Livestock transport vehicles

A guide to best practice for vehicle ventilation

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Department for Environment Food and Rural Affairs

Why is ventilation important?

- Ventilation within your vehicle is important to remove the heat and moisture produced by animals during transport.
- If heat and moisture are not removed, then conditions in the vehicle become different from those outside the vehicle.
- During transport, thermal conditions around the animals are the greatest stressor to the animals.

How much heat and moisture do animals produce?

This depends on many factors including the number of animals on the vehicle (more animals = more heat produced) and the weather conditions.

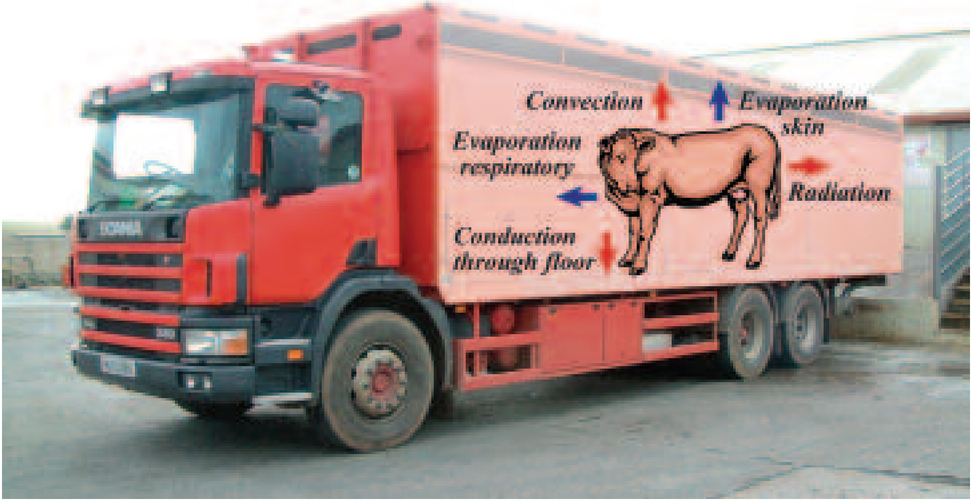
Typical values of heat production are:

Species	Liveweight (kg)	Heat (Watts)
Cattle	500	500
Calves	70	100
Pigs	100	200
Sheep	40	75

In addition to heat, animals also produce water – in urine, through their skin, and in their breath. In warm conditions they will produce even more water by panting or sweating.

This heat and moisture produces hot and humid conditions within the vehicle close to the animals – different from the outside ambient conditions.

How do animals lose (and gain) heat?



Heat exchange can occur by:

- **Convection** – transfer of heat in an airstream.
- **Radiation** – transfer by emission of heat in the air.
- **Conduction** – transfer of heat by contact with another surface.

Convection, radiation, and conduction depend on temperature difference or gradient.

Hot weather limits losses by convection, radiation and conduction.

- **Evaporation** – transfer of heat by evaporation of water from skin or respiratory tract (for example, sweating or panting).

Evaporation depends on a water vapour gradient.

Humid weather limits losses by evaporation.

What conditions are acceptable on the vehicle?

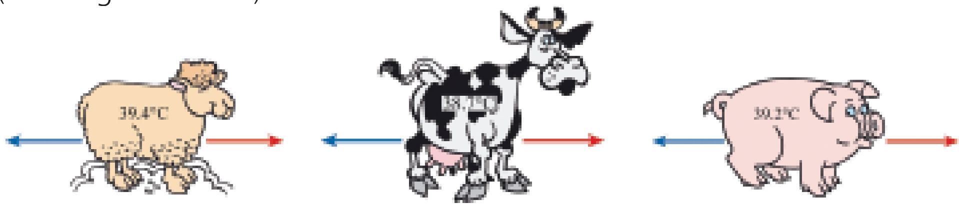
Acceptable conditions are those which do not cause an animal to suffer unnecessarily.

Farm animals (like humans) have a set ‘normal’ body temperature. This is usually maintained despite changes in outside temperature because the animals are able to balance their heat production to their heat loss. But if they are unable to do this, then their body temperature will change.

Normal body temperatures are:

Species	Body temperature
Cattle	38.7°C
Calves	39.0°C
Pigs	39.2°C
Sheep	39.4°C

However, for each species there is a range, either side of the normal, within which the animal can survive without harm or undue suffering (see diagram below).



