

# Meat technology update

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## Electrical Stunning of Smallstock

All smallstock presented for slaughter must be effectively stunned (rendered immediately unconscious) prior to sticking. Electrical stunning is the most commonly used method for calves, sheep and lambs. It is also used with pigs, although carbon dioxide (CO<sub>2</sub>) stunning is used in some of the larger pig processing works.

The passage of sufficient electric current through the brain will produce a stunned state.

A minimum of 1 amp is recommended for effective stunning of calves, sheep and lambs and a minimum current of 1.3 amp is recommended for effective stunning of pigs.

Ideally, the stunner should incorporate an ammeter which indicates the current under load, and this should be positioned where it is visible to the operator. Works should use the stunning voltage switch position which ensures the current specified above for the particular species.

The stun current should be applied for at least one second, but longer times may be necessary to ensure effective stunning. The equipment should incorporate a visible device which indicates when the current is being applied to the animal.

### Symptoms of an Effective Electric Stun

Electric stunning should achieve immediate unconsciousness. An effective electric stun is characterised by two phases:

- a tonic (rigid) phase;
- a clonic (kicking) phase.

When a stunning current is applied to an animal it becomes rigid and normal breathing ceases. During the rigid (tonic) phase the head becomes raised and the hindlegs are flexed into the body. The forelegs may be flexed to begin with, and then they gradually straighten out during the tonic phase, but the presence of bending depends on the species and current that is used. Overall, rigidity in the animal normally lasts for 10-20 seconds and may be followed by a relaxation phase before the onset of the kicking (clonic) phase. If the animal shows paddling or kicking movements with its legs as soon as the stunning current stops, it is possible that the animal is not properly stunned. The normal kicking (clonic) phase usually lasts for 15-45 seconds.

The presence of a tonic and clonic phase in this sequence is taken to be a sign that the animal has been effectively stunned. There is no point in trying to assess corneal or other reflexes during these phases as the animal is convulsing, and no meaningful results will be obtained. The clonic phase is usually less

pronounced following head-to-back stunning than with 'head only' (reversible) stunning.

## 'Head Only' (Reversible) Stunning

'Head only' stunning will not kill the animal and is sometimes called 'reversible' stunning. The electrodes should be applied so that they span the brain, enabling the current to pass through it. They should never be applied in a position which would lead to current flowing across the back of the neck, rather than across the brain.

With head only stunning, the death of the animal is brought about by sticking, which dramatically reduces the blood flow to the brain. Thus, both the stunning procedure and the sticking procedure must be correct if we are to have a humane slaughter procedure.

As a general guideline, sheep and pigs should be stuck within 15 seconds of stunning, and calves should be stuck within 10 seconds. A practical advantage of sticking as soon as this is that, because the animal's body will still be in the rigid (tonic) phase after the stun, it can be stuck before it starts kicking. It is also important to stick accurately. With gash (ear-to-ear) sticking, both common carotid arteries must always be cut. With thoracic (chest) sticking, the aorta or brachiocephalic trunk must be severed.

If a reversibly stunned animal has not been effectively stuck, breathing starts, recovery commences and the animal starts to regain awareness of its surroundings. A simple test that can be carried out in the slaughterhouse is to watch the animals' flanks for normal or rapid rhythmic breathing movements. The movements should be distinguished from gagging where the animals make erratic inspiratory gasps. Gagging movements are an indication of a dying brain and they have a lower frequency than normal breathing movements.

Signs that indicate the animal is not recovering and that the stun/stick procedure

has been effective include:

- no response when the eye is touched (the corneal reflex);
- no response when the nose region is pricked with a needle.

**NB:** It is a requirement that, where stunning equipment that produces a reversible stun is used and the equipment is fixed and cannot be used to stun animals which may recover, an alternative means of stunning the animals should be available in the stunning area (AQIS Operational Guidelines for the Welfare of Animals at Abattoirs and Slaughterhouses 2nd edition, 1995).

## 'Cardiac Arrest' (Irreversible) Stunning

When this method is applied as recommended it will stop the animal's heart and hence kill it. If performed correctly, there is little likelihood of it regaining consciousness. From the humane point of view it becomes less important to stick soon after stunning, but sticking should occur as soon as possible.

