ASHRAE VIRTUAL ANNUAL CONFERENCE

June 28-30, 2021

Seminar 19-Infrared Heating and Grow Facilities

"Infrared Heating"

(Basic theory and application of gas fired infrared heat)

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Learning Objectives

- Understand the physical properties of infrared radiation.
- Identify the difference in thermal efficiency and radiant efficiency.
- Identify the advantage of infrared radiant heat forplants in a greenhouse.
- Understand the comparison of infrared heated greenhouses compared to indoor grow houses.

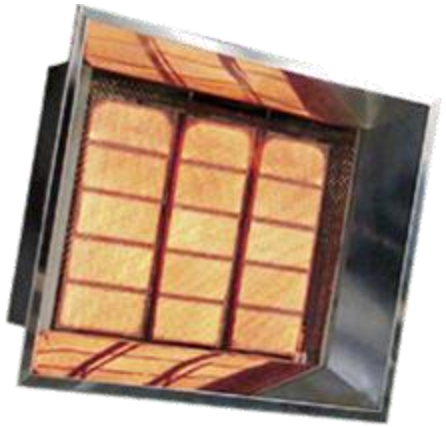
Where to apply infrared systems

- Warehouses / Industrial facilities
- Distribution / Fulfillment Centers
- Aircraft Hangars
- CNG vehicle service facilities
- Outdoor Venues

Types of Infrared Heat

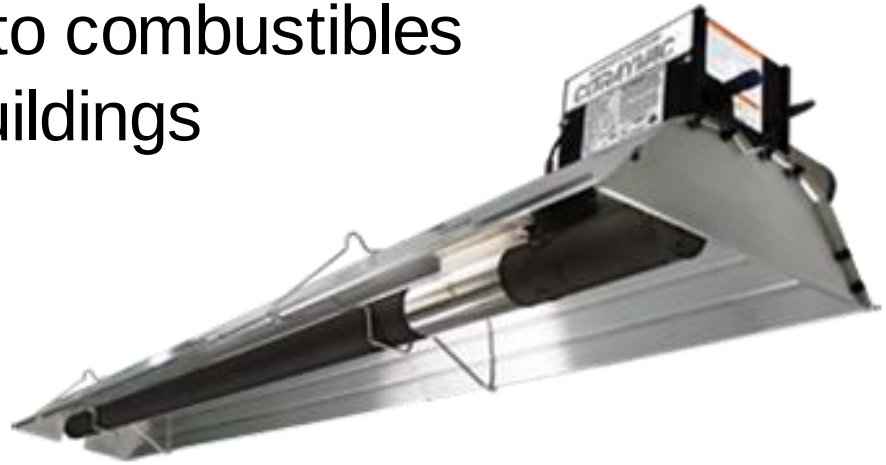
High Intensity

Spot heating applications



Low-Intensity

- Flexible design
- Ideal for spot or general space heating
- Lower clearances to combustibles
- Low or high bay buildings



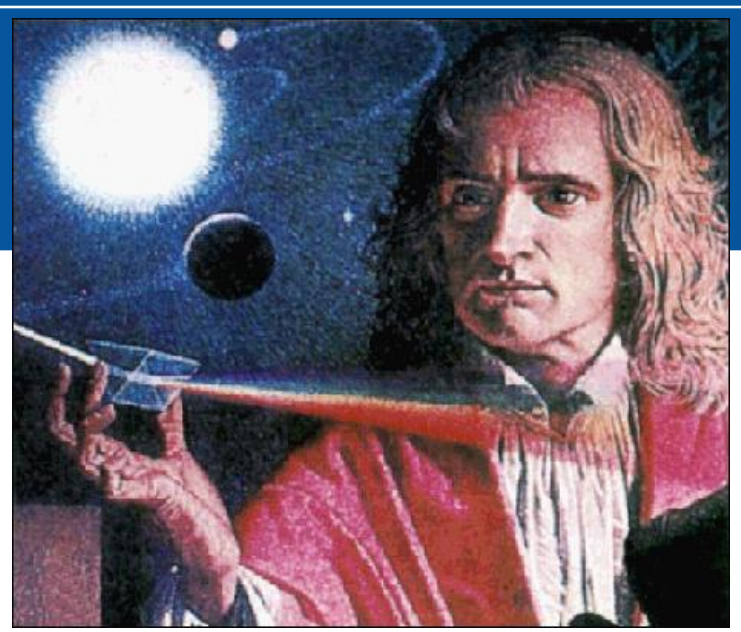
Controls:

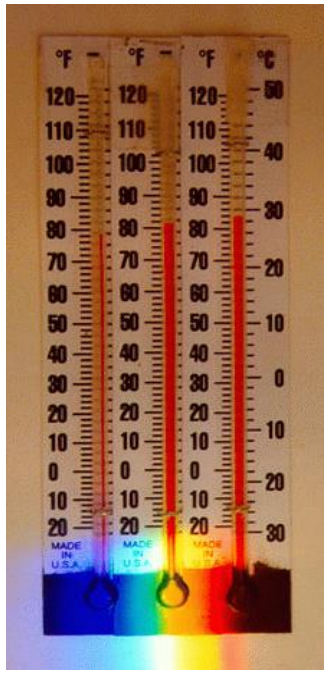
- Single Stage
- Two Stage
- Fully Modulating

