

Solving the Problem of Heat Stress in Pigs

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1. Introduction

This booklet is intended to describe the main causes of heat stress in pigs and to outline some of the common sense management measures that will help to prevent it.

Heat stress can occur in all classes of pigs under a wide range of production systems during periods of high ambient temperatures. It can also be caused by badly adjusted manual and malfunctioning automatic ventilation systems. Heat stress not only causes unnecessary suffering to the animals and even death, but it also reduces productivity and consequently profitability.

This booklet discusses some of the key principles involved in heat stress. Whilst it embodies much of the latest advice and the best current husbandry practices, it cannot be exhaustive and is not intended as a substitute for expert advice. If in doubt about a problem, expert advice should be sought.

2. What is heat stress?

The body temperature of any pig should remain within certain limits to safeguard welfare and maintain production. When a pig's body temperature rises beyond these limits, the animal becomes heat stressed. The first sign is panting and, if the body temperature continues to rise, the animal will collapse, become comatose and finally die.

3. Heat balance

Body heat balance



Heat is produced by essential bodily processes (metabolism) which include maintenance, growth and lactation. Normally this heat is lost, at a controlled rate, so that body temperature is held constant. The following factors affect the rates of heat production and loss.

Heat Production: This is affected by body weight, level of energy intake, and to a lesser extent by the amount of activity and exercise.

Heat loss: Heat is lost by radiation, convection, evaporation and conduction. Given sufficient freedom, the pig adapts itself and its environment to take advantage of these.

- *Radiation* - losses are proportional to the temperature difference between the body surface and the surrounding surfaces. Thus, hot, poorly insulated roofs and walls accentuate heat stress in hot weather, as does direct sun on outdoor sows.
- *Convection* - occurs by the natural rise of warm air from around a hot body. It can be assisted by providing moving air, but only if the air moves fast enough to break down the boundary layer of still air which surrounds the body.
- *Evaporation* - losses are very important at high temperatures. Pigs do not sweat, but they depend on panting, and this is only effective if the humidity is not too high. Pigs are poor "panters" - *if they pant, they are too hot*. The pig also can 'create' evaporative heat loss by wallowing in liquid material if this is available.
- *Conduction* - the pig can alter its posture to provide greater contact with the floor surface. This can increase conductive heat loss depending on the floor construction and insulation and stocking rate.

House Heat Balance

Heat is added to the air of a building by body heat production, supplementary heating, by electric lights and motors and by fermentation in deep bedding systems. Of these only the first two are really significant.

Heat is lost via the ventilation air, by evaporation from wet surfaces and by conduction through the roof and walls. The proportion of structural heat loss depends on surface area, insulation value and the difference between inside and outside temperatures. Structural heat loss is minimal during hot weather.

4. Prevention of heat stress

General

Producers have a number of ways in which they can prevent heat stress occurring. The design of the building and its ventilation system, siting of new buildings and construction materials will have an effect.

In existing buildings preventative action is confined to good maintenance and adjustment of equipment, increasing ventilation rates where possible, providing additional insulation, using showers and, finally, not exceeding the recommended stocking rates.

Buildings - Reducing Radiant Heat Gain

Even in a British summer it is surprising how much solar heat can penetrate a roof if the insulation is deficient. Recent measurements have shown solar gains of up to 30 Watts per square metre (W/m^2) coming through old roofs, and as much as $85 W/m^2$ through single skin roofs. It is important to check the standard of your insulation and to bring it up to modern recommended standard U value* of $0.4 W/m^2 /C$ or better, as soon as possible. This will also give winter benefits to both welfare and production, by permitting higher ventilation rates. Insulation does deteriorate, particularly if rodents are active or moisture has penetrated. This is difficult to detect where insulation is sealed in the roof. Roof colour, reflectivity, pitch and orientation, whether it is sheltered or in the shade are also factors which will have a small bearing on solar heat gain.

