Annex 25

DRAFT CHAPTER 7.5.

ANIMAL WELFARE DURING SLAUGHTER

Article 7.5.1.

Introduction

Providing good welfare to ~~the~~ animals at *slaughter* is ethically and economically beneficial. The implementation of animal welfare measures, in addition to giving value to the product directly for ethical reasons, contributes to the improvement of workers' wellbeing, health and safety. This will also contribute to food safety and product quality, ~~and product quality, and is essential for~~ ~~(including food safety)~~ and consequently to the improvement of economic~~al~~ returns [Blokhuis *et al.*, 2008; Lara and Rostagno, 2018].

Article 7.5.2.

Scope

This chapter identifies ~~potential~~ *hazards* to *animal welfare* *~~hazards~~* during *slaughter* and provides recommendations for arrival and *unloading*, *lairage*, handling, *restraint*, *stunning* and bleeding of animals in *slaughterhouses/abattoirs*. It provides animal-based measures to assess the level of welfare and recommends remedial actions to be applied, when necessary.

This chapter applies to the *slaughter* in *slaughterhouses/abattoirs* of free-moving animals ~~the following domestic animals~~, e.g. ~~cattle, buffalo, bison, sheep, goats, horses, donkeys, mules,~~ruminants, equids and pigs, and animals in *containers* ~~(~~e.g. rabbits and most *poultry* species~~)~~.~~hereafter referred as “animals.” Recommendations consider whether animals arrive at the~~ *~~slaughterhouse/abattoir~~* ~~in~~ *~~containers~~* ~~or are free-moving.~~

The principles underpinning these recommendations should also be applied to the *slaughter* of other species and those slaughtered in other places.

This chapter should be read in conjunction with the guiding principles for *animal welfare* provided in Chapter 7.1., Chapter 7.14. ~~killing of reptiles for their skins, meat and other products~~ and with relevant provisions of Chapters 6.2. and 6.3.

~~The principles underpinning these recommendations may should also be applied apply to the~~ *~~slaughter~~* ~~of other species and those slaughtered in other places.~~

Article 7.5.3.

Definitions ~~for the purpose of this chapter~~

For the purposes of this chapter:

Bleeding means the act of severing major blood vessels that supply the brain, to ensure death.

Article 7.5.4.

Hazards to a~~A~~nimal welfare ~~hazards~~

*Hazards* to *animal welfare* during each of the pre-slaughter stages have a~~n~~ ~~additive~~ cumulative effect on the stress of the animals [Moberg and Mench, 2000].

At ~~the~~ *slaughterhouses/abattoirs*, animals are exposed to *hazards* to *animal welfare* *~~hazards~~* including ~~fasting~~ feed and water deprivation, mixing of unfamiliar *animals*, handling by humans, exposure to a novel environment (e.g. noise, lighting, flooring), forced movement ~~physical exercise~~, limited space allowance, ~~extreme~~ adverse weather conditions and ineffective ~~inadequate~~ *stunning* and bleeding. These *hazards* can have negative impacts on the welfare of the animals that can be assessed through animal-based measures. In the absence of feasible animal-based measures, ~~In addition~~ resource-based measures and management-based measures may be used as a ~~substitute~~ proxy. *Hazards* to a*~~A~~nimal welfare hazards* can be minimised by appropriate design of premises and choice of equipment, and through good management, training and competency of personnel.

Article 7.5.5.

~~Criteria (or m~~ Measures~~)~~

The welfare of animals at *slaughter* should be assessed using ~~outcome~~ animal-based measures. Although consideration should be given to the resources provided as well as the design and management of the system, animal-based ~~criteria~~ measures are preferential. However, key stunning parameters need to be considered alongside animal-based measures.

The routine use of these ~~outcome~~ animal-based measures and the appropriate thresholds should be adapted to the different situations in which animals are managed at a *slaughterhouse/abattoir*. It is recommended that target values or thresholds for animal-based measures *~~welfare~~* ~~measurables~~ be based on current scientific ~~knowledge~~ evidence and appropriate national, sectorial or regional standards.

Article 7.5.6.

Management

The *slaughterhouse/abattoir* operator is responsible for the development and ~~enforcement~~ implementation of a dedicated operating plan that should consider the following:

‒ training and competency of personnel;

‒ design of premises and choice of equipment;

‒ standard operating procedure ~~and corrective actions~~;

‒ recording, reporting adverse incidents and taking corrective actions;

~~‒~~ ~~training and competency of personnel;~~

‒ throughput (number of animals slaughtered per hour);

‒ maintenance and cleaning procedures of equipment and premises;

‒ ~~contingency~~ emergency plans.

~~‒~~ ~~operating procedure and corrective actions.~~

Article 7.5.7.

Training and competency of personnel

*Animal handlers* and other personnel have a crucial role to play in ensuring good *animal welfare* conditions from the time of arrival of the animals at the *slaughterhouse/abattoir* through to their *death*. Training for all personnel should emphasise the importance of *animal welfare* and their responsibility in contributing to the welfare of the animals that come through the *slaughterhouse/abattoir*.

