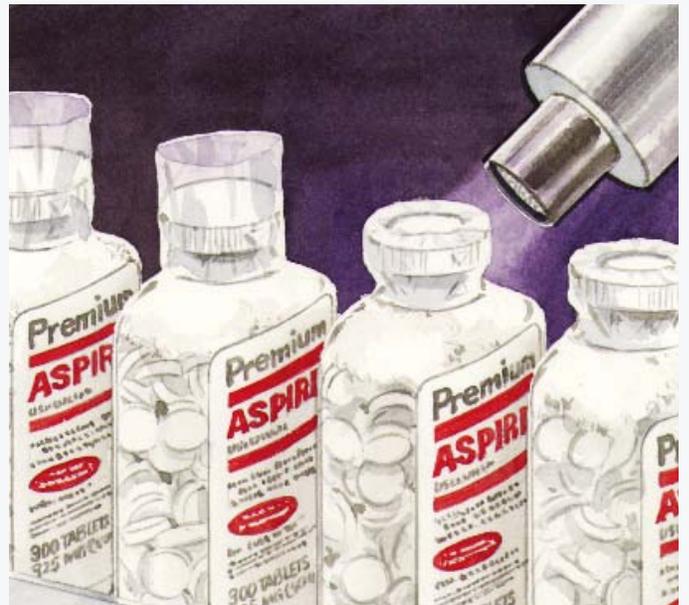
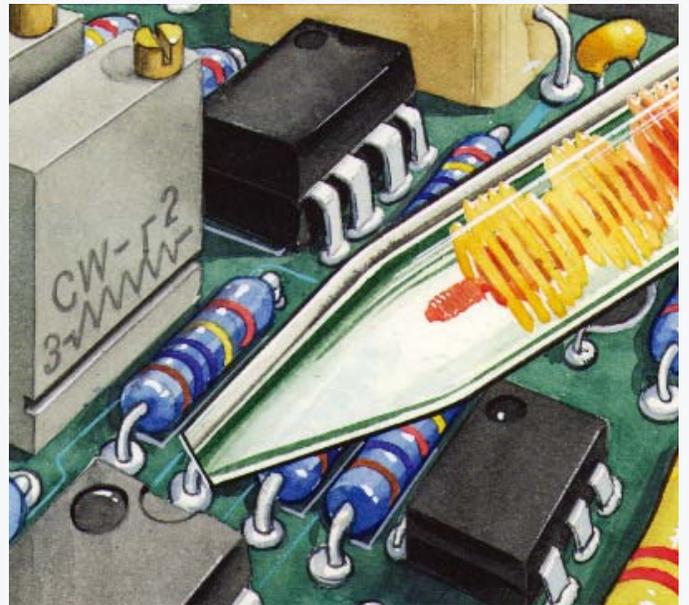
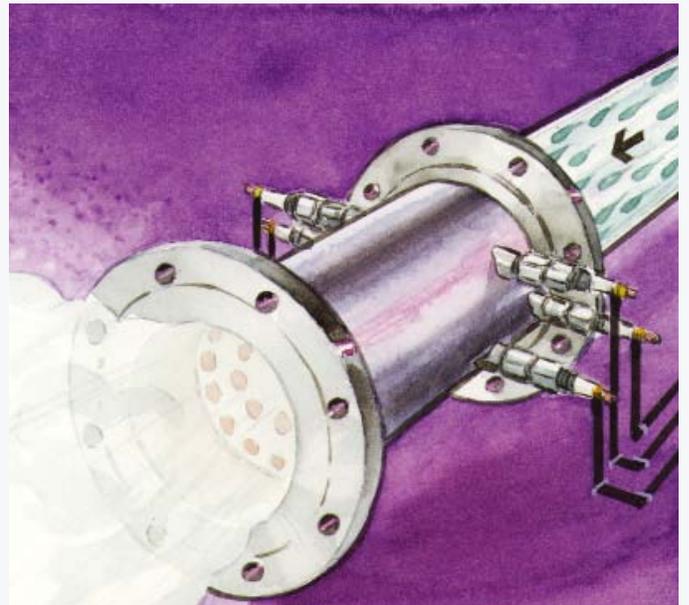
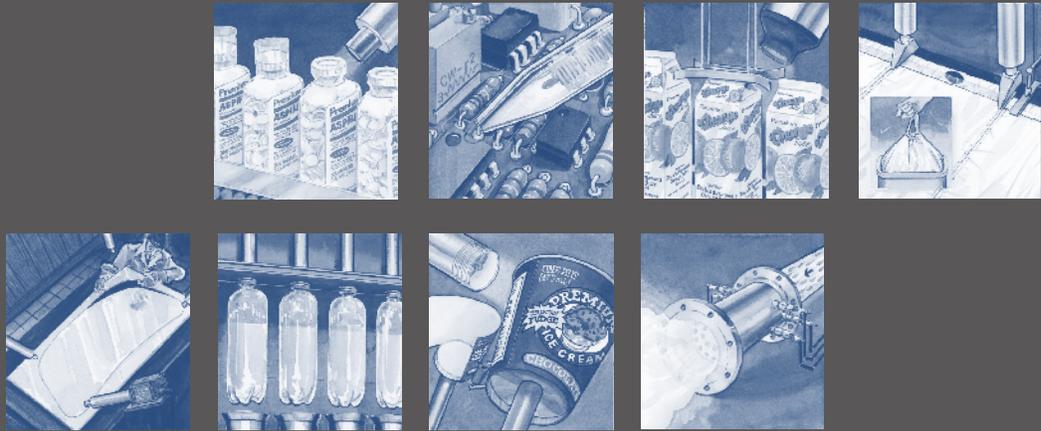




# Air Heaters





# Applications

## Food Service:

- Drying of wheat and red bean

## Packaging:

- High-speed, poly-coated paperboard sealing
- High-speed, heat-shrink installations
- Forming
- Curing adhesives
- Sterilizing bottles or cartons

## Automotive:

- Hot air bonding of body panels
- Curing adhesives
- Vacuum forming
- Simulation of engine exhaust
- Fuel cell testing

## Plastics/Rubber:

- Salt removal from rubber extrusions
- Bending and forming of plastics
- De-flashing of molded parts

## Textiles:

- Welding plastic or vinyl fabrics
- Heat-treating specialty fabrics

## Semiconductor and Electronics:

- Air knife in wave solder machines
- Soldering/desoldering PC boards, lead frames, capacitors
- Wafer and PC board drying
- Heat-shrinking wire insulation
- Preheating process gases

## Sterilization:

- Pharmaceuticals
- Medical/surgical hardware
- Packaging materials

## Paper/Printing:

- Speed drying coated paper
- Adhesive activation
- Ink drying

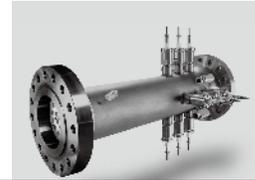
**WARNING:** TUTCO SUREHEAT Air/Inert Gas Heaters should be used to heat air or an inert gas only. Use with explosive gases or in an explosive ambient can result in an explosive event, possibly leading to a serious accident or injury.

# SUREHEAT Air Heaters

With air temperatures controllable to 1652°F (900°C), SUREHEAT Air Heaters are your solution for many critical applications. If our “standard” heaters below do not meet your needs, contact us. Since 1968, SUREHEAT has developed hundreds of unique and custom products for the most demanding applications. Let us know what we can do for you.