The choice of insulation material depends upon the type of building structure, but, whatever material is chosen, it is important to provide a vapour check layer between the insulant and the internal air. It is deficiencies in this cheap but important detail which have often been the cause of premature deterioration of expensive insulation materials. Some of the modern rigid sheet insulants are supplied with a vapour check layer, or are inherently vapour impervious. This should be checked with the supplier. It is most important that the joints between the sheets are sealed after fitting.

When heated piglet creeps are used in farrowing sheds, it is important to ensure that heat loss from the creeps into the house does not overheat the sows. Where necessary creeps should be covered and insulated.

* U Value is the heat in Watts which passes through each square metre for every 1C difference between inside and outside temperature.

Ventilation and Air Distribution

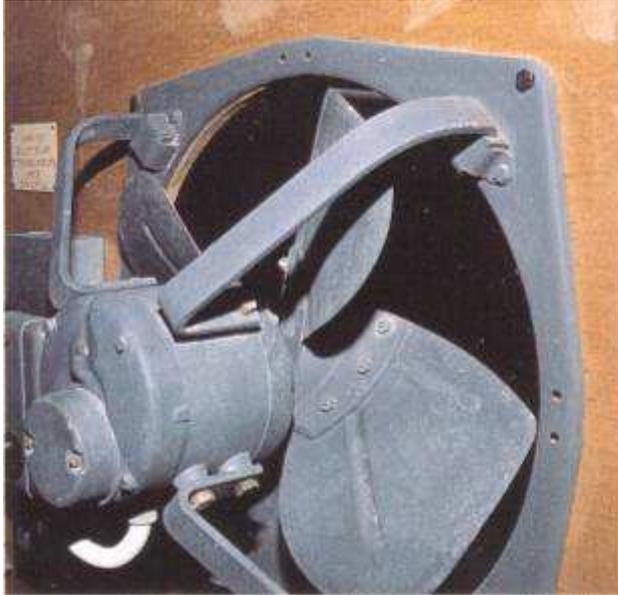
Maximum ventilation rate recommendations are based on calculations of the quantity of air needed to prevent house temperature exceeding outside temperature by more than 3C or 4C depending on the class of pig.

Ventilation requirements for any category of pig can be calculated by your local ADAS adviser or other expert consultants. In power ventilated houses these dictate the size and number of fans, and the size of air inlets and outlets.

In automatically controlled natural ventilation (ACNV) buildings the required ventilation rate dictates the size of the wall and roof openings. Calculations are always based on an assumption of very low wind speeds.

Problems with Ventilation Systems

In many cases inadequate ventilation is caused by having insufficient fans or natural ventilation openings for the size and numbers of pigs housed.



Fan in accurately cut hole in the wall

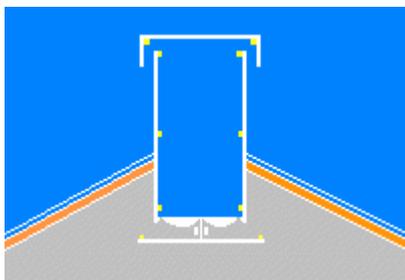
Unfortunately there are many installations where the fan performance has been impaired by simple installation errors or poor maintenance. Some of the common errors are:

- Fan box too small for its fan.
- Fan box with obstructions to airflow.
- No bellmouth or diaphragm fitting on the fan mounting, and incorrect mounting ring.
- Dirty or damaged fans and fan boxes.

All these errors are easily avoided by mounting according to the manufacturers instructions, preferably using complete installation packages and by providing proper maintenance.

In ventilation systems dependent upon convection (e.g. ACNV) inadequate or blocked inlets or outlets can cause overheating.

