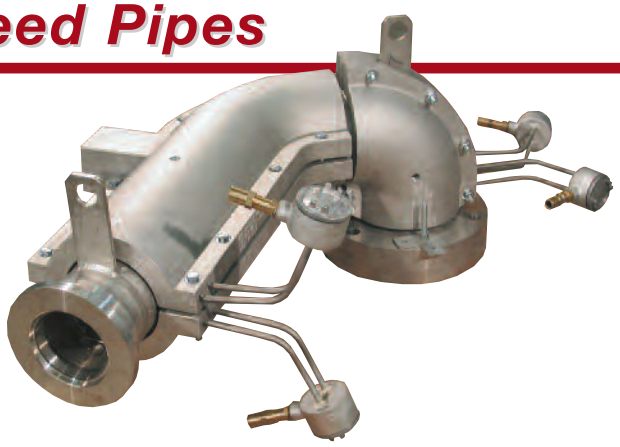
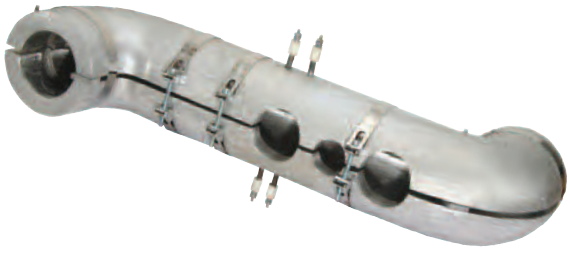
Cast-In Heaters for Transfer/Feed Pipes

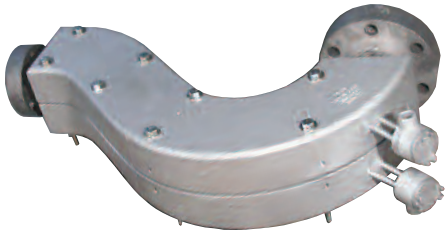


Tempco offers the perfect solution to heat Complex Transfer/Feed Pipes

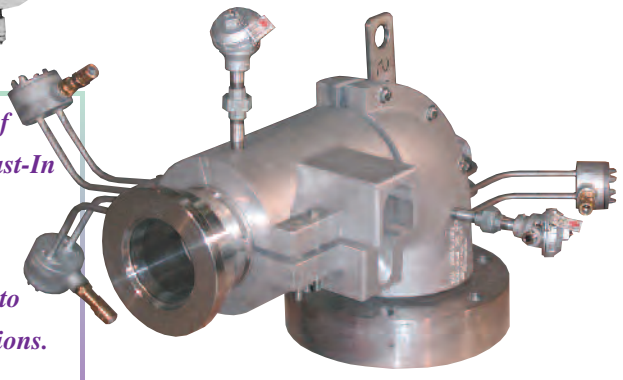
Transfer pipes used in large-scale extrusion lines are difficult to heat because of their irregular geometry. They are not machined cylinders so proper contact and heat transfer are difficult to achieve.

Consequently, a special Cast-In Heater must be engineered for each pipe to accommodate its individual characteristics. Typically, this entails the customer sending the pipe to Tempco and our Engineering staff designing a Cast-In Heater System that will optimally fit the pipe. The quality of the process will be improved because hot spots and/or unevenly heated surfaces can be eliminated. In some cases, we cast the heater directly onto the pipe.





Let Tempco's Creative Team of Professionals Tackle Your Next Cast-In Thermal Component Project. We Have the Technology, Infrastructure & Commitment to Exceed Our Customers' Expectations.



Special Cast-In Process for Unusual and Complex Applications

In the event that a cast-in heater cannot be made the conventional way for assembly into a machine part, Tempco has the expertise to directly attach a tubular heating element or a tube for cooling purposes to a customer supplied part.

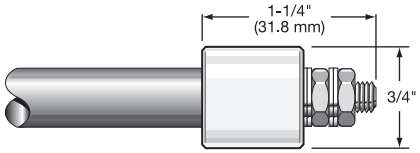
By making a wood pattern with the required shape we can create a sand mold to encapsulate the entire assembly and pour the molten aluminum or bronze over the part.

