

## Technical Note

### Electrical Stun-Kill in disease control situations



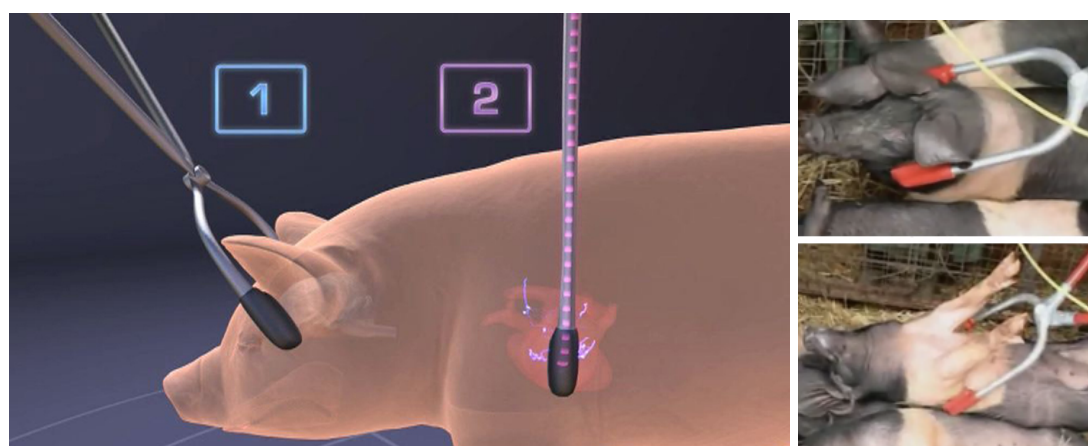
#### Introduction

Effective head-only stunning (often used in slaughterhouses) only produces a short period of unconsciousness. The pig can partially or fully recover from this process if not quickly and correctly killed. Electrical stun-kill is an OIE Technical chapter 7.6 approved method for killing animals during disease control and can be applied efficiently and safely on farm. This method is very useful as it can be mobile, readily trained, contain the disease agent in the carcass (avoids release of blood or bodily fluids) and one of the most humane methods at any scale on farm.

The stun-kill method can be very efficiently conducted (two steps in less than six seconds in total). This is less time than it takes to move the next animal into position. If it takes any longer there is a problem, and the process could be causing pain to pigs and risks to workers. Pigs must be presented for stun-kill in a calm, organised manner, usually in a small pen or race way - see the other technical notes on behaviour and handling of pigs.

#### How does it work?

When electricity is used to kill animals it is called electrocution. The equipment used on farm usually delivers electricity in two separate manual applications; (1, top) stun across the brain to immediately make the pig unconscious first, followed quickly by (2, lower) application across the heart to induce cardiac arrest to kill the pig.



The electrodes must be applied in a way that current always **flows through the brain first to stun the pig**, so that it is unconscious and does not feel pain, before current is directed through the heart. Exact positioning is very important and detailed below. **If this process is not sequentially applied, the process is not humane. Death must always be confirmed.**

**IMPORTANT:** It is essential to only use an approved, tested and regulated device (electrical pack and tongs). These can be used on farm with mains electricity input or if unreliable, with a generator to produce adequate and reliable voltage and

current. **The input to the electrical device will need to be minimum 400 volts and 20 amperages current.** Home-made or battery devices are not adequate as the electrical parameters cannot be assured, reliably measured or effective for each step. See details below. Rubber boots must be worn for safety.

To understand the process, equipment, parameters and be also able to problem solve, it's essential to understand the principles behind effective electrical stun-kill. It is also essential that pigs are calm and restrained. Handling guidance is provided in a separate technical note. **All operators must be well trained.**

## **Step 1 – head stunning**

Electrical stunning (electronarcosis) involves passing an electric current through the brain. This disrupts the normal electrical activity in the brain to the extent that the animal becomes unconscious and insensible to pain.

Electrical stunning involves stimulation of the whole brain and with sufficient current results in repeat firing of nerve cells which is immediately followed by an exhausted brain state similar to '*grand mal*' epilepsy in humans.

The effect on the animal is only temporary so the objective is to induce unconsciousness quickly and ensure that the duration of unconsciousness lasts until the main blood vessels in the chest to be cut and that the animal dies.

### **Electrical Principles**

It is the current delivered to the brain which stuns the animal. At a constant voltage the amount of current flowing through the brain is inversely proportional to the total electrical resistance pathway. This is known as Ohm's Law where:

$$I(\text{amps}) = \frac{V(\text{volts})}{R(\text{ohms})}$$

The current is the rate of flow of the electricity, the voltage is the electrical pressure that drives the current through the head and through the brain, and the resistance reduces the flow of an electric current. The resistance will vary pig to pig, affecting the final parameters applied to the pig.