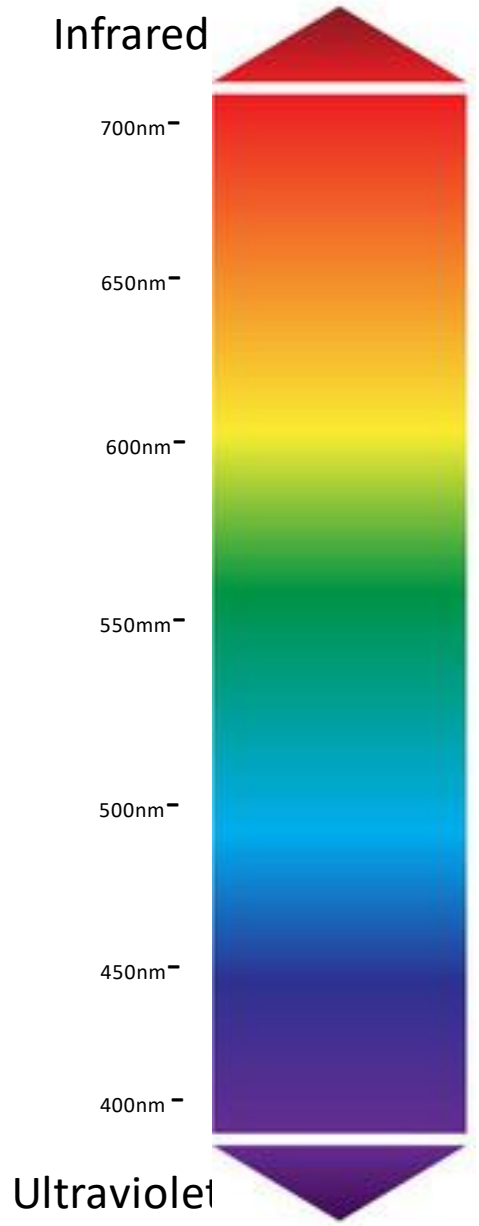
Infrared Heat History

Discovered in the year 1800

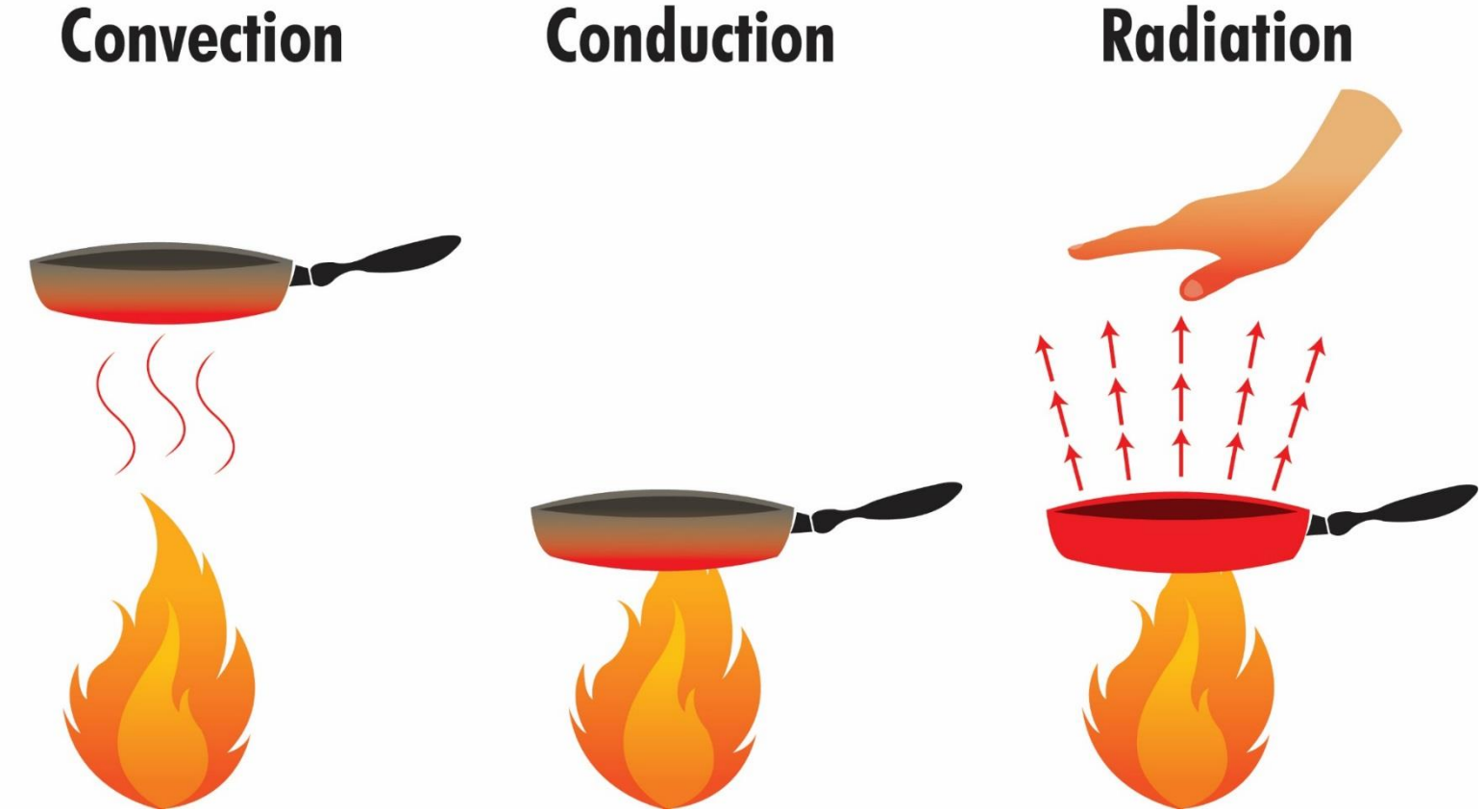
by Sir William Herschel



