

Electric Underfloor Heating for Pigs

Introduction

After many years of successful use in the agricultural industry, underfloor heating is now accepted as a reliable, convenient and economical way of providing the correct environment for many types of livestock, most notably for pigs in farrowing and weaning accommodation.

Electric underfloor heating can easily be installed by farm staff in new or existing buildings, providing a safe, reliable heating system that requires virtually no maintenance.

Underfloor Heating Cables

The cables used for site cast underfloor heating fall into two main categories:

a) Mains Voltage

There are two commonly used cables. The first is a single core cross linked polythene (XLPE) sheathed and insulated cable. This is light to handle and inexpensive, but can be susceptible to damage if laid carelessly.

The second is a more robust cable with a plastic covered copper sheath. This cable is less susceptible to damage on installation, but is more expensive especially for smaller heated areas.

Heating cables cannot be connected directly into normal electrical terminations as the heat would damage them. To overcome this the majority of cables are supplied with "cold tails"; these are standard pieces of cable jointed to the heater cable to allow direct electrical connection.

b) Low Voltage

Low voltage cables are operated from a transformer which reduces the mains voltage. A low voltage system tends to be more expensive because of the need for a transformer.

Although mains and low voltage cables differ in price, installed correctly they are both equally effective as a heating source and will give many years of reliable service.

Control

Underfloor heating cables are normally thermostatically controlled to ensure that correct temperatures and low running costs are maintained. There are two alternative positions at which temperature can be sensed.

a) Floor Screed Sensing

This is done by inserting the probe from the thermostat into a pipe which has been cast into the screed above the cables. This will provide accurate floor temperature control.

b) Air Sensing

The thermostat sensor can be positioned in the air just above the heated floor. To protect the sensor from interference by the pigs a piece of slotted metal flooring or drilled conduit pipe can be used. The protection must allow free air movement around the sensor.

Both systems of sensing are successful, the choice normally being made to suit individual requirements.

Capillary or electronic thermostats can be used. Electronic thermostats tend to respond more quickly to changes in temperature and are therefore preferable, especially where air temperature is to be sensed.

In weaner kennels, it is desirable to thermostatically control ventilation as well as heating. Controllers are available which operate ventilation flaps when cooling is required, but then ensure that they are closed when heating takes place. Failure to interlock the heating and ventilation systems will almost certainly result in high running costs.

Loading of Underfloor Heating Cables

The normal rating of the cables required for both weaner kennels and for piglet creep boxes is between 160W and 200W per square metre of floor area. This will depend on the size, construction and position of the heated area.

Designing a System

Layout

The first consideration when designing an underfloor heating system is to decide how many individual heating cables will be required.

For example, in a farrowing room with twelve forward creeps, each heated creep could be provided with its own individual cable and thermostat which would allow independent operation of all creep boxes. This would be the most flexible approach but it would also be the most expensive.

With costs in mind, a more practical approach would be to lay and control the creep areas in groups of say 2, 4 or 6, so that each heating cable and thermostat service a number of creep boxes. In other words the system should be designed to match the farrowing policy.

Design Example

Take a twelve place farrowing room where the creeps are to be controlled in four batches of three. This means that four heating cables and four thermostats will be required.

In this example each heating cable is to cover a total area of about 2.5m². With a loading requirement of 160 W/m², this gives a total floor requirement of 400W.

As cables are manufactured in standard ratings, it is common to purchase a cable of a rating as near as possible to that calculated, but preferably a little on the high side. In the case of our example, the nearest available size is 500W.

From one manufacturer's data on a typical 500W cable, the length of the cable is given as 31.5m. For a uniform spread of heat, this length of cable must be distributed as evenly as possible over the area of the creeps and is done by running the cable in loops, either along the length of the area, or across its width.

It is helpful to be able to calculate the number of loops and the spacings of the cables before starting to install a system, as this will reduce the time spent setting out the cables on site.

If it is decided to lay the cables lengthways, then the number of times the cable must cross the area is given by dividing the cable length by the length of the area to be heated. In our case, the cable length (31.5m) must be divided by the length of the area to be heated (4.45m). To the nearest whole number, this works out to be seven lengths.

This might prove to be a little awkward in practice, as an odd number of lengths will result in a termination at each end of the heated area.

