Captive-bolt stunning and signs of unconsciousness in adult bovines

The welfare team and industry representatives have discussed welfare reporting in the slaughter of adult bovines. Concerns were raised about more than two repeat shots and assessment of unconsciousness, which will be covered in this article.

Restraint

WATOK (2015) Sch 1, Para 8 *The business operator must ensure that a stunning pen used to restrain adult bovine animals for the purpose of stunning is constructed so as to—; (d) allow unimpeded access to the forehead of an animal confined in it.*

WATOK (2015) Sch 1, Para 19 *Without prejudice to the generality of paragraph 18, no person may stun or kill an adult bovine animal unless at the time it is stunned or killed it is confined in a stunning pen or in a restraining pen which (in either case) is in good working order.*

Repeat shots

The application of a second shot by a slaughterman should always be considered as good practice where that person has any concerns about the effectiveness of the initial shot. A second shot is **not a failure** by an individual.

Regulation (EC) 1099/2009 Article 9, (2) requires that appropriate back-up equipment is available immediately in the event of failure of the equipment initially used, including cartridge. In the case of adult bovines this will normally be a second captive-bolt stunner which must be readily available, loaded and ready to use. Ideally, the original captive-bolt stunner should not be reloaded and used again, in case the failure is linked to that particular device, however it may be necessary to do this in some cases.

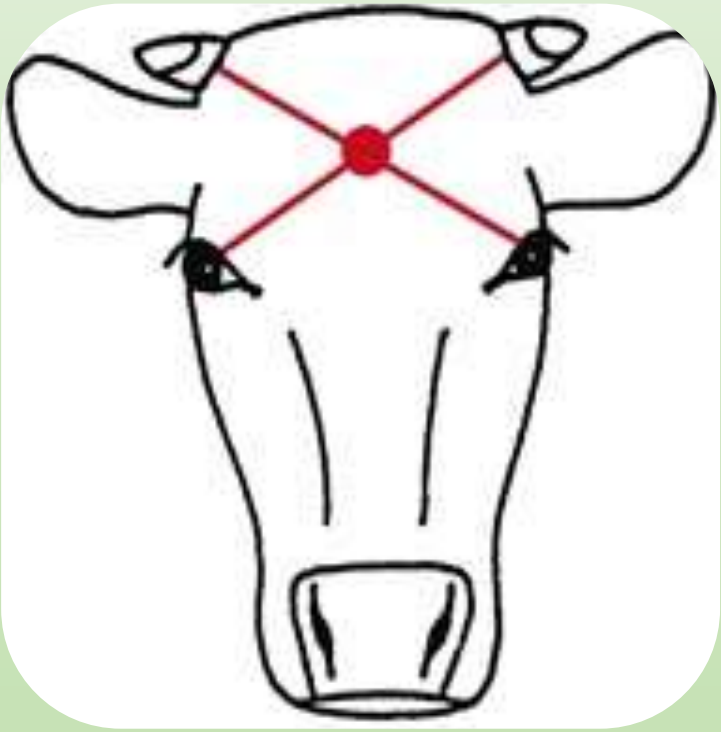

***Figure 1 and 2**: Showing the correct positioning of a shot in cattle, images provided by Humane Slaughter Association.*

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Best practice will be that the back-up stunner has a heavier grain cartridge than normally used and, if possible, a longer captive-bolt. This will increase significantly the ability of the second shot to render the animal unconscious. Where the back-up stunner has the same length captive-bolt then a heavier grain cartridge should be used.

When a repeat shot is required because the slaughterman assesses that the first shot has not achieved a satisfactory stun this should be applied as quickly as possible in a position close to but not through the original shot hole if correctly placed. If the initial shot was incorrectly placed the second shot must be in the optimum position.

Where the first shot was correctly placed, any second shot should be placed 1cm above and 0.5cm to one side of the original shot. If a third shot is required then this should be placed 1cm above and 0.5 cm to the other side of the original shot. After the first shot the cranial cavity is no longer a closed cavity and so any shock wave that would normally be created by the impact of the captive-bolt on the skull will be considerably reduced. It is important not to place any repeat shot too close to the original shot hole because the tissue damage resulting from the first shot will reduce the percussive force achieved.