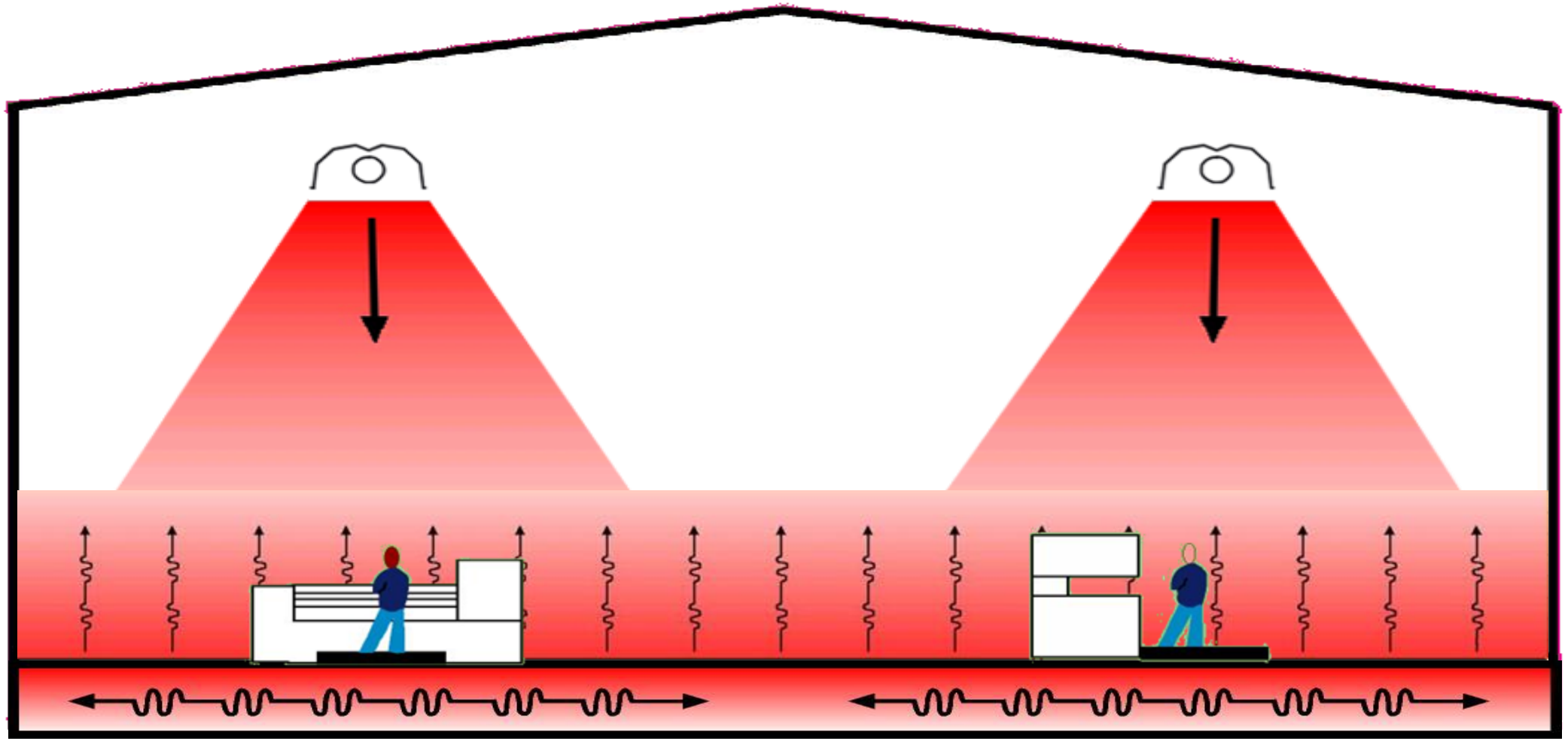




Infrared Heating Utilizes All Methods of Heat Transfer

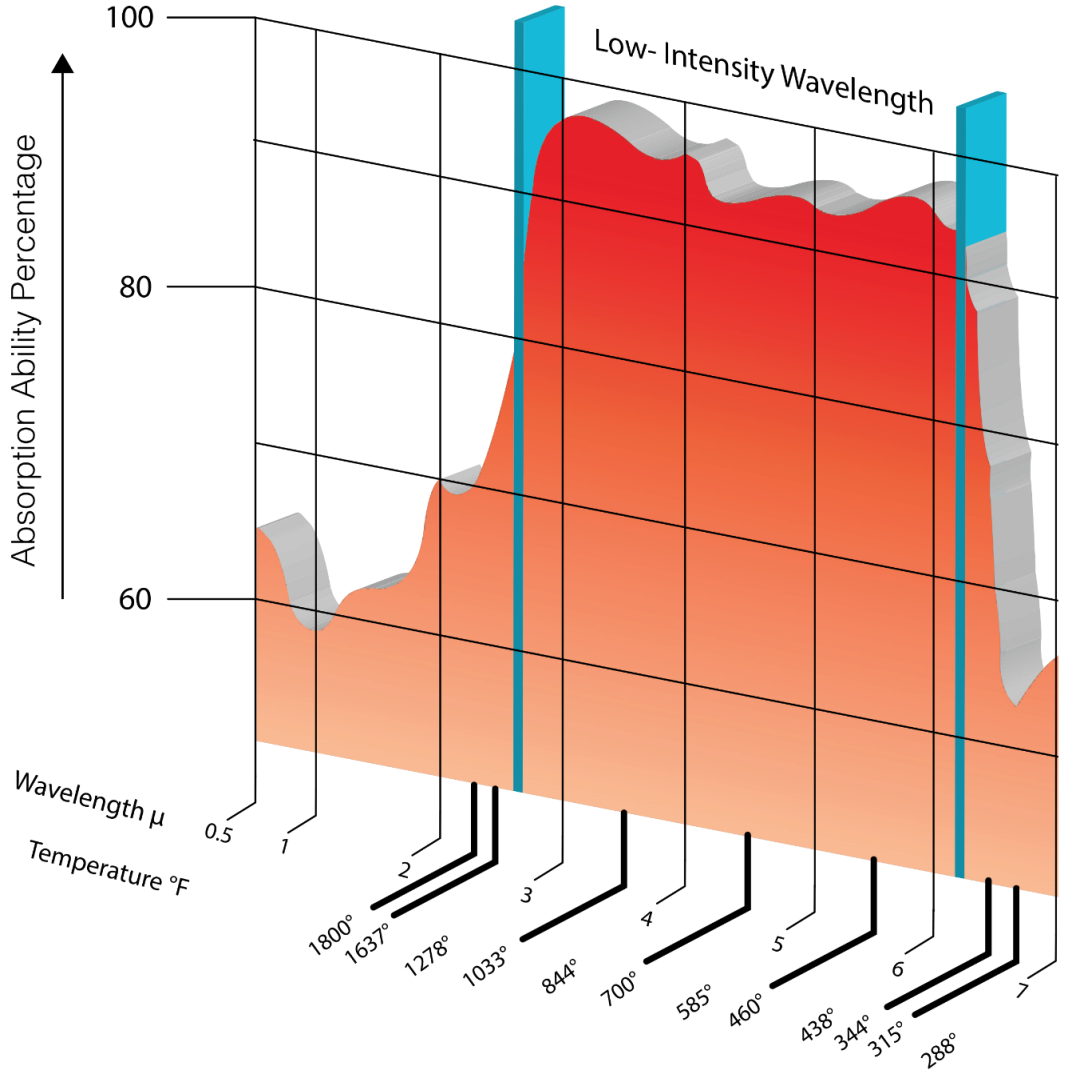


The Process of Infrared




90°F (32°C)