Product	Series I, II, III	Hot Air Tool	Serpentine II, VI	Threaded Inline
Features	Basic heater with quartz insulator tube. Ideal for “spot” heating applications.	Compact size. Built-in Type K thermocouple allows for precise $\pm 1$ degree control.	Triple-pass exchanger housing improves efficiency and safety.	Serpentine element in high-pressure pipe for critical processes.
kW	0.6 – 2.4 1 phase	1.5 – 3.5 1 phase	2.0 – 8.0 1 phase	1.6 – 18.0 1/3 phase
Max. Air Temperature °F (°C)	1600 (871)	1400 (760)	1500 (815)	1400 (760)
Max. Air Pressure psi (bar)	7 (0.5)	60 (4)	25 (1.7)	150 (10)
Use with Blower?	No	No	No	No
Page	8	10	12	14



**SUREHEAT® JET**

**SUREHEAT® MAX**

**SUREHEAT® MAX HT**

**SKORPION™**

**Flanged Inline**

All-purpose single-phase heater with two built-in Type K thermocouples for precise control and overtemp protection.

All-purpose three-phase heater with two built-in Type K thermocouples for precise control and overtemp protection.

High temperature heater to 900°C with a built-in Type K thermocouple for precise control and overtemp protection.

The complete heater, blower and control unit that is ready to plug in and use. Includes built-in overtemp protection.

ANSI flange-mount heater for extremely high pressure and high flow applications. Significantly smaller, lighter weight and faster response than tubular designs.

3.0 – 8.0  
1 phase

6.0 – 36.0  
1/3 phase

30.0 – 36.0  
3 phase

1.5 – 4.5  
1 phase

18.0 – 400.0  
3 phase

1400 (760)

1400 (760)

1652 (900)

1400 (760)

1500 (815)

60 (4)

60 (4)

60 (4)

1 (0.07)

150 (10)\*  
\*higher pressure models available

Yes

Yes

Yes

Yes

Yes

16

18

20

22

24

# About Air Heaters

## Selecting an Air Heater

The energy (kW) requirement is calculated from the following formula:

$$kW = \frac{SCFM \times (T_{exit} - T_{inlet})}{2500}$$

- SCFM = Air flow in Standard\* Cubic Feet per Minute
- Tinlet = Inlet Air Temperature (°F) (typically 70°F)
- Texit = Desired Exit Air Temperature (°F)
- 2500 = Unit conversion factor which includes 20% heat losses

### Example:

Heating 10 SCFM from ambient temperature (70°F) to 800°F:

$$kW = \frac{10 \text{ SCFM} \times (800^\circ\text{F} - 70^\circ\text{F})}{2500} = 2.9 \text{ kW}$$

### Conversion Formulas:

(Liters per Minute)/28.3 = Cubic Feet per Minute

°C = 5/9 (°F-32)

°F = 9/5 (°C) + 32

\*Please refer below for an explanation of Standard flow rate.

## Air Sources

If used properly, heater life of 5000 hours or greater can be expected. To ensure long heater life and safe operation, follow these guidelines. Also read and understand your heater operating manual before use. Failure to follow these guidelines can result in heater damage, failure or personal injury.

### Air Sources

In general, compressed air and air from regenerative blowers may be used to supply TUTCO SUREHEAT air heaters. Your air source should be clean and dry. Dirt, grease, oil, or oil vapors, or corrosive or reactive gases will damage an air heater. Also, use air or inert gas only. Do not use with volatile or combustible gases.

### Regenerative Blowers

Regenerative blowers are compact and inexpensive clean air sources. They can provide large amounts of low-pressure air for your air heating system. Blower size is based on the maximum amount of airflow (CFM or LPM) it can produce without any inlet or exit restrictions. When a heater or other restriction is attached to a blower, the maximum flow decreases. If the blower is severely restricted, the blower motor can overheat and fail.

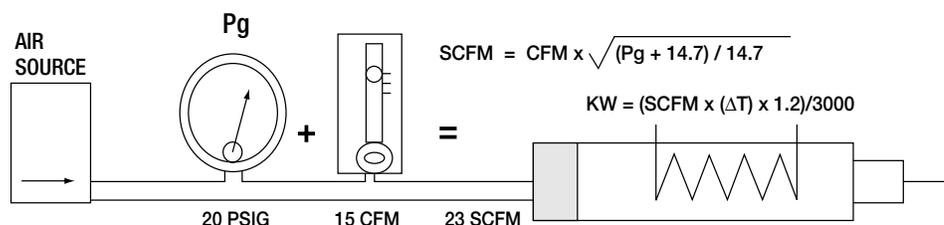
When designing your heating system, you should try to minimize air restrictions and select a blower sufficient to

overcome the backpressure generated by the heater, flare and associated piping. Because of their small size, the Series, Hot Air Tool, and Serpentine II heaters should not be used with regenerative blowers.

### Compressed Air

Compressed air is commonly available in most factories. It is high-pressure regulated air (typically to 100 psi), and often contains oil for lubricating pneumatic valves and equipment. You must filter this oil to prevent fouling and damage to the electric air heater elements.

When measuring compressed air flow rates, be sure you are measuring Standard CFM or Standard LPM units. The "Standard" means that the units are measured at standard temperature and pressure. Many flow meters are labeled SCFM, but this is incorrect at the higher pressures produced by compressed air. For accurate flow measurements, you must consult your flow meter manual for converting CFM to "Standard" CFM. In the diagram below, the flow meter reading (CFM) is converted to SCFM using a Dwyer ball-type flow meter conversion.



## Controls

A good control system is critical for long heater life. Before turning your control system on, you must have sufficient airflow through the heater before applying power. (Applies to heaters without SUREHEAT® over-temperature protection.) Only qualified individuals should install TUTCO SUREHEAT heaters and controls. Follow all applicable electrical codes and use proper wiring.

### Open-Loop (Manual) Control

This simple method of control uses a manually operated power controller to apply a fixed voltage to the heating element. Using this system, the operator manually adjusts the controller to change heater temperature. Note that if the airflow is suddenly interrupted, the element could fail. The open-loop controller is generally used with heaters from TUTCO SUREHEAT.

### Closed-Loop (Feedback) Control

A closed-loop heater control system uses a power controller, temperature controller and thermocouple to provide a constant output temperature, regardless of changes in airflow. The temperature controller also provides a convenient display of your process air temperature.

### Power Controller

Phase angle fired SCR (Silicon Controlled Rectifier) power controls will provide the smoothest power regulation for TUTCO SUREHEAT air heaters.

Other power controls may be suitable, such as distributive zero cross SSR (Solid State Relays) or other fast-switching SSR's, but you should contact TUTCO SUREHEAT for approval before use.

### Temperature Controller

Use only digital temperature controls with Type K thermocouple inputs. The temperature control output must match the input of the power control (i.e., 4-20mA or 0-10VDC).

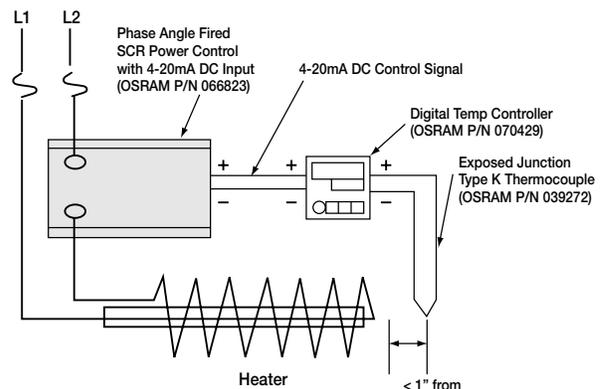
A standard PID-type control with a wide proportional band setting will work best to minimize temperature overshoot. PID parameters may be auto-tuned, but only at temperatures well below the maximum of the heater. If the temperature rises too high during auto-tune, turn power off immediately.

