Charity Registered in England & Wales No 1159690
Charitable Incorporated Organisation

Humane Slaughter Association

Technical Note No 10

Electrical Waterbaths

Summary

Approximately 20% of birds slaughtered in UK abattoirs are stunned using an electrical waterbath. These systems are also widely used in other parts of the world.

The Humane Slaughter Association (HSA) considers that the **electrical waterbath stunning of poultry presents significant and inherent animal welfare concerns**. Even when operated under optimal conditions, electrical waterbath stunning is associated with major risks, including pain and distress caused by conscious shackling and inversion, the occurrence of pre-stun electric shocks, inconsistent induction of unconsciousness, and the difficulty of distinguishing birds that are effectively stunned from those that are merely paralysed or immobilised. **We recommend that operators using these systems replace them with more humane alternatives** such as automated head-only electrical systems or suitable Controlled Atmosphere Stunning (CAS) systems as soon as possible.

Nonetheless, it is acknowledged that waterbath systems are still in use and their operation will continue while alternative small-scale CAS and large-scale electrical systems are further developed.

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 as far as possible. More detailed information on operation of electrical waterbaths can be found in HSA Guidance Notes 7: Electrical Waterbath Sunning of Poultry and the HSA Online Guide: Electrical Waterbath Stunning of Poultry.

Humane Slaughter Association

The Old School, Brewhouse Hill Wheathampstead,
Herts AL4 8AN, UK
t: 01582 831919
e: info@hsa.org.uk
w: www.hsa.org.uk
Registered in England Charity No 1159690 Charitable Incorporated Organisation

UK Legislation

According to UK and EU legislation, an electrical waterbath can be used to stun or kill poultry providing 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." EC.1099/2009*

Council Regulation (EC) No. 1099/2009 on the protection of animals at the time of killing.
Annex 1, Ch. 1, Table 2: Electrical Methods (3) Electrical waterbath

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 birds are immediately rendered unconscious and insensible to pain and remain so until dead.

To understand how an electrical waterbath operates, it is useful to understand 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.

Ohms law:

$$\text{Current (I)} = \frac{\text{Voltage (V)}}{\text{Resistance (R)}}$$

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

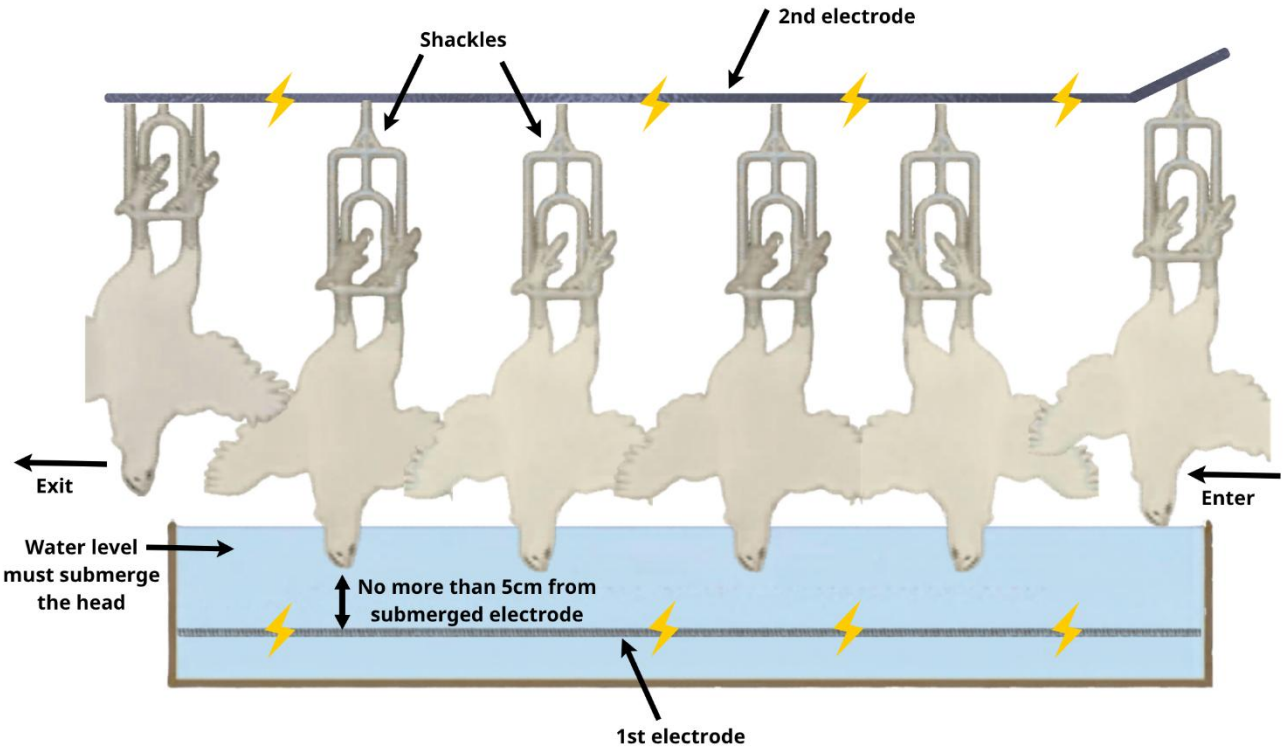
Current

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 i.e. the cycle repeats itself 50 times per second. Higher frequency waveforms repeat more times per second i.e. 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 several reasons including:

- poor contact between the bird's leg and shackle
- poor contact between the shackle and earthing bar
- resistance variation in the bird’s skull bone and/or legs
- whether the bird's wings are in the water.

A bird's head must always be the first part of its body to enter the electrified water. Any possibility for a part of a bird to contact electrified water before the head is immersed may result in a severely painful electric shock. It is estimated to take approximately 100 - 150 milliseconds (ms) for an animal to perceive the application of a potentially painful stimulus (e.g. electric shock) to its body. This means a bird's head must be submerged within the electrified water within approximately 100ms of the first electrical contact, Otherwise, the bird may experience a painful pre-stun electric shock.

The large wingspan of geese and turkeys puts them at particular risk of pre-stun shocks because their wings often hang below their head. Ducks and geese are also capable of swan-necking (curling their necks and raising their heads) so their heads miss the waterbath. As well as not being stunned, such birds may receive pre-stun shocks to their wings. Similarly, if a bird's chest contacts the water but its head is not submerged, this may lead to electroimmobilisation (conscious paralysis).

The waterbath entry design is crucial to minimising the risk of pre-stun shocks and enabling effective stunning. An entry ramp designed and positioned to allow a gentle but rapid flick of the birds' heads into the water can help minimise the number of birds experiencing pre-stun shocks. Well-designed entry ramps also keep wings above the waterline, again assisting in preventing pre-stun shocks. Neck extenders are available for ducks to help ensure their heads enter the water effectively.

More information about pre-stun shocks at the entrance to a waterbath, and potential prevention techniques, can be found in HSA Guidance Notes 7: Electrical Waterbath Sunning of Poultry under **Pre-slaughter handling and restraint**.

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

UK legislation requires several parameters to be met before a waterbath can be used:

- Birds shall not be shackled if they are too small for the waterbath stunner or if shackling is likely to induce or increase the pain suffered (such as visibly injured animals). In these cases, they shall be killed by an alternative method.
- 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 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 poultry being stunned
- The electrode which is immersed in the water extends the length of the waterbath

- The waterbath stunner does not overflow at the entrance, or if an overflow is unavoidable, measures are taken to ensure that no poultry receive an electric shock before they are 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.

The Welfare of Animals at the Time of Killing (England) Regulations 2015
Schedule 1, Part 5: Stunning and killing operations (28) Electrical stunning by waterbath.

Council Regulation (EC) No. 1099/2009 on the protection of animals at the time of killing.
Annex 1. Ch 2. Specific requirements for certain methods (6) Electrical waterbath stunning of poultry
Annex 2. (5) Waterbath stunning equipment

Low frequency electrical stunning (50 Hz)
Waterbaths which are set to deliver a low-frequency (50 Hz) electrical current can result in most birds dying from cardiac arrest in the waterbath, when sufficient current is applied. 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 birds that have only been stunned to die through blood loss before the start of recovery.