When a premises slaughters large or male adult bovines, provision should ideally be made for at least a long captive-bolt stunner using heavy duty cartridges.

In some cases the use of a back-up free-bullet firearm, or humane killer, could be an option when large and breeding bulls are regularly handled. This can be either a pistol- or rifle-type firearm or a shotgun. When using a free-bullet weapon, it is recommended that a round-nose lead bullet is used to reduce the possibility of the bullet exiting. Shotgun pellets are unlikely to exit the carcase; however, when using a 'free projectile' appropriate health and safety provisions should be agreed and adhered to, as exits are a possibility.
Reference: **https://www.hsa.org.uk/ammunition/ammunition**

If an operator is going to use a 'free projectile' then the user must have the appropriate CoC and firearm certificate if the animal is intended for human consumption.

Food Standards Agency (FSA) staff should ensure they are made aware of a decision to use

***Figure 3 and 4**: Sample images of captive-bolt stunners, images provided by Accles Shelvoke.*

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a ‘free projectile’ and follow appropriate health and safety procedures. In England it should be possible to observe the operation through the CCTV system.

In the event of a failed shot the premises’ standard operating procedure (SOP) must set out clear procedures to follow. These should be adhered to at all times.

Once an animal has received an initial captive-bolt stun and two back-up stuns, a total of three stun attempts, it is very unlikely that further use of the captive-bolt will be effective due to the loss of cranial percussive effect. The premises’ SOP should consider such a scenario and have a clearly laid out approach for such an eventuality.

After one shot in the correct position and where necessary two above and to the sides (as described above) but where one or more eye-related indicator(s) of partial consciousness remain, sticking after the third shot is advisable on animal welfare grounds rather than continuing with further stunning, providing the animal has collapsed and is not rhythmically breathing.

An extension handle is available for the Cowpuncher model captive-bolt stunner. These can be helpful in instances when an animal has collapsed and is difficult to access.

One of the commonest causes of an ineffective stun is reduced velocity of the captive-bolt. The commonest cause is variation in cartridge power and/or a failure to clean carbon deposits from the chamber and this will adversely affect the bolt velocity. A captive-bolt stunner should be cleaned daily and have an additional maintenance check of the recuperator sleeves on a regular (at least monthly) basis. If the bolt is not fully retracting the failure of recuperator sleeves is the most common cause. All captive-bolt stunners should be fully checked and serviced with a velocity check at least annually. If a captive-bolt stunner is used that has no recuperator sleeves (as part of its design), the bolt must always be fully retracted and locked in position. WATOK (2015) Sch 1 Part 5 Para 24 (4) *(4 A person who uses a captive-bolt device must check that the bolt is retracted to its full extent after each shot and if it is not so retracted must ensure that the device is not used again until it has been repaired*.

The OV and FSA team must ensure that they review and monitor stunner maintenance on a regular basis, checking records of the cleaning and replacement of parts. Regulation (EC) 1099/2009 Article 9 *Business operators shall draw up a record of maintenance. They shall keep those records for at least one year and shall make them available to the competent authority upon request*.

The Humane Slaughter Association has extensive guidance on captive-bolt stunners and their maintenance available on its website at **https://www.hsa.org.uk/** or **https://www.hsa.org.uk/introduction/introduction**

Captive-bolt stunner manufacturers have online guidance on the maintenance and use of captive-bolt stunners.

There will be some instances where a captive-bolt stun fails and that the cause cannot be identified, despite the correct equipment being used and correct procedures applied. There have been a very small number of cattle identified with unusual positioning of the cranial cavity.

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The following section is used with the permission of Andy Grist, Bristol University.