When using a Solid State Relay power control, the temperature controller cycle time should be set for 100ms or less.

### Thermocouple

Use only a fine-wire (.030" max. wire diameter), exposed junction, Type K thermocouple placed within 1" of the heater exit for accurate temperature readings. Other thermocouple styles,

or varying the distance from the heater exit, will result in temperature measurement errors and/or heater failure.



# Series I, II, III Heaters

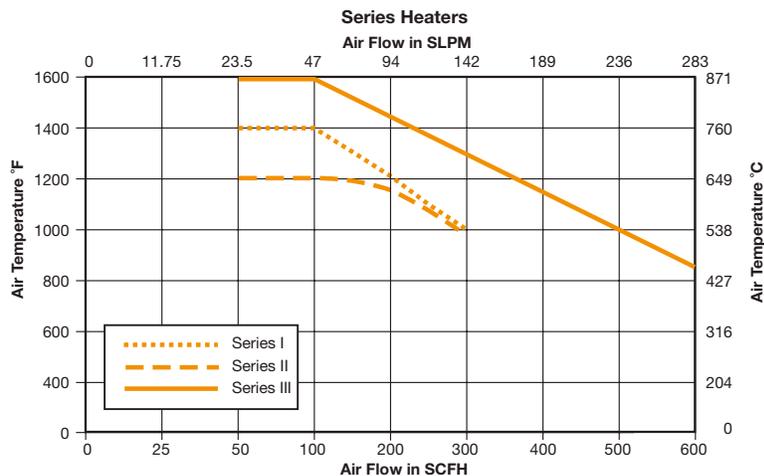


## Specifications

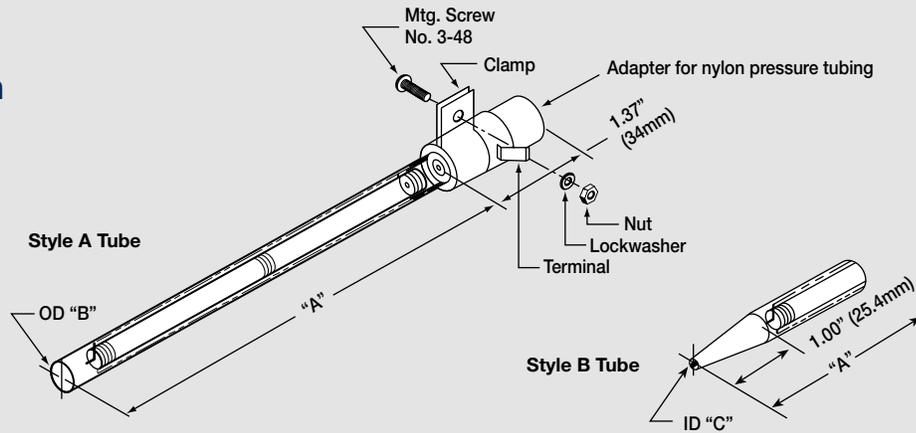
- Air temperature controllable to 1600°F (871°C)
- Quartz outer tube housing
- Nozzled (Style B) or open-ended (Style A) design
- High-temperature silicone rubber rear adapter/terminal assembly
- Maximum air pressure 7 psi (0.5 bar)
- Maximum inlet temperature 120°F (49°C)
- Recommended minimum airflow 1 SCFM (60 SCFH)
- RoHS compliant



## Performance



## Installation



## Products

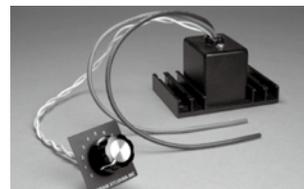
Part Number	Tube Style	Max. Watts	Max. Volts	Tube Length "A"	Tube O.D. "B"	Nozzle I.D. (Style B) "C"
<b>Series I</b>						
010226	A	1050W	180	6.88" (175mm)	.41" (10mm)	—
014372	A	1000W	130	7.75" (197mm)	.41" (10mm)	—
014682	B	680W	145	7.88" (200mm)	.41" (10mm)	.07" (2mm)
014683	B	650W	105	8.75" (222mm)	.41" (10mm)	.07" (2mm)
<b>Series II</b>						
016501	A	1125W	130	3.88" (98mm)	.41" (10mm)	—
016503	A	850W	80	3.88" (98mm)	.41" (10mm)	—
016502	B	600W	95	4.88" (124mm)	.41" (10mm)	.07" (2mm)
016504	B	650W	70	4.88" (124mm)	.41" (10mm)	.07" (2mm)
<b>Series III</b>						
017558	A	2050W	160	6.88" (175mm)	.59" (15mm)	—
017575	B	1450W	135	7.88" (200mm)	.59" (15mm)	.12" (3mm)

## Accessories

Part Number	Description
057081	Open-loop (manual) power control 120-277V 25A

### Stainless Steel Outer Shields - Open Ended

015509	For Series I heater	(P/N 014372)
057083	For Series I heater	(P/N 010226)
017853	For Series II heater	(P/N 016501, 016503)



057081

# Hot Air Tools

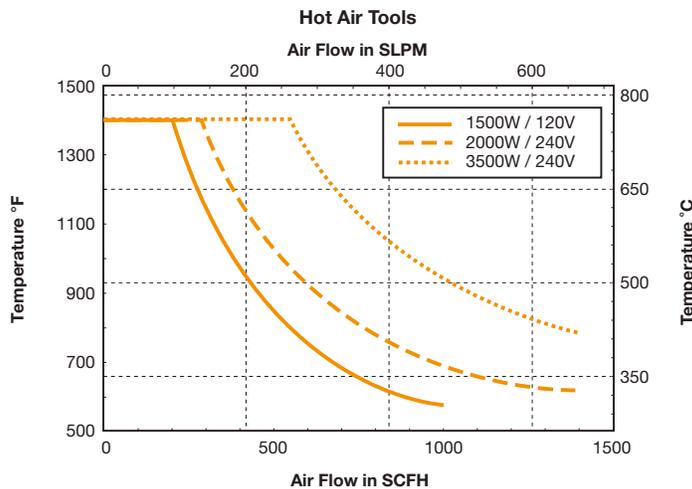


## Specifications

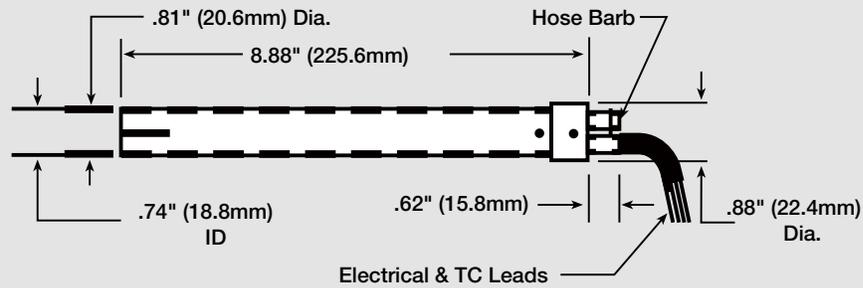
- Air temperature controllable to 1400°F (760°C)
- Built-in Type K thermocouple
- 1/4" hose barb air connection
- Maximum inlet temperature 120°F (49°C)
- Maximum air pressure 60 psi (4 bar)
- Slotted exit for flare attachment
- 304 stainless steel body
- 3' (914mm) power and thermocouple leads
- RoHS compliant