*Animal handlers* should understand the species-specific behavioural patterns of the animals they are working with and the~~ir~~ underlying principles ~~to~~ for carrying out the required tasks whilst ensuring good *animal welfare*. They should be experienced and competent in handling and moving the animals with knowledge ~~about animal behaviour and physiology and able~~ that allows them to identify signs of distress, fear, pain and suffering and take preventive and corrective actions. Personnel in charge of *restraint* (including pre-stun shackling) and of *stunning* and bleeding operations should be familiar with the relevant equipment, ~~their~~ its key working parameters and procedures. Personnel *stunning*, post-stun shackling and bleeding animals should be able to identify and take corrective actions in case of: ~~ineffective~~ *~~stunning~~* ~~of the animal~~ ~~and signs of recovery of consciousness, should be able to detect if an animal is still alive prior to dressing or scalding and should be able to take corrective actions, if necessary~~ [EFSA, 2013a; EFSA 2013b].

a) ineffective *stunning* of the animal;

b) recovery of consciousness;

c) ~~animal is still alive~~ signs of life prior to dressing or scalding.

Competencies may be gained through a combination of formal training and practical experience. These competencies should be assessed by the *Competent Authority* or by an independent body recognised by the *Competent Authority*.

Only the personnel actively working ~~on the slaughter line~~in areas where live animals are handled should be present in these areas ~~where animals are handled~~. The presence of visitors or other personnel should be limited in ~~those~~ these areas in order to prevent unnecessary noise, shouting~~, or~~ and movement ~~or~~ and to reduce risk of accidents.

Article 7.5.8.

Design of premises and choice of equipment

The design of premises and the choice of equipment used in a *slaughterhouse/abattoir* have an important impact on the welfare of animals. The~~y should consider the~~ animals' needs should be considered~~, in terms of their physical comfort~~ including:

‒ thermal comfort ~~conditions~~,;

‒ ease of movement~~,~~ ;

‒ protection from injury, ~~protection from sudden or excessive noise~~;

‒ protection from visual, auditory and olfactory overstimulation;

‒ minimising fear~~,~~;

‒ ~~and~~ ability to perform natural and social behaviours~~,~~ ;~~as well as~~

‒ watering and feeding needs~~, including the need of sick or injured animals~~;

‒ needs arising from illness or injury;

‒ needs arising from other vulnerabilities (e.g. pregnant, lactating or neonatal animals).

Premises should be designed to eliminate distractions that may cause approaching animals to stop, baulk or turn back.

Flooring should be non-slip to prevent injury and stress due to slipping or falling. There should be ~~A~~adequate quality and quantity of lighting to allow ~~allowing adequate~~ appropriate ante-mortem inspection of animals and to enable ~~assist~~ the moving of animals utilising low-stress handling techniques.

The design of the *slaughterhouse/abattoir* and choice of equipment should take into consideration the species, categories, quantities, ~~and~~ size or weight and age of the animals. *Restraint*, *stunning* and bleeding equipment is critical for the welfare of an animal at the time of *slaughte*r. Appropriate back-up equipment should be available for immediate use in case of failure of the primary *stunning* equipment ~~initially used~~.

Article 7.5.9.

~~The t~~Throughput ~~is (number of animals slaughtered per hour)~~

The throughput of the *slaughterhouse/abattoir* is the number of animals slaughtered per hour.It **s**hould never exceed the maximum specification of the design of the facilities or equipment. ~~and may~~ The *slaughterhouse/abattoir* operators should continuously monitor throughput and adjust it to any operational changes, such as staff numbers and experience or line breakdowns. ~~It~~Throughput may ~~also~~ need to be reduced ~~depending on the~~if welfare ~~outcomes~~ ~~are~~ is negatively impacted.

Personnel allocation should be adequate for the anticipated throughput and be sufficient to implement the *slaughterhouse/abattoir* operating plan as well as ante and post-mortem inspections.

Article 7.5.10.

Maintenance and cleaning procedures

All equipment should be clean and well maintained, including calibration, in accordance with the manufacturer’s instructions in order to ensure positive outcomes for *animal welfare* ~~and safety of personnel~~.

Maintenance and cleaning of handling, *unloading*, *lairage* and moving facilities and equipment contribute to ensuring that animals are handled smoothly, preventing pain and fear.

Maintenance and cleaning of handling, *restraining*, *stunning* and bleeding equipment are essential to ensure reliable and ~~efficient~~ effective *stunning* and *slaughter*, thereby minimising pain, fear and suffering.

Article 7.5.11.

~~Contingency~~ Emergency plans

~~Contingency~~ Emergency plans should be in place at the *slaughterhouse/abattoir* to protect the welfare of the animals in the event of an emergency. The ~~contingency~~ plans should consider the most likely emergency situations given the species slaughtered and the location of the *slaughterhouse/abattoir.*

~~Contingency~~ Emergency plans should be documented and communicated to all responsible parties.

~~Each p~~Personnel who ~~has~~have a role to play in implementing ~~contingency~~ the plans should be well trained on the tasks they have to perform ~~in case of emergency~~.

**Article 7.5.12.**

**Arrival of free-moving animals**

On arrival at the *slaughterhouse/abattoir*, animals will already have been exposed to *hazards* that may have negative impacts on their welfare. Any previous *hazards* will have a cumulative effect that may affect the welfare of the animals throughout the *slaughter* process. Therefore, animals should be transported to the *slaughterhouse/abattoir* in a manner that minimises adverse animal health and welfare ~~outcomes~~, and in accordance with Chapters 7.2. and 7.3.

1~~.~~) Animal welfare concerns:

Delay in *unloading* of animals is a major ~~the main~~ *animal welfare* concern at arrival [NAMI, ~~2017~~2021].