The electrodes must be applied so that they span both the brain and the heart. The front electrodes should be placed towards the back of the head, but not on the neck. Ideally they should be in line with the rear margin of the eyes. The position of the rear electrode is important. If the distance between the electrodes is too short, then the heart will not be spanned and cardiac arrest will not occur at stunning. However, if the rear electrode is positioned too far back (9th – 12th ribs) then broken backs (see under 'Commercial Problems') may occur. Head-to-leg and head-to-brisket electrode arrangements can also be used to achieve a 'cardiac arrest' stun. The electrodes and application sites must be wetted to ensure good electrical contact, particularly in sheep, in order to avoid skin burns.

There are some commercial advantages from stopping the heart. For instance, the incidence of blood splash and bruises that are inflicted near to stunning can be reduced.

In addition it will provide a quieter carcass that shows less kicking and is easier to handle.

## Effective Stunning

When stunning electrodes are applied to the animal it must become rigid instantaneously. If it escapes from the electrodes, or if the initial contact is insufficient to produce rigidity, the animal becomes distressed and struggles, which in turn makes it more difficult to apply the electrodes. If a particular electrical stunning method persistently leads to such interrupted stunning, the problem can be alleviated by either improving the presentation of the animal to the slaughterman so that the electrodes are placed more accurately and more firmly, or improving the equipment to help it overcome the electrical resistance of the animal and the electrodes.

Every experienced slaughterman will have a preference for the way in which an animal should be presented for stunning, but a few general tips can be given which may prove useful in evaluating a system:

- It is easier to apply electrodes accurately if the slaughterman does not have to support too much of his weight at the time he makes the application. For example, it is usually easier to apply electrodes downwards instead of horizontally.
- Once the electrodes are positioned, it is easier to apply pressure onto the animal if the electrodes are relatively heavy.
- It is easier to place electrodes accurately if the animal is restrained instead of free-standing on the floor.
- Head-to-back electrodes can be applied with greater pressure and accuracy if they are held in both hands.
- The slaughterman should not have to bend his back each time he applies the electrodes; it becomes tiring, and this can lead to inaccurate application.

- The slaughterman should not have to concentrate on keeping his balance when he is applying the electrodes.
- Once the probes are applied and the current turned on, it is vital that contact remains positive and there is no interruption to the current flow for the duration of the stun.

The electrical resistance between the electrodes and the animal can be reduced by ensuring good electrical contact in the following ways:

- Wetting the application sites on the animal before the electrodes are applied.
- Wetting the electrodes. This will improve the electrical contact with the animal and help to reduce the build-up of carbon on the electrodes.
- Regular decarbonising of dry electrodes, e.g. with a powered, rotary wire brush situated alongside the stunning position.

An uninterrupted current flow at the level recommended, for the minimum time needed to achieve an effective stun, is necessary if meat quality problems are to be minimised.

## Safety Aspects

All electrical stunning equipment is potentially dangerous to staff if it is misused. Protection is given in different ways, including:

- Stunning with an isolated circuit in which current flows preferably between the two electrodes. Nevertheless, if a human comes between both electrodes, or touches one electrode while he is well earthed, he can receive a potentially lethal shock. It is essential that the safety procedures recommended by the equipment manufacturers are closely followed.
- Using safety switches or triggers. Never tape down the switches so that the

electrodes are permanently live.

- Having a preset timer that regulates the duration of stunning current flow. With some makes of equipment the voltage returns to a low level between each stunning episode. The low voltage is used for sensing the resistance of the animal and, once this is detected, the stunner switches to the higher stunning voltage and is kept there for a set duration.
- Housing the control box in a separate area which is always kept dry.
- Using spring-mounted electrodes which have to be pressed against the animal or an object to allow current flow.
- Regular maintenance.

## Checking the Stunning Equipment

Electrical stunning systems are of two major types:

- constant current (or a fixed minimum current);
- constant voltage.

In general, modern stunners are constant current. Ideally, they incorporate a device which measures the resistance of the load and prevents operation of the apparatus if the minimum required current cannot be passed. The older-type stunners are constant voltage.