CEILING TEMPERATURE
HOW WARM AIR
HEATS A
BUILDING
60°F (16°C)
GROUND LEVEL TEMPERATURE

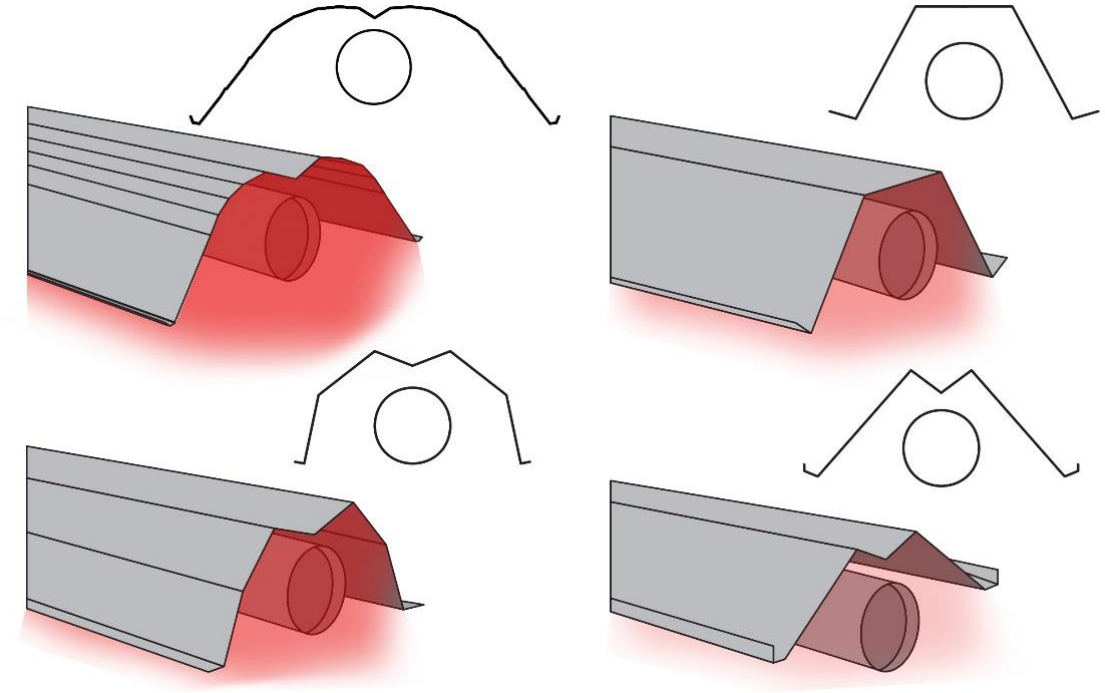
Absorption of Infrared Energy by Concrete