## Performance



## Installation

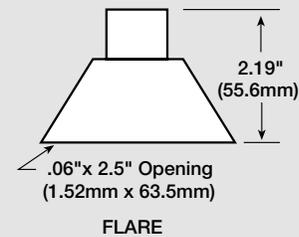


## Products

Part Number	Max. Watts	Max. Volts	Max. Amps	Min. Flow SCFH (SLPM)
068462	1500W	120	13	30 (14)
068463	2000W	240	9	70 (33)
068464	3500W	240	15	90 (43)

## Accessories

Part Number	Description
068472	Flare (includes clamp) .06" x 2.5" (1.52mm x 63.5mm) opening
057081	Open-loop (manual) power control 120-277V 25A
066823	Closed-loop power control, 30A, 240V, 4-20mA (used with 070429)
070429	Digital temperature control, 1/16 DIN (used with 066823), 4-20mA



057081



066823



070429

# Serpentine II, VI Triple Pass Heaters

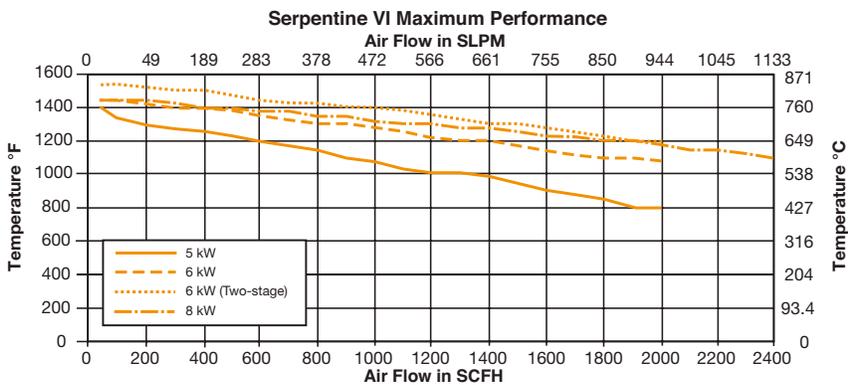
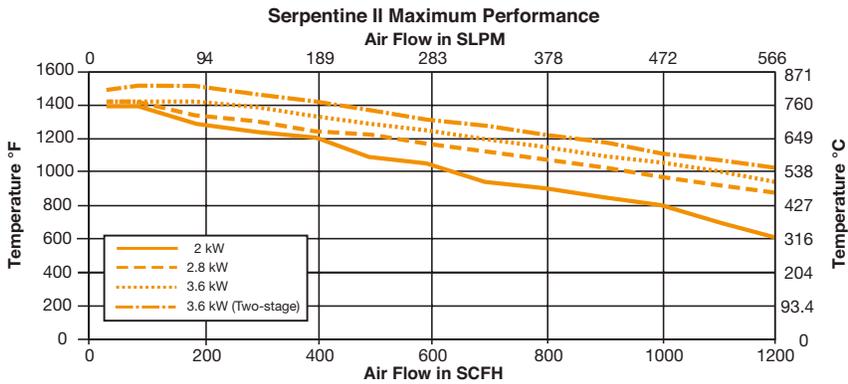


## Specifications

- Air temperature controllable to 1500°F (815°C)
- Serpentine II to 3.6kW
- Serpentine VI to 8.0kW
- Triple Pass Heat Exchanger uses incoming air to cool outer shell
- Maximum air pressure 25 psi (1.7 bar)
- Replaceable element assemblies
- Recommended minimum airflow 60 SCFH
- RoHS compliant

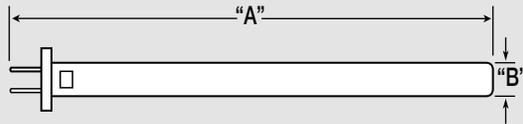


## Performance

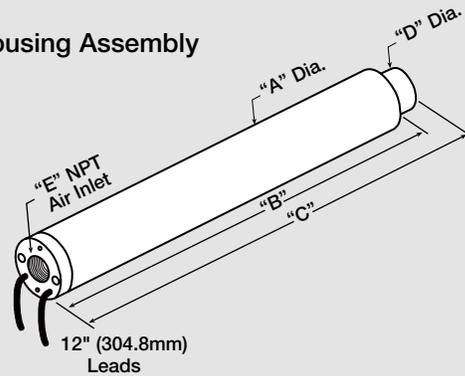


## Installation

Element



Housing Assembly



## Elements

Part Number	Max. Watts	Max. Volts	Max. Amps	Overall Length "A"	Tube O.D. "B"
<b>Serpentine II Elements</b> used with housing 029763					
029765	2.0kW	240	8	8.20" (208mm)	0.63" (16mm)
029766	2.8kW	240	12	8.20" (208mm)	0.63" (16mm)
029767	3.6kW	240	15	8.20" (208mm)	0.63" (16mm)
060418	3.6kW (Two-stage)	240	15	8.63" (219mm)	0.63" (16mm)
<b>Serpentine VI Elements</b> used with housing 057088					
040291	5.0kW	240	21	10.88" (276mm)	1.25" (32mm)
040292	6.0kW	240	25	10.88" (276mm)	1.25" (32mm)
061429	6.0kW (Two-stage)	240	25	10.88" (276mm)	1.25" (32mm)
056548	8.0kW	240	33	10.88" (276mm)	1.25" (32mm)

## Housing Assemblies

Part Number	Serpentine Type	"A"	"B"	"C"	"D"	"E"
029763	II	1.6" (40mm)	9.0" (229mm)	10.0" (254mm)	0.7" (18mm)	3/8" NPT
057088	VI	2.1" (54mm)	11.9" (302mm)	12.9" (327mm)	1.4" (35mm)	3/4" NPT

## Accessories

Part Number	Description
039739	Serpentine II base adaptor assembly
042339	Serpentine VI base adaptor assembly
029485	Serpentine II TC holder (includes TC)
040299	Serpentine VI TC holder (includes TC)
039272	Type K thermocouple probe, 3/16" (4.8mm) O.D.
066823	Closed-loop power control, 240V, 30A, 4–20mA
057081	Open-loop (manual) power control 120–277V 25A
070429	Digital temperature controller, 1/16 DIN, 4–20mA



039272



057081



039739/042339



066823



070429

# Threaded Inline Heaters



## Specifications

- Air temperature controllable to 1400°F (760°C)
- For applications requiring high pressure air
- Both ends threaded 3/8", 1/2", 1-1/4", and 2-1/2" NPT
- 304 stainless steel housing
- Recommended minimum airflow 60 SCFH

### Style A

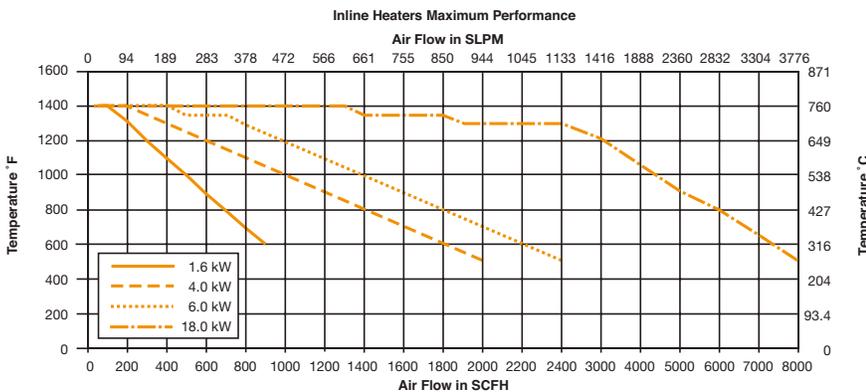
- Should be used whenever an absolute leak-proof system up to 150 psi (10 bar) is required
- Two high-temperature power feedthroughs
- Maximum inlet temperature 900°F (482°C)

