

Aircraft Hangar Heating

**A guide to application and
selection**

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 25 FEB 2004	2. REPORT TYPE N/A	3. DATES COVERED -	
4. TITLE AND SUBTITLE Aircraft Hangar Heating		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AMBRAD		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)	
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited			
13. SUPPLEMENTARY NOTES See also ADM001865, Industrial Process and Energy Optimization. Proceedings of the Industry Workshop Held in Gettysburg, PA, 25-27 February 2004., The original document contains color images.			
14. ABSTRACT			
15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	UU
			18. NUMBER OF PAGES 31
			19a. NAME OF RESPONSIBLE PERSON

Presentation

- **Company introduction**
- **Hangar heating - factors to consider**
- **Comparison of heating systems**
 - Case study
 - Benefits and limitations
- **Product overview**
- **Open forum**

Company Overview



- Established 1979
- Privately owned
- 215 employees
- \$ 35m GROUP TURNOVER

AMBIRAD
ENERGY EFFICIENT HEATING SYSTEMS

Company Development

- World wide market leader in radiant
- Export to over 35 countries
- Largest individual market is USA
- Facilities in IN, NC, CO, UT, TX
- Distributor network throughout USA
- Established over 20 years in USA

Mission Statement

- To establish and maintain world-class status in the provision of energy-efficient heating solutions
- We aim to deliver
 - Innovative products
 - Quality service
 - Value for money
 - Total customer satisfaction at all times

Company Standards

- **Quality assurance**
 - BS EN ISO 9000: 2000
 - All products CSA / AGA approved
 - Member of GAMA

Over 200 Military and Hangar Installations Worldwide

- Buckley AFB, CO
- Elemendorf AFB, AK
- Fairchild AFB, WA
- Fort Carson AB, CO
- Kelly AFB, TX
- Little Rock AFB, AR
- McConnell AFB, KS
- Malmstrom AFB, MT
- Oceana Naval Air Station, VA
- Pueblo Army Depot, CO
- Sulfridge ANG, MI
- Stockton ANG, CA
- Tyndall AFB, FL
- Warren AFB, WY

Military Buildings

- Aircraft hangars
- Vehicle workshops and storage
- Storage areas and warehouses
- Garages
- Sports facilities
- Museums

Commercial References

- American Airlines
- BP
- Chevrolet
- Chrysler
- Delta Airlines
- Eli Lilly
- Firestone
- Green Bay Packers
- Hyundai
- Isuzu
- Lowes
- Nabisco
- Nissan
- Northwest Airlines
- Shell
- Schneider
- US Postal Service
- Wal-Mart

Hangar Heating - Factors to be considered

Requirements of Buildings

- Large interior spaces - high roofs. Large volume of air
- Older buildings poorly insulated - prone to high air change rates
- Hangar doors can be left open - high air infiltration disrupts comfort conditions
 - Especially in exposed locations
- Rapid recovery to temperature essential
- Space can be used intermittently and sometimes partially
- Zone control is essential if energy is to be managed efficiently

Viabile Alternatives

- **Wet systems**
 - HTHW radiant panels
- **Dry systems**
 - Gas fired radiant tube
 - Gas indirect fired warm air

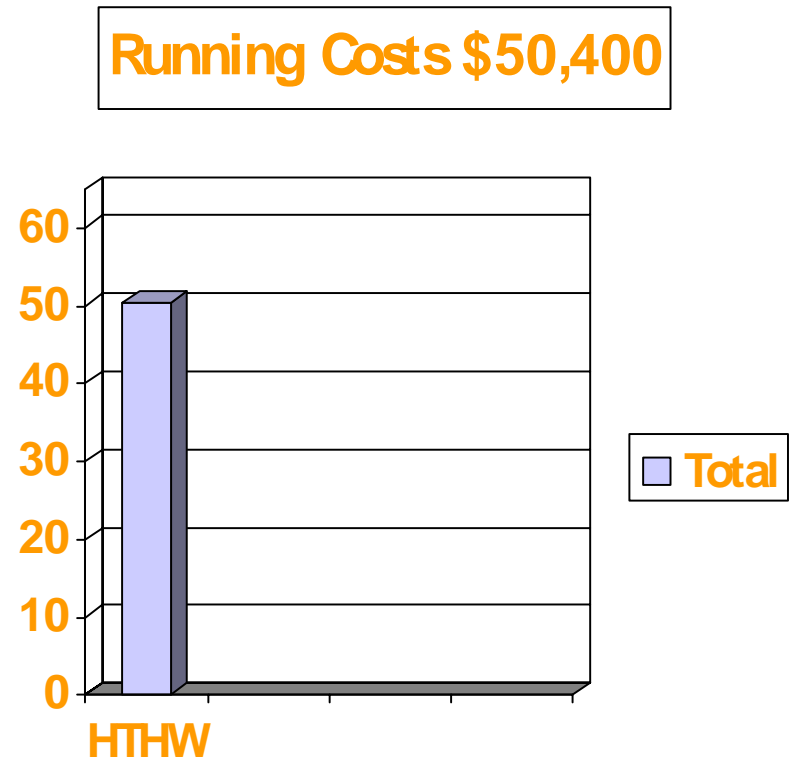
A large, high-ceilinged industrial hangar with a complex steel truss roof structure. The interior is illuminated by warm, yellowish lights. In the foreground, a dark-colored aircraft is visible, featuring a yellow and black checkered pattern on its nose and a yellow shield with a blue lion rampant. The aircraft is supported by a yellow maintenance stand. In the background, another aircraft is visible, and a person is crouching near a yellow maintenance stand. The overall scene depicts a busy aircraft maintenance hangar.

