





AMBIRAD

HEATING AND VENTILATION SOLUTIONS

Application Guide

Aircraft Hangar & Maintenance Shed Heating

AMBIRAD AIRBLOC NORDAIRNICHE BENSON

Application Guide

Aircraft hangar & maintenance shed heating

This guide aims to help those responsible for designing, building, refurbishing or maintaining aircraft hangars or maintenance sheds, to reduce operating costs, and improve comfort and safety, by introducing cost-effective energy efficient heating into their premises.

Whether it is a military, civil aviation or maintenance hangar considerable energy resources can be expended on delivering an adequate solution to providing comfort in these traditionally hard to heat environments.

This guide advises on the selection, design and operation of the most appropriate heating system.

AmbiRad has substantial experience having heated hangars and sheds around the world, saving many of our clients up to 65% of their annual heating costs.

The Climate Change Levy

The Climate Change Levy (CCL) became effective from 1 April 2001. After wide consultation an energy tax was considered the best way of 'promoting' reductions in energy use and achieve the Government's commitments in reducing greenhouse emissions.

The CCL levies 0.541* pence per kWh on electricity; and 0.188* pence per kWh on gas consumption; which equates to a 20% increase on the average gas bill and generally escalates year on year. This means that military and civil aviation establishments now need to consider how best to reduce the burden of the energy tax. Investment in energy efficient heating can substantially contribute to minimising the impact of the levy.

A correctly designed and installed energy efficient heating system, can reduce gas consumption by up to 65% depending on the application and provide many other benefits .

Table 1 CO_2 emissions per unit of delivery

Fuel	CO_2 (Kg/kWh)
Natual gas	0.19
Oil	0.27
Coal	0.30
Electric	0.52

* Rate as of 01.04.14

Requirements of the Building

> Hangars are invariably very large interior spaces that have high ceilings, contain a large volume of air and are prone to high air change rates.

> Hangar doors are large, may even be the size of the existing walls and are frequently open. This means that air infiltration can severely disrupt comfort conditions within the interior. A heating system need to be able to sustain a comfortable environment in these conditions and especially provide rapid recovery to full operating temperatures once the doors are closed.

> Hangars are often used at irregular time intervals and with partial occupation, it is therefore important, for efficient use of energy, that the heating system can be easily and effectively zone controlled.

> Hangars, particularly military, house very expensive equipment often containing highly explosive fuel or armaments. It is therefore essential that the heating system complies with the mandatory fire regulations of the prevailing authority.

Factors to be Considered

Energy and fuel considerations

Natural gas is, on balance, the most efficient environmentally friendly practicable form of energy. Although slightly less efficient at the point use than electricity, natural gas produces nearly 2¾ times less 'greenhouse' emission in its overall production (see table 1), and is on average only one quarter of the cost. Therefore natural gas clearly is the most cost-effective, clean fuel, for aircraft hangars.

Heating Systems

Comparison of Heating Systems for Aircraft Hangars

Crown Fire Standards

For military premises in the UK, Defence Infrastructure Organisation (formerly Defense Estates) publish the Crown Fire Standards (CFS), which outline the design and specification of both the structure and the services within the building. The procedures and practices within the CFS are mandatory for military properties and advisory on civil estates.

The following sections apply for hangar type buildings:

Fire Standard E9: Vehicle workshops and storage, garages and car parks.

Fire standard E10: Aircraft hangars

Fire Standard E11: Storage premises

For military requirements of these standards, documentation is available from Property Advisors to the Civil Estate (PACE) on behalf of the DIO.

Comparison of Heating Systems for Aircraft Hangars

Actual case study based on 3 RAF Type C Hangars. Hangars dimensions 92m long x 47m wide x 14m high.

	Hangar 1 HTHW panels from boiler plant	Hangar 2 Sonning Warm air re-circulating radiant system	Hangar 3 AmbiRad gas fired radiant tube heating system
Annual energy consumption (kWh)	4,000,000	2,571,428	1,428,571
% Energy savings compared to HTHW panels	-	36%	**64%**

Available Radiant System Options

> **Nor-Ray-Vac System**
- Continuous gas fired radiant system, widely specified throughout the military and civil estates for heating hangars, whether for operational aircraft, vehicle maintenance or storage

> **VSX Radiant Tubes**
- High output radiant tube for extremely high mounting, spot heating scenarios and very high air change rate situations

