



Operation and Maintenance Manual

2" and 3" Resistive Substrate Heaters

Model No. _____

Serial No. _____

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WARNING



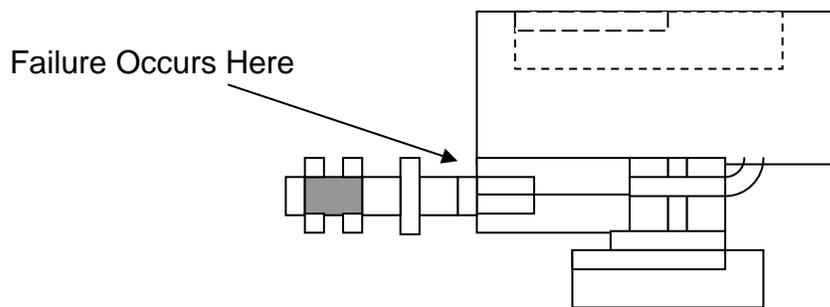
The Maximum Heater Current Limits are:

2" = 10 Amps
3" = 9 Amps

The Maximum Heater Voltage Limits are:

2" = 45 volts DC or AC_{rms}
3" = 85 volts DC or AC_{rms}

Premature failure of the connector block to element wire may occur if the heater is operated with a proportional temperature controller without voltage limit.



Voltage should be limited by the use of a transformer or Variac between the temperature controller and the SCR unit.

Note: Warranty is void if heater is operated without voltage limiting.

TABLE OF CONTENTS

INTRODUCTION	4
PRE-INSTALLATION	4
INSTALLATION	5
OPERATION	9
MAINTENANCE	10
TROUBLESHOOTING	11
SPECIFICATIONS	12
OPERATING DATA	13
DRAWING AND DIMENSIONS	16
REPLACEMENT PARTS	17
ACCESSORIES	18

I. INTRODUCTION

The High Temperature Resistive Substrate Heater is specifically designed to provide stable, uniform heating of substrates during thin film deposition. At the heart of the heater is a resistive coil embedded in a super alloy block. When current is applied, the block can reach temperatures of up to 950°C. This simple design makes the heater quite efficient and durable.

The materials used were carefully chosen for thermal performance, chemical stability, durability, and UHV compatibility. The heater has been successfully used in such processes as sputtering, pulsed laser deposition, and chemical vapor deposition.

This manual contains important information about the installation, operation and maintenance of the heater. In order to insure proper operation, these instructions should be followed carefully.

II. PRE-INSTALLATION

Before installing the heater into your system, it is very important to operate the heater in air at 700°C for a minimum of 1 hour. This produces an oxide passivation layer on the heater block surface; thus preventing any contamination of your system and/or process.

Use a DC or AC power supply (e.g., AC “Variac”, 0-120V) or a temperature controller (e.g., Eurotherm Models 808 controller and 425 SCR). The output of your power source **should not exceed:**

**45V DC or AC_{rms} (typ.) for the 2" heater, or
85V DC or AC_{rms} (typ.) for the 3" heater**

Refer to the heater tag for the correct maximum voltage for your heater. **DO NOT USE 120V LINE VOLTAGE.** If a temperature controller is used, it may be necessary to use a transformer to reduce the output voltage. Some controllers have a voltage limiter that can be adjusted by the user. **ALWAYS MEASURE THE VOLTAGE ACROSS THE HEATER WHILE IT IS IN USE.**

******* CAUTION *******

DO NOT OPERATE 2" HEATER ABOVE 10 AMPS.

DO NOT OPERATE 3" HEATER ABOVE 9 AMPS.

[Back to Table of Contents](#)

III. INSTALLATION

When installing the heater, it is important to determine what type of equipment will be in close proximity to it. Even though many applications are performed under vacuum (where heat transfer is reduced), radiated heat can affect water temperatures, magnets, or soft metals, etc.

It is important that the heater, especially the electrical contact posts, be isolated from electrically conductive parts of the system to prevent arcing and possible destruction of the heater. Keep at least 1" of space around the heater at all times.

Place the mounting bracket on the mounting plate or surface that has the same bolt circle as the bracket (see Figure 1 for typical installation, and Figure 2 for bolt circle dimensions). It is important that the open end of the mounting bracket be facing upward. Slip the "T" shaped mounting foot on the bottom of the heater into the mounting bracket.