The sample depicted in this picture represents the typical process. In this case, a tubular heating element is attached to a steel roller and is then placed in a sand mold prior to casting. After casting, the roller OD is machined per customer specifications — in addition, the aluminum roller will be vulcanized with rubber. The finished heated roller will be used in a laminating web press.

Made in USA

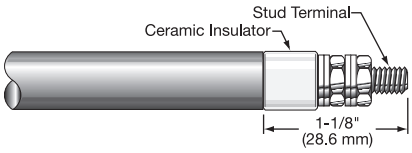
Standard Tubular Heater Terminations for Cast-In Heaters

Select the termination style that meets your requirements for space, accessibility and reliability.



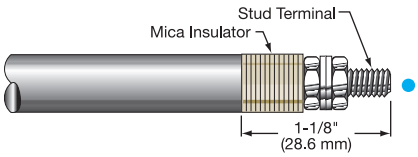
Type S Standard Unless Otherwise Specified

Heavy Duty Ceramic Insulators.
.315" diameter heater has 8-32 screw terminals.
.430" diameter heater has 10-32 screw terminals.



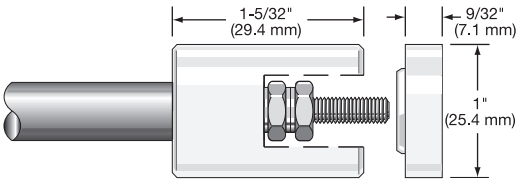
Type T7

Ceramic insulator is the same diameter as the heating element.
.260" diameter heater has 6-32 screw terminals.
.315" diameter heater has 8-32 screw terminals.
.430" diameter heater has 10-32 screw terminals.



Type T

Mica insulator is the same diameter as the heating element.
.260" diameter heater has 6-32 screw terminals.
.315" diameter heater has 8-32 screw terminals.
.430" diameter heater has 10-32 screw terminals.



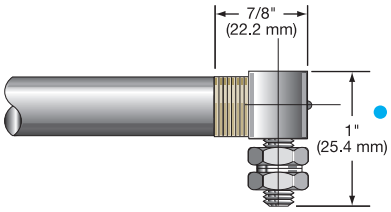
Type C4

Heavy duty ceramic insulator with terminal cover.
.315" diameter heater has 10-32 screw terminals.
.430" diameter heater has 10-32 screw terminals.

TYPE P—Plain Pin

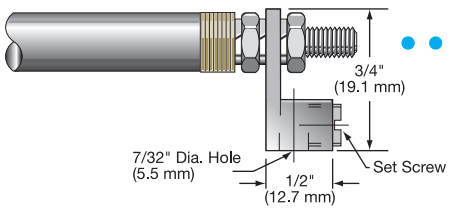
Plain terminal pin. Specify Length "L." Standard 1/2" (12.7 mm) pin length.

Element Diameter		Nominal Pin Diameter	
in	mm	in	mm
.260	6.6	.091	2.3
.315	8.0	.100	2.5
.430	10.9	.120	3.0



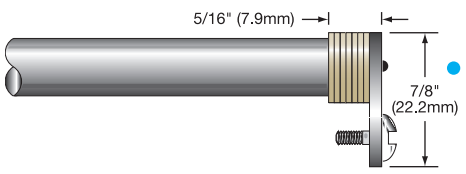
Type R

Mica washers with 90° blockhead screw terminal with 10-32 screw threads. Available for .315" and .430" diameter heaters.



Type R2

Mica washers with blockhead and through hole for lead wire connection. Eliminates the use of ring terminals. Available for .315" and .430" diameter heaters. Accepts 6-14 gauge wire.



Type E

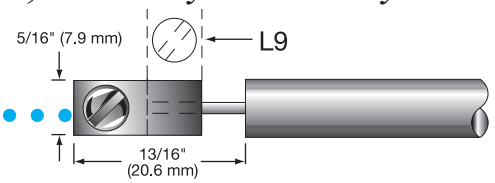
Right-angle lug welded to pin with mica washer insulators and 10-32 binding head screw. Available for .260", .315" and .430" diameter heaters.

Standard Tubular Heater Terminations for Cast-In Heaters

Select the termination style that meets your requirements for space, accessibility and reliability.