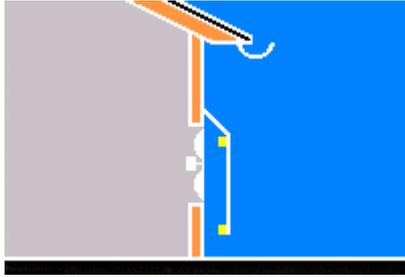
Roof Fan Boxes



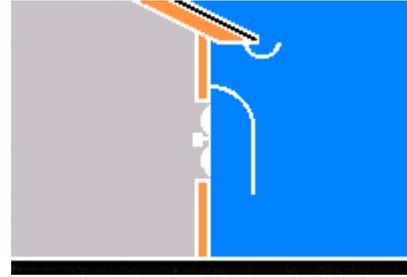
Poor design - international obstruction, square cap and turbulent airflow



Good design - rounded cap and streamlined flow



Poor design - obstructed interior, too near ground and too narrow.



Good design - rounded, smooth interior, ground clearance and correct far width.

Poor Air Distribution

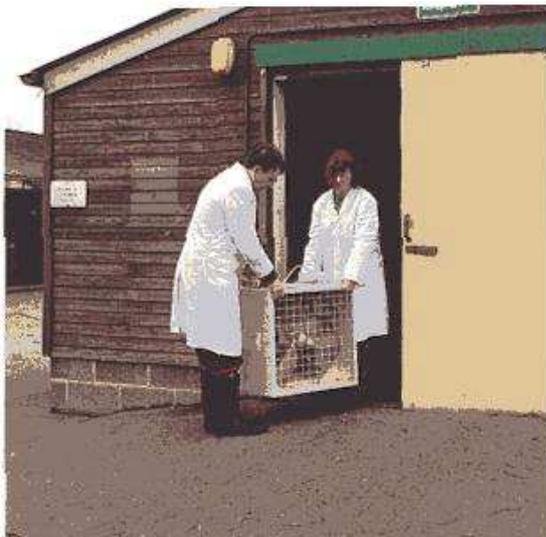
Even if there is enough air it is necessary to distribute it uniformly to all of the pigs. Modern ventilation systems are designed to achieve this, but there are still many inherently poor systems in the industry.

Where temperature records indicate poor distribution in existing houses the system can be redesigned to improve circulation, and some improvement can be achieved with circulation fans. It is important to distinguish between internal circulation fans, which do not change the air, and the main ventilation fans that do.

Enhancing Conventional Losses from the Pigs

In hot weather it is useful to increase the rate of convection from the pigs by increasing air speed at pig level using high speed air jets. The design of the system is critical as it is vital not to subject the pigs to high air speed unless the temperature is approaching their upper critical temperature

Evaporative cooling



A cooling fan

Evaporative cooling is very important in controlling heat stress in the pig. The pig will wallow if any liquid material is available and in partially slatted systems this will mean the pigs create a dung and urine wallow in the solid lying area which is highly undesirable for pig cleanliness. Modern automatic shower systems are now available which can wet the pigs thoroughly, causing evaporative heat loss and eliminating the need to wallow. Careful adjustment of the shower time is needed to ensure effective showering with minimum water consumption. The shower should be positioned in the dunging area. In fully slatted systems a shower system is an effective way of alleviating heat stress, but could create problems at times when very high humidity and high temperatures coincide.

Stocking Density

If stocking densities are too high, heat stresses are worsened for two main reasons. Firstly, the house temperature rises as more metabolic heat is added to the house air than the ventilation system is designed to cope with.

Secondly, the pig is unable to adopt its extended posture which could increase conductive heat loss. In addition the pig fails to lose maximum heat if any of its skin is in contact with other pigs.

Outdoor Pig Keeping

Pigs kept outdoors are particularly vulnerable to radiant heat gain and it is important that they have access to shade in sunny weather. At such times heat losses from convection and conduction are minimal and it becomes important that evaporative heat loss by wallowing can occur. This will mean providing wallows for the pigs.



Wallows should provide a 'mud bath' for heat loss and to minimise sunburn

Traditionally the wallows are constructed in the paddocks using water from a bowser or overflowing water trough. It is important that this water provides a 'mud bath' so that not only can evaporative heat loss take place following a wallow but sunburn can be minimised by the layer of mud on the body.

It is important that there is a separate supply of clean water for drinking in addition to the wallow.