Recognition of Effective Stunning

Some of the secondary shot applications seen in industry tend to be because the slaughter person is not sure that the animal is stunned. In my view this is commendable. Any doubt should warrant a further application of a second, back-up device. We have, however, observed secondary stuns by slaughter staff and indeed requested by government officials, on animals that were initially successfully stunned. The second shot requirement based on behavioural indicators that have been identified by science as having a low specificity. We know what areas of the brain we need to affect to produce loss of consciousness (Terlouw et al., 2016a), so the behavioural signs we should be examining should be indicators of this level of brain disruption. The reticular formation and ascending reticular activating system can be thought of as the electrical 'fuse-box' of the brain, where all the signals enter before spreading out into the cortex for processing (Figure 1). Below is the list of currently used behavioural indicators of unconsciousness, the reliable indicators being loss of posture, no rhythmic breathing and no corneal reflex.

Loss of posture – Posture is controlled by a reflex arc that passes through the reticular formation, and is indicative of disruption to this area (Terlouw et al., 2016b, Purves et al., 2001; Schepens & Drew, 2004).

No rhythmic breathing – The act of inhalation and exhalation (respiration) is controlled by groups of neurons within the medulla oblongata that are stimulated by the reticular formation. Therefore, an animal that is breathing rhythmically may be unconscious - but an animal that is not breathing rhythmically is either unconscious, dying or dead (Verhoeven, Gerritzen, Hellebrekers, & Kemp, 2015a; Siegel & Sapru, 2006; Silbernagl & Despopoulos, 2003). Agonal gasping should not be confused with rhythmic breathing and is controlled in the brain stem (Grist 2017, 2018a-d).