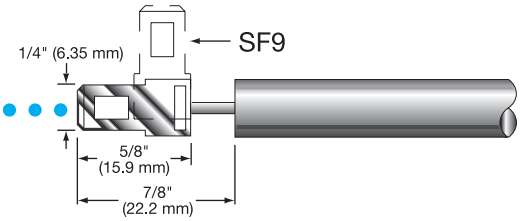
Type L & L9

Terminal lug spot welded to pin with 10-32 binding head screw. Available for .260", .315" and .430" diameter heaters. Type L represents straight; Type L9 represents 90° to pin. Specify lug orientation.



Type SF & SF9

Quick-disconnect spade tabs spot welded to pin. Available for .260", .315" and .430" diameter heaters. Type SF represents straight. Type SF9 represents 90° to pin. Specify tab orientation.

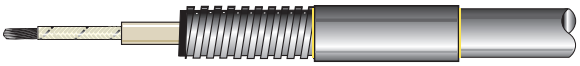


Type F

Flexible lead: insulated stranded wire crimped to cold pin. Crimp connection is insulated with fiberglass sleeving. Available for .260", .315" and .430" diameter heaters. Wire insulation rated to 250°C, 450°C optional. Specify lead length.

Type R1

Flexible Armor Cable provides excellent protection to lead wires against abrasion and contaminants. Available for .260", .315" and .430" diameter heaters. Specify cable length and lead length. Style may vary from depiction depending on heater diameter and cable diameter used.

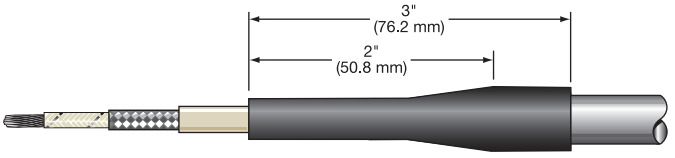


Type R1A

Stainless Steel Wire Overbraid provides flexibility and excellent protection to lead wires against abrasion. Available for .260", .315" and .430" diameter heaters. Specify stainless steel wire overbraid length and lead length. Style may vary from depiction depending on heater diameter and braid diameter used.

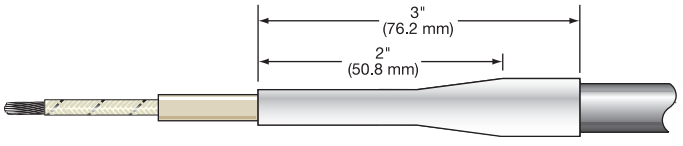
Type MR

Moisture resistant shrink strain relief and lead wire with or without stainless steel overbraid. Available for .260", .315" and .430" diameter heaters. Specify lead wire and overbraid length. Maximum operating temperature is 350°F (177°C).



Type TS

Contamination seal shrink-down Teflon® sleeving over the heater and lead wire splice. Provides a good moisture resistant seal. Maximum operating temperature 500°F (260°C). Available for .260", .315" and .430" and diameter heaters. Specify lead length.



Type P1

Quick -disconnect plug, either mounted directly on casting or on elements ends offset a specified distance from casting. Rating: 16A-250VAC.

General Purpose Terminal Protection Boxes For Cast-In Heaters

Standard Box Type C2

Terminal Boxes provide a simple and economical means to eliminate exposed heater terminals and live electrical wiring, protecting employees from potential electrical shock. They also eliminate electrical shorts that can result from exposed wiring on Cast-In Heater installations.

Type C2 is an individual terminal box for protecting the terminals on each Cast-In Band Heater half. It is also used on many other Cast-In Heater designs with one set of heater terminals. The C2 box design requires a flat pad on half-round castings or a flat surface on other casting designs for mounting. It is made from heavy gauge, rust-resistant sheet metal. The cover is removable for easy access to terminals. The box has two 7/8" diameter knockouts opposite each other for standard 1/2" BX connectors.

To simplify installation, Cast-In Heaters fitted with boxes can be factory prewired with high temperature lead wire that can be protected with armor cable. If one of these options is required, ***specify terminal box type, lead wire and cable length.*** Satisfies NEMA 1 requirements.