Animals in *vehicles* have smaller space allowances than on farm, undergo water and *feed* deprivation, may have suffered from an injury, ~~and~~ and may be exposed to ~~thermal stress due to~~ adverse weather conditions and to stress and discomfort from social disturbance, noise, vehicle vibration and motion. In addition, stationary *vehicles* may have insufficient ventilation. Delays in *unloading* animals will prolong or exacerbate the impact of these *hazards*. Under these circumstances, injured or sick animals requiring urgent attention ~~will~~ may not be identified or dealt with appropriately and therefore the duration of their suffering will be increased.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

It can be difficult to assess animal-based measures while animals are in the *vehicle*. Some measurables that may be assessed include animals with injuries, lameness and / or poor body condition or those that are sick or have died. Panting, shivering and huddling may indicate thermal stress. Drooling and licking may indicate prolonged thirst.

Animals dead or emergency killed (see Article 7.5.19.) on arrival ~~or condemned on arrival~~ should be recorded and monitored as an indicator of *animal welfare* prior to and during transport.

Time from arrival to *unloading* and the environmental temperature and humidity can be used to establish relevant thresholds for corrective action.

3~~.~~) Recommendations:

Animals should be unloaded promptly on arrival. This is facilitated by scheduling the arrival of the animals at the *slaughterhouse/abattoir* to ensure that there are sufficient personnel and adequate space in the *unloading* or *lairage* area.

Consignments of animals ~~assessed~~ whose welfare is ~~to be~~ at greater risk of being compromised *~~animal welfare hazards~~* should be unloaded first. When no space is immediately available, creating space should be a priority. Provision~~s~~ should be made to provide shelter, shade or additional ventilation during waiting periods, or animals should be transported to an alternative nearby location where such provision ~~i~~s available.

Animals should not be isolated throughout the slaughter process.

Animals should be provided with drinking water as soon as possible after *unloading*.

~~Special consideration should be given to a~~Animals that have undergone long or arduous journey times, are sick or injured ~~animals~~, are lactating or pregnant ~~animals~~ and ~~young~~ neonatal animals~~. These animals~~ should be slaughtered as a priority and without delay. If this is not possible, animals should be given appropriate care ~~arrangements should be made to mitigate or prevent suffering,~~ in particular by: milking dairy animals at intervals of not more than 12 hours and providing appropriate conditions for suckling and the welfare of the ~~newborn~~ neonatal animal in the case of a female having given birth. ~~Mortalities and injuries should be reported to the competent authority.~~

4~~.~~) Species-specific recommendations:

Some species such as ~~P~~pigs and shorn sheep are especially sensitive to extreme temperatures and therefore special attention should be ~~taken~~ paid when dealing with delays in *unloading* ~~this species~~sensitive animals. This may include careful consideration of transport plans to time arrival and processing, provision of additional ventilation / heating, etc.

~~Shorn sheep might be especially sensitive to extreme temperatures and therefore special attention should be taken when dealing with delays in~~ *~~unloading~~*~~.~~

~~Lactating animals should be given special attention and given priority when~~ *~~unloading~~* ~~and processing.~~

~~Unweaned animals are especially sensitive to extreme temperatures and can find it difficult to regulate their body temperature. They are verymore susceptible to dehydration, illness and stress after transportation and handling. These animals must be given special attention and be given priority when~~ *~~unloading~~* ~~and processing.~~

Article 7.5.13.

~~Displacements~~ Handling of free-moving animals

This article addresses the handling of animals during *unloading* and *lairage,* and in the killing area.

1~~.~~) Animal welfare concerns:

During *unloading,* animals are exposed to similar *hazards* to those encountered when being loaded (see Chapters 7.2. and 7.3.). Inappropriate equipment in the *vehicle* or the *slaughterhouse/abattoir*, such as a lack of lateral protection when *unloading*, excessively steep ramps, slippery surfaces~~,~~ or an absence of foot battens, may result in animals slipping, falling or being trampled, causing injuries. The absence of ramps, ~~or~~ lifts or an unloading bay or dock could ~~can~~ result in animals being pushed or thrown off the vehicle. These *hazards* can also be associated with inappropriate handling and forced physical movement of animals that are unable to move independently as a result of weakness or injuries. Exposure to novel environments (e.g. noise, lighting, flooring, smell) will cause fear and reluctance to move, or turning back. Poorly designed facilities will increase the risk of such fear and injuries.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a) animals ~~running~~ slipping and falling;

b) animals with broken or otherwise injured limbs;

c) animals turning-back, attempting to escape ~~and~~ or reluctant to move;

d) animal vocalisation ~~and frequency of~~ (e.g. high-pitched vocalisation ~~for~~ in pigs) ~~especially for pigs and cattle~~;

~~d~~ e) animals that are unable to move by themselves due to reasons other than ~~those with~~ broken or injured limbs;

~~e~~ f) animals that strike against the facilities;

~~f~~ g)~~frequency of~~ use of ~~excessive~~ force by personnel;

~~g~~ h*)* ~~frequency of~~ use of electrical prods.

Animals are safely handled when these measures are below an acceptable threshold.