To resolve this, the installer may choose to put in eight loops by slightly shortening the length of the heated run to provide the extra cable length needed.

Having decided that he wishes to use eight lengths, the spacing of the cable runs can be determined by dividing the width of the heated strip by the number of runs plus one.

Given that the width of the heated area is 550 mm and the number of runs is eight, then:

$$550 \text{ divided by } (8 + 1) = 61 \text{ mm}$$

Armed with an idea of the number of runs of cable and the approximate spacing, the installer may now proceed with the practical installation. More precise figures can be worked out by other means, or by drawing the whole installation out to scale on graph paper, but in practice this is unnecessary, as final adjustments can be made on site.

Construction Notes

Sub Base

The sub base should have the relevant falls and be well compacted. If hardcore is used it should be blinded with sharp sand.

Insulation

Expanded polystyrene insulation cannot withstand high temperatures and must not be used. Extruded polyurethane (Purlboard) or extruded polystyrene (Styrofoam, Polyfoam) insulation is recommended. No fines lightweight concrete such as "Lytag" can be used as an alternative.

Screed

The screed in which the cables are buried is laid in two layers. The bottom layer (1:3 cement, sharp sand) is laid on top of the insulation and the cables are then positioned on this screed, held firm with proprietary cable anchoring clips. This is followed by the final screed (1:2:2 cement, sharp sand, 10mm aggregate). The concrete mix should be fairly dry. It should retain its form after being compressed by hand, but should crumble easily when disturbed.

Where the top and the bottom screeds can be laid within an hour of each other then a thinner top screed can be used. If this is not practical then:

- a) slightly thicker screeds must be used to maintain the strength of the floor.
- b) the bottom screed should be covered with polythene and allowed to cure for twenty-four hours before laying the cables and top screed.

The cold tails of the cable are brought back to a convenient position where they come out of the concrete protected by a piece of pipe. This should be sealed on completion of the job with waterproof compound.

The top layer of concrete should be trowelled onto the cables, taking care that the cables are not damaged or moved together. If the cables become pushed together this could cause a hot spot in the screed which would lead to their failure. Thorough compaction of the concrete is necessary so that air pockets in the screed, which could lead to over-heating, are eliminated. A wooden float should be used to flatten the surface of the concrete, followed by the light application of a steel trowel to give a suitable finish.

Testing

A qualified electrician should be in attendance throughout the laying procedure to check the cable for continuity and insulation resistance. The testing is to ensure that the cable has not been damaged during the laying process; it is a lot easier to take up a damaged cable at this stage than after the concrete has set.

Curing

The completed floor should be covered with polythene for one week, or sprayed with a sealing resin to prevent it drying out too quickly. Ideally, it should be left to dry for five to six weeks before the cables are switched on. Then, the heating should be turned on at a low thermostat setting for a few hours each day, progressively increasing the number of hours until full input is achieved after four or five days.

Installation Onto Existing Floors

Insulation

If possible, insulation should be incorporated when laying underfloor heating onto existing floors. However, there are many successful conversions where no insulation was incorporated. The consequences of omitting the insulation will be slightly higher running costs and a larger thermal store in the floor.

Screed

If the screed is to be laid on top of the existing floor then the floor should either be:

- a) acid etched, or
- b) roughened up as the new screed will not stick to a dirty floor. Pressure washing alone is not normally adequate to get rid of ingrained dirt, fat, etc. Mechanised tools such as "scrabblers" can be hired to roughen up the surface. The process of laying the screed is then the same as described for new floors.

Sand/Cement Board Construction

An alternative laying system which has been successfully used for many years is a sand and cement board floor. It can be laid onto an existing floor, or a consolidated hardcore sub-base. No damp proof membrane is used, so that any water that goes through the joints can drain away freely.

Attraction Lights

When underfloor heating is installed for piglets in the farrowing house there will also be a need for the installation of a light to attract the piglets to the heated area. One method is to use a hose-proof bulkhead fitting which can be attached to a creep box wall.

Pre-Fabricated On-Floor Heater Pads

Where it is impractical to cast heating cables into the floor, pre-fabricated heater pads can be used. This solution is effective, but less convenient and more costly.

Many types are available made of a variety of different materials, including stainless steel, glass reinforced plastics (GRP) concrete (GRC), and rubber.