Standard C2 box size: L = 4" W = 2-1/2" H = 2-1/8"

Terminal Protection for Both Heater Halves Type C7

Type C7 terminal boxes are made from rust-resistant sheet metal. The C7 base is fixed to the clamping straps. The box has two 7/8" diameter knockouts opposite each other for standard 1/2" BX connectors. The cover is removable, providing easy access to the screw terminals for electrical wiring.

To simplify installation, Cast-In Heaters fitted with boxes can be factory prewired with high temperature lead wire, protected with armor cable. If either one of these options is required, ***specify terminal box type, lead wire and cable length.*** Satisfies NEMA 1 requirements.

C7 Terminal Box Size varies with dimensions of casting.

Quick-Disconnect High Temperature Cup and Box Assembly Type P2

Quick-Disconnect Cup assemblies provide the simplest and safest means for applying power to any type of Cast-In Heater installation. The box extends over the screw terminals on both Cast-In Band Heater halves. The combination of prewired cup and box assembly, along with factory prewired high temperature lead wire protected with armor cable, eliminates live exposed heater terminals and electrical wiring, protecting employees from electrical shock and the possibility of electrical shorts due to exposed wiring.

If prewired plugs are required, ***specify length of lead wire and cable***.

Rated 250V maximum, 15 Amp maximum

Terminal Box Size varies with dimensions of casting.

Terminal Protection Boxes for Cast-In Heaters

Type EP Explosion and Moisture Resistant Box

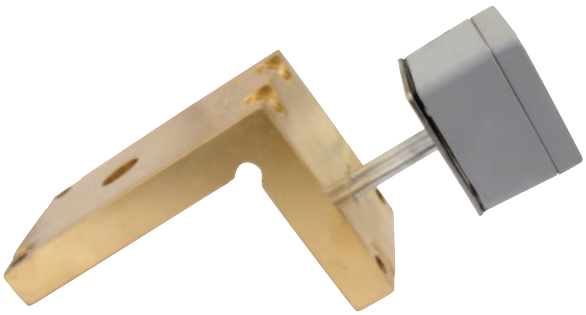
Cast iron explosion and moisture resistant boxes should be used in areas where the surrounding air may become contaminated with combustible gases or a high humidity level may exist. Installation requires one box per Cast-In Heater half and they are brazed to the tubular heater. The standard box has one 1/2" NPT hub.

Optional: Two hubs per box available. Cast-In Heater fitted with boxes can be factory prewired with high temperature lead wire, protected with special armor cable. If either of these options is required, please specify the following:

❒ Number of hubs ❒ Cable type ❒ Lead wire length ❒ Cable length

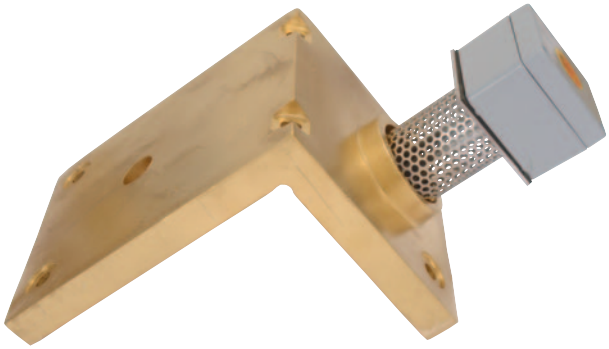
Type MPR Moisture Resistant Box

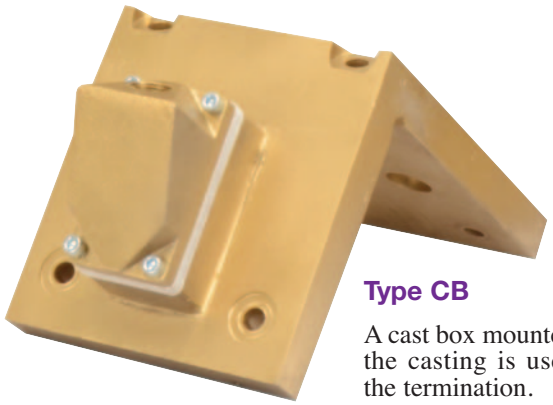
This design has a moisture resistant die cast aluminum box with a non-removable polyurethane gasket in the lid. Lid is secured with captive stainless steel screws. Body and lid are painted in basic industrial gray; interior contains copper ground screw. Box is mounted to a plate that is brazed to the element. Available in a wide variety of sizes.