A sheathed type K thermocouple (Omega P/N CHAL-010) or unsheathed type S thermocouple (Omega P/N P10R-010) should be used. If the sheathed type K thermocouple is used, strip the non-thermocouple end to expose the leads. For both thermocouple types, attach the leads to your feedthrough (your feedthrough must be the same type materials as your thermocouple wires). Be sure to cover all exposed areas of the leads with ceramic beads. Place the thermocouple as far into the hole on the side of the heater block as it will go. Position the heater so the thermocouple will not fall out.

Power leads must be vacuum grade nickel or OFHC copper wire, with a minimum diameter of 0.050". Cover all exposed wire within the vacuum system with ceramic (alumina) beads. Connect the leads to the heater's contact post using connectors. Connect the other ends in your power feedthrough in the same manner.

**POWER CONNECTIONS SHOULD BE CHECKED REGULARLY
TO ASSURE TIGHTNESS**

[Back to Table of Contents](#)

IMPORTANT

Install a 12 amp in-line fuse between the power supply output and the electrical feedthrough. This will prevent damage to the heater due to a broken thermocouple, a malfunctioning temperature controller, or a power surge.

Use a DC or AC power supply (e.g., AC “Variac”, 0-120V) or a temperature controller (e.g., Eurotherm Models 808 controller and 425 SCR). The output of your power source **should not exceed**:

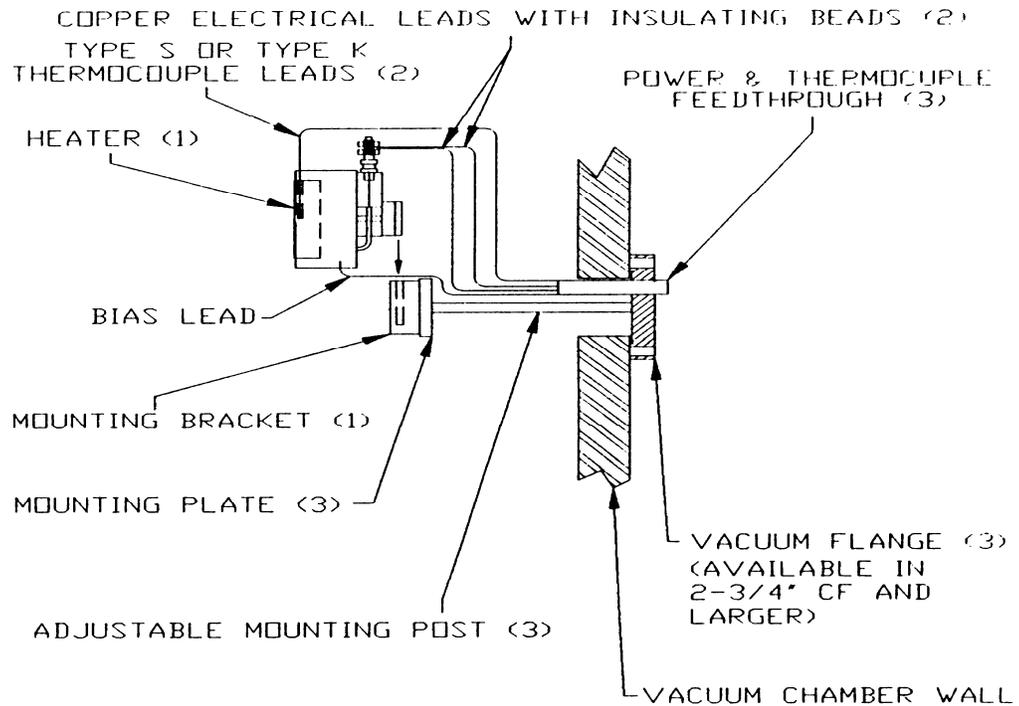
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ALWAYS MEASURE THE VOLTAGE ACROSS THE HEATER WHILE IT IS IN USE

[Back to Table of Contents](#)