What happens if there is too much heat in the vehicle?

When heat builds up within a vehicle (usually because of inadequate ventilation), a point can quickly be reached where the animals are no longer able to regulate their own body temperature – and therefore are likely to suffer or even die.

Deep body (core) temperature can be used as an indicator of thermal stress.

- Any change in deep body temperature is undesirable.
- Increased body temperatures (hyperthermia) are usually considered to be more harmful than low body temperatures (hypothermia).
- A **rise** in core temperature of 1.5°C or more may be considered to be **hyper**thermia. A rise of 4-5°C will almost always be fatal.
- A **fall** in core temperature of 1.5°C indicates **hypo**thermia. Decreases of 5°C or more may not be fatal but represent an unacceptable physiological stress.
- The onset of hyperthermia may be worsened by dehydration or exposure to direct sunlight.
- The onset of hypothermia may be worsened by wetting of the animals and exposure to direct air movement.

How can ventilation help?

- Air movement through a vehicle can remove heat AND moisture. This allows better heat loss from the animals.
- Air movement can be natural (through apertures) or mechanical (using fans).

What is the air movement within a naturally or passively ventilated vehicle?

Because external factors cannot be controlled there is little opportunity to control movement of air within a naturally ventilated vehicle.

Forward vehicle movement causes a low pressure area external to the container sides at the front (headboard) end. So, with a vehicle moving at speed, air will enter the container through the rear vents, move forward over the animals, and leave through the front vents.

This effect explains why fresh shavings, spread evenly over the container floor, tend to be blown towards the front of an empty vehicle whilst driving to the farm for loading.

Ventilation holes in the front headboard will let air into the container. But this air will be drawn out again (by suction) through the front vents, and will not travel the length of the container.

However, the pattern of air flow through the container is influenced by both the vehicle's movement and by the direction and speed of the wind. If there is a strong cross-wind, at low speed, the resulting air flow will be through and across the container.

What is the air movement within a mechanically or fan-ventilated vehicle?

As external factors cannot be controlled, it is useful to be able to control movement of air into, within, and out of a vehicle container. This can be achieved by a combination of suitably positioned mechanical fans of sufficient capacity, and natural apertures.

But simply mounting fans onto existing ventilation apertures is unlikely to ensure that air flows over all the animals, because air will always take the path of least resistance.

It is better to install fans at one end of the vehicle container and apertures at the other end (with closed sides in between). The direction of airflow created by the fans should enhance the natural airflow within the container caused by the vehicle's forward movement. Extraction fans at the front and natural inlet apertures at the rear are probably the most effective arrangement.

However, in case of mechanical failure, a fan ventilated vehicle should always have the capability of opening sufficient side apertures to enable emergency natural ventilation.

Controlled ventilation or controlled environment?

Controlled ventilation is **not** the same as controlled environment.

- Controlled **environment** (such as on refrigerated vehicles) can create conditions within the vehicle that are cooler than those outside the vehicle.
- Controlled **ventilation** (which is much simpler and cheaper) only provides a regulated ventilation rate. Inlet air temperature is the same as that outside the vehicle. As air passes over the animals, it 'picks up' heat and moisture from the animals. The air leaving the vehicle will feel hotter (and it will contain more moisture). This is perfectly normal and shows that the system is removing heat.

This is the preferred method of ventilating livestock vehicles.

What are the obvious signs of cold stress and of heat stress?

Signs of **cold stress** include:

- shivering,
- raising of coat hair, and
- huddling.

Signs of **heat stress** include:

- panting,
- sweating,
- salivation, and
- restlessness.

The effects of thermal stress may not be evident in the live animal but may become apparent after slaughter as, for example, changes in meat quality.

Summary

- Ventilation is the main method for removing heat and moisture generated inside the vehicle by animals during transport.
- Within the UK, excessive heat is likely to be a greater problem for the animals than extreme cold.
- When in motion, air tends to move from the back to the front of the vehicle.
- Active (mechanical) ventilation allows a greater opportunity to modify conditions around the animals than passive ventilation – especially on stationary vehicles.
- In hot weather avoid parking in direct sunlight for prolonged periods.
- If practical, park passively ventilated vehicles at right angles to the wind direction, with sufficient apertures open, to optimise air movement through the container.

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