> **Sonning System**
- Warm air recirculating radiant system with no moving parts to maintain at high level within the heated area

Feature	Nor-Ray-Vac	Sonning	VSX
Blanket heat coverage	✓	✓	✓
Spot heating			✓
Ability to zone	✓	✓	✓
Servicing at high level	✓		✓
Full burner modulation	✓	✓	
Hi/Lo			✓
Minimal flue penetrations	✓	✓	
Fuel - natural gas	✓	✓	✓
Fuel - LPG	✓	✓	✓
Fuel - Oil		✓	
Capital costs	Low	High	Low
Running costs	Low	Medium	Low
Crown fire std compliant	✓	✓	
Burner remote from heated area		✓	

Conclusions

1. Gas fired radiant tube heating systems save 64% of annual energy consumption against HTHW.

2. Sonning warm air re-circulating radiant systems offer a 36% energy consumption saving against HTHW, but 80% higher than a gas fired radiant tube heating system.

3. Gas fired radiant tube heating systems provide the most energy efficient solution for hangar heating.

Technologies in Application

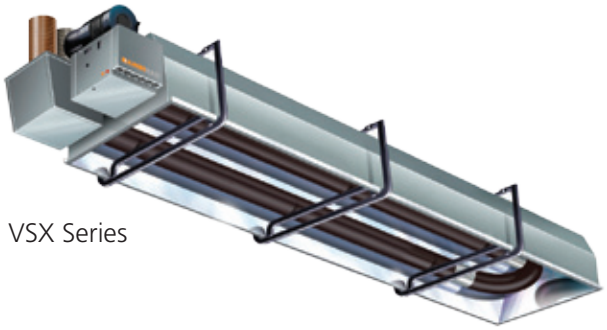
Radiant Heating

The primary source of radiant energy in the natural environment is the sun. By standing in the sun's rays a feeling of warmth is experienced, whilst in the shade it feels considerably cooler. Radiant heat warms all solid objects and surfaces in its path.

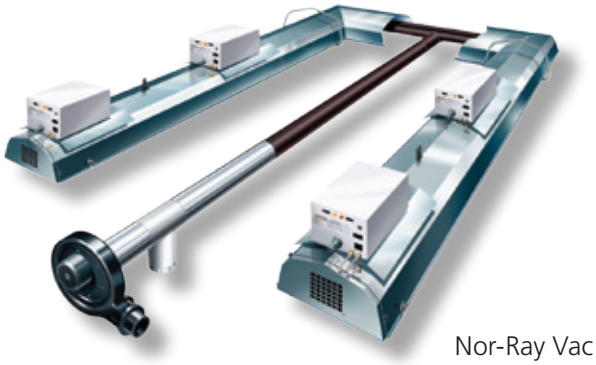
Radiant heat is transmitted in the form of electromagnetic vibrations or waves, which are emitted by a hot surface, travel in straight lines, just like light, and are absorbed by cooler solid objects on which they fall.

AmbiRad has exploited this concept in its energy efficient radiant heating systems. Radiant tube heaters, mounted overhead, produce infrared radiant heat that is directed downward by a reflector. The infra-red heat passes through the air without heating it and falls on people, floors and equipment below creating a comfortable all-round radiant warmth at low level, without wastefully heating the whole volume of the building or the roof space. Because radiant heat can be controlled directionally, only the occupied areas of the building need to be heated, which enables considerable energy savings to be realised.

The objective of a radiant heating system is to ensure that the people in the building are comfortably warm. After all, without people that need for heating any building becomes largely superfluous. The human body experiences a sensation of comfortable warmth when it is giving heat to its surroundings. If the body emits too much heat it feels cold. Conversely, if the body cannot emit sufficient heat it feels too hot. By the correct application of a radiant heating system comfort levels can be optimised. Radiant heat warms objects and surfaces, increasing the mean radiant temperature and reducing the body's loss of heat to its surroundings. In addition by eliminating air movement, convective loss of heat from the body will also be reduced.



VSX Series



Nor-Ray Vac

Benefits of Radiant Heat

- Savings between 25%-65% of fuel costs can be achieved against boiler systems
- Heaters can be mounted at very high level - up to 30 metres, with radiant heat still providing comfort at floor level
- Reduced stratification - minimises roof fabric and ventilation losses
- Warms floors, surfaces and tools, improving working environment
- Eliminates the need for plant room, further reducing building and operational costs (excluding Sonning)
- Provides rapid heating-up and recovery times compared to alternative heating systems
- Systems can be controlled easily to provide varying zoned temperature and operating times
- Easy to install
- Conforms to Crown Fire Standards E9, E10 and E11 (excluding VSX)

Case Study

RAF Cottesmore

Background

Comfortable working temperatures and greater control over energy management were the key criteria that prompted RAF Cottesmore to switch to Nor-Ray-Vac continuous radiant tube heating from AmbiRad.