FIGURE 1 - TYPICAL INSTALLATION DIAGRAM



(1) HEATER AND MOUNTING BRACKETS, P/N SU-200
OR SU-300

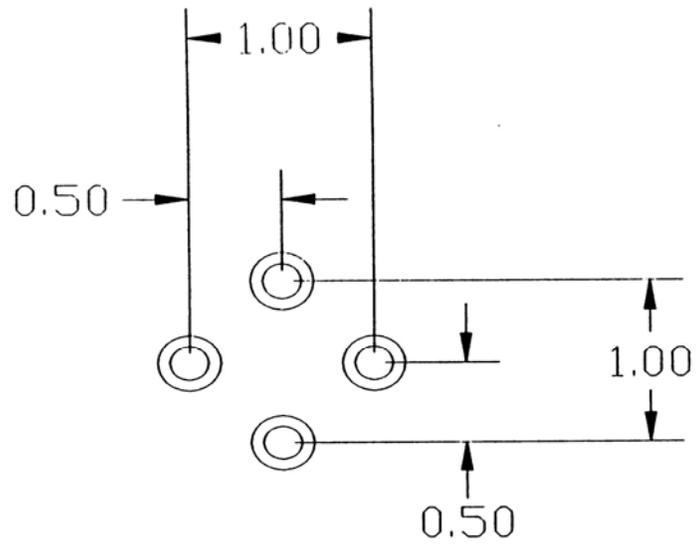
(2) 18" HOOK-UP KIT, P/N SU-918-S, SU-918-Y

(3) FEEDTHROUGH MOUNTING STAND, P/N SU-905
OR SU-925

[Back to Table of Contents](#)

FIGURE 2 - BOLT CIRCLE DIMENSIONS
(SAME FOR 2' AND 3' HEATER)

COUNTER BORED FOR 10-32
SOCKET HEAD CAP SCREWS (4)



(DIMENSIONS IN INCHES)

[Back to Table of Contents](#)

IV. OPERATION

After initial burn-in, the unit can be turned up to full power instantaneously. During operation, it is important to remember not to exceed the typical operating specifications.

2" Heater - 10 Amps, 45 Volts max.

3" Heater - 9 Amps, 85 Volts max.

Refer to the heater tag for the exact power specifications used during final test.

SILVER PASTING SMALL (<0.5 in²) SUBSTRATES

1. Apply silver paste (US Silver Paste for substrate mounting, P/N SU-900-AGP) to the substrate heater block over an area slightly less than the size of the substrate.
2. Place substrate on top of the silver paste.
3. With a pair of plastic tweezers, gently press on the substrate and move in an even circular motion until it is completely surrounded by the paste.

NOTE:

It is better to use too much silver paste than too little. Excessive paste can simply be spread over a larger area (making sure that it does not leach over the edge of the substrate). Too little paste will usually result in areas of poor thermal contact.

Small area (e.g., 0.25 in²) substrates are much easier to silver paste than larger substrates. If a larger substrate is poorly silver pasted, it will usually be poorly contacted at its corners/edges.

Heat substrates at 5° C/min. to 300° C in air. Substrates can then be placed under vacuum and brought up to deposition temperature at 30° C/min.

SUBSTRATE REMOVAL

Carefully push a sharp razor blade under the flat edges of the substrate (not under the corners). A gentle side-to-side motion will allow the blade to penetrate further and further under the substrate until it pops off. Work all sides of the substrate if possible. Be patient!!

[Back to Table of Contents](#)

SUBSTRATE HEATER CLEANING

1. Scrape residual silver paste off with a razor blade.
2. Wipe off loose particles with a clean room wiper and isopropyl alcohol.
3. Blow heater dry with N₂, or clean dry

NOTE:

*The heater can be more completely cleaned with a “Scotch Brite” abrasive pad or by bead blasting. However, either method will remove the heater’s oxide passivation layer (see Section, **Pre-Installation**), and the heater will need to be baked at 700° C in air for 30 minutes before further use. We recommend aggressive cleaning only if absolutely necessary.*

V. MAINTENANCE

Due to repeated thermal cycling, occasionally it may be necessary to tighten the heater’s screws, especially the assembly screws to the ceramic standoffs. To avoid damaging the ceramic standoffs, **do not** over-tighten the screws.

Excess deposited material can be removed with a razor blade. All deposited materials can be removed with a plastic metal finishing pad (“Scotch-Brite”). A metal finishing pad will also remove the heater block’s oxide passivation layer (see **Substrate Heater Cleaning** and **Pre-Installation** passivation directions).

If necessary, the heater may be degreased in 1,1,1 trichloroethane or methanol.