Heating System Comparison

A Case Study - RAF Type C
Hangars
(Source data : RAF Coltishall)

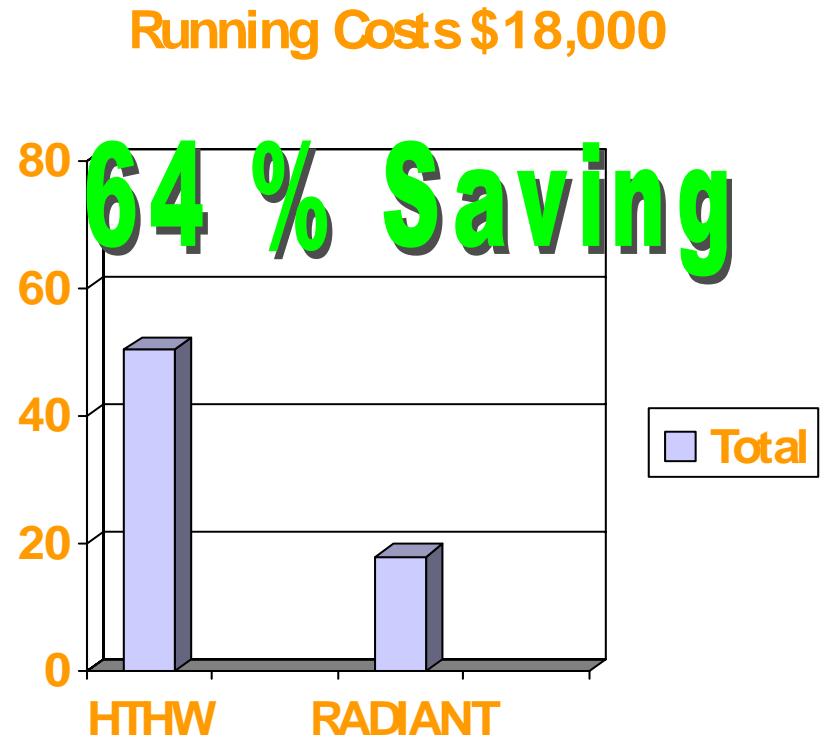
Option #1 HTHW System

- **Energy consumption**
 - 136,480 therms p.a.
- **Actual running cost**
 - \$ 50,400



Option #2 Gas Fired Radiant

- Energy consumption
 - 48,743 therms p.a.
- Actual running cost
 - \$ 18,000



Radiant Heating - An Overview

What is Radiant Heat?

- Heat transfer by radiation involves two objects at different temperatures separated by a space transparent to the radiation
- Radiant or infra-red heating is the transfer of energy by means of electromagnetic waves (comparable to “light” - differs in frequency)
- When the waves strike an object they stimulate molecular activity, causing them to move rapidly and to generate heat

