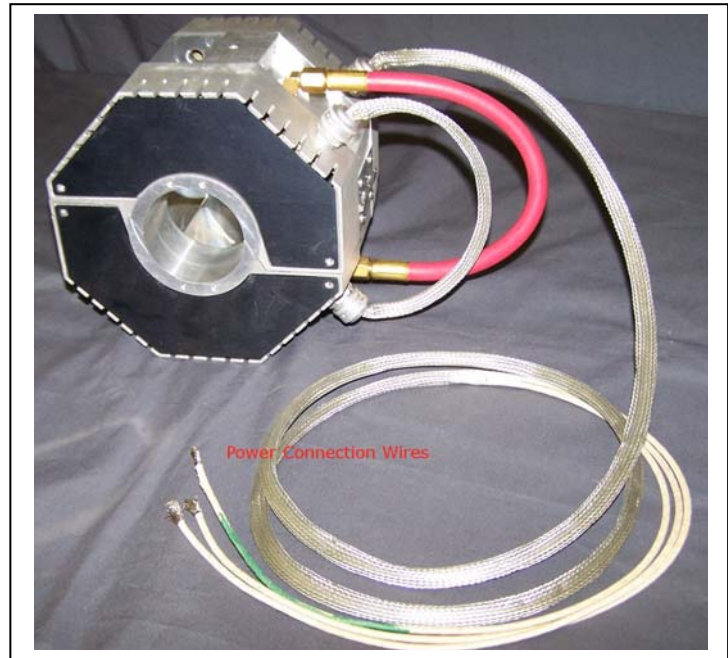
Note: The E4-02 has only two ¼-20 x .37 holes that are 1" apart, centered 1.25" from the edge of the reflector



Power Connection -

Power connections to the heater are made using the attached power cord as shown in figure 4-1 below.

Figure 4-1



Connect power according to the appropriate circuit diagram shown in figure 4-2, using the appropriate voltage rating as listed in specification table 2-1.

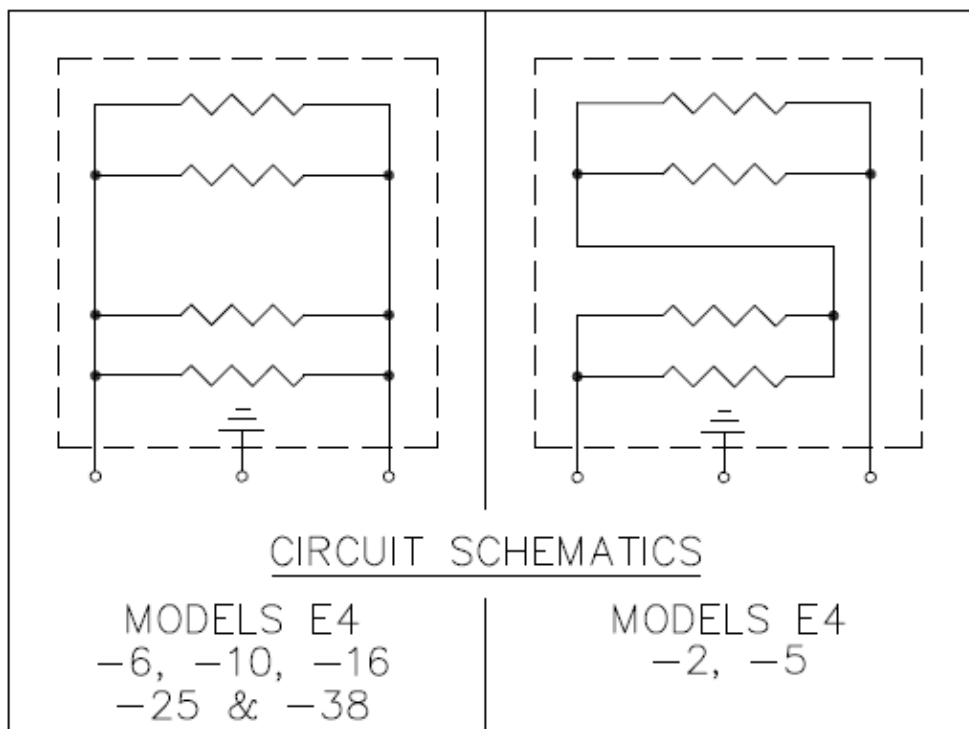


Figure 4-2

Cooling Water Connections -

1/8" NPT tapped holes are provided for lamp reflector cooling water connections. Clean water at 100°F maximum, less than 100 psi must be supplied to the unit, at flow rates indicated in specification table 2-1 for the appropriate sized Model E4 heater. Deionized water is preferred

Connect cooling water lines to water inlet and outlet ports such that water flows thru both halves of the unit at minimum flow rates given in specification table 2-1.

!CAUTION!