[Back to Table of Contents](#)

VI. TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE
1. Slight temperature drop during process as material is deposited.	<ul style="list-style-type: none">▪ Emissivity of heater is changing increase power slightly.
2. Heater needs significantly more power to achieve temperature, or fails to heat up at all.	<ul style="list-style-type: none">▪ Loose power connections.▪ Clean and re-tighten connections -or-▪ Power leads crossed or short-circuited to conductive parts of system. Increase space around heater.
3. Heater fails during the deposition process.	<ul style="list-style-type: none">▪ Power supply not functioning -or-▪ Heater damaged. Test the resistance between contact posts. It should be approximately 10 ohms for the 4-inch and should not change significantly with time or temperature.▪ Test the resistance between the contact posts and the substrate platter, and between the contact posts and the mounting bracket. They should be at least one mega-ohm.

[Back to Table of Contents](#)

VII. SPECIFICATIONS

		2"	3"
1)	Maximum Temperature	950°C	950°C
2)	Temperature Stability	±2%	±2%
3)	Temperature Uniformity (Center circle diameter)	±4°C 1.25"	±8°C 2.25"
4)	Maximum Voltage	60 Volts	90 Volts
5)	Maximum Current	10 amps	9 amps
6)	Heater Resistance (typical)	5 ohm	10 ohm
7)	Power Supply	AC/DC	AC/DC
8)	Ramp Time to 750°C (in atmosphere)	4 Min.	5 Min.
9)	Ramp Time to 950°C (in atmosphere)	12 Min.	13 Min.
10)	Cool-Down Time (950°C to room temp., 1 atm pressure)	35 Min.	45 Min.
11)	UHV Compatibility	Yes	Yes
12)	Electrical Biasing	Yes	Yes

Back to Table of Contents

VIII. OPERATING DATA

Typical power, voltage, and current versus temperature data (in air).

FIGURE 3
2" HEATER POWER VS TEMPERATURE
TYPICAL IN AIR

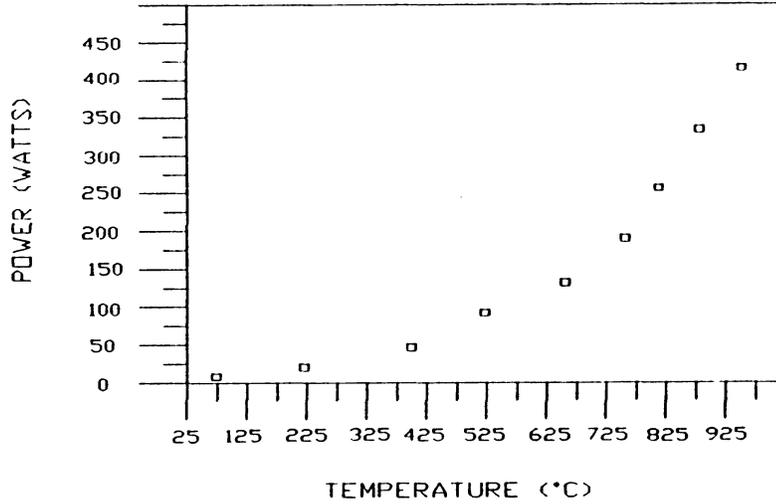
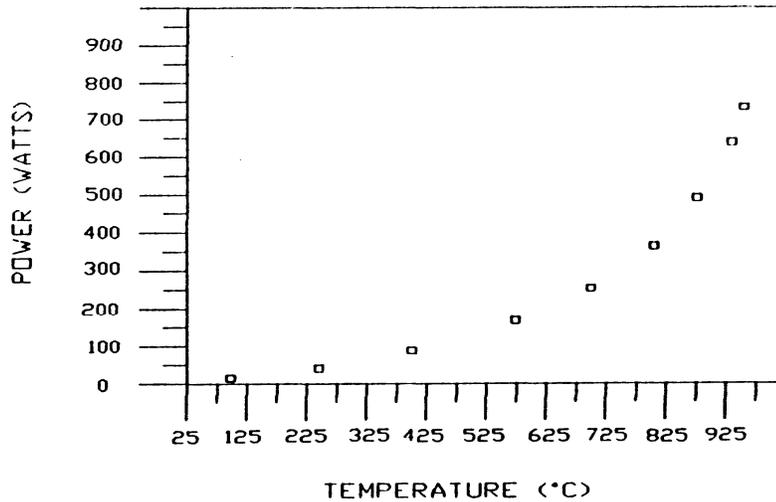