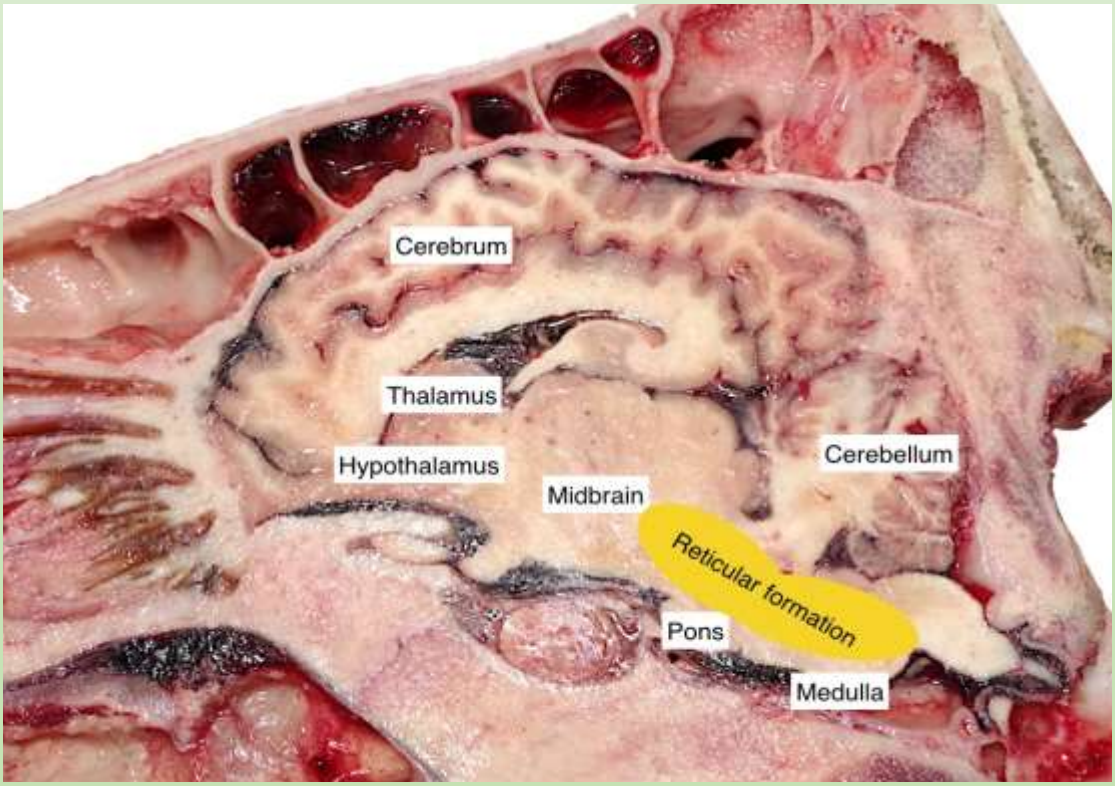

***Figure 1**: Position of reticular formation – Right sagittal section of bovine head (Grist et al 2019b)*

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No corneal reflex – The absence of a corneal reflex (the eye retracts slightly and the eyelid closes in response to a light touch of the cornea) is considered a reliable indicator of consciousness. An animal that has a positive reflex may be unconscious, but an animal with no reflex is either stunned, dying or dead. The neural circuit for this reflex crosses the reticular formation and the absence can be considered indicative of a wide brain dysfunction and therefore unconsciousness (Terlouw et al., 2016b). Studies have shown that corneal reflex can return during bleeding as residual brain activity in a cortically brain-dead animal (McKinstry & Anil, 2004; Vogel et al., 2011), but are not associated with any other signs. The important factor is to consider "when this reflex appears," as at approximately 17 seconds after a thoracic stick in cattle, the brain will be cortically dead due to lack of oxygen (Gregory and Wotton.,1984).

Natural Blinking (low specificity) - further studies are required to know their exact relationship with the level of consciousness. For example, in a study involving 20 bulls, none showed a corneal reflex after stunning, suggesting a state of unconsciousness, but 3 presented spontaneous blinking (Terlouw, Bourguet, Deiss & Mallet, 2015).

Nystagmus (low specificity) – Vertical or horizontal rapid extraocular muscle contraction is considered a poor indicator of the stunned state. It can be due to damage to the brain stem, or the cerebellum or vestibular system (balance). Gregory et al., (2007) estimated that when present there was only a one in three chance of the stun being non-effective.

Cartridges - Grist et al (2019a) demonstrated that there exists a variation in cartridge performance within any batch of cartridges. As the propellant source for captive-bolt devices, any variation in velocity will affect the ability to stun. A cartridge with a third of the power can still sound the same as a normal shot. Therefore, until a method of measuring the velocity of each shot is commercially available, cartridge performance must be considered as a possible cause of a failed stun.

The causes of repeated stun attempts

The need for secondary and tertiary stun attempts is multifactorial, with at least ten reasons, of which only one, shot position, can be due to the slaughter operative, which can also be dependent on the other factors. These include:

- The animal and it's level of stress
- Type of restraint, WATOK Sch 1 Para 8 (c)
- Time in restraint, EC1099/2009 Article 9 (1) and Annex II Para 3.1 (d) WATOK Sch 1 Para 23 (1) and (2)
- Head access, WATOK Sch 1 Para 8 (d)
- Head movement, WATOK Sch 1 Para 8 (c)
- Shot position, WATOK Sch 1 Para 8 (d)
- Stunner condition, EC1099/2009 Article 9, EC1099/2009 Article 9 (2)
- Stunner type,
- Cartridge variability,
- Anatomical variability.

Captive-bolt stunning and signs of unconsciousness in adult bovines...continued

The fact that the slaughter operative recognises the requirement for, and applies, a second or further stun based on behavioural indicators or as a precautionary measure should, in the authors' view be applauded and should be undertaken without hesitation due to fear of sanction (Grist et al 2019b).

FSA are grateful to Andy Grist for allowing us to publish the guidance above.

Assessment of unconsciousness

Regulation (EC)1099/2009 Article 16 requires that a slaughterhouse has a monitoring procedure in place to ensure that the checks described in Article 5 are being carried out. Article 5 requires these checks to ensure that there are no signs of consciousness or sensibility between stunning and death.

The checks should be carried out on a risk-based programme and records of checks maintained by the slaughterhouse operator. The SOP should detail the number of animals to be checked and the frequency, this may be every animal in a low throughput premises. Records should be reviewed by the OV and FSA team on a regular basis, at least monthly.

