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Charitable Incorporated Organisation

Humane Slaughter Association

Technical Note No 10

Electrical Waterbaths

Summary

The majority of birds slaughtered in UK abattoirs are stunned using an electrical waterbath.

Operators who are involved with the stunning, slaughtering or killing of poultry have a legal obligation that “animals shall be spared any avoidable pain, distress or suffering during their killing and related operations”. All staff involved with these procedures must fully understand the operation of the equipment they are using and how to deal with any problems that might arise.

This leaflet focuses on the different types of electrical waterbaths commonly used in the UK and aims to provide constructive, practical advice to maximise bird welfare.

Operatives must be trained to identify signs of ineffective stunning and must know the appropriate action to be taken to prevent birds from suffering unnecessarily.

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Legislation

An electrical waterbath can be used to stun or kill poultry providing that the following requirement is met:

"*Exposure of the entire body to a current generating a generalised epileptic form on the EEG and possibly the fibrillation or the stopping of the heart."*

Birds should be consistently monitored to ascertain the loss of consciousness and sensibility which shall be maintained until the death of the animal. If they have not been effectively stunned they must be manually stunned and slaughtered, or killed without delay.

Principles of electrical stunning

The principle of electrical stunning is to pass sufficient current, delivered by the electrode within the waterbath, through the brain to interrupt normal brain activity. Equipment used for stunning poultry must be designed, manufactured and maintained to ensure consistent, effective stunning so that the animal is immediately rendered unconscious and insensible to pain and remains so until dead.

To understand how an electrical waterbath operates, it is useful to have an understanding of the relationship between current, voltage and resistance, which is expressed by Ohm's Law. Current is measured in amps, voltage in volts and resistance in ohms. The current and voltage used by electrical waterbaths are displayed by the voltmeter and ammeter respectively.

Ohm's Law: $$\text{Current (I)} = \frac{\text{Voltage (V)}}{\text{Resistance (R)}}$$

In relation to electrical stunning of poultry in waterbaths, this means that the current flowing through each individual bird depends upon the overall voltage supplied and the particular resistance of each bird.

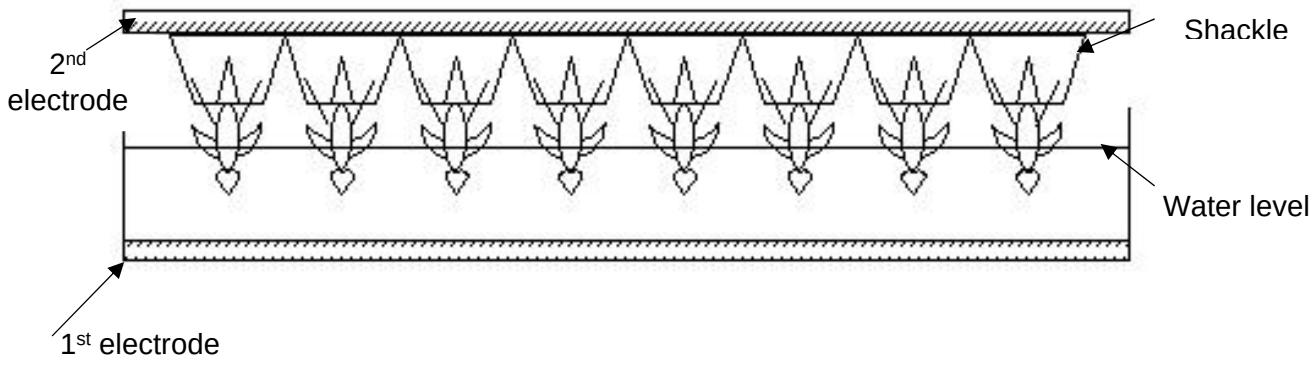
Current

Current can be generated either as alternating current (AC) where the direction of the current flow changes or as direct current (DC) which flows in one direction. Electrical waterbath stunners generally use high frequency alternating current (AC). The waveform of a current describes the shape of one cycle of the current; the frequency of the current, measured in hertz (Hz) is how many times one cycle of the waveform is repeated per second. Mains electricity has a frequency of 50 HZ ie the cycle repeats itself 50 times per second. Higher frequency waveforms repeat more times per second ie 200 Hz repeats 200 times a second.

Electrical waterbaths

Electrical stunning in poultry is conventionally carried out by passing birds' heads through a waterbath which contains a live electrode, making the water live. The birds' heads are submerged in the water, allowing the electrical current to pass through the birds up to the shackle and overhead rail, which are earthed.

Figure 1 Diagram of birds passing through an electrical waterbath



As the current passes through a bird's brain it produces a state of unconsciousness (stunning) and depending on frequency and current strength, can cause ventricular fibrillation of the heart (commonly known as cardiac arrest). Waterbaths tend to have several birds passing through the water at any one time, therefore it is critical that personnel are aware that the information displayed on the ammeter (measuring the current) represents the total current flowing through the waterbath, not through each individual bird.

A guide to the amount of current each bird is receiving can be found by dividing the figure displayed on the ammeter by the number of birds which are in the bath at one time. However, an exact figure cannot be calculated because the current received by individual birds can vary greatly due to differences in the resistance of each bird. These differences can occur for a number of reasons including: poor contact between the bird's leg and shackle, between the shackle and earthing bar, resistance variation in the skull bone and/or legs, and whether the bird's wings are in the water, etc.

IMPORTANT
If ineffective stunning is seen, the line should be stopped immediately and these areas checked and repaired before restarting.

