

# Electrical Stunning of Salmon

## SUMMARY

Due to developments in the fields of farmed fish welfare and quality, new stunning and killing systems are being developed around the world. These systems are being adopted to remove the need for less humane methods currently employed. As with other species of farmed animals, both percussive stunning and electrical stunning can provide humane alternatives and these methods should be implemented as soon as possible.

Fish must be rendered insensible within one second of application and that the stun is sufficient to ensure that the animal does not regain consciousness before dying.

**All operators must be capable of recognising signs of both effective and ineffective stunning.**

## Legislation

Legislation covering the welfare of farmed animals is present in many countries. In Europe this originates from the Council Directive 93/119/EC on the *protection of animals at the time of slaughter or killing*. However, few countries have specific legislation protecting the welfare of fish at the time of killing. Norway has just introduced domestic legislation covering the welfare of fish killed commercially, This is referred to as *Regulations on the slaughter and processing facilities for farmed fish, chapter 4*.

## Physiology

The general principle of electrical stunning is to pass sufficient current through the brain to cause an epileptic-like seizure. This results in immediate unconsciousness and insensibility to pain. The period of insensibility is dependent on a number of parameters including: species, size, stress levels, temperature, number of fish, and duration of stunning amongst others.

The electric current also causes spasms in the muscle of the fish which can, under some circumstances, result in haemorrhages and other carcass damage. Stunning conditions therefore have to be carefully designed to ensure the process causes neither welfare nor quality issues and that recovery is prevented. These conditions are known to vary widely between different species of fish. Because of this, the period of insensibility for salmon is finite so the fish must be killed by another method such as percussive stunning or bleeding before they recover from the stun.

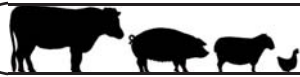
## Signs of an effective stun

- No eye roll reflex, ie when a fish is rotated, its eyes remain in same plane as body.
- Small muscular twitches
- No regular opercular movement
- No reaction to tail pinch

## Inappropriate stunning

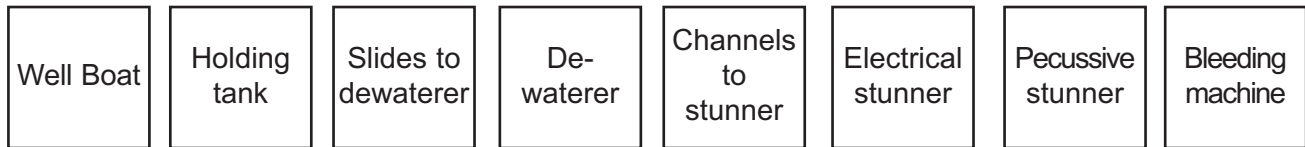
If an electrical field of inappropriate voltage, frequency, current or duration is applied to fish they will not be stunned, but they may become paralysed whilst conscious. Under these circumstances the fish cannot show typical pain responses or escape behaviour. Alternatively, exposure to a sufficient current, for only a short period of time, will result in an effective stun but with a very limited period of insensibility and a high risk of recovery before death.





## General recommendations

### Process flow:



When fitting a new electrical system, it is important to take into consideration a number of factors which are described in more detail below. Before introducing a new system, throughput rate needs to be considered to ensure the machine will be capable of keeping up with production. A machine that needs to work faster to cope with factory demand may compromise fish welfare if not adjusted correctly.

**As the stun is not permanent, it is vital that a killing method is employed which ensures death before recovery can occur. The practical answer is the use of percussive stunners.**

## Delivery

A consistent delivery of fish is essential to ensure the equipment works effectively. This is important as it reduces the chances of fish lying on top of each other on the stunner belt, and ensures fish are delivered at the same rate as the mechanical stunners operate. This needs to be considered when designing the crowding, pumping and/or the live cooling tank exit-flow and exit-valve system. When there is irregular delivery, there is opportunity for fish to be held out of water for longer, as well as a delay between bleeding and percussive stunning, which may result in recovery before death.

**Fish should never be left out of water for longer than 15 seconds whilst conscious**

## Dewatering

The design of the dewatering process and slide immediately after the dewaterer exit must:

- dewater the fish as close as possible to the stunner entry
- prevent fish being exposed to air at any stage whilst conscious for longer than 15 seconds
- prevent fish from hitting the sides of the chutes with any force
- orientate fish head-first into the stunner
- regulate flow of fish to the stunner

One suggested option to help achieve these parameters is a conveyor after the dewaterer that works at a different speed to the electrical stunner. This will have two effects – firstly, spreading the fish apart, ensuring they do not go in on top of each other, and secondly reducing their time spent out of water

## Channel design

Having passed over the dewaterer, fish still need to move to the stunner entrance quickly, to prevent from them becoming stuck out of water. This could be achieved by designing the slides and channels to keep the fish moving and/or by putting water jets in suitable positions to keep the channels wet, which will aid fish movement.

