The Key Benefits of Infrared

Regardless of brand type or features, an infrared heater will typically save energy when compared to traditional methods of heating. The overall operating efficiencies of an infrared system are proven and measurable.

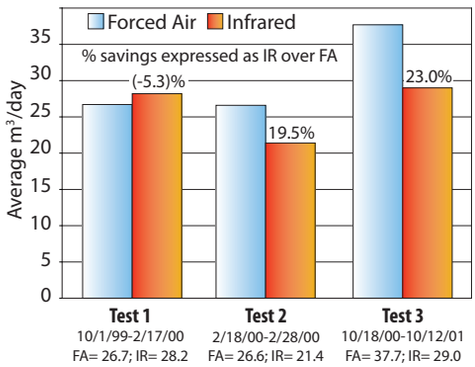
When selecting an infrared tube heater, there are several key features that contribute to the overall quality and effectiveness. Items such as two-stage technology, burner design, exchanger tube properties and reflector material all have a vital role to play in the makings of an exceptional infrared heater.

Independent Evaluation of Infrared vs. Forced Air Heating

A 2-½ year study (Oct. 1999 – March 2002) was conducted at a commercial facility to compare the effectiveness of a two-stage infrared heating system verses a forced air heating system. The study was recognized and published by ASHRAE in 2003 (see ASHRAE Paper 4643). A summary of the key findings is noted below.

- The results yielded a **fuel savings of up to 23%** over a conventional forced air heating system.
- The two-stage infrared heat system ran on low fire longer than the forced air unit per on-cycle, resulting in **reduced temperature swings** and **improved comfort**.
- The thermal flywheel effect in the concrete slab contributes to **energy use efficiency**.

Forced Air vs. Infrared Energy Usage.



Utility Rebate Programs

A growing number of gas utilities have formally recognized the energy saving benefits of infrared and have included them in sponsored rebate programs. A list of known programs is provided below.

Location	Amount	Company	Contact Information
Michigan*	$5.00	Consumers Energy	www.consumersenergy.com/eeprograms
	$2.50	DTE Energy	www.dteenergy.com
Minnesota**	10%	Center Point Energy	www.CenterPointEnergy.com/BusinessRebates
	10%	Austin Utilities	www.austinutilities.com
	10%	Owatonna Utilities	www.owatonnautilities.com
	10%	Rochester Utilities	www.rpu.org
New England***	$500	Gas Networks	www.gasnetworks.com/efficiency/comm_infrared.asp
Upstate New York***	$500	National Grid Efficiency	www.thinksmartthinkgreen.com
United States	TBD	Various State Programs	www.dsireusa.org

Listed programs apply to natural gas, low intensity infrared heaters only.
* Rebate amount per Therm. ** Rebate % of equipment cost with a maximum of $1500. *** Rebate amount per unit.

ASHRAE Paper of the Year

In 2003, Agviro Inc. was recognized by ASHRAE for their efforts in publishing Paper No. 4643 "*Evaluation of an Infrared Two-Stage Heating System in a Commercial Application*". Agviro Inc. has researched and authored a number of scientific, technical and informational papers on the subject of energy efficiency.

Benefits of Infrared

- **Proven Savings**: 20-50% over conventional forced air units.
- **Flexibility:** Heaters can be placed where they are most needed.
- **Superior Comfort:** Reduced stratification and increased perceived comfort.
- **Modular Design:** Unitary systems are excellent for spot heating or for total building heat.
- **Durability:** Low maintenance and quality components ensure a long life cycle.
- **Quiet and Clean:** No noisy air blowers pushing dirt and dust around.

Energy Conservation

ASHRAE Handbook -2008 HVAC Systems & Equipment.

"Infrared heaters are effective for spot heating. However, because of their efficient performance, they are also used for total heating of large areas and entire buildings (Buckley 1989). Radiant heaters transfer heat directly to solid objects. Little heat is lost during transmission because air is a poor absorber of radiant heat."

Ever Wonder...

Why your car gets better gas mileage when driving on the expressway? This is primarily due to a reduction of start – stop cycles prevalent to city driving. A two-stage heater also conserves energy by reducing its on/off cycles.

Two-Stage Operation

Don't be fooled by claims of reduced thermal efficiencies when considering two-stage technology. The key to two-stage operation is the reduction in cycles which directly translates to an overall improved operating efficiency.

