

Overhead Radiant Heating

[STRATEGY]

BRIEF DESCRIPTION

Unlike conventional heating systems that warm spaces primarily through convection heating, radiant heating systems directly heat occupants or objects. Radiant heating is especially beneficial in buildings containing large air volumes or with a high infiltration load, such as warehouses, air hangars, and other high bay facilities. Also known as infrared (IR) heaters, overhead radiant heaters can be fueled by natural gas, propane, or electricity.

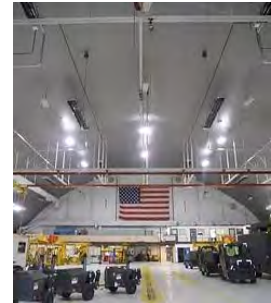
Applications **Warehouses, hangars, maintenance facilities, loading docks**



(a)



(b)



(c)

- (a) Overhead Radiant Heating in Auto Maintenance Facility (source: http://www.spaceray.com/apps_auto-maintenance-heater.php)
- (b) Overhead Radiant Heating in Aircraft Hangar (Source: http://www.spaceray.com/apps_aircraft-hangar-heater.php)
- (c) Overhead Radiant Heating in Aircraft Maintenance Facility (Source: <http://www.ambirad.blogspot.com/>)

Design Notes

Installation

- Un-vented gas heaters may only be located in buildings with high ceilings and sufficient exhaust air must be provided to the space.
- IR heaters provide one-directional heat – heaters must be placed in line with objects and/or occupants

Related Technologies

Concepts similar to Radiant Floor Heating.

References/Useful Resources:

- [1] ESource 2009. Radiant Space Heaters. Accessed August 2010 at <http://www.esource.com/node/25605?highlight=infrared%2Cheating>
- [2] ESource 1998. Electric Radiant Panel Heating. ER-98-6. Accessed August 2010 at http://www.esource.com/esource/getpub/members/frs_sb/pdf/ER9806.pdf

Overhead Radiant Heating

[ENERGY AND ENVIRONMENT]

Energy Savings

Lower Thermostat Set Points

- Occupants generally feel warmer at lower ambient air temperatures when heated by radiant heating systems. Energy savings can be realized if thermostat set points are lowered accordingly

Less Heat Loss through Loading Doors

- Using radiant heating in spaces with loading doors reduces the amount of heat lost to the outside when the doors are opened and closed.

Reduced Fan Energy Consumption

- Can reduce the amount of fan energy required with conventional heating systems. However, required ventilation rates must be maintained.

Social Benefits

Increased Occupant Comfort

- Occupants typically feel warmer, which could result in fewer temperature related complaints.

Guiding Principles¹

Optimize Energy Performance (Energy Efficiency)

- Reduce the energy use by 30 percent compared to the baseline building performance rating per the ANSI/ASHRAE/IESNA Standard 90.1-2007.

Associated LEED Credits (NC 2009)²

EAc1: Optimize Energy Performance (1-19 points)

- Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004.

¹ Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings
www.wbdg.org/pdfs/hpsb_guidance.pdf

² USGBC LEED Reference Guide for Green Building Design and Construction, 2009 Edition

Overhead Radiant Heating

[PRODUCT AND ECONOMICS]

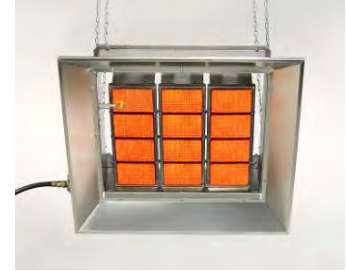
Product Images



(a)



(b)



(c)

Source:

- (a) http://www.spaceray.com/1_infrared-tube-heaters.php
- (b) <http://www.ambirad.com/ambiradUS/php/productRange.php>
- (c) http://www.spaceray.com/images/DK_ceramic-heater_510b.jpg

Cost Range

Product Type	Cost	Unit
Gas-fired,	\$435-\$970	Per unit. Varies according to capacity.
Electric	\$430-\$1,325	Per unit. Varies according to capacity.

Product Types

There are several types of gas-fired, infrared heaters, such as ceramic heaters, tube heaters and patio heaters. These heaters use a burner containing gas combustion controls, a heat exchanger element and reflectors. Electric infrared heaters are also available, when natural gas is not available.

Vendors

Ambirad

<http://www.ambirad.com/ambiradUS/php/productRange.php>

Spaceray

<http://www.spaceray.com/>

Roberts Gordan

<http://www.rg-inc.com/infrared-heating-products.htm>

Warranty Info

Varies according to vendor

Code

None.

Restrictions

These TechNotes are intended to provide general information for the consideration of design strategies. The TechNotes should NOT be interpreted as an endorsement of any specific product or technology.

Overhead Radiant Heating

[SPECIFICATIONS]

GENERAL³

Products included:

1. Unvented gas-fired infrared heaters
2. Vented gas-fired infrared heaters
3. Electric infrared heaters
4. Sheet metal

PRODUCT DESCRIPTION

Reflector-beam spread and operating conditions as indicated. Provide pre-wired control boxes, thermostats, reflector and duct hangers (if applicable).

A. Gas-fired Infrared Heaters

Heaters may be equipped for and adjusted to burn natural, liquefied petroleum, or dual fuel natural/liquefied petroleum gas as applicable. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment.

Heaters shall conform to the requirements of CSA/AM Z83.19 and may be vented or unvented type as applicable according to the space requirements⁴. Vented heaters shall be vented to the outside atmosphere. Heater style may be surface combustion or tubular type as indicated. Reflector shape may be parabolic, horizontal, or standard, as indicated. Heaters shall be provided with space thermostats which control the unit's burner. Thermostats located in the direct radiation pattern shall be covered with a metal shield.