The modern constant-current electrical stunners will generally have instructions as to how the equipment can be tested. Ask the works electrician to conduct the appropriate checks.

If your constant voltage stunner does not have testing instructions then ask your electrician to conduct the following basic checks:

- Switch off the stunning equipment.
- Connect a voltmeter across the stunning electrodes and select it for AC measurement.

- Operate the hand piece switch and record the open circuit voltage at the various voltage switch settings. The voltage recorded should approximate that marked at the particular switch position.
- Repeat the above operations using a dummy load to determine the voltage under load. The dummy load should be a high-wattage resistor in the range 160 – 200 ohm.
- The voltage under load should be only slightly less than the open circuit voltage.
- If the dummy load is of known resistance, an estimate of current flow can be obtained from Ohm's law: Current equals Voltage divided by Resistance. The measured current should be slightly greater than that recommended for the particular species.

If the stunning unit includes an ammeter, the above procedure can be used to provide a guide to its accuracy.

Ideally, the results of the above checks should be confirmed by recording the actual current applied to the animals when they are being stunned. The values should not be less than the appropriate recommendation given above. If the stunning equipment does not incorporate an ammeter, then to measure the current an animal receives, an ammeter or current sensing circuit has to be inserted in series with the stunning circuit, and this means that the circuit has to be interrupted in the stunning control box. The above checks can be simplified by incorporating the test resistor and an ammeter into an insulated box. The outside of the box has two metal plates to which the stunning tongs or wand can be applied. As the meter and resistor are connected internally to these plates, a reading of current flow is immediately obtainable. This equipment would allow a quality assurance officer, after training by the works electrician, to test the stunner, leads and tongs before stunning of animals commences for the day. A commercial prototype has been developed.

## Commercial Problems

Electrical stunning in pigs can lead to broken scapulae (shoulder blades), especially when they are stunned whilst free-standing on the floor. These breaks usually occur when an animal's forelegs make sudden impact with the floor at the start of stunning. This sends a shock wave up the forelegs and causes complete fractures at the necks of the shoulder blades. Star-like fractures also occur at the cup ends of the shoulder blades where they butt onto the humeri. The problem may be reduced by lifting the pigs off the floor at stunning, for example by using a 'V' restrainer.

Broken vertebrae can occur in pigs stunned with head-to-back tongs. These fractures are not usually associated with much bleeding if the heart is stopped at stunning, since this stops the pump which would otherwise force blood out of the ruptured vessels. In a similar way, inducing a cardiac arrest at stunning will reduce the expression of bruising inflicted either immediately before stunning, or between stunning and sticking.

If broken bones (scapulae and vertebrae) remain a persistent problem despite modifications to stunning tongs and stunning equipment, then works could consider trialling a stunner with a high-frequency output. It is claimed that these stunners, which have recently become commercially available, virtually eliminate broken bones and 'blood splash'.

Cardiac arrest stunning will help to produce a relaxed carcass which is easy to handle. It can, however, produce pelt burn in sheep if insufficient water is used at the back electrode. Burning of the skin may not be

evident in the fresh pelt but it can become noticeable after tanning.

Blood speckle in the fat of the carcass can also be associated with head-to-back stunning. It can look like a fiery rash at the site where the rear electrode was applied, or like a mild wool-pull bruise. The latter can occur anywhere along the side or back of the carcass, and is due to the wool being pulled between the sheep's body and the restrainer as the animal goes into a spasm.

Blood splash can be a problem with head only electrical stunning systems in lambs. There are three ways of reducing its incidence: by sticking very quickly after stunning (thus minimising the time available for blood to leak through the ruptured vessels), by changing to the captive bolt gun, or by cardiac arrest stunning. In the case of pigs, this problem is best avoided by using a cardiac arrest stunning method.

## Quality assurance

Each individual works should adapt the procedures recommended above to its own particular situation, incorporate them in both its Quality Assurance Manual and Animal Care Statement, and carry out training of the operators to ensure they have the knowledge and skill to perform the tasks humanely and efficiently.

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