The voltage must be high enough to overcome the resistance in the pathway between the electrodes and the animal's brain and deliver enough current to produce an effective stun.

Resistance to current flow is affected by:

- Electrode material – good, clean tongs are important
- Skin and hair – dirty pigs will be more resistant. Wet pigs less resistant.
- Thickness of the skull – sows and boars will be more resistant
- Brain tissue – placement is important

- Distance between the electrodes – all of the above.

In general terms the resistance can be reduced to improve current flow by ensuring electrodes are clean, the stunning site is wet (water is a good conductor of electricity) and there is little hair or dirt on the contact site. The resistance across the head of a pig weighing around 100kg can range between 150 and 350 ohms.

### Electrical Parameters (step 1)

Generalised epilepsy (grand mal seizure) is required to induce unconsciousness (so insensible to pain). It can be induced in the brain within 1 second of application of a **minimum current of 2.3 amps across the brain**. Usually application up to 3 seconds is needed to be sure, if longer than this required, there is a problem. A minimum voltage of 400 volts is required to deliver this amperage level in the required 1 second. Ideally, equipment with a pre-set current flow (variable voltage, constant current) should be used.

Lower voltages are not always capable of producing the required amperage within the 1 second target time; therefore it is possible that pigs may receive a painful shock before the onset of unconsciousness or it may immobilise them without unconsciousness. This is painful and not humane.

In order to be able to effectively monitor the stunning operation electrical equipment as a minimum should:

- Be capable of overcoming the resistance and clearly display the voltage and amperage for every application and the animal
- Not operate unless there is sufficient current to overcome the detected resistance
- Have audible and visible warning devices, which indicate the length of time of application

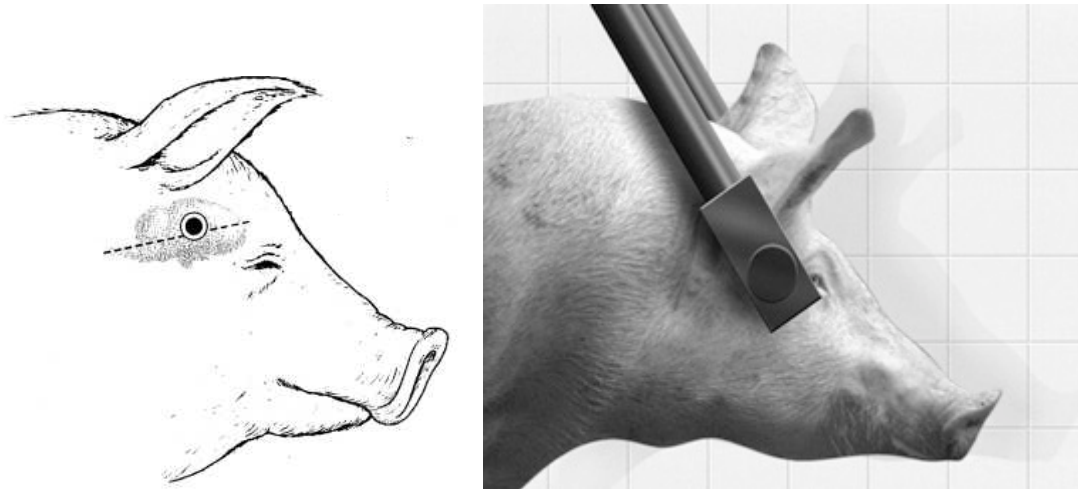
Example equipment below (electrodes or 'tongs', electrical devices, rubber boots) used in backyard and larger farms in Lithuania. (Source OIE 2019 webinar)



### Electrode Placement (step 1)

In order to be effective, stunning electrodes must be positioned **firmly on the head so that they are at either side of the brain**. The current must flow through the

skull and across the brain by the most direct route. Careful placement to avoid extra resistance from the mandibles and excess muscle is key.



Source: Modified from J.K. Shearer    Source: Humane Slaughter Association

Above you can see the size and position of the pig brain and the most commonly used and consistently effective electrode positioning. This position also allows the stunner to approach the pig from behind to minimise fear and movement, for most accurate positioning.

- Electrodes (tongs) must **never** be applied across the snout or jaws because electrodes are not spanning the brain.
- Electrodes (tongs) must **never** be used on any other part of the animal's body to encourage it to move, or to immobilise it.

Accurate electrode placement requires skill. Electrical stunning tongs should be applied in the right place the first time to prevent the animal suffering any pain. **If the first stun fails, you must stun the pig again immediately.**

Below is an unconscious pig in grand mal seizure, ready for step 2. (Source: Dr Dennis Will)



## Step 2 - Cardiac Ventricular Fibrillation and Arrest

Cardiac Ventricular Fibrillation occurs when the rhythm of the heart is disrupted and the heart muscle twitches randomly. Fibrillation impairs cardiac output (reduced to less than 30%) and normal blood circulation. As a result it induces hypoxia in the brain which prolongs the period of insensibility induced by the stun. Cardiac ventricular fibrillation leads to cardiac arrest, sometimes within seconds, but often after about 5-10 minutes. Under these conditions the ability of the pig to regain consciousness and sensibility is seriously impaired, even if it is not bled out.