FIGURE 4
3" HEATER POWER VS TEMPERATURE
TYPICAL IN AIR



[Back to Table of Contents](#)

FIGURE 5
2' HEATER VOLTAGE VS TEMPERATURE
TYPICAL IN AIR

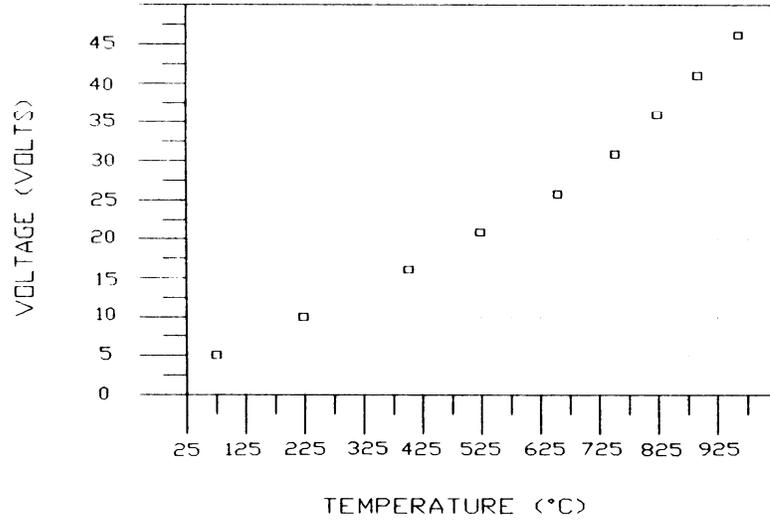
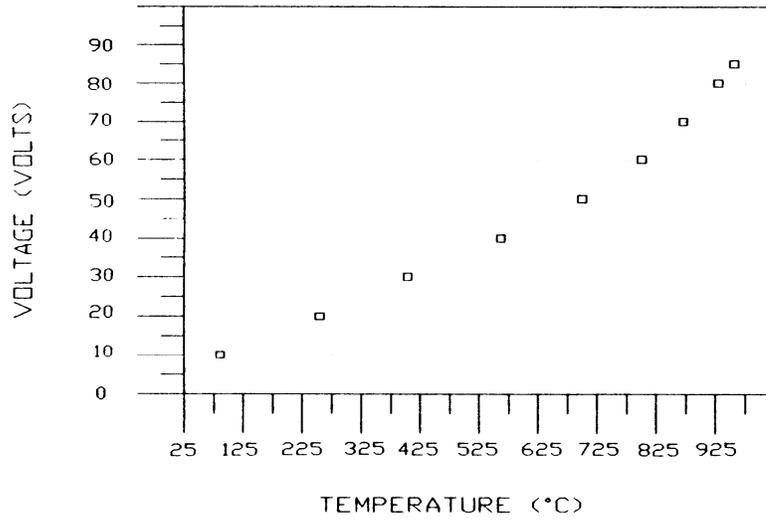


FIGURE 6
3' HEATER VOLTAGE VS TEMPERATURE
TYPICAL IN AIR



[Back to Table of Contents](#)