1. **Unvented Gas Infrared Heater**⁵
CSA/AM Z83.19 and AGA approved.

³ Specification language modified from:

UFGS 23 82 00.00 20 Terminal Heating and Cooling Units (November 2008). Accessed August 2010 at

<http://www.wbdg.org/ccb/DOD/UFGS/UFGS%2023%2082%2000.00%2020.pdf>

UFGS 23 54 16.00 10 Heating System; Gas-Fired Heaters (April 2008). Accessed August 2010 at

<http://www.wbdg.org/ccb/DOD/UFGS/UFGS%2023%2054%2016.00%2010.pdf>

⁴ Unvented infrared heaters may be employed only in buildings with high ceilings such as shop buildings, industrial buildings, etc

⁵ NOTE: Use only if adequate ventilation ensured for the project location

Overhead Radiant Heating

[SPECIFICATIONS]

- a. Heating Element
Perforated ceramic capable of withstanding thermal shock in [3] minutes from 2000 to 32 °F without fatigue and of minimum 1600 °F operating temperature. When re-radiating screens are used to obtain operating temperature, provide stainless-steel or chromized-steel matching screen, as applicable.
 - b. Reflector
Polished aluminum, stainless steel, or approved high infrared reflector materials as applicable. Provide reflector supports of manufacturer's standard.
 - c. Controls
Provide either an intermittent pilot ignition system or a solid-state direct ignition system. Provide automatic gas safety valve capable of withstanding a 10 percent voltage fluctuation.
 - d. Ventilation
Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.
2. **Vented Gas Infrared Heater**⁶
CSA/AM Z83.19 with AGA label, single-burner power vented, single-burner vacuum vented, or multiple-burner vacuum vented as applicable.
- a. Vent
NFPA 54 and NFPA 211, Type 316 stainless steel or high-temperature corrosion-resistant plastic rated for minimum 400 °F. Vent flue gas to outdoors by induced draft.
 - b. Reflector
Polished aluminum stainless steel or approved high infrared reflector materials, as applicable. Provide manufacturer's standard reflector supports.
 - c. Heat Exchanger and Combustion Chamber
Construct heat exchanger and combustion chamber of aluminum-clad steel ceramic-coated steel or stainless steel.
 - d. Controls
Incorporate either an intermittent pilot ignition system or a solid-state direct ignition system. Provide safety air-flow switch for each burner.

⁶ NOTE: For spot heating, use single-burner power vented heater; for small area heating, uses single-burner vacuum vented heater; and for large area or entire building heating, use multiple-burner vacuum vented heater. Do not use vented gas infrared heaters in projects in the SOUTHNAVFACENGCOCM area.

Overhead Radiant Heating

[SPECIFICATIONS]

- e. Fan or Vacuum Pump
Heater manufacturer's standard.
- f. Performance
Provide sufficient radiant heating surface to attain a minimum steady-state thermal efficiency and maximum heat release as indicated in the following table:

Heater Type	Minimum Steady State Thermal Efficiency (%)	Maximum Heat Release (BTU per square foot of heating space)
Single-Burner Power Vented	80%	2,750
Single-Burner Vacuum Vented	80%	2,900
Multiple-Burner Vacuum Vented	85%	2,100

B. Electric Infrared Heater

Self-contained, factory assembled, and UL listed and including the heating element, reflector, heater housing, mounting brackets, element holders, wire guards, and high-temperature internal wiring.

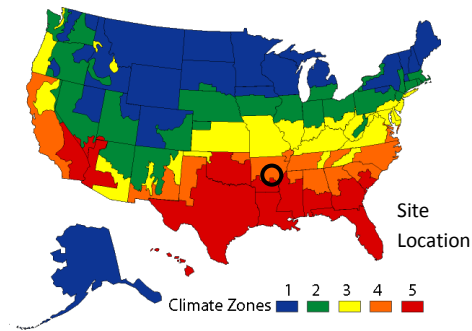
1. Heating Element
Minimum 3/8 inch diameter quartz tube or metal sheath with coiled resistor wire. Element operating temperature range shall be 1200 to 1800 °F.
2. Heater Housing
Weatherproof, aluminum-clad steel, stainless-steel, aluminum, or low-carbon steel construction as applicable. Provide a baked enamel finish over a corrosion-resistant primer. Provide a chrome-plated or stainless-steel wire guard to prevent heating elements from accidental damage. Furnish swivel brackets to position heater in any horizontal angle.
3. Reflector - Polished aluminum or stainless steel.
4. Wiring - Fully enclosed internal wiring. Provide minimum 6 inch slack fixture (heater) wire for connection to branch circuit wiring.

Overhead Radiant Heating

[CASE STUDY]

Little Rock Air Force Base⁷

Little Rock, Arkansas



Facility

- Although located in a warmer climate zone, Little Rock AFB can experience cold winters, with lows temperatures ranging between 30 and 40 °F .

Approach

- Overhead radiant heaters were installed in three large facilities including a 152,000 square foot air hangar, replacing conventional heating systems.

Results

- Average wintertime natural gas consumption in these facilities was reduced by 44% (after adjustments for weather differences)
- Using FY06 natural gas rates, the payback of this project is projected at 6 years

⁷ Air Force Civil Engineer Vol. 16 No. 3. Accessed August 2010 at <http://www.afcesa.af.mil/shared/media/document/AFD-081024-034.pdf>