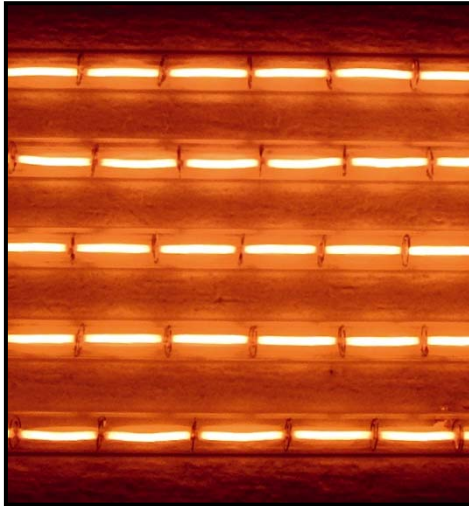


General Products Brochure

Thermal Solutions Products



Infrared Heating Solutions

Research, Inc has been producing fast heating, quartz T3 lamp systems since 1952. These systems were developed in conjunction with the United States Space Program to provide precise control of infrared heat in various aerospace applications. Today these heating systems are used in many industrial-heating applications to provide rapid, controlled infrared heat to a variety of thermal processes. Users of this type of T3 system realize many benefits including:

- Increased line speeds
- Reduced floor space requirements
- Lower energy consumption

Silicone Rubber Vulcanization

Cure silicone rubber tube and profiles at 4 times the speed of conventional hot wall resistance heaters

Wire and Cable Heating

Provide rapid heating of wire and co-axial cable for drying and heating prior to extrusion of plastic

Plastic Film Heating

Rapidly heat plastic film prior to laminating, stretching, or embossing

Plastic Softening

Preheat PET preforms or thermoformed sheet faster and more uniformly than with competitive systems

Coil and Strip Coating

Provide fast and uniform heat from edge to edge on coil and strip lines

Annealing

Anneal materials from low temperature plastics to high temperature metal

Fast. Focused. Controlled.



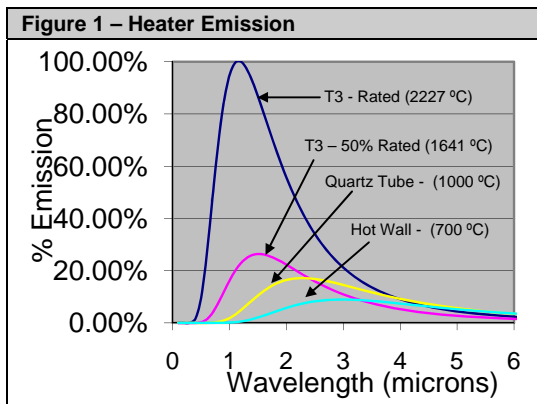
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Benefits of T3 Technology

Infrared (IR) halogen lamps (T3) consist of a tungsten filament encased in quartz. T3 lamps are available as a point source or as a linear source from 2 to 38 inches (51 to 965 mm) long, and power up to 5000 watts. Tungsten is a fast responding resistive element that produces high intensity infrared energy when power is applied. T3 lamps are coupled with either polished aluminum or ceramic reflectors to direct and enhance the infrared heating effect. As compared with other infrared emitters (see Table 1), T3 lamps have greater heating capability, greater radiating efficiency, and faster response.

	T3 Lamp	Quartz Tube	Hot Wall
Emitter Temp (max)	2227 °C	1000 °C	700 °C
Heating Density (max)	300 w/in ²	75 w/in ²	30 w/in ²
Radiating Efficiency	86%	60%	50%
Heat up	~ 2 sec	~ 30 sec	~ 30 min
Cool down	~ 5 sec	~ 60 sec	> 1 hr

T3 lamps produce a full spectrum of infrared heat (see Figure 1), that is optimum for most plastic, rubber, and coating materials.



Fast

One of the greatest benefits of using T3 lamps for heating is the ability to turn heat on and off almost instantly. The instant on/off feature offers a great number of benefits to the user. These benefits are important in extrusion, and web applications:

- Heat can be removed nearly instantly in the case of line stoppage to minimize risk of fire
- Maintenance can begin within minutes after electrical power is disconnected
- Reduced warm up and cool down times

Focused

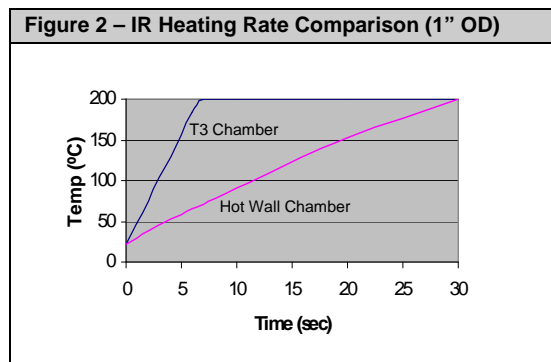
T3 lamps have a small filament, which allows the energy to be optically focused towards a target. By focusing the IR, the concentration of heat can be greatly increased. Multiple focused heaters can be arranged to heat radially inward (i.e. – heater facing heater) to surround the product with IR energy. Using this technique, products such as wire and tubing can be uniformly heated around their circumference. Area heating can be accomplished using an array of lamps, along with a diffuse reflector, which scatters the rays and provides uniform heating over an area.

The ability to focus IR heat can result in a number of benefits, including:

- Energy savings are achieved by focusing the IR to heat only desired area
- Higher process line speeds or reduced floor space can be achieved

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 compares the heating of a silicone tube extrudate with a 0.125 inch (3 mm) wall thickness. Heating the extrudate to 200 °C can be done in one-fourth the time, compared to a hot wall resistive chamber.