Guidance can be found on the signs of an effective stun in the BMPA Guide to Good Practice section 7.92 at the following link:
http://britishmeatindustry.org/resources/animal-health-and-welfare/

Guidance on the signs of an effective stun can also be found at the EFSA website at the following link: **http://www.efsa.europa.eu/en/efsajournal/pub/3460**

The Coordinated European Animal Welfare Network (EUWelNet) have produced guidance on the assessment of unconsciousness for commonly slaughtered species and this can form part of a SOP. The section on 'Assessment of unconsciousness in cattle after captive-bolt stunning' is included in this article as it is very relevant to the daily assessment of unconsciousness. When assessing unconsciousness more than one indicator should always be checked and the presence of a corneal reflex alone should never be considered as an indicator of consciousness.

If an operator is going to use a 'free projectile' then the user must have the appropriate CoC if the animal is intended for human consumption.

Captive-bolt stunning and signs of unconsciousness in adult bovines...continued

Coordinated European Animal Welfare Network (EUWelNet)
Standard Operating Procedure

Assessment of unconsciousness in cattle after captive-bolt stunning

Objective:

To assess unconsciousness from the stunning procedure until brain death due to bleeding.

Responsibility:

Animal welfare officer (AWO) and operators working on the stunning, hoisting and bleeding procedures.

Procedure

The operators involved in the stunning procedure, hoisting and bleeding will assess signs of unconsciousness in all animals (100%), immediately after stunning, before hoisting and before and during bleeding.

The AWO (or the person designated by the AWO with certified knowledge on the assessment of unconsciousness) will assess the unconsciousness of at least 10 animals each day, divided in two intervals. The assessment should last from the stunning application until brain death due to bleeding.

Control measures

By the operator

1. Just after stunning and before being released from the box:
    - Immediate collapse
    - Absence of righting reflex
    - Absence of vocalizations
    - Absence of rhythmic breathing
2. Immediately before and during hoisting:
    - Absence of righting reflex
    - Absence of vocalizations
    - Absence of rhythmic breathing
    - Absence of eye movements
3. Immediately before and during bleeding
    - Absence of righting reflex
    - Absence of vocalizations
    - Absence of rhythmic breathing
    - Absence of eye movements

Captive-bolt stunning and signs of unconsciousness in adult bovines...continued

By the AWO (or the person designated by the AWO with certified knowledge on assessment of unconsciousness)

Assessment of the following procedures:

a) Signs of unconsciousness from stunning application until brain death using the following indicators.
   - Immediate collapse
   - Absence of righting reflex
   - Absence of vocalizations
   - Absence of rhythmic breathing
   - Absence of eye movements
   - Absence of positive corneal reflex
   - Absence of nose pinching response

b) Implementation of the SOP by the operator, and the skill and aptitude of the operator in assessing unconsciousness.

c) The records of the operators regarding insufficient stunning effect / re-stunning.

Corrective action

Operator

Any animal not showing all the signs of unconsciousness:

- The animal should be re-stunned immediately, using a back-up stunner, a higher strength cartridge, 10 mm higher and 5 mm lateral from the correct shooting position (if it was correct) or in the correct shooting position, before reassessment and release from the stunning box, hoisting or bleeding.
- The ineffective stunner should be checked if it needs maintenance before further use.

AWO

If one or more signs of unconsciousness are absent, and have not been detected by the operator, or although being detected by the operator no corrective action has been taken:

- Ask the operator to re-stun (immediately) using the above protocol.
- Assess stunning procedures.
- Retrain operator in the application of the SOP.
- Internal Audit (long-term).

Records (a written record should be maintained of the effectiveness of the stunning method)