### Style B

- Maximum air pressure 150 psi (10 bar), but will have slight air leakage through power wire strands
- 12" (305mm) flexible power wires
- Maximum inlet temperature 200°F (93°C)
- RoHS compliant

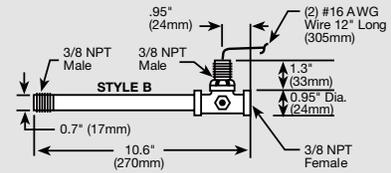
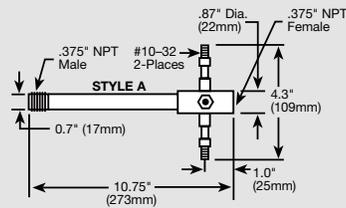


## Performance

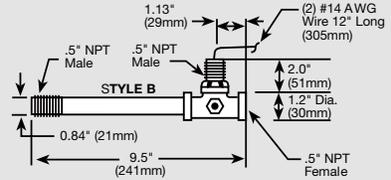
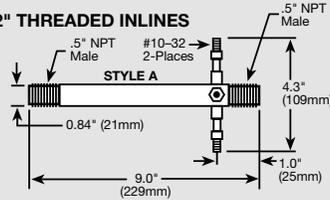


# Installation

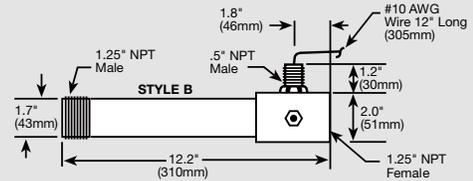
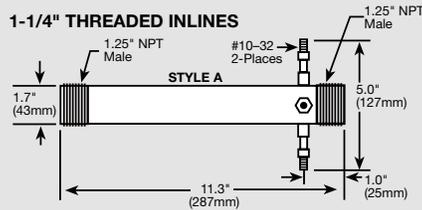
## 3/8" THREADED INLINES



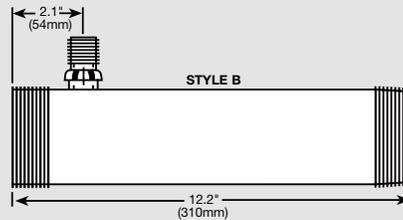
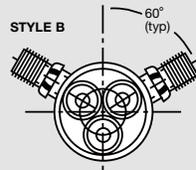
## 1/2" THREADED INLINES



## 1-1/4" THREADED INLINES



## 2-1/2" THREADED INLINE



## Products

Heater Size (NPT)	Max. Watts	Max. Volts	Max. Amps	Part No., Style A	Part No., Style B
3/8"	1.6kW	170	9.4	038821	038822
1/2"	4.0kW	220	18.2	038823	038824
1-1/4"	6.0kW	220	27.3	038825	038826
2-1/2"	18.0kW	240	75.0 (1φ)/44.0 (3φ)	N/A	063007
2-1/2"	24.0kW	240	100 (1φ)/57.8 (3φ)	N/A	074439

## Accessories

Part Number	Description
057081	Open-loop (manual) power control 120-277V 25A
066823	Closed-loop power control, 240V, 30A
070429	Temperature controller — 1/16 DIN, 4–20mA
039272	Type K thermocouple probe, 3/16" (4.8mm) O.D.

# SUREHEAT® JET Air Heater

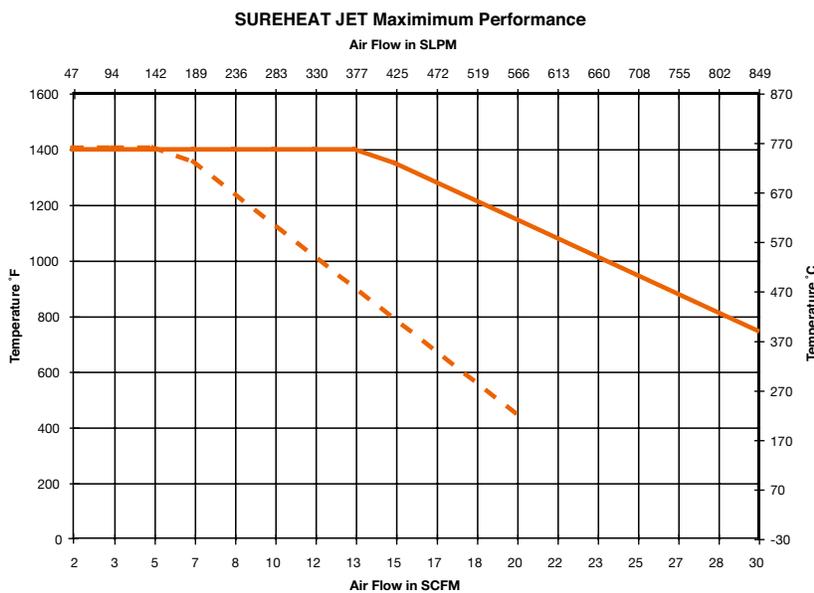


## Specifications

- Air temperature controllable to 1400°F (760°C)
- Power ratings 3.0kW - 8.0kW  
240V - 1φ
- Two internal Type K thermocouple sensors for control and safety:
  - S1 measures inlet temperature
  - S2 measures exit temperature
- Rapid heat-up and cool-down
- Maximum air pressure 60 psi (4 bar)
- Maximum inlet temperature 200°F (93°C)
- Use SUREHEAT JET Control (purchased separately) for easy installation
- Recommended minimum airflow 2 SCFM (57 SLPM)
- RoHS compliant



## Performance

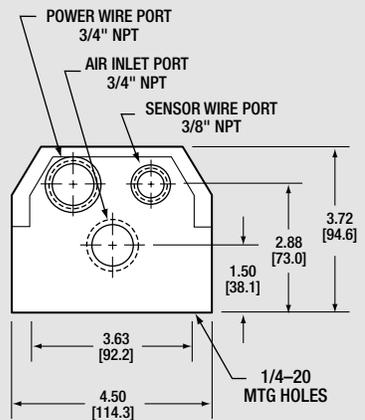
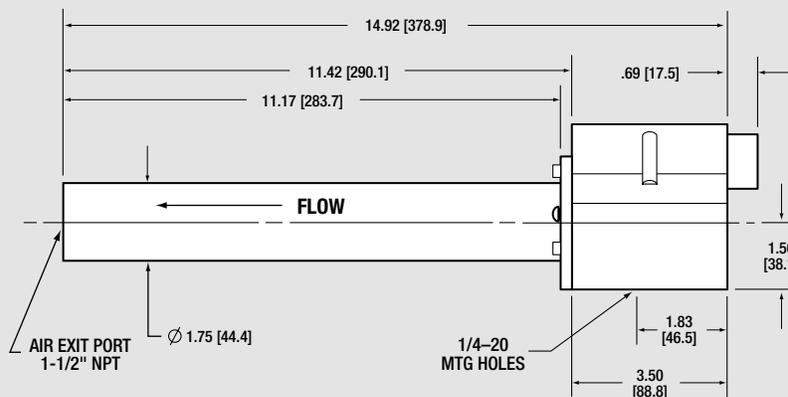
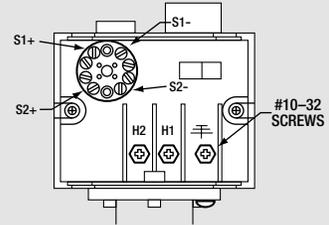


\* Temperature as measured by internal Type K thermocouple.