3~~.~~) Recommendations:

Ramps or lifts should be provided and used except when the *vehicle* and the unloading dock are at the same hight. ~~Ramps or lifts should be positioned so that the animals can be handled safely~~. There should be no gap between the *vehicle* and ~~the ramp~~ unloading dock.~~,~~ Ramps or lifts should be positioned so that the animals can be handled safely.T~~t~~he gradient should not be too steep preventing animals from moving voluntarily ~~moving~~, and solid side barriers should be in place.

Design of the facilities should promote the natural movements of animals, and, as far as possible, ~~with a~~ ~~minimal~~ minimise human interaction.

Preventive ~~measures~~ equipment such as foot battens, rubber mats and deep-groove flooring can help animals to avoid slipping.

The *unloading* area and raceways should be well lit so that animals can see where they are going.

The design of [*unloading*](http://www.oie.int/index.php?id=169&L=0&htmfile=glossaire.htm#terme_chargement_dechargement) areas and raceways should aim to minimise the potential for distractions that may cause animals to stop, baulk or turn back when being unloaded (e.g. shadows, changes in flooring, moving objects, loud or sudden noises). For details refer to Chapters 7.2. and 7.3.

Animals that are injured, sick or unable to rise require immediate action and, when necessary, emergency killing should be performed ~~euthanised~~ without moving them and without delay. Refer to Articles 7.5.19. and 7.5.2~~0~~1. Such animals should never be dragged, nor should they be lifted or handled in a way that might cause further pain~~,~~ and suffering or exacerbate injuries.

Personnel should be calm and patient, assisting the animals to move using a soft voice and slow movements. They should not shout, kick, or use any other means that is likely to cause fear or pain to the animals. Under no circumstances should *animal handlers* resort to violent acts to move animals (see Article 7.5.20.).

Personnel should not stand between an animal and where they want it to move to as this may cause the animal to baulk. They should keep in mind the flight distance and point of balance of the animal when positioning themselves to encourage movement.

Animals should be moved in small groups as this decreases fear and makes use of their natural tendency to follow other animals.

Mechanical handling aids ~~and electric goads~~ should be used in a manner to encourage and direct movement of the animals without causing distress, fear and ~~or~~ pain. Preferred mechanical aids include panels, flags, plastic paddles, flappers (a length of cane with a short strap of leather or canvas attached), plastic bags and ~~metallic~~ rattles.

Other handling aids should not be used as a substitute for good facility design and handling. They should not be used repeatedly if an animal fails to respond or move. In such cases it should be determined whether some physical or other impediment is preventing the animal from moving.

Electric goads should ~~only~~ not be used on a routine basis to move animals. ~~in extreme cases and not on a routine basis to move animals.~~ Electric goads may only be used when other measures have been ineffective, the animal has no injury or other condition that is impeding mobility and there is room for the animal to move forward without obstruction (e.g. obstacles or other animals).

The use of electric goads should be limited to ~~battery-powered~~ low-voltage goads applied to the hindquarters of adult pigs and large ruminants, and never to sensitive areas such as the eyes, mouth, ears, ano-genital region, udders or belly. Such instruments should not be used on equids, camelids, ratites, sheep and goats of any age, or on calves or piglets. Shocks ~~shall~~ should not be used repeatedly if the animal fails to respond and should not last longer than one second [Ritter *et al.*, 2008].

~~Mechanical Other Hhandling aids and electric goads should not be used as a substitute for good facility design and handling. They should not be used repeatedly if an animal fails to respond or move. In such cases it should be determined whether some physical or other impediment is preventing the animal from moving.~~

~~Electric goads should only be used in extreme cases and not on a routine basis to move animals.~~

~~The use of electric goads should be limited to battery-powered goads applied to the hindquarters of adult pigs and large ruminants, and never to sensitive areas such as the eyes, mouth, ears, anogenital region or belly. Such instruments should not be used on horses, sheep and goats of any age, or on calves or piglets.~~

The manual lifting of animals should be avoided; if it is necessary, animals should not be grasped or lifted in a manner which causes pain or suffering and physical damage (e.g. bruising, fractures, dislocations). (See Article 7.5.20.).

Animals should not be forced to move at a speed greater than their normal walking pace to minimise injury through slipping or falling. Facilities should be designed, constructed and staffed with competent animal handlers, so that less than 1% of the animals fall.

~~4.~~ ~~Species-specific recommendations:~~

~~None identified~~.

Article 7.5.14.

Lairage of free-moving animals

1~~.~~) Animal welfare concerns:

Animals ~~during~~ *~~lairage~~* may be exposed to several *hazards* to *animal welfare ~~hazards~~* during lairage including:

1. ~~food~~ *feed* and water deprivation leading to prolonged hunger and thirst~~,~~;

b) absence of protection against ~~extremes~~ adverse ~~in~~ weather or climate conditions, leading to thermal stress~~,~~;

c) sudden or excessive noises, including from personnel, ~~machinery, metal yards and gates~~ facilities, ~~and~~ equipment and gates, leading to fear~~,~~;

d) insufficient space to lie down and move freely leading to fatigue and aggressive behaviour~~,~~;

e) poor design and maintenance leading to distress and injuries~~,~~;

f) mixing of unfamiliar animals leading to aggressive behaviour, or social stress~~,~~;

g) limited access to resources (e.g. drinkers, bedding) leading to aggressive behaviour;

h) exposure to ~~hard, sharp or abrasive~~ surfaces leading to injury or lameness (e.g. sharp, abrasive).