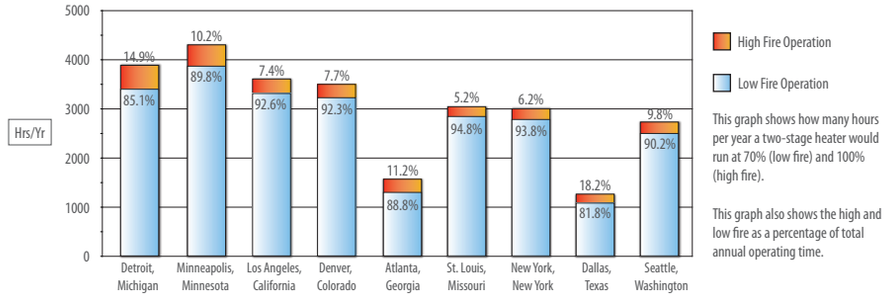
Buckley and Seel

Buckley and Seel (1987) compared energy savings of infrared heating with those of other types of heating systems. Recognizing the reduced fuel requirement for these applications, Buckley and Seel (1988) noted that it is desirable for manufacturers of radiant heaters to recommend installation of equipment with a rated output that is 80 to 85% of the heat loss calculated by methods described in Chapters 29 and 30 of the 2005 *ASHRAE Handbook - Fundamentals*.

Two-Stage Technology

Two-stage infrared technology is characterized by a high fire (typ. 100%) and a low fire (typ. 65%) operating mode. Because high fire is typically only needed 5-10% of the season, the dominant operating mode will be low fire.

Annual Heating Hours for Major Cities



This graph shows how many hours per year a two-stage heater would run at 70% (low fire) and 100% (high fire).

This graph also shows the high and low fire as a percentage of total annual operating time.

Unlike single stage heaters, two-stage operation allows for a 35% reduction in on/off cycles and has a documented 12% fuel savings over single stage heaters. Oftentimes, a 20% savings is realized. Two-stage heaters provide enhanced comfort levels and perform to the demands of the space. The two-stage operation also allows for faster heat recoveries, design flexibility and improved comfort levels.

Braneida Study

A six month study (Oct. 1993 - April 1994) was conducted to evaluate the operation of two-stage and single stage infrared heaters. The study was recognized and published by RDM Engineering in July 1994. A summary of the key findings is noted below.

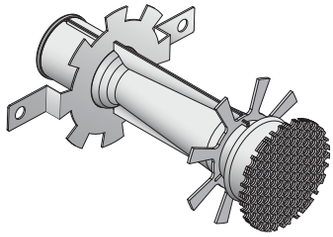
- **Fuel Savings**. A 12% additional fuel savings was observed.
- **Cycle Reduction**. A 35% reduction of on/off cycles directly correlates to fuel savings as it avoids the wasteful over-cycling nature of single stage appliances.
- **Superior Comfort**. The ability to operate in low fire for prolonged periods of time results in less intense, improved comfort levels.
- **Design Flexibility**. Two-stage technology allows one to design for the "worst case" scenarios, yet perform to the "normal" daily demands.
- **Faster Heat Recoveries**. An appliance operating at 65% will obtain full output (100%) much faster than an appliance that starts from off.
- **Reduced Carbon Dioxide Emissions**. Less energy consumption will result in less emissions.
- **Improved Product Life**. A reduction in operating cycles and temperatures yields less stress on the equipment thereby extending its life cycle.

Advanced Burner Design

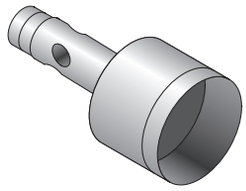
There are many different shapes, styles and configurations of burners in infrared appliances. A well designed burner has the ability to achieve complete combustion through a wide range of inputs without producing an unstable, noisy or incomplete burn. There are several key design characteristics that affect the performance of a burner in an infrared appliance.

Key design characteristics include:

- A **true venturi**.
- Separated **primary and secondary** combustion air.
- All **stainless steel** construction.
- Specialized **flame arrestor** designed to inhibit flashback or liftoff.
- **Vortex inducing fins** increase thermal heat transfer.



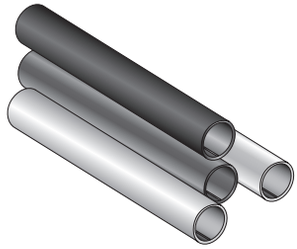
Vortex "Swirl" Burner



Cup-style Burner

Heat Exchanger Tubes

The exchanger tubes of a low intensity infrared heater are a critical part of the heater. Many criteria must be met in order to achieve the maximum thermal radiant output. For additional information on tube construction and design see Chapter 5.