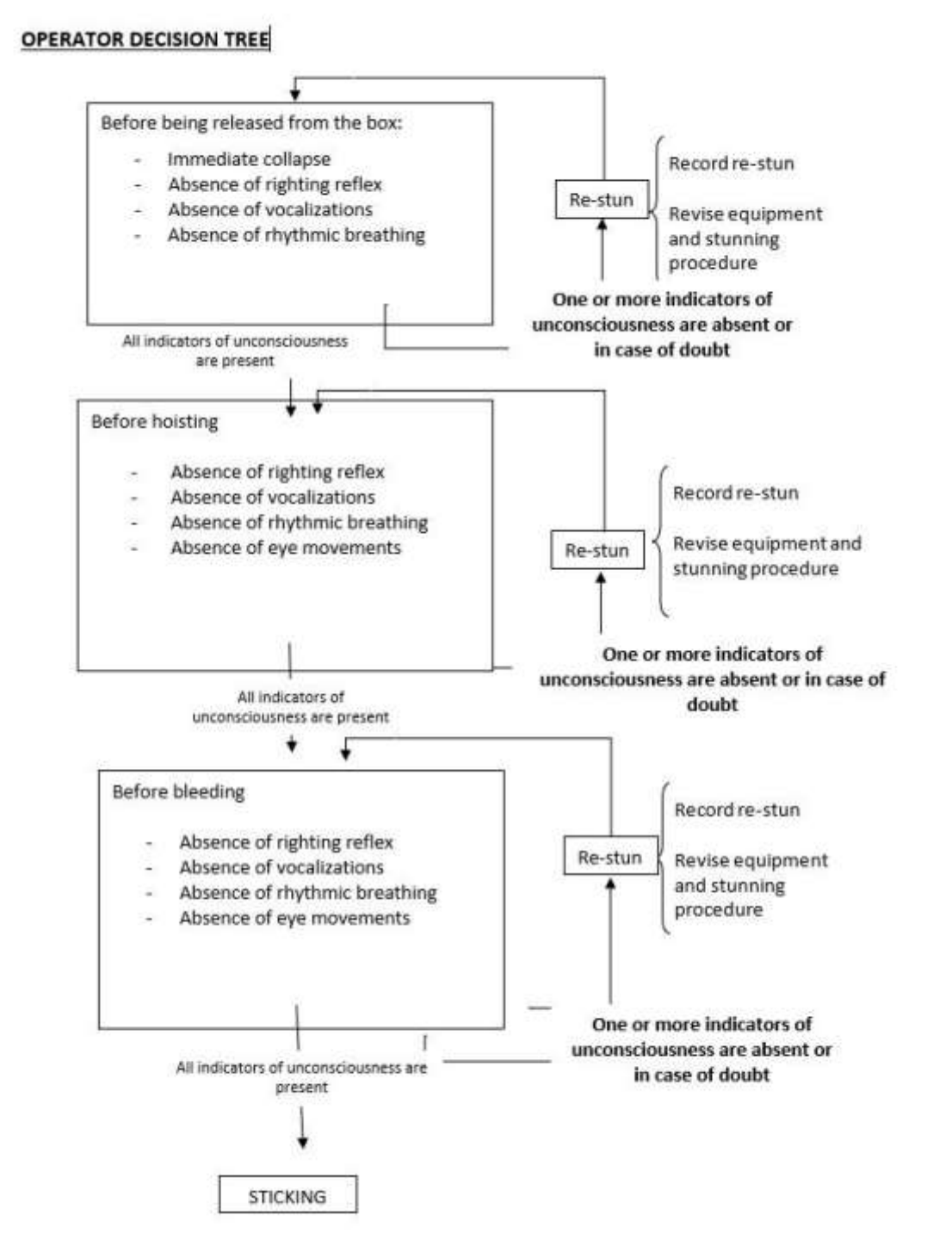
Operator:

- Animals not showing signs of unconsciousness.
- Corrective measures taken.
- Records of regular stunner maintenance

Captive-bolt stunning and signs of unconsciousness in adult bovines...continued

AWO: From the at least 10 animals assessed daily:

- Number of ineffectively stunned animals.
- Number of ineffectively stunned animal not detected by the operator.
- In addition the number of double stuns recorded by the stunning operator should be verified by an assessment of the double stuns on the skinned heads by the AWO.