Cooling Water exit temperatures not to exceed 150° F

NOTE

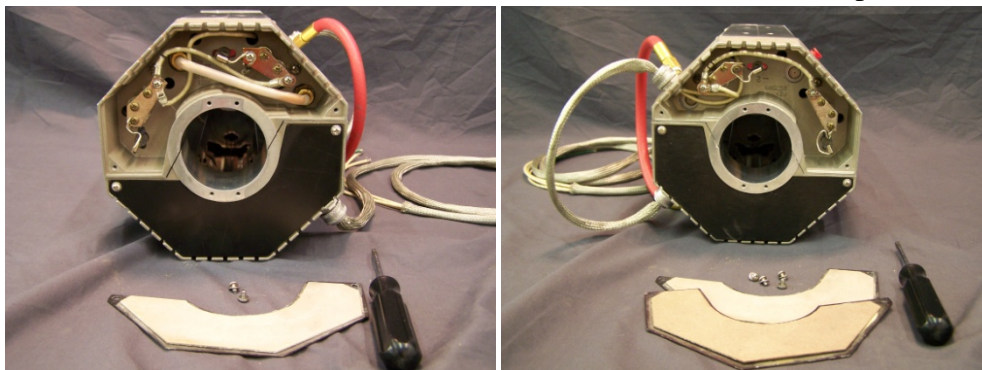
Cooling Flow is optional during short/ transient heating tests where reflector body temperatures will not exceed 350°F

Lamp Installation (E4-5, 10, 16, 25 and 38)

NOTE

The 2000 watt per inch lamps (2000T3 and 5MT3) should be used for intermittent operation only with 50% duty cycle at rated voltage and a maximum on-time of three minutes, or if it is determined that the exit water temperature remains at 150°F or less during experimental runs, higher duty cycles or maximum on-times may be increased accordingly. At no time should the reflector body exceed 350°F.

1. Remove power to the heater. **Turning down the voltage to 0 VAC on a SCR controller does not remove power from the lamps.**
2. Remove both covers for the heater half that has the burned out lamp.



3. **With a volt meter check to insure voltage is removed from the heater.**
4. Loosen the screws on the bus bar that the lamp lead wires are wrapped around and remove wires from the screws.



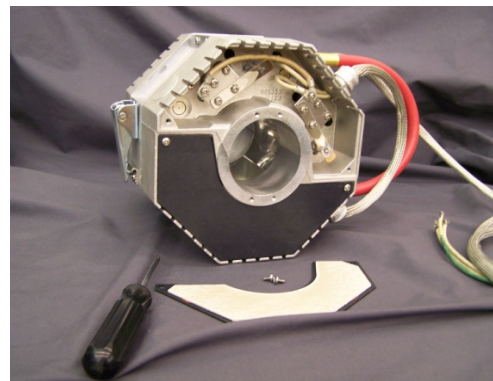
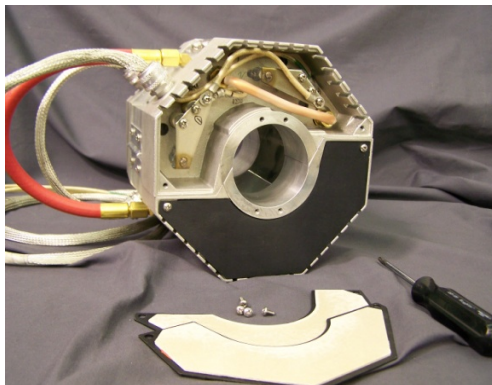
5. Remove the lamp.
6. Install a new lamp and center the lamp in the heater. Wrap the lamp lead wires around the screws as shown in the picture. Tighten bus bar screws and trim off the excess wire.
7. **Using a meter Ohm between the bus bar and ground checking for a short.**
8. Install the lamp end covers.

NOTE:

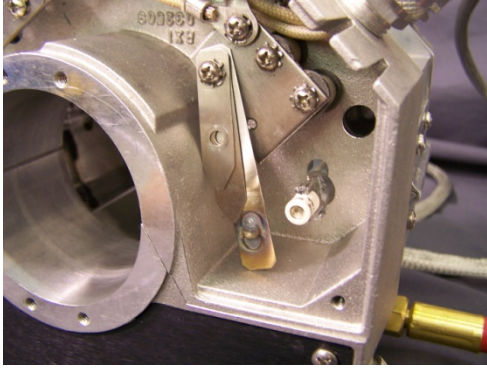
Should lamp surfaces become contaminated with smoke, dust, fingerprints or other foreign material, wipe clean before continuing operation or installation

Lamp Installation (E4-02, -06)

1. Remove power to the heater. **Turning down the voltage to 0 VAC on a SCR controller does not remove power from the lamps.**
2. Remove both covers for the heater half that has the burned out lamp.



3. **With a volt meter check to insure voltage is removed from the heater.**
4. Locate the leaf spring style contact and remove the screw from the leaf spring that is closest to the lamp. Loosen the remaining screw in the leaf spring so that it can be turned out of the way of the lamp.