Type MR1 Moisture Resistant Box with Perforated Shield

This design incorporates the MPR housing style along with a perforated tube shielding unheated extensions of the tubular heating elements. This feature provides mechanical strength to the element extension and prevents overheating of the terminals, reducing possible premature failure from corrosion and oxidation.





Type CB

A cast box mounted directly on the casting is used to protect the termination.

Exposed electrical wiring on cast-in heater installations is a violation of Electrical Safety Codes including O.S.H.A.

One Source Providing Extensive Engineering/Manufacturing Capabilities

Casting Process: Low Pressure

Used for large volume quantities. Specifically suited for intricate and challenging geometric shapes, producing quality castings with consistent dimensional accuracy and superior surface finish.

Alloy: Aluminum (only)
Tooling: Requires a Steel or Cast Iron Permanent Mold
Machining: Minimum to no machining
Weight Capacity: Up to 150 pounds depending on shape

Casting Process: Tilt-Pour Gravity Feed

Used extensively for medium to high volume quantities. Will accommodate simple to some irregular shape castings, producing good dimensional accuracy and surface finish.

Alloy: Aluminum (only)
Tooling: Requires a Steel or Cast Iron Permanent Mold
Machining: Moderate to Extensive
Weight Capacity: Up to 150 pounds depending on shape

Casting Process: No-Bake Sand Molds

Used for lower volume quantities, prototypes, very large irregular shapes and thermal platens.

Alloys: Aluminum, Brass, Bronze and Iron
Tooling: Requires a Wood or Plastic Pattern
Machining: Extensive
Weight Capacity: Up to 600 pounds

Melting Capabilities

Electric Reverb and Induction furnaces are used to minimize gas inclusion into the molten metal, thereby producing a denser, higher quality casting.

CNC Machining

There are certain dimensional and/or finish tolerances or geometry that cannot be produced as cast and must be machined. Tempco offers a full service state-of-the-art machine shop featuring various types of CNC machine tools to perform all of the precision machining required—from simple to complex contour geometrics, including turning and/or boring, with repeatable accuracy from one machined casting to the next. Machinists also build and maintain permanent mold tooling for the low pressure and tilt-pour gravity feed casting processes.

CMM Inspection

Coordinate Measuring Machine provides precise measurement of complex parts in process or at final inspection.

Pattern Shop

Tempco has an in-house Pattern Shop to build and maintain the wood or plastic patterns required to produce castings with no-bake sand molds.

No one can do it better than Tempco – LET US PROVE IT!

Experience Our Value-Added Services that are Second to None

Casting Alloys

Casting Alloy	Aluminum	Copper	Silicone	Zinc	Lead	Maximum Iron	Tin	Other
Aluminum 319	85.8 - 91.58%	3.0 - 4.0%	5.50 - 6.50%	≤ 1.0%	—	≤ 1.0%	—	≤1.7%
Aluminum 356	90.1 - 93.3 %	≤0.25%	6.50 - 7.50%	≤0.35%	—	≤0.60%	—	≤1.125%
Bronze	9.0 - 11.0%	≥ 86.0%	—	—	—	0.80 - 1.50%	—	≤1%
Yellow Brass	≤0.55%	58.0 - 64.0%	≤0.05%	32.0 - 40.0%	0.80 - 1.50%	≤0.70%	0.50 - 1.50%	≤1%

Material Properties

Material	Classification	Max. Surface Temperature °F (°C)	Density (lb/in^3)	Coefficient of Linear Thermal Expansion (in/in/°F x 10^{-6})	Specific Heat Capacity (BTU/lb-°F)	Thermal Conductivity (BTU-in/hr-ft^2-°F)	Melting Point (°F)
Aluminum 319	Aluminum 319.0	700 (371)	0.101	12.7 @ 68° – 572°F	0.23	754	960 – 1120
Aluminum 356	Aluminum 356.0	750 (399)	0.0968	12.9 @ 68° – 572°F	0.23	1160	1030 – 1140
Bronze	UNS C95300	1350 (732)	0.272	9 @ 68° – 572°F	0.0896	437	1900 – 1913
Yellow Brass	UNS C85700	1200 (649)	0.304	12.2 @68° – 500°F	0.0899	582	1660 – 1690