- 16-gauge construction for improved performance and longevity.
- Overlapping **swage design** to ensure a continuous seal.
- Various **material offerings** to meet the needs of any application.
- Specially formulated **silicon-resin coating** increases radiant output.

Emissive Values for Common Industry Heat Exchangers

Highly emissive silicone-based resin coating: $\varepsilon = .95$
Heat-treated exchanger: $\varepsilon = .80$
Untreated exchanger: $\varepsilon = .70$

Definitions

Emissivity: The ratio of the radiant energy emitted by a surface to that emitted by a black body at the same temperature. Perfect black body emissivity is 1. A perfect reflector is 0.

Venturi: A venturi burner with a tapered throat follows Bernoulli's Principle that states, "where there is a decrease in pressure, there must be an increase in velocity at the same rate that the pressure decreases."

Did You Know?

The Stefan-Boltzmann Law states that the total energy radiated from a body is directly proportional to the fourth power of the black body's thermodynamic temperature, T (also called absolute temperature), and can be calculated by the following formula:

$\mathbf{w = A\varepsilon\sigma T^4}$ (total radiant output)

A = Area of emitting surface
ε = Emissive Value
σ = Stefan-Boltzmann constant
T = Absolute temperature

A high temperature black resin coating (aka/ Pyromark) enhances the ability of a radiant emitter tube to emit infrared energy. This black coating is the same material used by NASA on the nose of the space shuttle to disperse heat away from the space shuttle during re-entry into the Earth's atmosphere.

Labor Savings:

A heater featuring a swaged tube design is far easier to install than a non-swaged design and will typically reduce the comparable installation time by 1-2 man hours.

Reflectivity:

Reflectivity is a material's ability to radiate energy to the floor. The best example of this is to compare how well a flashlight is reflected from a highly reflective surface verses a dull surface.

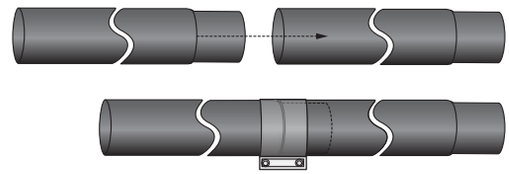
Despite the availability of bright aluminum, most reflectors used in the infrared industry are constructed of a mill finish aluminum that only provides a 60-70% reflectivity value.

Did You Know?

Detroit Radiant Products performs a 100% function test on each unit prior to its approval for shipment from the factory. This dedication to quality ensures that the end user will receive a quality product able to consistently serve their heating needs for many years to come.

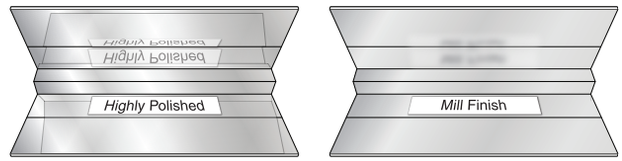
Interlocking Tube Design

Detroit Radiant Products Co. utilizes a unique interlocking tube design that overlaps each tube by four inches. This is accomplished by swaging (pronounced "swedging") one end of the tube to fit into the next. The benefits of this design include structural integrity, a better seal, assurance that the clamp will not act as a heat exchanger, and labor savings on the initial installation.



Quality Reflectors

Aluminum reflectors that have a highly polished, mirror-like finish — with 85 to 95% reflectivity — are most effective in reflecting infrared heat energy to people and objects at the floor level. This manufacturing detail is optimal for targeting the heat energy to specific areas.



When radiant energy falls on a reflector's surface, it is either reflected or absorbed. Aluminum has a low absorption value and when combined with a polished surface, it will have a very high reflective value.

Reflector Grade	Reflectivity	Absorption Value	Radiant Energy on Reflective Surface
Mill Grade	60 - 70%	.40 - .65	35 - 60%
Polished Aluminum	85 - 95%	.10	90%

Quality Components

In addition to the enhanced key components outlined in this chapter, Detroit Radiant Products Co. utilizes many other quality components, such as:

- Reliable ignition systems.
- Fully digital controls.
- Industry proven gas controls.
- Various upgrade options.
- Service friendly designs.
- Flexible control and voltage options.
- Quality accessories for custom configurations.