5. Remove the lamp. Inspect the lamp contact points on both ends of the heater for damage. Replace as needed.
6. Install a new lamp and install the screw removed from the lamp contact in step #2. Tighten both screws.
7. Make sure the metal contacts of the lamp are in contact with the button contacts of the heater.
8. Install the lamp end covers

Operation

General

The following paragraphs describe the general principles of Infrared Heating and the detailed operation procedures for the Model E4 Quad Elliptical Heating Chamber.

Principals of Infrared Heating

General -

Heat energy from a resistance element is transformed into infrared radiant energy at the surface of the heating element. Infrared radiant energy passes through the air (without heating it) to the receiving object where it is absorbed and converted back into heat energy. The receiving object then heats up. (Actually in an infrared installation, the air does heat up, but this is due to convection heating from the work piece, reflector and lamp walls)

A substance ideally transparent to infrared energy converts none of the radiant energy to heat, since the infrared energy passes through the substance. A surface with high infrared absorptance characteristics converts almost all the infrared energy striking it into heat energy. A surface having a low infrared absorptance characteristics reflect most of the radiant energy striking it.

All materials absorb some infrared energy, and usually their absorptivity can be increased by coating the surface with a material which is a good infrared absorber.

Temperature -

Maximum workpiece temperature is dependent on:

1. Heat Input Factors: Radiation to workpiece, area of workpiece being irradiated, and absorptivity of workpiece.
2. Heat Loss Factors: Conduction to unheated masses, convection losses and radiation to non-reflective surface.

Highest workpiece temperatures are attained when heat input factors are high, and heat loss factors are held to a minimum. Overall efficiency is improved by blackening the heated side and insulating the unheated side of the workpiece.

Workpiece -

For highest efficiency, the workpiece should have a dark, non-reflective (high absorptance to infrared energy) surface; The workpiece should be located as close as possible to the focal line of the heater.

Instrumentation -

Workpiece temperature can be monitored by a thermocouple attached directly to the specimen. For measuring temperature on a moving web workpiece an optical pyrometer may be used.

Power Controls -

To control rapid rates in high response application a closed loop temperature controller should be used. To reduce excessive inrush current, always preheat lamp filament for at least ½ second before applying full voltage.

Operating Procedures

The following procedures are used to operate the Model E4 Quad Elliptical Heating chamber.

Warning

Prior to operation, ensure all installation procedures are performed as described in section 4, Installation

1. Unlock hinge fastener and open up unit
2. Center and locate specimen within Heating Chamber opening, and if desired, attach thermocouples to specimen.
3. Close unit and lock hinge fastener
4. Turn on coolant water. Check for leaks and obstructions in coolant flow lines.
5. Select appropriate voltage level on power controller or input power source and switch power to On. (See table 2-1 for input voltage ratings for lamps used in appropriate model E4)
6. Control heating rate for desired time interval and switch power to off.
7. Allow heat to dissipate from heating chamber and specimen, then open unit and remove specimen.
8. Visually inspect lamps and interior reflector surfaces of heating chamber for foreign matter and contamination. Clean (if required) before installing another specimen. (Refer to section 5, Maintenance, for proper cleaning procedures.)

Maximum specimen temperature depends on:

- a) Conduction and convection heat loss
- b) Surface area;
- c) Reflectivity of specimen. Up to 3000°F for short periods, i.e., a few seconds, is permissible where above parameters are relatively small.

Warning

Do not exceed 2000°F continuous specimen setpoint temperatures

Maintenance

Periodic inspection and removal of dirt and contaminants will ensure that equipment can be operated safely.

In dirty environments or heating operations the lamps & reflectors may become contaminated with smoke, dust, fingerprints or other foreign matter. When this occurs it is recommended that the lamp be cleaned. Doing so will extend the life of the lamp and improve the heater's overall performance. Use the following procedure:

!WARNING!

Disconnect the power cable from the power source and allow the heater to cool before continuing.

!CAUTION!

Wear soft, clean, oil-free flannel or plastic gloves when handling quartz lamps. If skin oils come in contact with the quartz tube, the lamp will fail prematurely.

Cleaning Procedures

Lamp Surfaces -

With a soft, dry cloth or tissue, wipe the residue from the lamps. Household strength ammonia can be used to clean the lamps if necessary.

Reflector Surfaces -

With a soft, dry cloth or tissue, wipe the residue from the lamps. Household strength ammonia can be used to clean the lamps if necessary. In the event of high concentrations of contaminants it may be necessary to disassemble the unit, clean, and repolish the reflector surfaces to a specular finish. Contact Research Inc. Service for this.

Exterior Surfaces -

Periodic inspection for dirt and contaminations and a visual check of all water connections to assure they are leak proof, will insure that equipment can be operated safely