Linear Thermal Expansion Formula: $\Delta L = Li \times \alpha \times (T_f - T_i) \times 10^{-6}$

ΔL = Change in Length
Li = Initial Length α = Coefficient of Linear Thermal Expansion
T_f = Final Temperature T_i = Initial Temperature

Minimum Casting Thickness vs. Heating Element and/or Cooling Tube Diameters

Casting Thickness	Maximum Available Element Diameter Heat Only	Maximum Available Cooling Tube Diameter Cool Only	Maximum Element and Cooling Tube Combination Heat and Cool
5/8" (15.9 mm)	.260	1/4	—
3/4" (19.1 mm)	.375	3/8	—
1" (25.4 mm)	.430	1/2	—
1-1/4" (31.8 mm)	.430	1/2	.260 and 3/8
1-3/8" (34.9 mm)	.430	1/2	.315 and 1/2
1-1/2" (38.1 mm)	.430	1/2	.430 and 1/2
1-5/8" (41.3 mm)	.430	1/2	.430 and 1/2
1-3/4" (44.5 mm)	.430	1/2	.430 and 1/2
Finned Casting			
3/4" (19.1 mm)	.375	—	—
7/8" (22.2 mm)	.430	—	—
1" (25.4 mm)	.430	—	—
1-3/4" (44.5 mm)	.430	—	—

Casting Size & Weight Limitations

	Cylindrical	Platen
Minimum Inside Diameter:	1" (25.4 mm)	—
Maximum Inside Diameter:	48" (1219 mm)	—
Minimum Width:	—	1-1/2" (38.1 mm)
Maximum Width:	—	60" (1524 mm)
Minimum Length:	1-3/4" (44.5 mm)	4" (102 mm)
Maximum Length:	40" (1016 mm)	72" (1829 mm)
Finish:	125 RMS Standard or to customer spec.	

Gap (two-piece cylindrical cast-in band heaters)**:** 1/4" (6.4 mm) top and bottom or to customer specification

Maximum Weight: Aluminum— 600 pounds
Bronze & Brass— 300 pounds

NOTES: Cylindrical heaters are made with two half-round heaters. Cast-In thermal components can be made in any practical size, weight and geometric shape.

Heating Element Electrical Specifications

Tubular Heater Diameter	.260"	.315"	.375"	.430"
Maximum Volts	240	277	480	600
Maximum Amps **Per Element**	15	30	40	40

Maximum Watt Density: Aluminum Alloy—35 W/in^2 on the element
Bronze or Brass—45 W/in^2 on the element

Resistance Tolerance: +10%, –5% **Wattage Tolerance:** +5%, –10%

Three Phase available depending on casting size.
Ground Studs can be added to most cast-ins.

Note: Tempco-Pak mineral insulated cable heaters can be used in place of tubular heating elements to fit physical constraints not possible with conventional heating elements. See catalog Section 5 for more details.

Cooling Tube Materials for Castings with Liquid Cooling

Tube Material	Tube OD and Wall Thickness
Stainless Steel (Standard)	1/4" O.D. × .028 wall
Stainless Steel (Standard)	3/8" O.D. × .035 wall
Stainless Steel (Standard)	1/2" O.D. × .049 wall
Stainless Steel (Optional)	5/8" O.D. × .049 wall
Incoloy® 840 (Optional)	1/2" O.D. × .049 wall

Tubing with heavier wall thickness is available upon request.

Options for Cast-In Thermal Components

Casting Surface Treatments

Special surface finishes are required in some applications:

- Electroless Nickel Plating
- Teflon®
- Magnaplate
- Anodizing
- Hard-Coat Anodizing

Lab Services

- Computerized Infrared Heating Profiles
- Life Cycle Testing
- X-Rays to confirm heating element location and casting density
- Heating Ramp Rate Testing

Agency c UL us ***Approvals***

Cast-In Heater Elements are UL recognized under UL File Number E90771.
If you require UL Agency Approval, please specify when ordering.