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a)thermal stress (e.g. panting, sweating, shivering, huddling behaviour)~~,~~;

b) space allowance~~,~~;

c) excessive soiling with faeces (e.g. coat cleanliness, dag score for sheep)~~,~~;

d) injuries (e.g. lameness, open wounds, fractures)~~,~~;

e) illness (e.g. ~~limping,~~ diarrhoea, coughing)~~,~~;

f)aggressive behaviours (e.g. mounting, fighting)~~,~~;

g) ~~frequency of~~ animal vocalisation referring to distress ~~especially for pigs and cattle~~ (e.g. ~~hitch~~ high-pitched vocalisation in pigs; loud moos or bellows in bovines)~~,~~;

h) restlessness (e.g. pacing, walking with continuous ear movements and frequency of snorts – especially ~~for~~ in horses) [Micera *et al.*, 2010 and Visser *et al.*, 2008]~~,~~;

i) carcass bruising.

3~~.~~) Recommendations:

Animals should have constant access to clean water. Water supply points should be designed according to the species and age of the animal, with environmental conditions that allow for effective consumption. The number and location of the water supply points should minimise competition.

~~Animals should be provided with~~ *~~feed~~* ~~in~~ *~~lairage~~* ~~if the duration between loading and expected time for~~ *~~slaughter~~* ~~exceeds 24 hours~~. Animals should be provided with *feed* in *lairage* if the duration between ~~loading~~ their last meal and expected time for *slaughter* exceeds a period appropriate for the species and age of animals. In the absence of information on the transport duration ~~in any case~~, ~~A~~animals ~~which~~ that are not expected to be slaughtered ~~after~~within 12 hours of arrival should be fed as appropriate for the age and species ~~and should be given moderate amounts of food at appropriate intervals~~.

The *lairage* should provide animals with protection against adverse weather conditions including shade and shelter.

Animals should be protected from excessive and sudden noise (e.g. ventilation fans, alarms, or other indoor or outdoor equipment).

*Lairage* areas should be free from sharp edges and other *hazards* that may cause injury to animals.

The *lairage* should provide enough space for all animals to lie down at the same time, to move freely and to move away in case of aggressive behaviours.

*Lairage* areas should have adequate lighting levels to allow inspection of the animals.

Animals from different categories (e.g. sexes, sizes, horned or not, species) ~~groups (or different species)~~ should not be mixed except if they are already familiar to each other.

Animals that ~~can move freely but~~ are injured, sick, ~~very young~~ neonate or pregnant should be slaughtered with priority or ~~isolated~~ separated to protect them from other animals ~~and be slaughtered with priority~~. Animals that are very ill or down or have catastrophic injuries should be euthanized (see Article 7.5.19.).

4~~.~~) Species-specific recommendations:

~~None identified.~~ Pigs should be ~~kept~~ moved in small groups (up to 15) [Barton-Gade and Christensen ,1998] ~~when resting in lairage, when moving to the stunner and when stunned~~.

Bison and cervids need specific design and construction standards for ~~the~~ unloading and holding prior to slaughter.

Article 7.5.15.

Restraint for stunning or bleeding (free-moving animals)

1~~.~~) Animal welfare concerns:

The purpose of *restraint* is to facilitate the correct application of the *stunning* or bleeding equipment. Incorrect *restraint* may not only lead to ineffective *stunning* or bleeding, but also cause distress, fear and pain ~~and distress~~.

Other *hazards* include:

a) slippery ~~ing or falling of animals entering the~~ restraining area;

b) ~~struggling or escape attempts caused by~~ insecure *restraint*;

c) ~~injuries and pain caused by~~ excessive force of *restraint*;

d) a restraint box that is not appropriate to the size of the animal;

~~d~~e) ~~fear caused by~~ prolonged *restraint*, which may exacerbate insecure or excessive *restraint*.

~~In addition,~~ *~~s~~Slaughter* without *stunning* increases the risk of pain and fear due to the need for robust *restraint* of conscious animals for neck cutting, especially if animals are turned on their sides or backs [von Holleben *et al.*, 2010; Pleiter, 2010].

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a) animal slipping or falling;

b) struggling;

c) escape attempts;

d) animal vocalisation ~~(cattle and pigs)~~(e.g. high-pitched vocalisation in pigs);

e) reluctance to enter the restrainer;

f) frequency of use of electric goads.

3~~.~~) Recommendations:

Where individual restraint is used, ~~T~~the restrainer should be narrow enough that the animals cannot move ~~either~~ backwards ~~or~~ ,forwards or turn around.

The restrainer being used should be appropriate to the size of the animals and the restrainer should not be loaded beyond its design capacity.

In case of *slaughter* without *stunning*, the restrainer should restrain the head ~~appropriately~~ and should support the body of the animal ~~appropriately~~.

The restraint~~ing~~ should be maintained until the animal is unconscious.

When restrainers ~~are used~~ that hold an animal with its feet off the floor are used, the animal ~~must~~ should be held in a balanced, comfortable, upright position.

When a restrainer is used to rotate an animal from an upright position, the body and head ~~must~~ should be securely held and supported to prevent struggling and slipping within the device.

Restrainers should not have sharp edges and should be well maintained to minimise risk of injury.

Non-slip flooring should be used to prevent animals from slipping or falling.

Flooring design and handling methods that ~~intentionally~~ cause loss of balance, slipping or falling, i.e. a box with a floor that rises on one side upon entry to the box, should not be used intentionally.