Four hangars on the base at Oakham, Leicestershire, now benefit from the even heat distribution and constant air temperatures of between 16-19°C generated by the Nor-Ray-Vac burners – in spite of full height and width doors that frequently open to allow aircraft to manoeuvre in and out. The new system also achieves improved comfort and flexibility without increase in fuel consumption.

The 5,500m² hangars are used for storage and maintenance of aircraft on the base, which is known to be one of the highest in the country and exposed to winds. Previously, heat was supplied via a high temperature hot water system fed by one dedicated boiler house. Distribution losses were enormous and the system was burning fuel without producing much heat.

Technical Information

Area	5,500m² per hangar
Heaters	Hangars; A, B, C & D - 24 x 46kW burners each

Application

At times, especially at night and in cold weather, operators were working in single figure temperatures. While far from ideal, these working conditions also had potentially dangerous consequences should flight safety be compromised.

The existing heating system was decommissioned and each hangar equipped with its own Nor-Ray-Vac continuous radiant tube system comprising 24 Nor-Ray-Vac 46kW LR series linear burners with four vacuum fans. The AmbiRad heaters are controlled centrally by a Trend BMS and each can be operated in four zones.

Rapid warm up and heat recovery are key considerations for comfort in the hangars. Both are achieved easily by radiant tube heating. The AmbiRad Nor-Ray-Vac system is also flexible enough to work with the existing Trend BMS.

Benefits

Zoned heating has an unusual advantage in this application. On occasion, the cockpit is secured into place using epoxy glue. The aircraft can be positioned in one of the zones and the heating left to run overnight to set the glue. With the previous heating, the entire system had to be left on to achieve this.

Additional economies have been achieved by micro-switching the personnel entry doors. If they are left open for too long, the heating automatically switches off. Station energy manager Alan Agate comments: 'This encourages people to close the doors. So much so that the £10,000 investment in the micro-switching system was paid back in 18 weeks.'

The Nor-Ray-Vac heating system was installed by SG Maintenance of Solihull for consultants Templeman Associates of Kings Lynn.

Case Study

Ryan Air

Background

A Nor-Ray-Vac continuous radiant tube heating system from AmbiRad, positioned at 22m high in the roof of Ryan Air's prestigious new hangar at Prestwick airport, ensures night-shift workers keep warm in spite of open doorways and cold winds.

The hangar is used for the maintenance of Ryan Air's fleet of 737-800 aircraft. The 189-passenger planes are brought into the building at night for repairs and servicing, before jetting off the following day to international destinations.

Since all work is carried out overnight and large doorways remain open for long periods, the temperature within the hangar can fall dramatically, particularly in winter.

Application

An under floor heating system was originally specified, but rejected because of the discomfort working on a warm floor can cause to employees. Instead, Ryan Air requested a radiant system from AmbiRad.

Ed Cunningham, Hangar Manager, says: "We required heating to the hangar with all services installed above a minimum aircraft clearance height."

Nor-Ray-Vac continuous radiant tube heating was selected. Suspended from the roof, the heaters emit infra-red rays that warm only objects and people in their path. They do not waste fuel heating the volume of air in the building. In Ryan Air's case this will ensure that running costs are kept to a minimum.

Benefits

The Nor-Ray-Vac system provides even heat coverage throughout the building, with rapid warm up time and low noise operation.

Although built as a single space, the hangar effectively operates in two bays. Closest to the doorway, the roof height is 22m to accommodate the aircraft tail fin. Further inside, where the body section of the plane sits, the roof height is just 11m.

In the higher area, six Nor-Ray-Vac 46LR burners were installed in two zones. Above the aircraft body area, sixteen Nor-Ray-Vac 32LR burners, zoned into eight separately controlled sections, were fitted.

Lyall Smith of Haden Young comments: "Ryan Air wanted an effective system that would maintain comfort levels throughout even the coldest night at Prestwick."