Made in USA

Installation Recommendations for Cast-In Thermal Components

Tempco Cast-In Heaters will provide long life and dependable, trouble-free service if properly installed, operated, and maintained as per the following recommendations:

Installation

1. Allow sufficient space for thermal expansion. The amount of space required depends upon the Cast-In Heater size, operating temperature and alloy.
2. Surface being heated must be free of any foreign materials and have a smooth finish.
3. Make sure that the casting is properly seated. The clamping devices used should be tightened down to the correct recommended torque. After initial heat-up, retighten fasteners to the correct recommended torque.

Recommended Torque:
10 ft-lb for 1/4–5/16 bolts, 20 ft-lb for 7/16–5/8 bolts

5. Thermal insulation can be used to reduce heat losses.
6. Avoid mounting heaters in an atmosphere containing combustible gases and vapors unless specifically manufactured for use in such conditions.
7. Liquid Cooled Cast-In Heater fittings must be securely tightened to prevent leaks.
8. To prevent overheating and heater failure, adequate temperature controls should be installed. For assistance in selecting temperature controls and thermocouples, see Tempco's (in-stock) complete line of Plug-In type Proportional Temperature Controls for heating and cooling applications in Section 13. Also see the listing on standard and hot melt thermocouples in Section 14.

Wiring

1. For connections at the heater terminals, use high temperature nickel conductor or nickel clad copper lead wire or alloy bus bar. Keep all electrical connections properly protected to eliminate electric shock to machine operators.
2. Heaters of equal wattage and voltage can be connected in series for higher voltage.
3. Heater installations must be properly grounded to eliminate electric shock hazard, and wiring must comply with electrical codes.
4. Always have a qualified electrician perform all wiring and connection of heaters and control components. Terminals must be tightened to the correct torque (2.5 ft/lb for terminal connections).

CAUTION: Castings are not designed to be lifted or carried by the terminations or leads.

Exposed electrical wiring on cast-in heater installations is a violation of Electrical Safety Codes including O.S.H.A.

Note: See page 16-11 for Wiring Diagrams and page 15-2 for lead wire selection

Operation

1. It is recommended to slow start the process during first use.
2. Do not operate above rated voltage. Excess voltage will result in heater failure.
3. Do not operate Cast-In Heaters above recommended temperatures. Heater temperature must be monitored and controlled. Use of over-temperature T/C is strongly recommended for higher temperature applications. Excess temperatures will result in heater failure and/or melting.
4. Electrical terminals must be kept free of contaminants, as spillage of plastic, water, oils, and their vapors can cause electric shorts, resulting in heater failure.
5. Liquid Cooled Cast-In Heaters must not be cycled to operate simultaneously. Thermal stresses may result in shorter heater life.
6. The water used on Liquid Cooled Cast-In Heaters must be properly treated. Hard water contains corrosive media that will contaminate the tubing, producing stress corrosion cracks and resulting in shorter heater life. Presence of minerals in water can cause clogged tubes that can result in poor heat transfer and eventually heater failure.

Maintenance

1. Never perform any type of service on heaters prior to disconnecting all electrical power.
2. To ensure good surface contact, periodically check clamping. Retighten clamping to the correct torque when required.
3. Repeat cycling of temperature controls can indicate poor surface contact or a burned-out heater.
4. Heater terminals must be kept free of plastics, oil, water, and any other foreign matter. As these materials carbonize, they create electrical shorts.
5. Heater terminal electrical connections must be kept tight. Loose connections can overheat and eventual destroy the connection or the heater terminal.
6. Water lines must be periodically checked for leaks. Water on heater terminals can be detrimental to the entire heating system.
7. Thermocouples must be kept free of contaminants and be checked for good response to temperature changes. Our recommendation is to change them periodically, as a bad thermocouple can be the cause of destroying an entire heating zone.

Complete Your Installation With Accessories Available From Stock

Accessory	*Catalog Section*
✳ *Stainless Steel Tubing and Fittings For Cooling Lines*	*3*
✳ *Pressure Transducers and Rupture Disks*	*12*
✳ *Temperature Controllers*	*13*
✳ *Temperature Sensors, Thermocouple Wire, Jacks & Plugs*	*14*
✳ *High Temperature Lead Wire & Fiberglass Tape, Ceramic Terminal Covers and Electric Plugs*	*15*

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