In the example, the faster heating capability of the T3 lamp system provides benefits of either:

- Reduce floor space requirement for the heater portion by a factor of four
- Increase production line speed by a factor of four

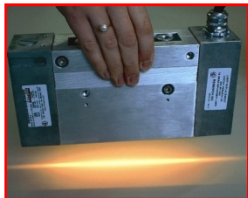
Products



The **ChambIR**[®] family offers two unique heater designs. The parabolic clamshell is designed to heat continuous materials

such as tube, pipe, and profiles that have an outer diameter from 0.25 inch (6 mm) to 6 inches (152 mm). The elliptical chamber is designed for thermally processing smaller size continuous materials such as tube, cable, and wire with an outer diameter less than from 0.25 inch (6 mm).

The ChambIR[®] family provides heating rates four times greater than convection or hot wall IR systems. The water-cooled reflectors coupled with the rapid response T3 lamps offers the users benefits of a high density heating solution and instant on and off response.



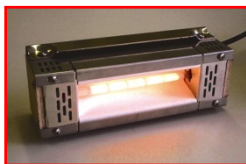
The **LineIR**[®] concentrates infrared energy to a long, narrow area of up to 0.18 x 38 inches (5 x 965 mm). The LineIR[®] is commonly used in wire heating and plastic bending applications. The

water-cooled reflectors coupled with the rapid response T3 lamps offers the users benefits of a high density heating solution and instant on and off response.

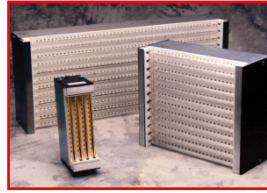


The aluminum, water-cooled **StripIR**[®] concentrates radiant heat to an area up to 1.5 x 38 inches (38 x 965 mm). The water-cooled reflectors coupled with the rapid response T3 lamps

offers the users benefits of a high density heating solution and instant on and off response.



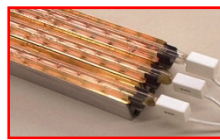
The ceramic, air-cooled **StripIR**[®] concentrates radiant heat to an area up to 1.7 x 38 inches (43 x 965 mm). The maintenance free ceramic reflector creates a uniform heating pattern, and the StripIR[®] is ideal for heating in environments where process out gassing may cause reflector contamination.



The **PanelIR**[®] rapidly heats larger flat areas. These heaters are commonly used over moving webs and coil lines. The air-cooled ceramic reflectors, coupled with the rapid

response T3 lamps offers the users benefits of a high density heating solution and instant on and off response. These heaters can be used alone, or together to create a larger heated area.

The **ModuleIR**[®] offers the capability to create a custom area heater design to match the application's area heating needs. Multiple modules are housed together in a sheet metal enclosure to provide



the desired heating effect. The water-cooled aluminum reflectors coupled with the rapid

response T3 lamps offers the users benefits of a high density heating solution and instant on and off response. Heating densities of up to 330 watts/in² are available. The ModuleIR[®] heater can replace several older Research, Inc. heaters including models 5090, 5094, and 5236.



The **LoTempIR**[®] offers the capability to heat with quartz halogen lamps in low density heating applications. This air-cooled heater can be

used in a bank of multiple heaters to provide a relatively low heating density to a large area.



The **SpotIR**[®] from Research Inc. offers the capability to heat a small circular area. The air-cooled reflectors coupled with the rapid response T3 lamps offers the users benefits of a high density heating solution and instant on and off

response. There are two unique heaters in this family designed for different spot sizes and heater densities.

Products – continued

The **ControllIR**[®] Series of power controllers and systems are designed to provide safe, high-precision voltage control in a variety of applications. The control systems are designed to meet the needs of the Research Inc. Infrared product line.



Packaged power control solutions are available with a range of sizes and features. This line of cabinets is designed to provide proper control for Research, Inc. heating products.



Stand-alone single-phase power controls designed specifically for Research Inc. heating products. These units are ideal for the test lab, small production setting, and prototype development areas.



Individual power controls are available with a wide range of amperages, voltages, and features. These are designed for applications where the power controller is integrated into system.



A line of power control boxes designed to meet the needs of our heaters are also available. Our "PC Options" provide a simple standard power control solution to match the given heaters.

In addition, we provide system solutions for those customers who have requirements beyond the standard product line. The customization may be in the form of the following:

- Heater design
- Process control (multi-zone, pyrometers, alarms, and software control)
- Framework and mounting
- Water chillers and heat exchangers for cooling the water-cooled reflectors

Process Testing

We offer free process verification testing to qualified customers. Our test lab is available for customers to visit, or to send in their test samples, to determine how well T3 lamp technology works in their application.

About Research, Inc.

Research, Inc. designs, manufactures, and sells heating and associated control systems used in various thermal processing. Research Inc. products are marketed worldwide and many have received the CE mark.

Founded in 1952, the company's headquarters and manufacturing facilities are located in Eden Prairie, Minnesota. The company was initially established to develop infrared-based heating systems for the aerospace industry. Since then, Research Inc. has grown into a major supplier of heating products and systems used in many different markets including graphic arts and print media, plastic and rubber processing, metal coatings, and material testing.

Research, Inc. reserves the right, without notice, to alter or improve the designs or specifications of the products described herein. No warranty or guarantee of any kind is expressed or implied by information contained herein.

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