Technical Specification

Area	3,442.5m²
Height	11m - 22m
Volume	47,124m³
Heaters	6 x 46LR burners
	16 x 32LR burners

Case Study

RAF Valley

Background

The replacement of the original 1960's high temperature hot water heating system with Nor-Ray-Vac continuous radiant tube heaters has transformed comfort conditions – and reduced fuel consumption by 50% - at RAF Valley's Gaydon hangar on the island of Anglesey.

The hangar is temporary home to Hawk training jets while they are being maintained and repaired. The 5,000m² building can accommodate up to 15 jets at any one time. With a 20m high roof at the apex, there is little problem manoeuvring the aircraft in and out of the building through the doors at either end. Providing adequate heating in such a large space is another matter, particularly as the site is exposed to freezing winter winds blowing off the Irish Sea.

Application

Because of the roof clearances required, it was not practical to install the new heating system at low level. The semi-circular roof – which, with a single span, was the largest of its kind when installed over 40 years ago – meant the heaters had to be carefully positioned following the line of the roof.

The heating comprising of four Nor-Ray-Vac gas fired continuous radiant tube systems, with a total of 28 no. 46LR burners was installed by Gradwoods of Stockport on behalf of the client; Amey BPO Services at RAF Valley and Design Consultants, Carl Bro.

The heaters are zoned in six separate areas, ensuring that heat is available only in those areas where people are working. No energy is wasted in heating unoccupied parts of the building.

Benefits

A key factor in the decision to install Nor-Ray-Vac was its flexibility and rapid warm up. Working areas reach working temperatures of 16-20°C, according to requirements, within five to ten minutes. This is a major benefit when mechanics are called in at a moment's notice, often outside normal working hours, to carry out maintenance work.

Flight Lieutenant Stuart Geary, Property Manager at RAF Valley, comments: "The radiant tube system gives us the flexibility we require in this hangar. It is also providing us with significant cost benefits."

Technical Information

Area	5,000m² per hangar
Heaters	28 x 46kW burners

Case Study

RAF Culdrose

Background

Cornwall-based RNAS Culdrose is one of the Royal Navy's busiest aircraft bases, home to training and operations squadrons of Sea King and Merlin helicopters, and a large squadron of Hawk training aircraft. It also houses the main 771 Search and Rescue fleet which helped the people of Boscastle, when the town was hit by devastating floods in August 2004.

The hangars on the base are in constant use for maintenance and servicing. The buildings have proved hard to heat in the past since the doors have to be opened several times a day to manoeuvre aircraft in and out, and the site is exposed to fierce coastal winds. With no gas infrastructure, a steam heated radiant panel and oil fired warm air ducted radiant heating systems have been in use, but a more efficient alternative was sought.

Technical Information

Area	4 x 2,700m² per hangar
Heaters (per hangar)	12 x 38kW burners
	4 x 32kW burners

Application

Station energy manager John Gardner has overseen the progressive conversion of the base to more energy efficient heating, starting with the installation of mains gas. Four hangars each of 2,700m², have since been equipped with Nor-Ray-Vac continuous radiant tube heating from AmbiRad, an economic form of heating ideally suited to aircraft hangar applications.

The radiant tube heaters are suspended at high level (approximately 7-10m from ground level) to ensure clearance above the aircraft. The heaters emit even, low intensity warmth throughout the building, eliminating cold spots and heat stratification. From start-up, or following a period when doors are open, comfort temperatures are achieved within minutes.

Benefits

Radiant tube heating works like the sun, emitting infra-red rays that warm only people and objects in their path, but not the volume of air in the building. This makes radiant heating one of the most energy efficient space heating systems available.

To maximise the heaters' efficiency, the Nor-Ray-Vac burners were equipped with an automatic shut-off facility which comes into operation when the doors remain open for longer than five minutes. Once doors are closed again, the heaters switch on and heat recovery follows rapidly.

John Gardner comments: "Our coastal location means the buildings are subject to strong winds off the sea and dampness. These problems have been eliminated in the hangars equipped with the Nor-Ray-Vac system. The heaters maintain comfortable temperatures for our personnel. They even take the early morning chill off tools."

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AMBIRAD LIMITED
Fens Pool Avenue
Brierley Hill
West Midlands DY5 1QA
United Kingdom

Tel: **01384 489 700**
Fax: **01384 489 707**

ambiradsales@nordyne.com
www.ambirad.co.uk

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AMBIRAD AIRBLOC NORDAIRNICHE BENSON