Table 1 shows the legally required minimum average currents to effectively stun different species of birds when using a low frequency (50 Hz) waterbath. Based on the scientific literature, the HSA recommends using higher average currents for chickens, ducks and geese. Further information can be found at:
www.hsa.org.uk/operating-an-electrical-waterbath/parameters-for-stun-killing

Species	Legal minimum	HSA recommended
	Minimum average current (milliamps)	
Broiler	100	170
Turkey	250	250
Ducks	130	255
Geese	130	225
Quail	45	45

Table 1 Legal vs HSA recommended minimum average currents per bird with a 50 Hz waterbath.

High-frequency electrical stunning

High-frequency electrical stunning is most commonly used, as it is thought to reduce the incidence of broken pectoral bones and haemorrhaging in comparison to low frequency electrical stunning. Higher frequencies are also less likely to kill the bird, which means this method can be acceptable for halal slaughter.

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 most 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 average currents by species according to the legislation ((EC) 1099/2009). It is also a requirement that birds are exposed to that current for a minimum duration of at least four seconds.

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

Table 2 – Electrical requirements for waterbath stunning equipment (Average values per animal) according to the legislation ((EC) 1099/2009)

However, note the electrical parameters currently permitted under Annex I of EC 1099/2009 do not strictly reflect the electrical parameters demonstrated to be effective in scientific research.

Specifically, frequencies of 600 Hz or more, at the 200mA specified in current legislation, have sometimes failed to successfully stun broiler chickens**. The HSA does not recommend using frequencies over 600 Hz.** Further information can be found at: www.hsa.org.uk/operating-an-electrical-waterbath/parameters-for-stunning

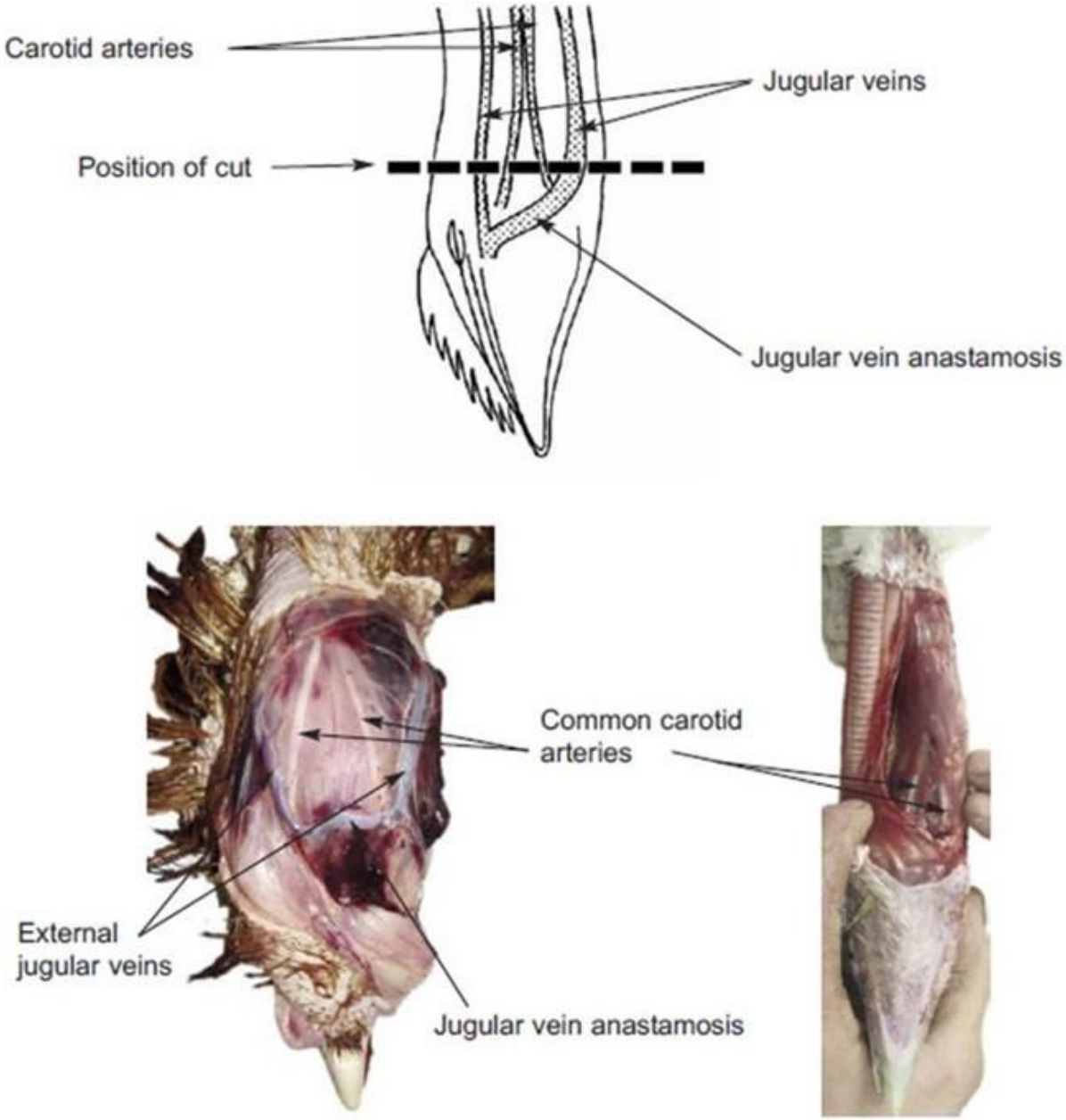
Based on available research, the HSA suggests the electrical parameters outlined below in Table 3 are used.