Emissivity

MATERIAL	EMISSIVITY
Aluminized Steel (Heat Treated)	0.80
Hot Rolled Steel	0.80
Porcelainized Steel	0.92 to 0.96
Cast Iron	0.95
Stainless Steel (type 304)	0.44 to 0.62
Paint	0.80

Reflectivity



MATERIAL	REFLECTIVITY
Aluminum (Mill Finish)	0.91 to 0.95
Aluminum (Polished)	0.91 to 0.95
Stainless Steel (Type 304)	0.48 to 0.66

Infrared Design Concepts

- **Sufficient "Charge"**

  Floor must exchange energy with surroundings

- **Heat distribution**

  Must heat floor evenly to increase MRT

- **Design for comfort**

  Receive gentle blanket of infrared heat

Stefan-Boltzmann Law

$$E^* = \sigma T^4$$

Where σ (sigma) = 5.67×10^{-8} Wm^2 K^4

and T is the temperature in Kelvin.

- A small increase in emitter temperature results in a large amount of heat transfer to people and objects.
- An increase in heat transfer to people and objects raises the MRT.

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OPERATIVE TEMPERATURE (T_o) CALCULATIONS

Formula: $$t_o = \frac{MRT + t_a}{2}$$

Air Heating (example)

MRT = 65°F **T_a = 75°F**

$$T_o = \frac{65\,°F + 75°F}{2} = 70\,°F$$

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OPERATIVE TEMPERATURE (T_o) CALCULATIONS

Formula: $$t_o = \frac{MRT + t_a}{2}$$

Radiant Heating (example)

MRT = 75°F **T_a = 65°F**

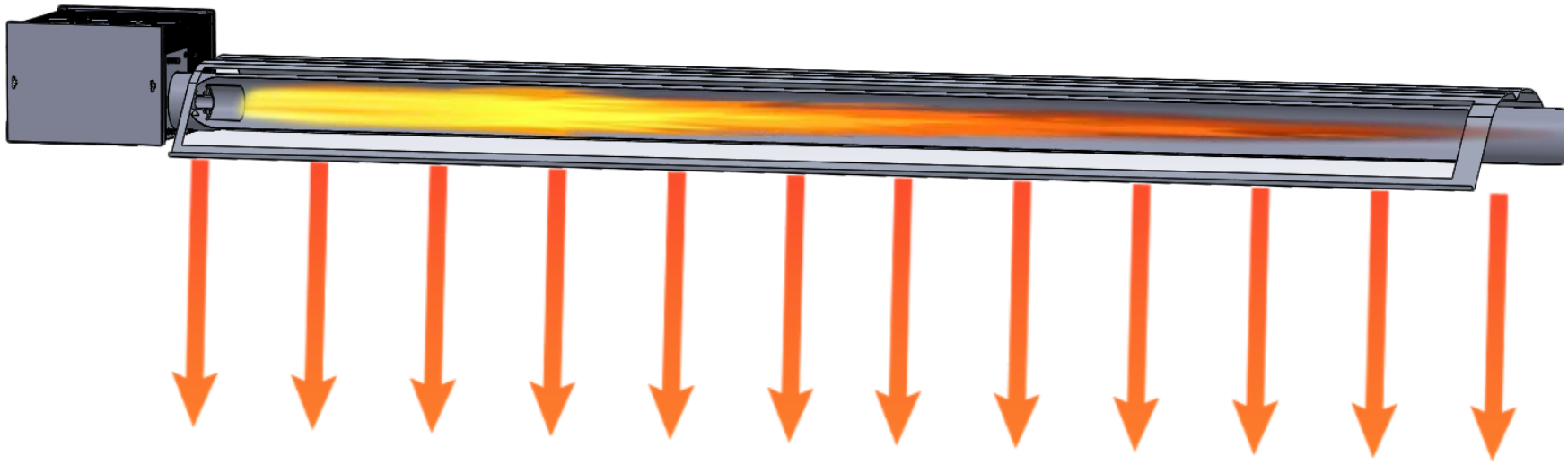
$$T_o = \frac{75\,°F + 65°F}{2} = 70\,°F$$

Increasing the Mean Radiant Temperature (MRT) improves the Operative Temperature (t_o)

Advantage:
Infrared

Thermal Efficiency (heat transfer losses)	Radiant Efficiency (heat transfer increases)
1,000,000 Load	1,000,000 Load
÷ .80	X .85
1,250,000 btu/hr	850,000 btu/hr
Unit Size	Unit Size

Infrared Heaters deliver more heat energy than any other type of heat.