Distractions (e.g. movements of equipment or people, loose chains or objects, shadows, shiny surfaces or floors) should be minimised to prevent baulking ~~balking~~ and improve ease of entry into the restrainer.

No animals should enter the restrainer until equipment and personnel are ready to stun and slaughter that animal.

No animals should be released from the restrainer until the operator has confirmed loss of consciousness.

Animals should not be left in conveyor style restrainers during work breaks, and in the event of a breakdown animals should be removed from the conveyor promptly.

The restrainer should be in a clean and non-slip condition.

Animals should not be able to pile on top of each other in the restrainer, nor receive pre-stun shocks from contact with the animal in front, in the case of electrical stunning.

Animals subject to specific methods of stunning should be individually restrained to ensure precise positioning of the stunning equipment. However, this should not apply when restraining is likely to cause additional distress or pain as well as excessive and unpredictable movements (e.g. animals that cannot move normally due to injuries or sickness, wild animals or horses).

4~~.~~) Species-specific recommendations:

Gondolas for gas *stunning* of pigs should not be overloaded and pigs should be able to stand without being on top of each other.

Head *restraint* is recommended for ~~cattle~~ bovines.

Specialised restraining equipment and methods are required for Bison and cervids as well as any species which may be processed with or without stunning.

Article 7.5.16.

General principles for ~~S~~stunning of free-moving animals and animals in containers

~~1.~~ ~~Animal welfare concerns:~~

~~The main~~ *~~animal welfare~~* ~~concern associated with~~ *~~stunning~~* ~~is ‘ineffective~~ *~~stunning~~*~~’ which results in pain, distress or fear during induction of unconsciousness and possible recovery before~~ *~~death~~*~~.~~

~~The most common methods for~~ *~~stunning~~* ~~are mechanical, electrical and exposure to controlled atmosphere.~~

*~~Stunning~~* ~~prior to~~ *~~slaughter~~* ~~decreases or avoidprevents pain and suffering to animals and also improves workers’ safety.~~

~~Mechanical~~ *~~stunning~~* ~~is divided into penetrativeng~~ *~~stunning~~* ~~and non-penetrating non-penetrative percussive~~ *~~stunning~~* ~~applications. Both applications use different types of devices aimed to induce immediate loss of consciousness as the impact of the bolt on the skull results in concussion and disruption of normal brain function [Daly~~ *~~et al.~~*~~, 1987; EFSA, 2004]. Penetrative~~ *~~stunning~~* ~~devices propel a bolt which penetrates the skull and enters the cranium damaging the brain. Non-penetrative percussive~~ *~~stunning~~* ~~devices propel a blunt bolt which does not penetrate the skull, but results in rapid loss of consciousness from impact. The main~~ *~~hazards~~* ~~preventing effective mechanical~~ *~~stunning~~* ~~are incorrect shooting position and incorrect direction of the impact. These may cause ineffective~~ *~~stunning~~* ~~and pain or short-lasting unconsciousness. Poor maintenance of the equipment or inadequate cartridge power or air line pressure (in pneumatic stunners) can result in low bolt velocity., Llow bolt velocity, misuseInappropriate use of cartridge Low bolt velocity, narrow bolt diameter or short length of bolt leading to shallow penetration, may also affect the effectiveness of~~ *~~stunning~~*~~. In older animals with a thicker skull, low bolt velocity may result inthere is an increase risk of an ineffective stun., especially with In non-penetrating non-penetrative percussive~~ *~~stunning~~* ~~applications, high bolt velocity may cause fracture of the skull and ineffective~~ *~~stunning~~* ~~[Gibson~~ *~~et al.~~*~~, 2014]. If not applied correctly, fracture of the skull and ineffective~~ *~~stunning~~* ~~are more likely to occur with young animals such as calves, when a higher bolt velocity is used. Absence of or incorrect restraint can lead to an incorrect shooting position.~~

~~Electrical~~ *~~stunning~~* ~~involves application of an electric current to the brain of sufficient magnitude to induce immediate unconsciousness [EFSA, 2004; Grandin, 1980]. The main~~ *~~hazards~~* ~~preventing effective electrical~~ *~~stunning~~* ~~are: incorrect electrode placement, poor contact, electrical arcing, high contact resistance caused by wool or dirt on the animal surface, dirty or corroded electrode, low voltage/current or high frequency [EFSA, 2004].~~

~~Controlled atmosphere~~ *~~stunning~~* ~~methods involve the exposure to high concentrations of carbon dioxide (hypercapnia), low concentration of oxygen (hypoxia) or a combination of the two (hypercapnic hypoxia). Loss of consciousness is not immediate following exposure of animals to controlled atmosphere~~ *~~stunning~~*~~. The main~~ *~~hazards~~* ~~causing increased distress during induction of unconsciousness are irritant or aversive gas mixtures (e.g. CO~~~~2~~ ~~in high concentrations), low gas temperature and humidity. The main~~ *~~hazards~~* ~~causing ineffective controlled atmosphere~~ *~~stunning~~* ~~are incorrect gas concentration and too short gas exposure time [Anon, 2018; EFSA, 2004; Velarde~~ *~~et al.~~*~~, 2007].~~

~~Gases or gas mixtures that are painful to inhale should preferably not be used to stun or kill pigs.~~