Waveform & Frequency (Hz)	Chickens (mA)	Ducks (mA)
Sine AC 50 – 199 Hz	100 RMS	
Sine AC 200 Hz	150 RMS	
Sine AC 400 Hz	200 RMS	
Square AC 50 Hz		170 RMS

Table 3- HSA suggestions for good practice electrical parameters

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

Figure 2: Effective neck cutting in poultry



Assessment of effective stunning

It is difficult to reliably assess whether waterbath stunning has been effective in an abattoir environment. This is partly due to fast line speeds, but also because research suggests that, immediately after application of electricity, the presence/absence of physical reflexes, convulsions and other behaviours may be unreliable indicators of an effective stun, particularly for whole-body application methods (such as waterbaths) and at high frequencies. Further information can be found at: www.hsa.org.uk/indicators-of-the-effectiveness-of-stunning/indicators-of-the-effectiveness-of-stunning

Nonetheless, recommendations for signs to look for are outlined below:

Signs that a bird has been <u>effectively stunned</u> 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

Signs that a bird has been effectively <u>killed</u> are:
- no breathing
- dilated pupils
- wings drooping
- the absence of a third eyelid (nictitating membrane) reflex

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 indicators of an ineffective stun are seen, the bird/s should be killed immediately: stun using a back-up method (such as a captive-bolt), 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
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 using an isolated circuit. Nevertheless, if a person comes between the electrodes there is a danger of a fatal electric shock.

Further Reading

HSA Online Guides: www.hsa.org.uk/publications/online-guides

- Electrical Waterbath Stunning of Poultry
- Effective neck-cutting of poultry (poster)

Defra Guidance:

- White meat slaughterhouses: unloading, handling, holding, restraining, stunning and killing
  www.gov.uk/guidance/white-meat-slaughterhouses-unloading-handling-and-holding-restraining-stunning-killing#waterbath-stunning-for-poultry

Relevant Legislation:

- Regulation (EC) 1099/2009 on the protection of animals at the time of killing
  www.legislation.gov.uk/eur/2009/1099

- The Welfare of Animals at the Time of Killing (England) Regulations 2015*
  www.legislation.gov.uk/uksi/2015/1782

* Northern Ireland, Scotland and Wales have their own variations of this regulation