AMBIRAD

ENERGY EFFICIENT HEATING SYSTEMS

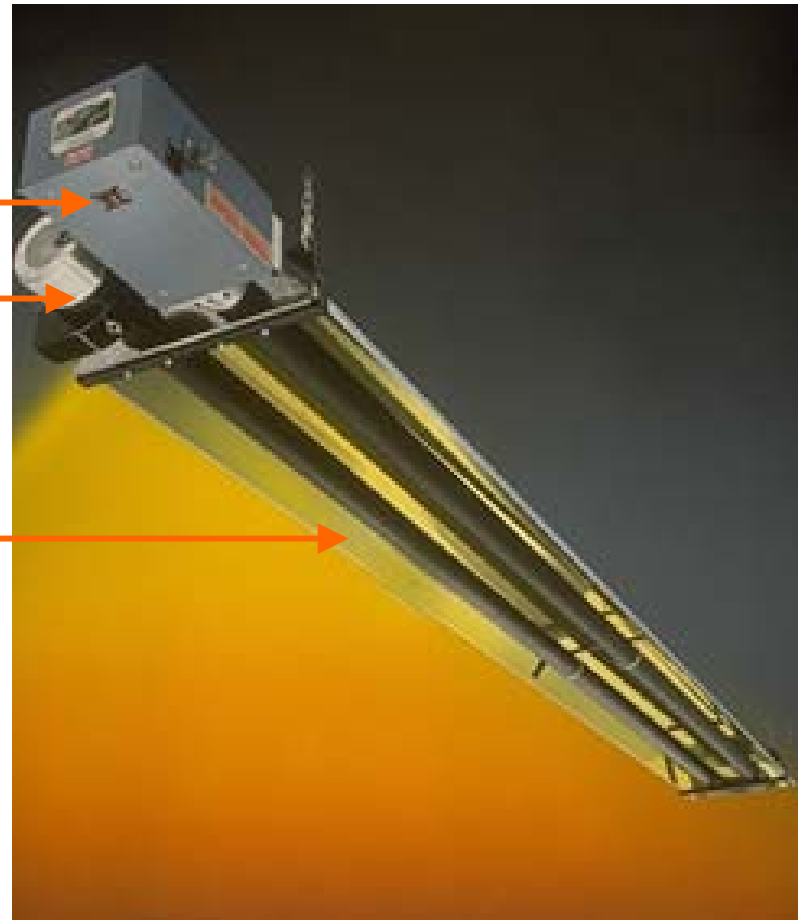
What Is Radiant Heat?

- Properties of radiant energy
- Emitted by hot surfaces
- Travels in straight lines
- Passes through the air without heating it
- Absorbed by cooler solid objects on which it falls

Radiant Heat

How It Is Delivered?

- Mounted overhead
- Gas burner firing into black tube
- Vented via vacuum fan
- Radiant reflected downward by a reflector
- Unitary or system
- Totally enclosed flame
- Fail-safe devices