- Converting energy input into useable radiant heat
- AHRI 1330 measurement methodology

Benefits of Low-Intensity Infrared

Energy Efficient

Easy to Install,
Operate, Maintain

Clean, Quiet,
Draft Free Heat

Quality Product with
Field-Proven Performance

Simple “Stick“ Heater

- Single Stage
- Positive Pressure
- Low Cost
- External Blower

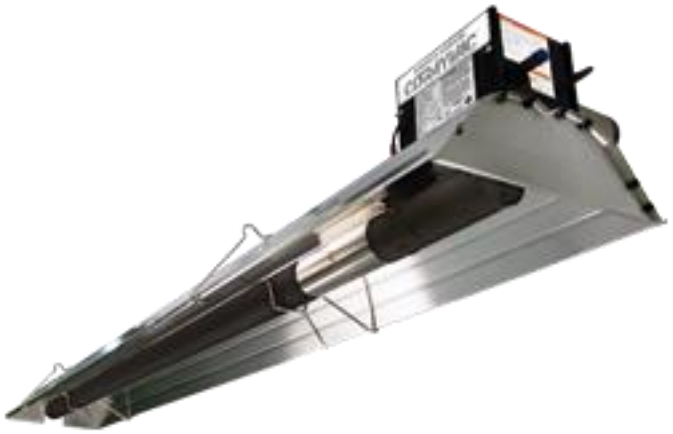
Harsh Environment
"Stick" Heater

- Hazardous Environments
- Suitable for Car Washes
- Outdoor Use
- Stainless Steel Reflector

Two directional "Stick" Heater

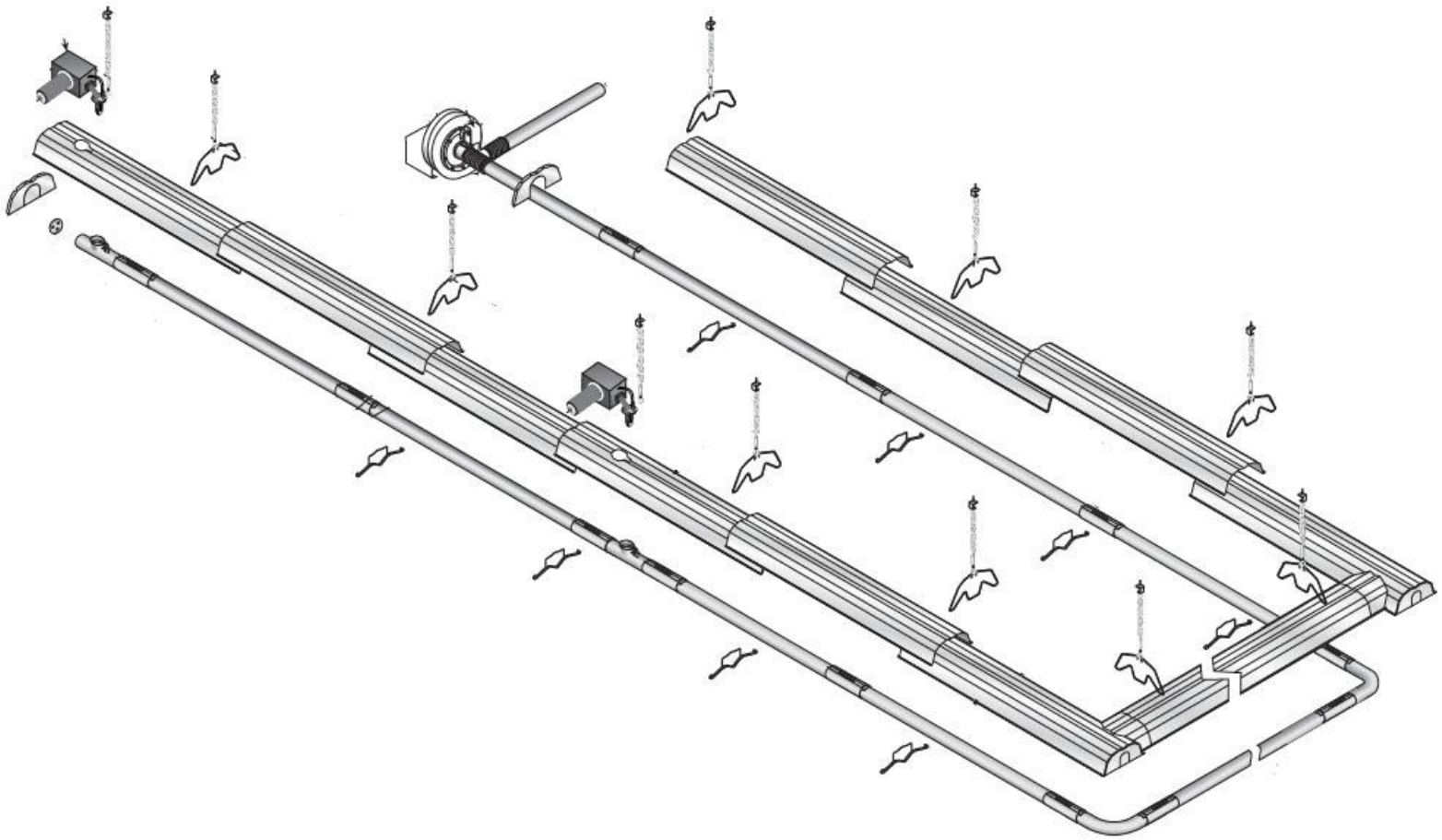
- Combines two burners into one.
- Burner fires in two directions
- Reduces gas, OSA, vent & electrical connections
- Straight, U, L, "box" configurations

Burners in Series



- Vacuum Fired
- Burners In Series
- Most Even Heat
- Lowest Operating Cost
- Custom Design