FIGURE 7
2" HEATER CURRENT VS TEMPERATURE
TYPICAL IN AIR

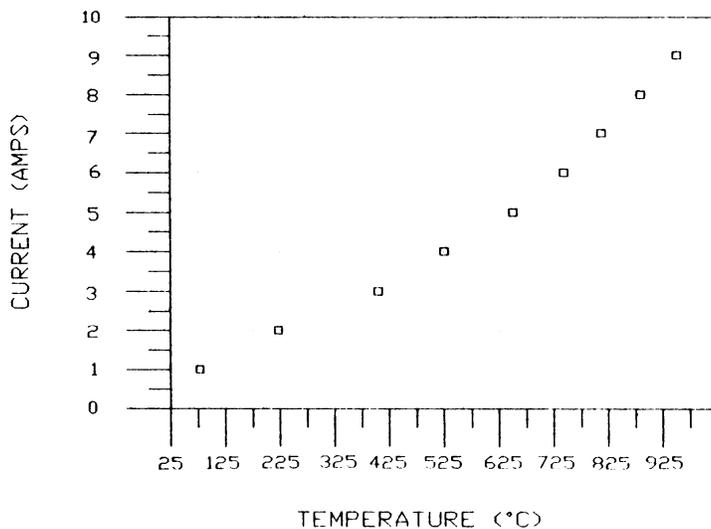
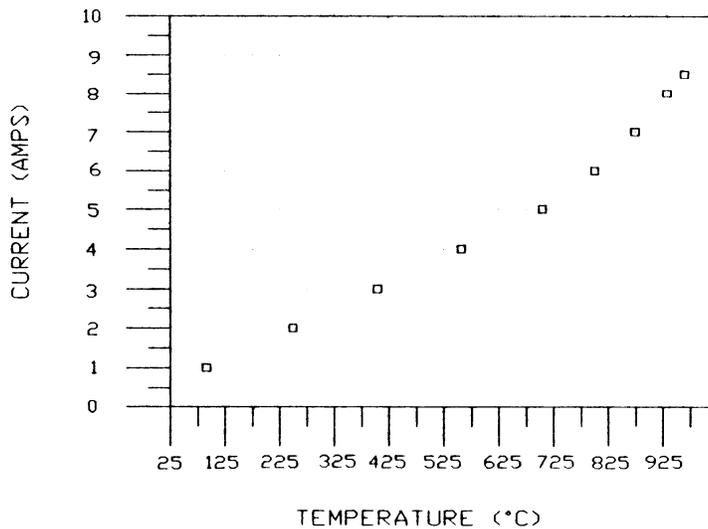
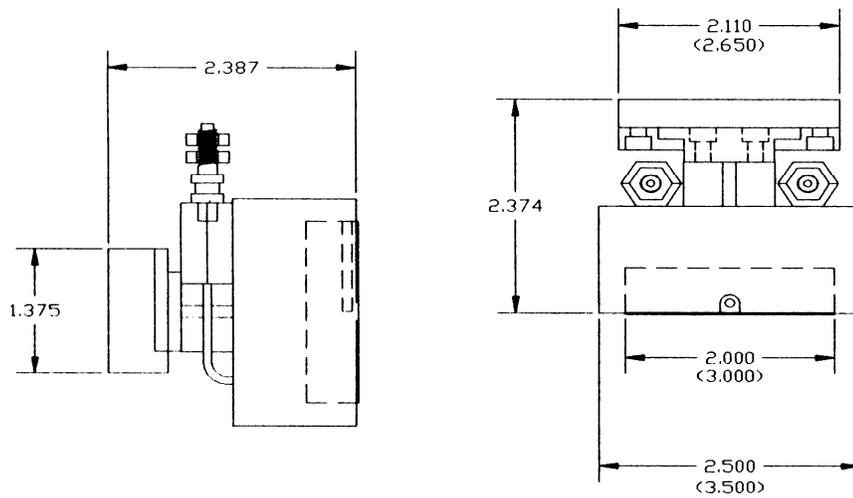
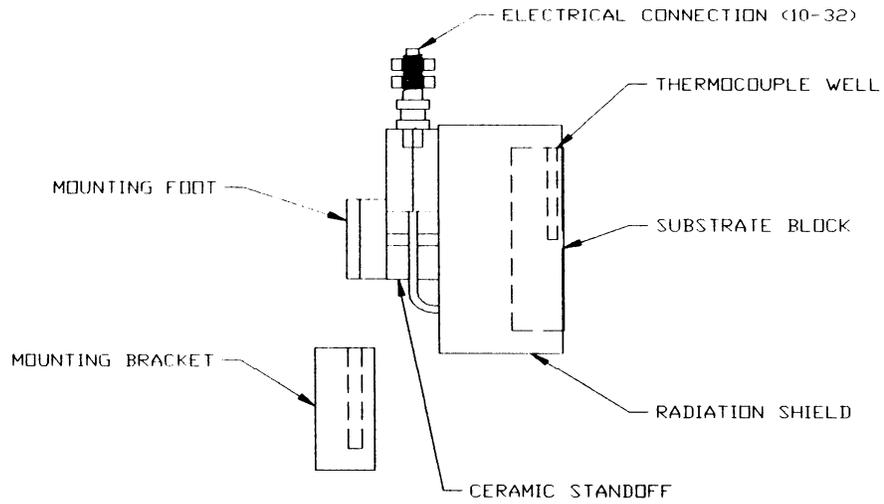


