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Zone Heater
Heat Source (Element) Style Comparison
Infrared Quartz (Bulbs) vs. Mineral Insulated Finned Tube

As Tacony began research on zone heaters in preparation for getting into the business, we had the opportunity to start with a clean piece of paper and question everything.

We were already sold on the great advantage of zone heaters – home heating cost savings resulting from energy conservation. We also appreciated the need for completely safe zone heat and the concept of disguising the heater as furniture. For us, the only question was the type of heat source style to use to make it the best heater on the market.

There is much confusion and some significant deception in this zone heater market. But, there are laws of nature and science that cannot be altered. Heat is energy in transient form that flows due to temperature difference. The movement or transfer of heat has several forms. Infrared radiation (IR) heat, unlike heat transmitted by thermal conduction or thermal convection, travels through the air in waveform the same as light, without heating the air. IR heat must come in contact with something of a significant size or mass before it can be absorbed. Air cannot be directly heated by IR as air does not have sufficient mass.

If you have ever been warmed by a bonfire on a cold night, you have experienced IR heat. While your body is in cold air and there is cold air between you and the fire, the bonfire can keep you warm (as long as you rotate) by projecting and transferring its heat over some distance. IR of the bonfire does not become heat until it is absorbed by the people or objects that surround it.

Most of our main competitors in the market are selling what they call "infrared" heaters. In reality, they are all "forced air" heaters. While the heat source of these heaters may be IR, the IR source is only used to heat a heat exchanger of some kind, which in turn is used to heat the air which is forced through the unit by a fan.

True infrared radiation heaters have many appropriate applications. They are used in industrial applications where the need is to heat an object, such as drying of coatings. IR heaters also work well in applications where it is impractical to heat the surrounding air, but the need is to heat an object. A patio heater is a good example of a true IR heater. The IR patio heater does not work to heat the outside air. That would be impractical as the air is not contained. Instead, the patio heater heats the objects (i.e. people, the patio itself, etc.) that surround it. There are also true IR home heaters. The glow of a cheap exposed quartz tube (or wire element) IR space heater transmits IR heat directly on objects in the home without heating the air.

It's important to know that IR elements or bulbs are designed and intended to project energy over distance, not to be contained in a small chamber where much of the radiation is reflected back upon the element. This condition raises the temperature of the element and components surrounding the element. The operating temperature of the element and the components is a key factor in their life expectancy. Direct and efficient removal of heat from the element is critical in ensuring long element life.

So, while IR heat has specific application, heating air is not one of them. Why then use IR as the heat source of a forced-air heater? IR heat <u>can</u> be used as the heat source in a forced air heater by heating an object, a heat exchanger, which can then be used to heat the air. But, why do it that way? The indirect IR heaters offer no real advantage, and have the very real disadvantage of the relatively short life of the bulbs or quartz elements. This short life presents both reliability issues and on-going maintenance costs. Instead, why not heat the air <u>directly</u> with a heat source that is reliable and has a service life many times longer than that of the best bulb or quartz element?

It is not a matter of efficiency of the heat source, as all electric heat creation is 100% efficient. IR heat (even the indirect heating of air with IR) is not inherently more or less efficient than other forms of electric heat. 1 kilowatt Hour equals 3,413 BTU (British Thermal Units) of heat. There is no perpetual motion machine or any electric heat source that is more than 100% efficient. Anyone who leads people to believe otherwise is selling snake oil.

There are other determining factors that control a heater's overall performance, or efficiency in heating a room. The design of the enclosure, the speed and performance of the fan, the air path, the size and direction of the exhaust grill, all are important contributing factors in the ability of a heater to do its job. The process of converting electricity into BTU is not an efficiency determinant, as the ratio of electric consumption to BTU generation is fixed by science: 1 kilowatt-hour (kWh) = 3413 British Thermal Units (BTU).

Early prototypes of the Tacony Zone Heater included units that utilized a quartz element and heat exchanger very similar to that of the high-end market leader. We had made our prototypes work as well as any indirect IR heater, but we were not satisfied with the relatively short life (maximum of 5,000 hours, usually less) of the quartz elements or bulbs. As with most things we sell, we wanted a true and demonstrable competitive advantage that consumers would care about.

To that end, we sourced what we believe is the best possible heat source for our Tacony Zone Heater. Our zone heaters use a Magnesium Oxide Insulated Finned Tubular Heating Element. Inside the tube is coiled element wire. The fundamental difference between our finned tube element and a quartz element or bulb is that we are not trying to create IR heat, so instead of the bulb (or enclosure) being quartz, our enclosure is stainless steel. Our goal is to transfer the heat energy of the wire to the stainless steel tube and fins, which act as our integrated heat exchanger with the air.

The finned element tube is filled with Magnesium Oxide (MgO mineral). The MgO insulation is a fine granular powder that is layered between the resistance wire and the tube. The MgO is compacted around the element wire. The compacted MgO offers excellent thermal conductivity. In other words, it provides an efficient means for transferring the heat energy.

The MgO pulls heat away from the wire and transfers it to the finned tube. The heat is efficiently removed from the finned tube by the flowing air. The result is dramatically reduced resistance element (coiled wire) temperatures compared to that of quartz elements or bulbs. This dramatic reduction in wire temperature resulting from the efficient transfer of heat away from the element wires prevents element burn-out and provides longer element service life.

The MgO also has great dielectric strength. It acts to hold the wire element stationary, insulating the wire and preventing shorts and hot spots that can result in premature failure in bulb or quartz style heaters.

When we replaced the IR quartz element of our prototypes with our Magnesium Oxide Insulated Finned Tubular Heating Element and eliminated the separate heat exchanger, the exit air temperature of the heater increased and the metal enclosure (box) temperature decreased. It made it a better, more efficient, more reliable, lower maintenance, longer lasting heater. The decision became clear that we should leave IR style elements behind and go with what is simply a better technology for heating air and provides a dramatically longer element life.

Our Finned Tube heating element has a rated design life of 50,000+ hours. With this design, we are able to address the main durability/maintenance issue of quartz heaters and offer a full 10 Year Warranty on our heating element.

We hope this helps you to understand why we decided not to copy the quartz heaters currently on the market and instead develop a superior zone heater product for your customers.

Thanks,

John Kaido