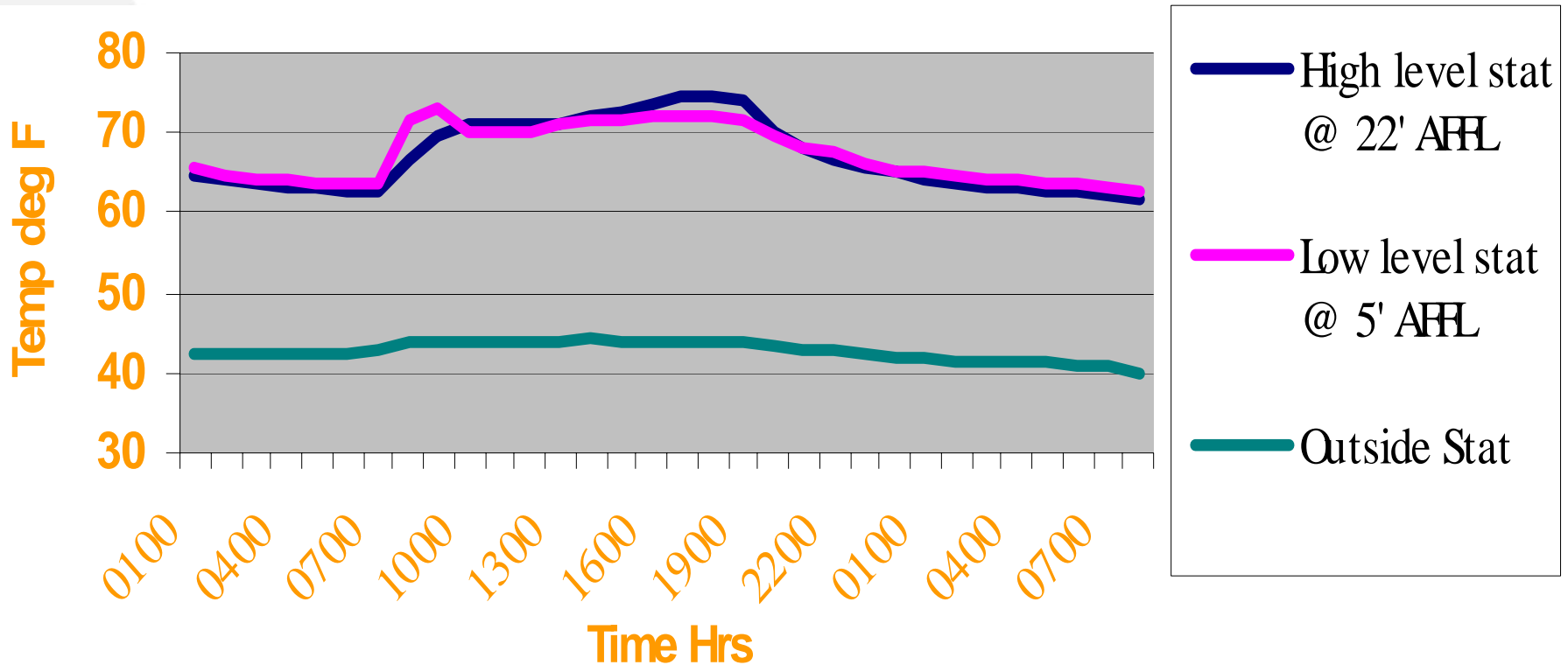


Gas Fired Radiant Tube Heating

The Benefits

- **Creates warmth at low level**
 - Can be mounted up to 100'
- **Does not heat entire volume of the building**
 - Reduced stratification
 - Minimizes roof fabric and ventilation losses
- **Can be zoned and controlled, heating occupied areas only**
- **Provides rapid heat up and recovery**

Case Study - Temp. Stratification 8/9 Feb'01



Gas Fired Radiant Tube Heating

The Benefits

- High efficiency at the point of use-no distribution losses
- Warms floors, surfaces and tools, improving working conditions
- Eliminates the need for a utility room
 - Reducing building and operational costs
- Easy to install

Gas Fired Radiant Tube Heating Savings!

- 10 Year Life Cycle Cost less than initial capital cost of warm air radiant system
- Annual energy cost savings
 - 65% versus HTHW
 - 35% versus warm air
- Minimal maintenance cost.



Product Solutions

AMBIRAD
ENERGY EFFICIENT HEATING SYSTEMS

Ambi-Rad Solutions

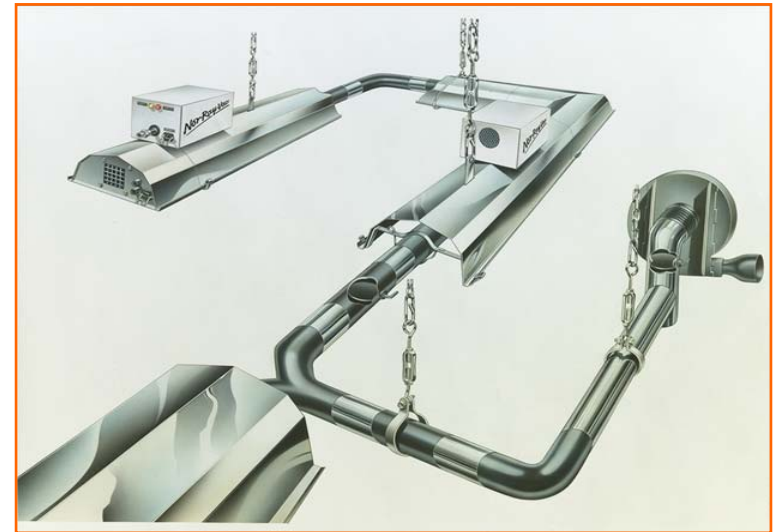
- Radiant tube
- ER series
 - 40,000 to 150,000 Btu/hr
 - UT, Linear & double linear
 - Venting options
 - Individually flued
 - Herringbone combined flue
- PT heater
 - 60,000 to 225,000 Btu/hr
 - Individually flued
 - 20' to 80' long



AMBI RAD
ENERGY EFFICIENT HEATING SYSTEMS

Ambi-Rad Solutions

- Continuous radiant tube
- ARC
 - 40,000 to 157,000 Btu/hr
 - In-line burners
 - Single exhaust point
 - Low intensity
 - Streamlined appearance
 - Over 90% combustion efficiency



AMBIRAD
ENERGY EFFICIENT HEATING SYSTEMS

Company Philosophy

- **Provide a supply based service**
 - **Contractors – installation support**
 - **Engineers – design assistance**
 - **End users – operating costs**

Company Services

- **Sales support**
 - Pre-contract
 - Contract
 - Post-contract
- **In house design**
 - Scheme drawings
 - Cost evaluation
 - Heat loss calculations
- **On site support**
 - Technical advice

After Sales Support

- Technical and spares support
- Over night parts availability
- Extended warranties available

Open Forum

AMBIRAD
ENERGY EFFICIENT HEATING SYSTEMS