FIGURE 8
3" HEATER CURRENT VS TEMPERATURE
TYPICAL IN AIR



[Back to Table of Contents](#)

IX. DRAWINGS AND DIMENSIONS

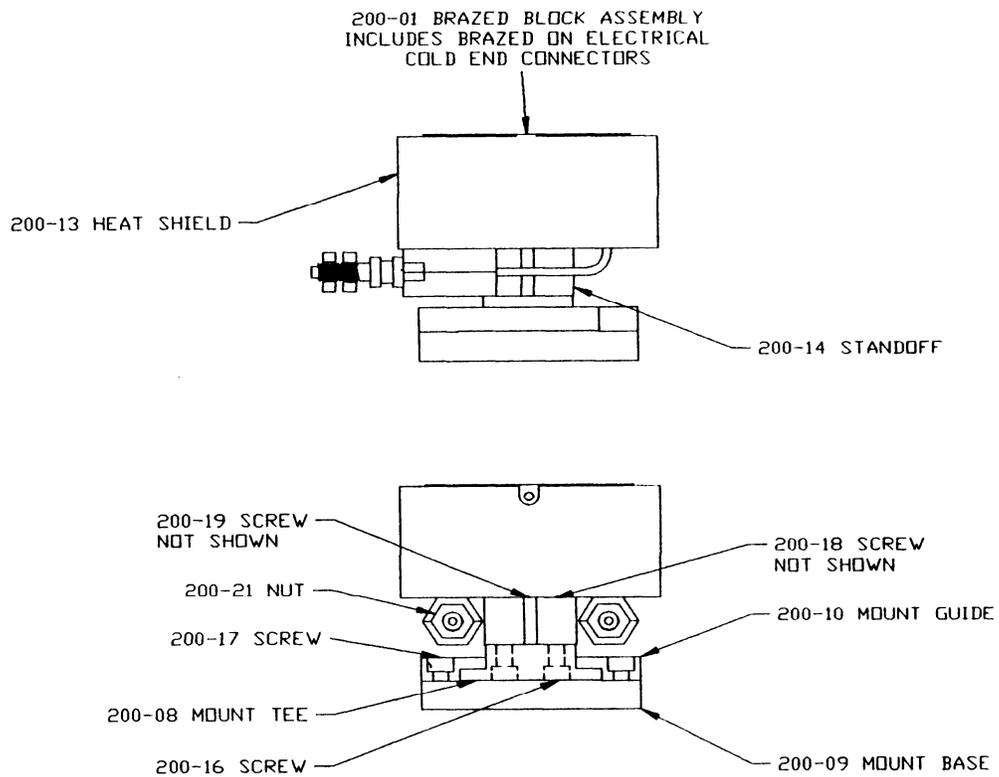


2" HEATER DIMENSION APPEARS FIRST
 3" HEATER DIMENSION APPEARS (X.XXX)

[Back to Table of Contents](#)

X. REPLACEMENT PARTS

HEATER ASSEMBLY C REVISION PARTS CALLOUT



NOTE: 2" PART NUMBERS ARE SHOWN, FOR
3" PART NUMBERS, CHANGE PREFIX 200 TO 300

[Back to Table of Contents](#)

ACCESSORIES

<u>Part Number</u>	<u>Description</u>
SU-900-AGP	Silver Paste for substrate mounting (SU-200-HH and SU-300-HH ONLY)
SU-905-275	Mounting Feedthrough attached to a 2.75" Con-Flat® flange
SU-905-450	Mounting Feedthrough attached to a 4.50" Con-Flat® flange
SU-905-600	Mounting Feedthrough attached to a 6.00" Con-Flat® flange
SU-1018-K	18" Hook-up kit with type "K" TC wire
SU-1018-S	18" Hook-up kit with type "S" TC wire
1921-2643-0	Ceramic Standoffs for 2" & 3" Substrate Heaters (set of 4 each)
SU-925-275	Deluxe Mounting Feedthrough attached to a 2.75" Con-Flat® flange
SU-925-450	Deluxe Mounting Feedthrough attached to a 4.50" Con-Flat® flange
SU-925-600	Deluxe Mounting Feedthrough attached to a 6.00" Con-Flat® flange

Please call Meivac, Inc. at (408) 362-1000 for price and delivery

[Back to Table of Contents](#)