~~2. Animal-based and other measurables include.:~~

~~Effectiveness of~~ *~~stunning~~* ~~should be monitored at different stages: immediately after~~ *~~stunning~~*~~, just before and during bleeding until death occursis confirmed neck cutting, and during bleed-out [EFSA, 2013a; EFSA, 2013b; AVMA, 2016].~~

~~No single indicator should be relied upon alone. Multiple indicators should be used to determine whether a stun is effective and the animal is unconscious.~~

~~Mechanical~~ *~~stunning:~~*

~~An effective stun is characterised by the presence of all the following signs: immediate collapse; apnoea; tonic seizure; absence of corneal reflex; absence of eye movements.~~

~~The presence of any of the following signs may indicates an a high risk of ineffective stun or recovery of consciousness: rapid eye movement or nystagmus, vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex; rhythmic breathing.~~

~~Electrical~~ *~~stunning:~~*

~~An effective stun is characterised by the presence of all the following signs: tonic-clonic seizures; loss of posture; apnoea; and absence of corneal reflex.~~

~~The presence of any of the following signs may indicates an high risk of ineffective stun or recovery of consciousness: vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex; rhythmic breathing.~~

~~Gas~~ *~~stunning~~*~~:~~

~~An effective stun is characterised by the presence of all the following signs: loss of posture; apnoea; absence of corneal reflex; absence of muscle tone.~~

~~The presence of any of the following signs may indicates an high risk of ineffective stun or recovery of consciousness: vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex; rhythmic breathing.~~

~~3. Recommendations:~~

~~Animals should always be stunned as soon as they are restrained.~~

~~When a two-step electrical stun-kill method is used, the electrical current must reachbe applied to the brain before it reaches the heart otherwise the animal will experience cardiac arrest while still conscious.~~

~~In the case of ineffective~~ *~~stunning~~* ~~or recovery, animals should be re-stunned immediately using a backup system method. Ineffective~~ *~~stunning~~* ~~or return to consciousness should be systematically recorded and the cause of the failure identified and rectified.~~

*~~Stunning~~* ~~equipment should be used, cleaned, maintained and stored following manufacturer’s recommendations.~~

~~Regular calibration of the equipment according to the manufacturer’s procedure areis recommended. Effectiveness of the~~ *~~stunning~~* ~~should be monitored regularly.~~

*~~Slaughterhouses/abattoir~~*~~s should have standard operating procedures that define key operating parameters or and follow the manufacturer’s recommendations for~~ *~~stunning~~*~~, such as:~~

~~a)~~~~Mechanical:~~

~~‒ position and direction of the shot [AVMA, 2016];~~

~~‒ grain of the cartridge or air pressure appropriate to the type of animal (captive bolt) [Gibson~~ *~~et al.~~*~~, 20152014];~~

~~‒ length and diameter of the bolt (captive bolt);~~

~~‒ calibre and type of gun and ammunition (free bullet).~~

~~b)~~~~Electrical:~~

~~‒ shape, size and placement of the electrodes [AVMA, 2016];~~

~~‒ pressure contact between electrode and head;~~

~~‒ wetting point of contact;~~

~~‒ minimum exposure time;~~

~~‒ electrical parameters (current intensity(A), waveform type (AC and DC), voltage(V) and frequency(Hz));~~

~~‒ visual or auditory warning system to alert the operator to proper or improper function such as a device that monitors and displays duration of exposure, voltage and applied current.~~

~~c)~~~~Controlled atmosphere:~~

~~‒ gas concentrations and exposure time;~~

~~‒ temperature and humidity;~~

~~‒ rate of decompression (law atmospheric pressure system for~~ *~~stunning~~*~~);~~

~~‒~~~~animal based measure should be monitored during the induction phase, if possible, because this can be a point of highest welfare risk for animals.~~

~~‒ visual or auditory warning system to alert the operator to proper or improper function such as a device that monitors gas concentration and temperature.~~

~~‒ gases or gas mixtures that are painful to inhale should preferably not be used to stun or kill pigs~~

~~4.~~ ~~Species-specific recommendations:~~

~~Non-penetrativeng captive bolt should not be used in animals with thick skull (e.g. bison, water buffalo)mature cattle and pigs [Finnie, 1993 and Finnie~~ *~~et al.~~*~~, 2003].~~

~~The~~ *~~Competent Authority~~* ~~should determine effective electrical parameters, based on scientific evidence for different types of animals.~~

~~Where high electrical frequencies is used, the amperage should also be increased.~~

~~Gases or gas mixtures that are painful to inhale should preferably not be used to stun or kill pigs.~~

1~~.~~) Animal welfare concerns:

The main *animal welfare* concern associated with *stunning* is ‘ineffective *stunning*’ which results in distress, fear and pain, ~~distress or fear~~ during induction of unconsciousness and possible recovery before death.

Animals should only be stunned using stunning methods that have been scientifically validated as effective for stunning that species. The most common methods for *stunning* are mechanical, electrical and exposure to controlled atmosphere. Animals should only be stunned using stunning methods that have been scientifically validated as effective for stunning that species.

*Stunning* prior to *slaughter* ~~decreases or~~ ~~avoid~~ prevents distress, fear and pain ~~and suffering~~ to animals during neck cutting and bleeding ~~and also improves workers’ safety~~.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include.~~:

~~Effectiveness of~~ *~~stunning~~* ~~should be monitored at different stages: immediately after~~ *~~stunning~~*~~, just before and during bleeding until death occursis confirmed neck cutting, and during bleed-out [EFSA, 2013a; EFSA, 2013b; AVMA, 2016].~~

~~No single indicator should be relied upon alone~~. Multiple indicators should be used to determine whether a stun is effective and the animal is unconscious.