Legislation requires a number of parameters to be met before a waterbath can be used:

- Birds must be suspended by both legs
- Shackles must be wet before live birds are shackled and exposed to the current
- The level of the water in the waterbath has been adjusted in order to ensure there is good contact with each bird's head
- The strength and duration of the current used is such that the poultry are immediately rendered unconscious and remain so until dead
- Where poultry are stunned in groups in a waterbath, a voltage sufficient to produce a current strong enough to ensure that every bird is stunned is maintained

- Appropriate measures are taken to ensure the current passes efficiently and effectively, in particular that there are good electrical contacts
- The waterbath stunner is adequate in size and depth for the type of poultry being stunned
- A person is available to ascertain whether a waterbath stunner has been effective in stunning the poultry and, if it has not been effective, will either stun or kill the poultry without delay

It is also strongly recommended that measures be taken to prevent birds receiving pre-stun shocks, eg preventing water overflowing at the entrance to the waterbath.

Low frequency electrical stunning (50 Hz)
Waterbaths which are set to deliver a low-frequency (50 Hz) electrical current will result in the majority of birds dying from cardiac arrest in the waterbath. It is still essential, however, that all birds have their necks cut within 15 seconds of exiting the waterbath. This ensures a rapid loss of blood and allows for the birds that have only been stunned to die through loss of blood before the start of recovery.

Table 1 shows the minimum current required to effectively stun different species of birds when using a low-frequency (50 Hz) waterbath.

Species	**Mimimum current (milliamps)**
Broiler	105 (0.105 A)
Turkey	150 (0.150 A)
Duck	130 (0.130 A)
Goose	130 (0.130 A)

Table 1 Defra recommended minimum currents per bird with a 50 Hz waterbath.

High frequency electrical stunning
Because the heart muscle is more sensitive to certain electrical frequencies, cardiac arrest can only be induced when the electrical waterbath has been set within particular electrical parameters (between 50 Hz and 500 Hz). Waterbaths which have been set to deliver high-frequency (>500 Hz) electrical currents will result in the majority of birds being stunned only. They will remain unconscious and insensible to pain for a short period of time, therefore their necks need to be cut as quickly as possible (recommended 5 - 10 seconds) to ensure the birds die from loss of blood before recovery.

Table 2 shows the minimum currents by species, and the animals shall be exposed to that current for a minimum duration of at least four seconds.

Table 2 – Electrical requirements for waterbath stunning equipment (Average values per animal)

Frequency (Hz)	Chickens	Turkeys	Ducks & Geese	Quails
< 200 Hz	100 mA	250 mA	130 mA	45 mA
From 200 to 400 Hz	150 mA	400 mA	Not permitted	Not permitted
From 400 to 1500 Hz	200 mA	400 mA	Not permitted	Not permitted

Legislation requires that bleeding must sever both of the carotid arteries. This is to ensure that death occurs before consciousness is regained.

High-frequency electrical stunning is now more commonly used, as it is thought to reduce the incidence of broken pectoral bones and haemorrhaging in comparison to low-frequency electrical stunning.

The signs that a bird has been effectively stunned are:

- the neck is arched with head held vertically
- eyes open
- no rhythmic breathing
- rigidly extended legs
- constant rapid body tremors
- wings held tightly against the body

The signs that a bird has been effectively killed are:

- no breathing
- dilated pupils
- wings drooping
- the absence of a third eyelid (nictitating membrane) reflex

The signs that a bird has been ineffectively stunned are:

- rhythmic breathing (look at movements in the vent area)
- tension in the neck (able to control the movement of its head)
- the presence of a third (nictitating membrane) reflex

Staff training

If any of these indicators are seen, the bird/s should be killed immediately and effectively, before the neck is cut. Any corrective adjustments necessary, should be made to the equipment to ensure no further ineffective stuns are seen.

To ensure that electrical waterbaths are used correctly, staff must be trained in accordance with the recommendations set out by the manufacturers' specifications and by EC Regulation 1099/2009 on the protection of animals at the time of killing.

Staff training should include how the machine works, the welfare problems associated with its incorrect use and signs of effective and ineffective stunning. Stunning and bleeding equipment should be checked before each kill and regularly throughout the day. Any problems found need to be reported and rectified immediately.
In the case of a line stoppage or prolonged delay, live birds should be slaughtered using a back-up method. Manual or back-up bleeding must be provided so that stunned birds which miss the automatic bleeding equipment are noticed and humanely slaughtered by a licensed slaughterman.

IMPORTANT
All staff should be aware of the potential risk of shocks and injury from electrical stunning equipment.

Cleaning and maintenance
Particular care should be taken when cleaning the equipment and this should be done in accordance with the instructions given in the manufacturer's manual. Cleaning and maintenance operations should only be carried out when the machine is not in operation. Even when the machine is switched off, any work carried out should be done with extreme care, without removing or blocking safety devices. The electrical waterbath should be thoroughly cleaned and disinfected inside and out every day and the build-up of fat from the shackle line removed.

Regular checks need to be carried out by a qualified electrician. All electrical stunning equipment should work by the use of an isolated circuit nevertheless if a person comes between the electrodes there is a danger of a fatal electric shock.

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DISCLAIMER OF LIABILITY
In no circumstances can the HSA accept liability for the way in which the equipment in this leaflet is used: or for any loss, damage, death or injury caused thereby, since this depends on circumstance wholly outside the HSA's control

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Further Reading

Council Regulation (EC) no 1099/2009
OJ of the EU 2009

The Welfare of Animals at the Time of Killing (England) Regulations
Defra 2015

Electrical Waterbath Stunnning of Poultry (HSA Online Guide)
HSA 2016
https://www.hsa.org.uk/downloads/publications/hsaonlineguidewaterbathpoultryapril2016.pdf

Full details of all legislation can be found on the following website: www.tso.co.uk

For electrical waterbath evaluation services, either Paul Berry at Paul Berry Technical (paulberry@pbtech.co.uk) or Steve Wotton, University of Bristol can be contacted for further information.