A supply of clean, fresh water for drinking

Prevention Summary

Pigs subjected to high temperatures not only suffer as a result of heat stress, but also productivity is reduced with a lower growth rate in finishing pigs and lower fertility in sows and boars. The use of good ventilation design and insulation combined with the use of evaporative cooling techniques for indoor pigs, and the combination of shade and evaporative cooling for outdoor pigs, can alleviate heat stress in pigs under most UK conditions.

5. Transporting pigs in hot weather

Pigs should be loaded and transported as early as possible to avoid the heat of midday. Avoid feeding immediately prior to transport, but provide half rations about four hours before loading as necessary. Stress at loading can be minimised by appropriate design of the loading ramp to match the tailboard height and the use of a hydraulic lift to load pigs onto the top deck rather than using a steel ramp. If transport in the heat of midday is unavoidable, it is an advantage to wet the pigs' skin as they board the vehicle.

Consideration should be given to reducing stocking rates on lorries during hot weather. Adequate ventilation of the pigs is essential to minimise the increase in temperature within the vehicle. The vehicle must be fitted with sufficient ventilation apertures which can be opened as necessary. The lorry must be stationary for as little time as possible as temperatures in a fully loaded stationary vehicle can rapidly exceed 30C (above the Upper Critical Temperature of a pig) regardless of weather conditions. Routes should be carefully planned to minimise stoppages.

6. Adequate provisions for emergencies

Alarms to warn of failure of the ventilation system are not only sensible and common features of modern ventilation systems, but they are also mandatory when the pigs' welfare depends on powered ventilation. The Welfare of Livestock (Intensive Units) Regulations (1978) as amended by the Welfare of Livestock Regulations (1990) require that all buildings with powered ventilation systems should be fitted with an alarm to give adequate warning of system failure and additional equipment to prevent unnecessary pain or distress to the pigs in the event of system failure. In practice this means the provision of equipment such as 'fail-safe' panels, automatic self starting generators and 'invertors' on ACNV systems.

The detailed design of emergency equipment is beyond the scope of this booklet, but designs and required capacities are readily available from ADAS and other pig consultants.

7. Staff training

It cannot be emphasised too strongly that pigs kept under any system can be prone to heat stress if management and husbandry are not of a high standard.

The Welfare of Livestock Regulations 1990 require that stockmen and others who look after livestock should receive instruction and guidance in, and have access to, any Welfare Codes relevant to the livestock kept on the farm.

In this case staff should be familiar with the Welfare Codes for Pigs and in particular, the sections on Ventilation and Temperature.

Contingency Plans

Pig producers should ensure that all staff are able to recognise the early signs of heat stress and that senior stockmen and certain other staff are familiar with the ventilation systems in all pig buildings on the farm. There should be a contingency plan in the event of either a partial or complete breakdown of equipment (such as back-up systems failing) designating different roles to members of staff as necessary. In situations where heat stress is occurring in a building, consideration should always be given to removing some or all of the pigs from the building. Emergency instructions should be clearly displayed for all staff and these should include telephone numbers of veterinary surgeons and equipment engineers. A person should be available or on-call at all times who has authority to take whatever decisions are necessary to protect the welfare of the pigs.

To Avoid Heat Stress

- Adequate ventilation for the number and weight of pigs housed.
- Recommended Welfare stocking densities not exceeded.
- Stocking densities may have to be reduced during hot weather.
- Alarms and emergency ventilation equipment regularly maintained and tested (at least once per week).
- House structure sufficiently insulated to avoid solar heat gain.
- Provide shelter and wallows for outdoor pigs.

8. Further advice

For general advice on all veterinary matters, consult your private veterinary surgeon.

Heat Stress:

Further general advice on heat stress may be obtained from:

- The State Veterinary Service (Local Animal Health Office - address and telephone number in your local telephone directory),
- Your local ADAS pig advisor or other expert consultants, equipment manufacturers or suppliers.

A list of publications on animal welfare from MAFF is available on our World Wide Web site.