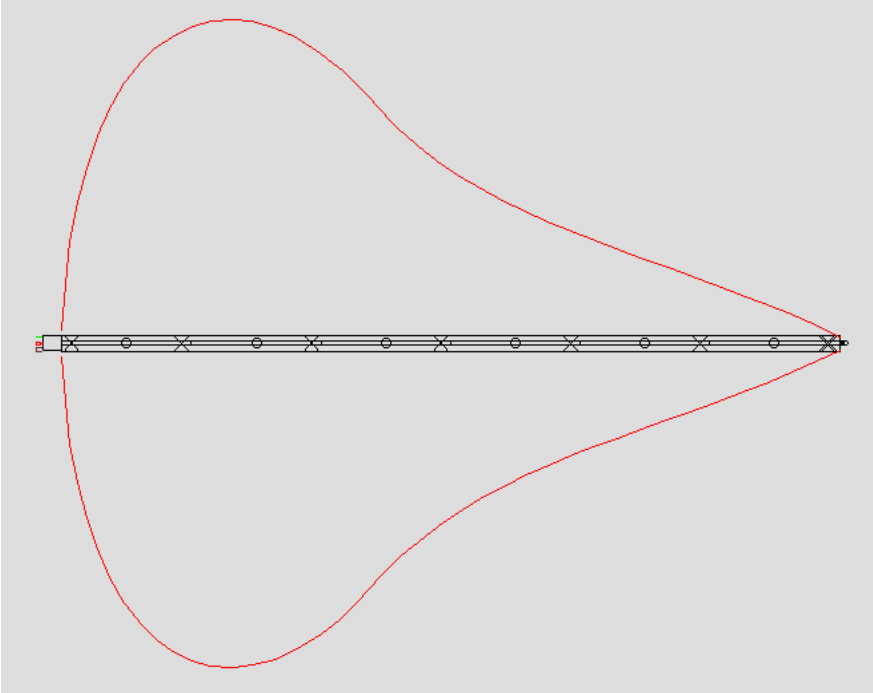
Burners in Series Layout



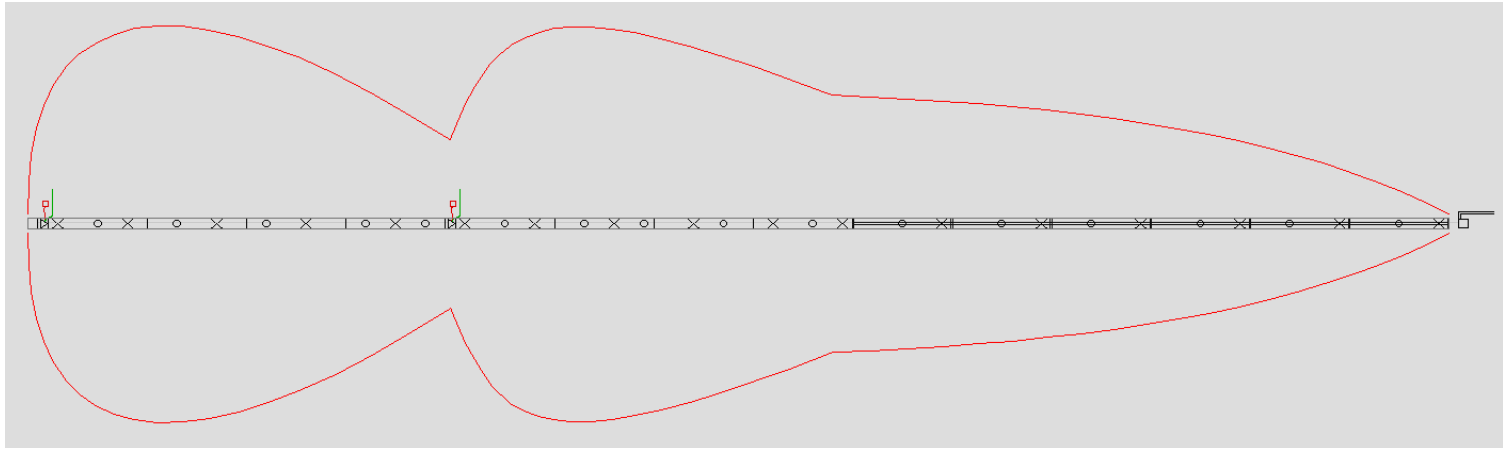
Burners-In-Series Condensing System Design

- Three or more burners in a single heat exchanger with 10’-60’ heat exchanger between burners.
- Long lengths of evenly heated radiant tube
- More even heat felt by occupants
- Flue gasses condense in the heat exchanger, double coated porcelain tubing
- Up to 12 burners vented at a single vent penetration
- Long, custom shaped systems provide heat where needed and minimize the need for roof penetrations even in large buildings.