## Installation

### Wiring Notes:

- S1 and S2 sensors are Type K thermocouple.
- S1 measures inlet air temperature.
- S2 measures exit air temperature.
- See operating manual for control settings.



## Products

Heater Size (NPT)	Description	Max. Watts	Max. Volts	Max. Amps
074718	SUREHEAT® JET 3.0kW heater	3.0kW	240	12.5
074719	SUREHEAT JET 8.0kW heater	8.0kW	240	33.3

## Accessories

Part Number	Description
074722	SUREHEAT JET control cabinet 8.0kW/240V/35A/1 $\phi$
075526	SUREHEAT JET control cabinet 8.0kW/240V/35A/1 $\phi$ w/RS-232 comm.
074829	1/16 DIN digital temperature control (for S2 KTC)
074835	Inlet temperature limit circuit (For S1 KTC)



074829



074835



074722

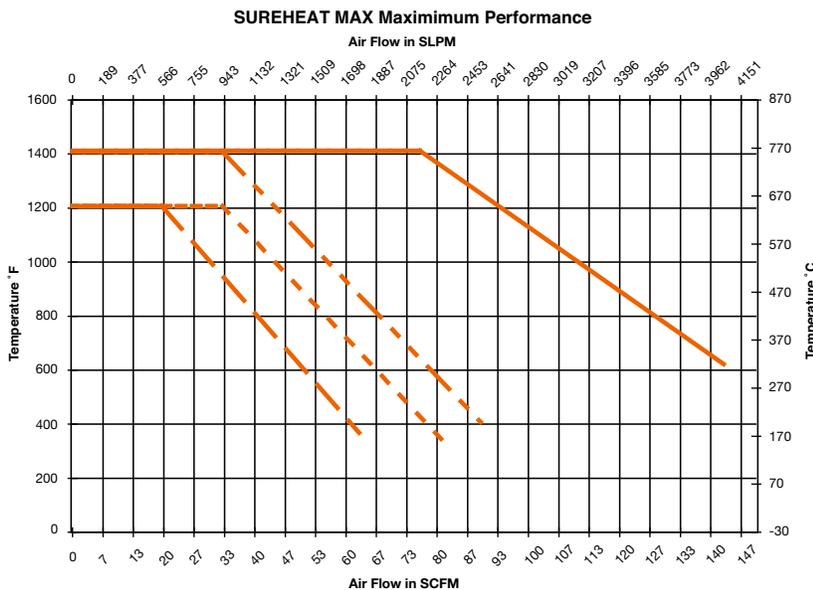
# SUREHEAT® MAX Air Heater



## Specifications

- Air temperature controllable to 1400°F (760°C)
- Power ratings 6.0kW - 36.0kW  
240/380/480V - 1φ /3φ
- Two internal Type K thermocouple sensors for control and safety:
  - S1 measures inlet temperature
  - S2 measures exit temperature
- Rapid heat-up and cool-down
- Maximum air pressure 60 psi (4 bar)
- Maximum inlet temperature 200°F (93°C)
- Recommended minimum airflow 12 SCFM
- Use SUREHEAT MAX Control (purchased separately) for easy installation
- RoHS compliant

## Performance



\* Temperature as measured by internal Type K thermocouple.



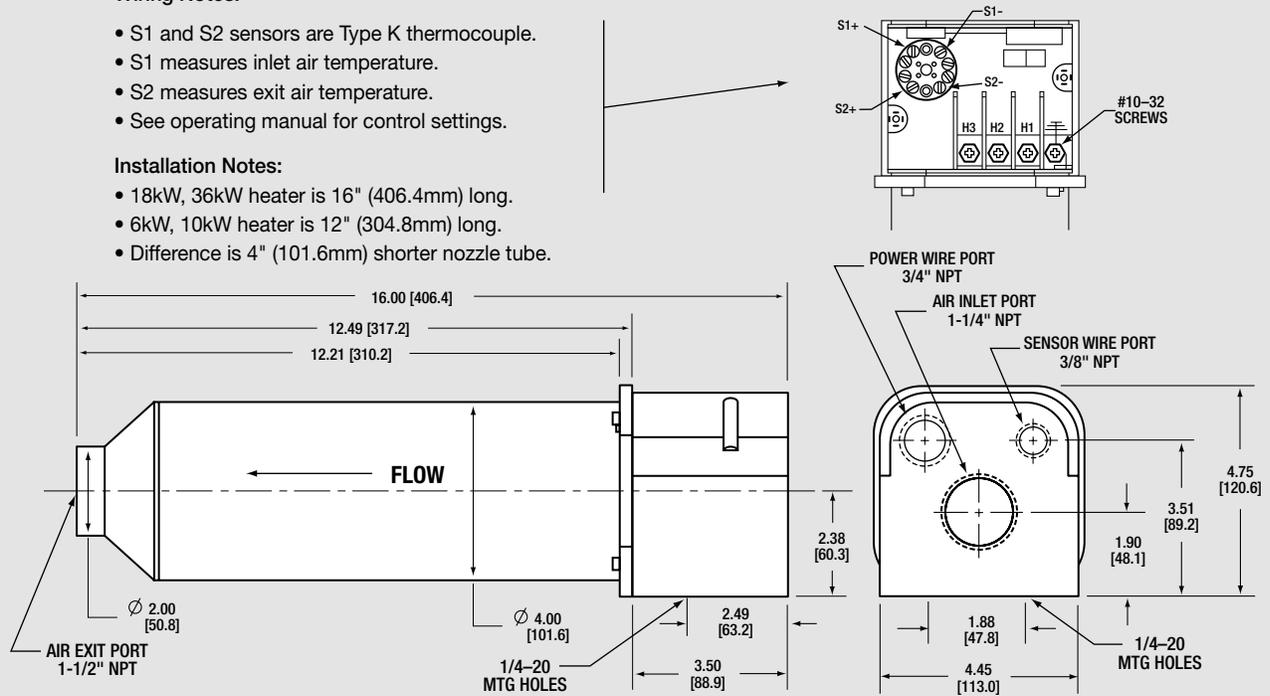
## Installation

### Wiring Notes:

- S1 and S2 sensors are Type K thermocouple.
- S1 measures inlet air temperature.
- S2 measures exit air temperature.
- See operating manual for control settings.

### Installation Notes:

- 18kW, 36kW heater is 16" (406.4mm) long.
- 6kW, 10kW heater is 12" (304.8mm) long.
- Difference is 4" (101.6mm) shorter nozzle tube.