## Entry into stunning machine

To prevent fish going into the machine on top of each other, the design should be developed to funnel them into single file. Care needs to be taken to eliminate extra impact points and potential areas for bruising.



## Observation

Fish entering the stunning machine must be monitored to ensure they receive a rapid stun. The use of a camera and monitor may be a suitable alternative if a viewing platform cannot be easily constructed and positioned over the entry to the machine. This will help identify any stunning problems early on and will keep a check on the number of fish entering on top of each other.

Observations should be routine for staff working in the stun/kill area, but it also needs to be carried out by technical staff on a regular basis and the results recorded.

## Fish orientation

To ensure a humane stun, fish must receive the electric current through the brain to induce insensibility. Where a fish enters the system head first, insensibility will occur almost instantaneously and is the best possible result. However, when fish enter backwards, they will receive a current which will not stun them until it reaches the brain and will compromise welfare. To minimise this, fish must pass through the system quickly enough for the current to cause insensibility within one second. Work is continuing on the machine to improve the percentage of fish entering the stunning machine head first. If conveyors are adjusted, it is essential that the fish contact time with the electric current is sufficient to provide a reasonable period of insensibility.

## Monitoring animals

In addition to monitoring equipment for the system, individual animals must also be monitored. Insensibility must be rapid and last for a sufficient period of time to ensure all fish reach the percussive stunner before the start of recovery. 100% of the fish must remain insensible from leaving the electrical stunner to the point of percussive stunning (which causes permanent insensibility). This needs regular monitoring and fish entering, passing through and exiting the machine should be observed for a set period of time throughout the kill. Signs of recovery should also be looked for whilst animals are on the bleed table. The accuracy of the percussive stunner must be monitored to ensure fish are being effectively and rapidly stunned at all times.

## Monitoring equipment

Monitors to indicate how much current is being applied to each row of electrodes should be positioned in such a way that they are clearly visible to the operators when they are working. This will allow easy identification of any problem areas and also enable operators and assessors to identify if all rows of electrodes are switched on and delivering sufficient current.

## Maintenance

Corrosion quickly builds up on the electrodes; if this was to build up on areas that contact the fish, the amount of current delivered to the fish would be reduced and stunning might become ineffective. Saltwater, electricity and metal do not mix well and every way of ensuring regular maintenance should be sought. Easy removal of electrodes and a spare set to allow rotation would be beneficial. In addition a safe platform to access the electrodes to enable checking, removal and general maintenance must be provided.

A strict maintenance routine for all the equipment is essential and should include:

- regular cleaning of electrodes to prevent build up of dirt and corrosion
- checking the blades on the bleeding machine are sharp enough and the pushing mechanism works effectively.
- checking the percussive stunner to ensure it is always providing enough power and speed to produce an effective stun.



## Contingency plans

Plans and procedures need to be in place to prevent fish being left at any point in the system for any period of time. Conscious fish must not be left out of water for longer than 15 seconds or left in the stunning machine. This would be a welfare concern if any of the rows of electrodes are not delivering current, as the period of insensibility is limited once the fish stop being in contact with the electric current. It may also cause quality issues if they are in contact with the electricity for long periods of time.

Staff must remain skilled at manual gill cutting and manual percussion in case either need to be used as a backup method in case of machine breakdown.

## Conclusions

In conclusion, the HSA welcomes the introduction of this method as a means to stun large volumes of salmon directly from well boats or waiting cages. Further refinements are being actively developed to ensure that all of the fish are stunned within one second of exposure to the electric current.

**It is essential that the parameters of the electrical stunning machine are set to deliver an adequate stun, within one second, and that the period of insensibility lasts for sufficient time for the fish to reach the percussive stunner.**

## Further details

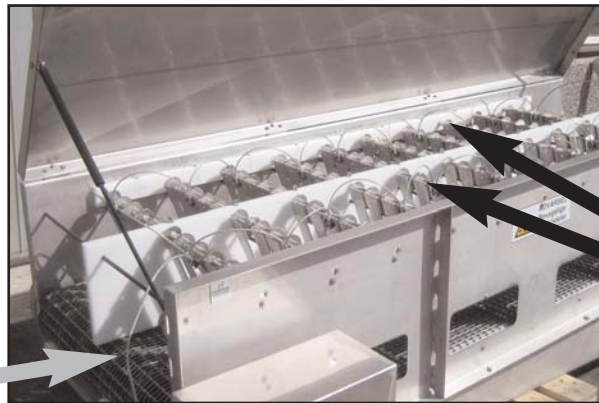
*The Welfare of Animals (Slaughter or Killing) Regulations 1995* (as amended) HMSO 1995

*Humane Harvesting of Salmon and Trout* HSA 2005

*Regulations on the slaughter and processing facilities for farmed fish, chapter 4*

The machine shown below is manufactured by: SeaSide AS, Box 66, N-6201 Stranda, NORWAY

Entry of  
conscious  
fish



Exit of  
stunned  
fish



conveyor belt

Rows of  
electrodes

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January 2007