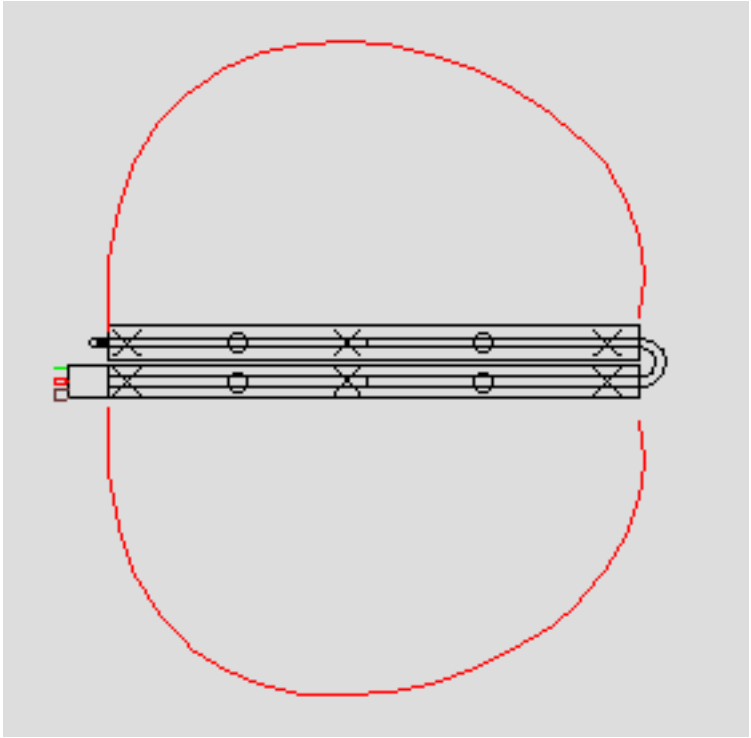
Radiant Pattern, Straight Tube Heaters



Radiant Pattern, Burners in Series



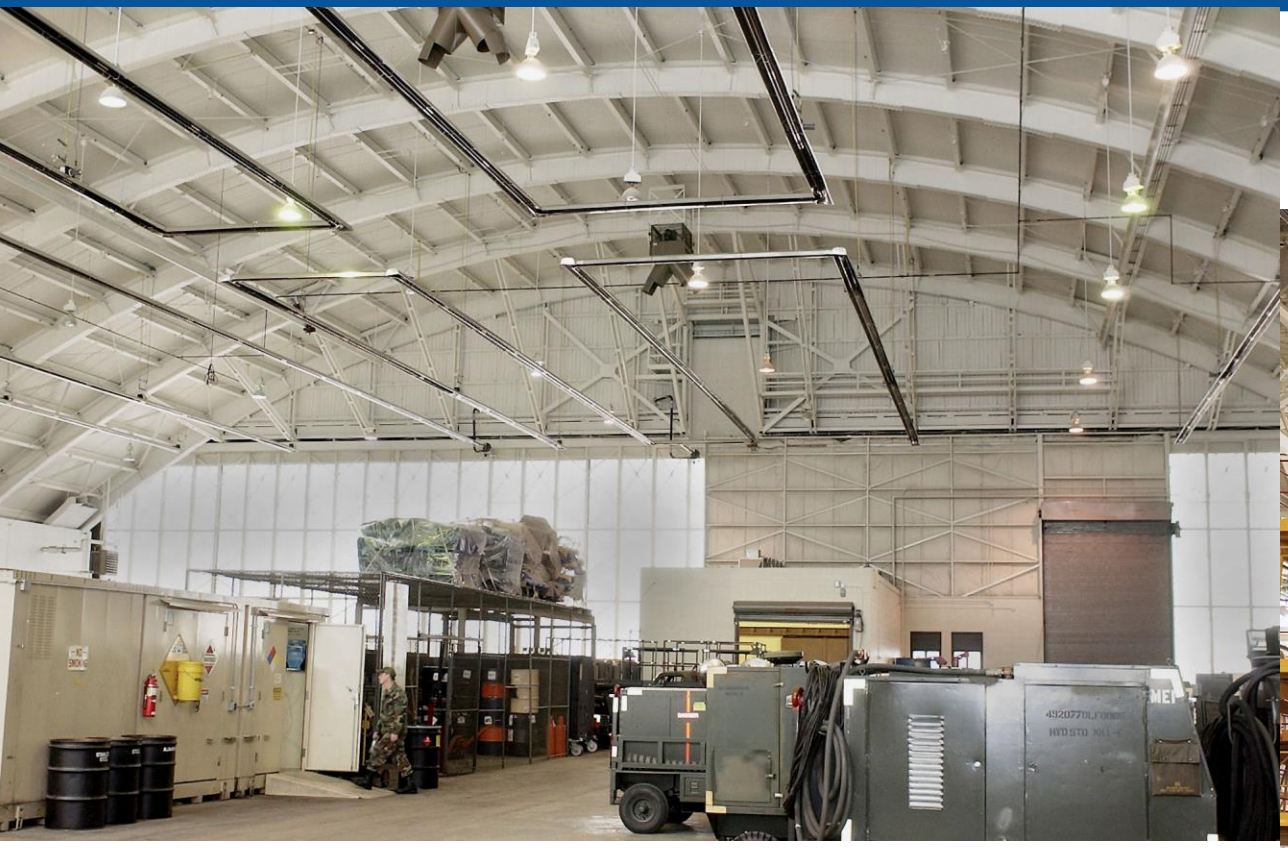
Radiant Pattern, U-Tube Configuration



Control Options

- Zone Sensor
- Analog Input (0-10v, 4-20mA) from a building management system
- Potentiometer (wall mounted dial)
- Electronic Thermostat
- Building Management System interface available

Aircraft Hangars



Aircraft Museum

Aircraft Hangar

Distribution / Fulfillment Centers

Outdoor Patio Heating: Restaurants/Cafes

Fire Stations

Many Bays/Doors, High Air Change, Large Cold Mass Intrusion

Indoor Tennis Facilities

Light Rail Maintenance

Heavy Equipment Shops

Questions?

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