## Products

Part Number	Description	Max. Watts	Max. Volts	Max. Amps
074723	SUREHEAT® MAX 6.0kW heater	6.0kW	240 - 1 $\phi$	25.0
074724	SUREHEAT MAX 6.0kW heater	6.0kW	240 - 3 $\phi$	14.5
074725	SUREHEAT MAX 6.0kW heater	6.0kW	380 - 3 $\phi$	9.1
074726	SUREHEAT MAX 6.0kW heater	6.0kW	480 - 3 $\phi$	7.2
074727	SUREHEAT MAX 10.0kW heater	10.0kW	240 - 1 $\phi$	41.7
074728	SUREHEAT MAX 10.0kW heater	10.0kW	240 - 3 $\phi$	24.1
074729	SUREHEAT MAX 10.0kW heater	10.0kW	380 - 3 $\phi$	15.2
074731	SUREHEAT MAX 10.0kW heater	10.0kW	480 - 3 $\phi$	12.0
074732	SUREHEAT MAX 18.0kW heater	18.0kW	240 - 3 $\phi$	43.4
074733	SUREHEAT MAX 18.0kW heater	18.0kW	380 - 3 $\phi$	27.4
074734	SUREHEAT MAX 18.0kW heater	18.0kW	480 - 3 $\phi$	21.7
074735	SUREHEAT MAX 30.0kW heater	30.0kW	380 - 3 $\phi$	45.6
074736	SUREHEAT MAX 36.0kW heater	36.0kW	480 - 3 $\phi$	43.4

## Accessories

Part Number	Description
075725	SUREHEAT MAX control cabinet 18.0kW/480V/25A/3 $\phi$
074829	1/16 DIN digital temperature control (for S2 KTC)
074835	Inlet temperature limit circuit (for S1 KTC)



074829



074835

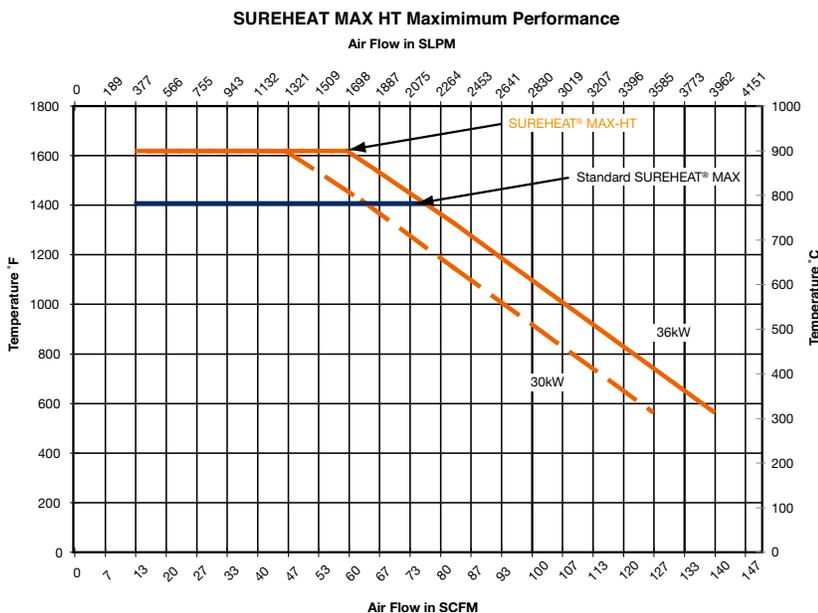
# SUREHEAT® MAX HT Air Heater



## Specifications

- Specially constructed SUREHEAT MAX air heater for heating air and inert gases to 900°C (1652°F)
- For applications demanding extremely high temperature including automotive sensors, diesel filter regeneration, thermal stress conditioning, general R&D, etc.
- Two (2) current models available:
  - 30kW 380V - 3 $\phi$  45.6A (P/N F076189)
  - 36kW 480V - 3 $\phi$  43.4A (P/N F076197)
  - Custom sizes available upon request

## Performance

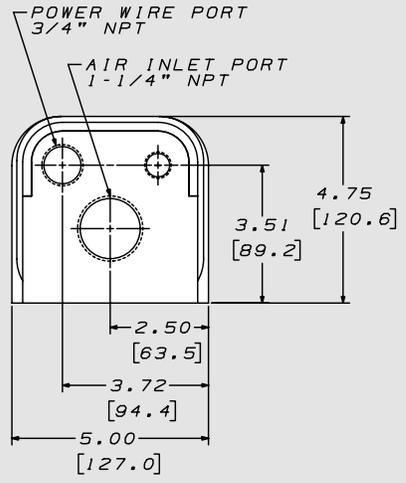
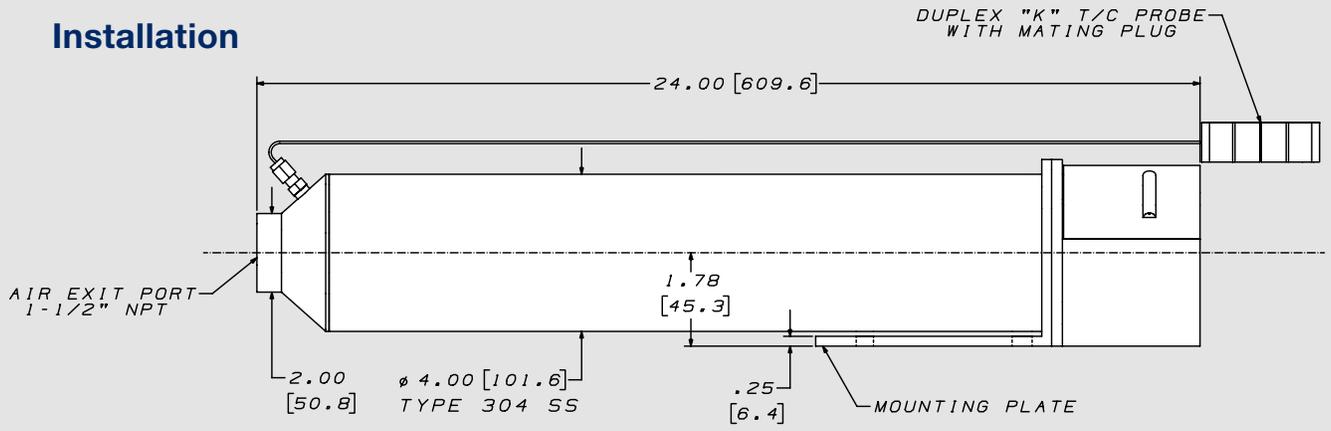


\* Temperature as measured by internal Type K thermocouple.

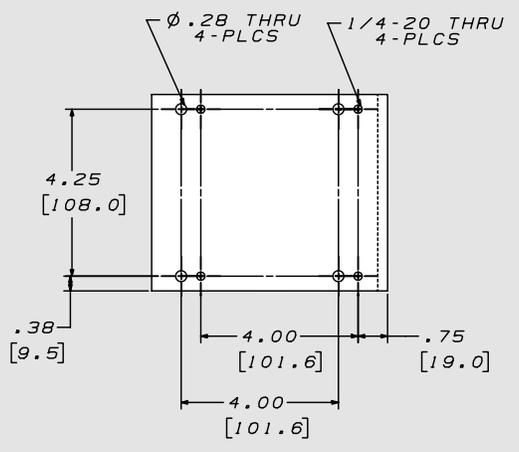
- One (1) dual exposed junction, Type K thermocouple probe included for precision control and over-temperature protection
- Recommended minimum airflow 12 SCFM (340 SLPM)
- RoHS compliant