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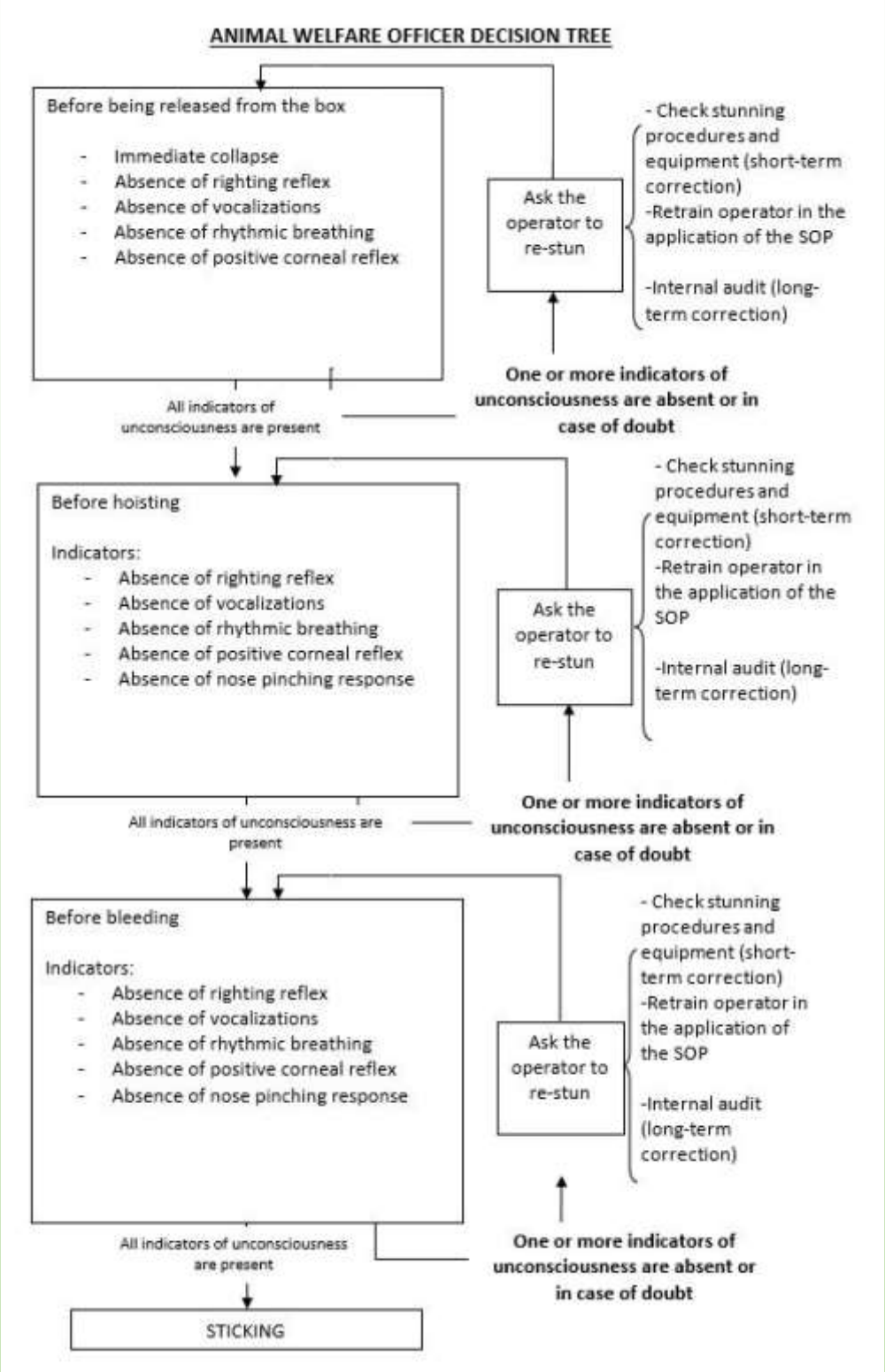

Coordinated European Animal Welfare Network (EUWelNet) (2013), Standard operating procedures (SOPs) for the waterbath stunning of poultry and the valid and reliable assessment of unconsciousness following mechanical stunning in bovines, electrical stunning in ovines, water bath electrical stunning in poultry and gas stunning in pigs. Note on page 17 – 21. Available at: http://www.euwelnet.eu/media/1176/d5_appendix_29_final.pdf (Accessed on 2 April 2020).

Article by Collin Willson