### Electrical Parameters (step 2)

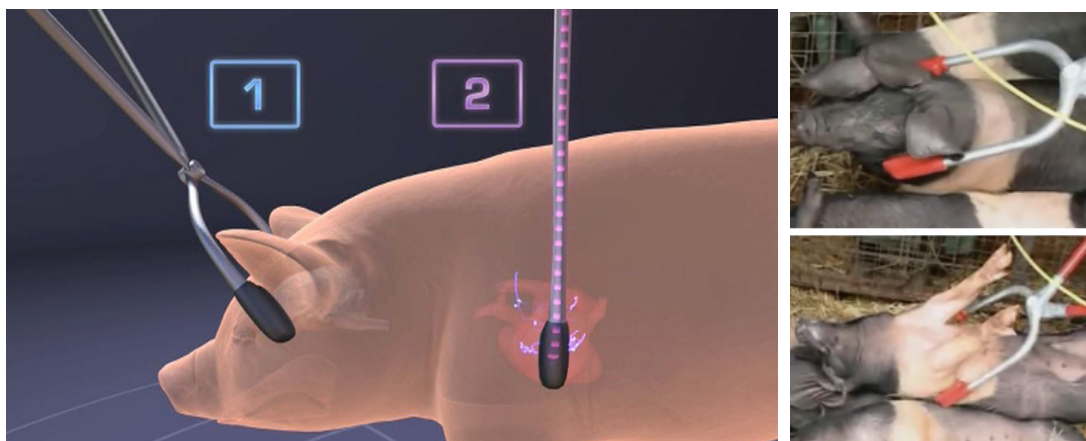
The stunning current is the same as it is for head-only systems. It must deliver a minimum of 2.3 amps. A minimum voltage of 400 volts is needed to achieve this.

Cardiac ventricular fibrillation can be effectively induced with a 50Hz AC sine wave electricity. Higher frequencies **do not** produce cardiac ventricular fibrillation.

As with head-only stunning (step 1) the electrodes must be clean, to reduce the resistance and ensure the maximum amount of electricity flows both to and through the heart.

### Electrode Position (step 2)

When electricity is used to kill pigs **they must be well restrained**, usually in some form of race way, crush restrainer or small pen (on farm). For manual systems this must present the pig to the operator so that the electrodes can be positioned accurately on the head (1) to get an effective stun and then (2) across the heart to get cardiac arrest. **The tongs must open wide enough to fit all pig sizes for step 2.**



To achieve ventricular fibrillation and cardiac arrest in every pig, the electrodes must be positioned directly **over the heart between the ribs** as show in (2) above

or more practically when pig collapsed **across both hairless axilla regions** as shown below. **Do not place electrodes over the scapular, humerus or ribs as this greatly increases the resistance to electrical flow.**



The most practical application, especially for large pigs, sows, boars is shown above for step 2 is with electrodes placed at each axilla, so current passes directly across the hairless skin and heart. (Source: Dr Dennis Will)

With manual equipment, the current should be applied for three seconds immediately after the first step (head stun). Electrodes must **never** be put on the heart before the pig is stunned as this may cause acute pain.

### **Signs of an Effective Stun-Kill**

Following an effective electrical stun, the pig will collapse immediately in a grand mal seizure as shown below. There will be a tonic seizure (legs outstretched, high tone), and a clonic phase (seen as leg paddling). (Source: Dr Dennis Will)



The pupils will be dilated and the body will then gradually relax. Even after the second step (and full process), pigs may show brain stem reflexes, such as final gagging or gasping (not to be confused with rhythmic breathing) and corneal reflex for a short time. These brain stem reflexes indicate a dying brain rather than presence of consciousness and sensibility.

Pigs should *never*:

- Return to rhythmic breathing

- Have focused eye movements
- Vocalise during or after the process
- Attempt to right themselves (ie. should not raise their heads, attempt to get up or stand).

**If any of the above 4 signs seen** – reapply to stun again immediately across the brain, and then apply the electrodes to kill.

## Confirming death

All of the following signs should be reliably checked to confirm death before movement and disposal. This is essential to humane practice.

No rhythmic breathing at any stage: check no movements in abdominal area and in front of the nostrils



Plus....

Dilated pupil and no corneal reflex: in practice it is difficult to check corneal reflex, also variable and unreliable.



No nose prick twitching: repeatedly no response to pain (use fingers or small pliers carefully)



Plus.... no head righting reflex.