# Installation



REAR VIEW



MOUNTING PLATE VIEW

# SKORPION™ Air Heater

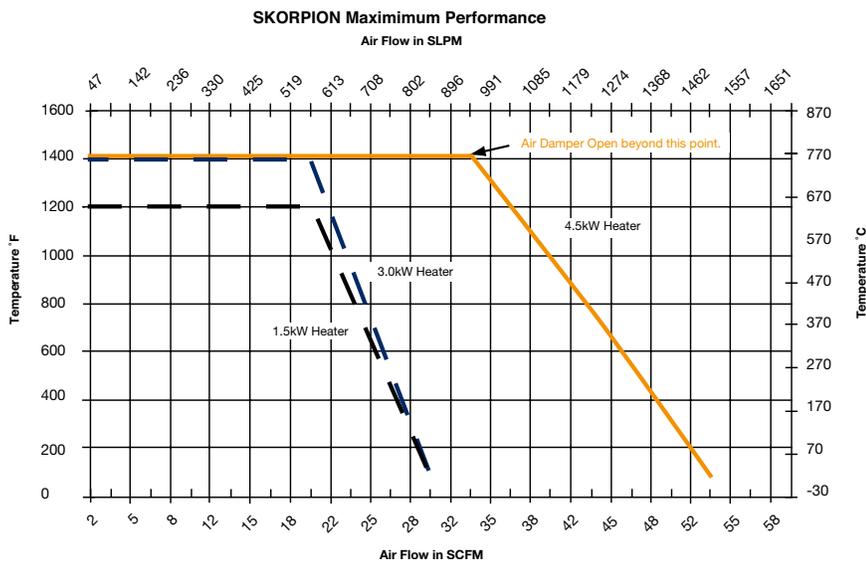


## Specifications

- Air temperature controllable to 1400°F (760°C)
- Power ratings 1.5kW – 4.5kW  
120/230 - 1φ
- Complete heater including blower and control unit that is ready to plug in and use
- Convenient digital display shows current operating temperature
- Built in over-temperature protection and a two-year limited warranty
- Models also available without blower for use with customer supplied air source
  - Maximum inlet temperature 200°F (93°C)
  - Recommended minimum airflow 2 SCFM
- RoHS compliant

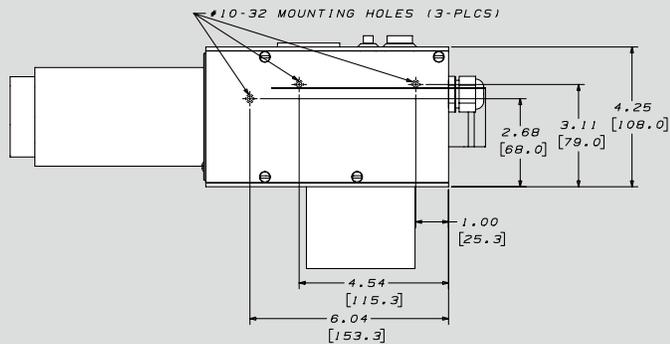
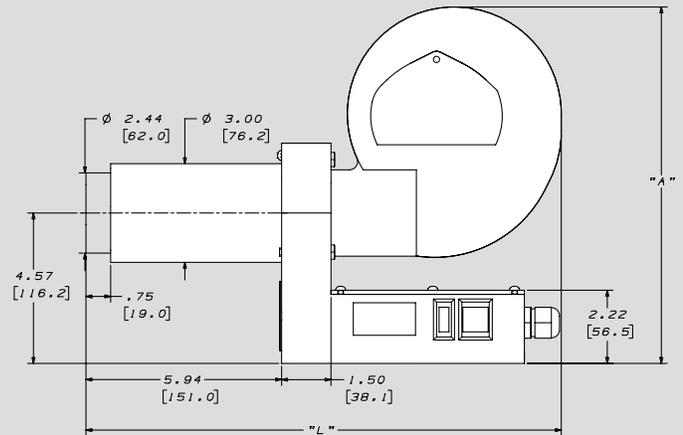


## Performance



\* Air Temperature as measured by internal Type K thermocouple.

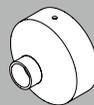
## Installation



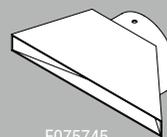
## Products

Part Number	Description	Max. Watts	Max. Volts	Max. Amps	Height "A"	Height "B"
075615	SKORPION™ air heater	1.5kW	120 - 1 $\phi$	12.5A	9.18"	13.58"
075616	SKORPION air heater	3.0kW	230 - 1 $\phi$	12.5A	9.18"	13.58"
076008	SKORPION air heater	4.5kW	230 - 1 $\phi$	20.0A	10.84"	14.44"
075869	SKORPION air heater without blower	1.5kW	120 - 1 $\phi$	12.5A		
075835	SKORPION air heater without blower	3.0kW	230 - 1 $\phi$	12.5A		
076029	SKORPION air heater without blower	4.5kW	230 - 1 $\phi$	20.0A		

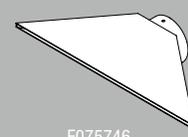
## Accessories



F075744



F075745



F075746

Part Number	Description	
075744	High flow nozzle	21mm (1") diameter opening – slip-on mount with set screw
075745	Standard flare	150mm x 12mm (6" x 0.5") opening – slip-on mount with set screw
075746	Wide flare	300mm x 4mm (12" x 0.16") opening – slip-on mount with set screw

# Reference Data

## A. Air Heater Energy Requirement

$$kW = SCFM \times (T_{exit} - T_{inlet}) / 2500$$

## B. Temperature Conversions

$$^{\circ}F = 9/5 (^{\circ}C) + 32$$

$$^{\circ}C = 5/9 (^{\circ}F - 32)$$

## C. Air Flow Conversions

$$SCFM = SCFH / 60 = SLPM / 28.3$$

$$SLPM = SCFH / 2.12$$

$$SCMH = SCFH / 35.3$$

$$SCFM = (\text{Pounds of Air Per Minute}) / (.076 \text{ lbs/ft}^3)$$

$$SCFM = \text{grams/sec.} \times 1.74$$

$$SCFM = \text{kg/min.} \times 28.9$$

$$SCFM = \text{Standard Cubic Feet per Minute}$$

$$SCFH = \text{Standard Cubic Feet per Hour}$$

$$SLPM = \text{Standard Liters per Minute}$$

$$SCMH = \text{Standard Cubic Meters per Hour}$$

## D. Single Phase Wiring

$$V = I \times R \text{ (Volts = Amps} \times \text{Ohms)}$$

$$I = W / V \text{ (Amps = Watts / Volts)}$$

$$W = V^2/R \text{ (Watts = (Volts} \times \text{Volts) / Ohms)}$$

## E. Three Phase Wiring

### Delta Configuration

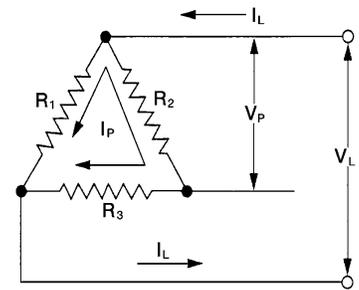
$$R = R_1 = R_2 = R_3$$

$$W_{\text{delta}} = 3(V_L^2)/R$$

$$W_{\text{delta}} = 1.73 \times V_L \times I_L$$

$$I_P = I_L/1.73$$

$$V_P = V_L$$



Delta Configuration

### Wye Configuration

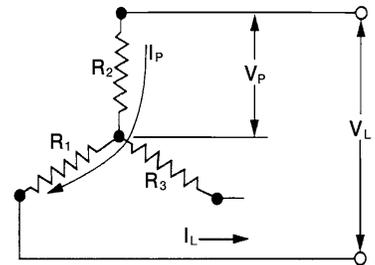
$$R = R_1 = R_2 = R_3$$

$$W_{\text{wye}} = (V_L^2)/R = 3(V_P^2)/R$$

$$W_{\text{wye}} = 1.73 \times V_L \times I_P$$

$$I_P = I_L$$

$$V_P = V_L/1.73$$



Wye Configuration

## F. Thermocouple Configuration (Type K)

(+) = Yellow = Alumel (non-magnetic)

(-) = Red = Chromel (magnetic)



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