After stunning, the state of consciousness is assessed to identify if animals are successfully rendered unconscious or if they are conscious (e.g. stunning was ineffective or they recovered consciousness) and therefore at risk of experiencing distress, fear and pain. For each animal-based measures of state of consciousness, outcomes either suggesting unconsciousness (e.g. presence of tonic seizures) or suggesting consciousness (e.g. absence of tonic seizures) have been identified for each stunning method.

3~~.~~) Recommendations:

Animals should always be stunned as soon as they are restrained.

In the case of ineffective *stunning* or recovery, animals should be re-stunned immediately using a backup ~~system~~ method. Ineffective *stunning* or return to consciousness should be systematically recorded and the cause of the failure identified and rectified.

Effectiveness of *stunning* should be monitored using multiple animal-based measures at different stages: immediately after *stunning*, just before and during bleeding until death ~~occurs~~ is confirmed ~~neck cutting, and during bleed-out~~ [EFSA, 2013a; EFSA, 2013b; AVMA, 2016].

*Stunning* equipment should be used, cleaned, maintained and stored following manufacturer’s recommendations.

Regular calibration of the equipment according to the manufacturer’s procedure ~~are~~is recommended. ~~Effectiveness of the~~ *~~stunning~~* ~~should be monitored regularly.~~

*Slaughterhouses/abattoir*s should have standard operating procedures that define key operating parameters ~~or~~ and follow the manufacturer’s recommendations for *stunning* the species and age group concerned.~~, such as:~~

~~4.)~~ ~~Species-specific recommendations:~~

Article 7.5.17

Mechanical stunning of free-moving animals

1~~.~~) Animal welfare concerns:

Mechanical *stunning* is divided into penetrative~~ng~~ *~~stunning~~* and ~~non-penetrating~~ non-penetrative percussive *stunning* applications. Both applications use different types of devices aimed to induce immediate loss of consciousness as the impact of the bolt on the skull results in concussion and disruption of normal brain function [Daly *et al.*, 1987; EFSA, 2004]. In addition to the concussive effect, ~~P~~penetrative *stunning* devices propel a bolt which penetrates the skull and enters the cranium causing additional damag~~ing~~e to the brain. Non-penetrative percussive *stunning* devices propel a blunt bolt which does not penetrate the skull, but results in rapid loss of consciousness from impact (concussive effect). The main *hazards* preventing effective mechanical *stunning* are incorrect shooting position and incorrect direction of the impact. These may cause ineffective *stunning* ~~and pain~~ or short-lasting unconsciousness. Poor maintenance of the equipment or inadequate cartridge power or air line pressure (in pneumatic stunners) can result in low bolt velocity which delivers less concussive impact to the skull., ~~Llow bolt velocity, misuse~~ Inappropriate use of cartridge ~~Low bolt velocity~~, narrow bolt diameter or short length of bolt leading to shallow penetration~~,~~ may also affect the effectiveness of *stunning*. In ~~older~~ animals with a thicker skull, ~~low bolt velocity may result in~~ there is an increased risk of an ineffective stun~~.~~, especially with ~~In non-penetrating~~ non-penetrative percussive *stunning* ~~applications, high bolt velocity may cause fracture of the skull and ineffective~~ *~~stunning~~* ~~[Gibson~~ *~~et al.~~*~~, 2014]~~. If not applied correctly, fracture of the skull and ineffective *stunning* are more likely to occur with young animals such as calves, when a higher bolt velocity is used. Absence of or incorrect restraint can lead to an incorrect shooting position.

For *wild* or *feral animals*, on-site shooting with a free bullet in the brain can be an alternative to prevent stressful handling and transport. Under such circumstances, the main animal welfare concern is a shot that kills the animal immediately.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

~~Mechanical~~ *~~stunning:~~*

Animal-based measures of a~~A~~n effective stun are ~~is characterised by the presence of all the following signs~~: immediate collapse; apnoea; tonic-clonic seizure; absence of corneal reflex; absence of eye movements.

Animal-based measures ~~The presence of any of the following signs may indicates an a high risk~~ of ineffective stun or recovery of consciousness are: absence of collapse or attempts to regain posture rapid eye movement or nystagmus, vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex; rhythmic breathing.

3~~.~~) Recommendations:

Slaughterhouses/abattoirs should have standard operating procedures that define key operating parameters ~~or~~ and follow the manufacturer’s recommendations for stunning the species and age group concerned, such as*:*

~~Mechanical:~~

~~‒ position and direction of the shot [AVMA, 2016];~~

‒ grain of the cartridge or air pressure ~~appropriate to the type of animal~~ (captive bolt) [Gibson *et al.*, 2015~~2014~~];

‒ calibre and type of gun and ammunition (free bullet);

‒ length and diameter of the penetrating bolt ~~(captive bolt)~~;

‒ shape and diameter of the non-penetrating bolt;

‒ position and direction of the shot [AVMA, 2016];

~~‒ calibre and type of gun and ammunition (free bullet).~~

4~~.~~) Species-specific recommendations:

Non-penetrative~~ng~~ captive bolt should not be used in animals with thick skull (e.g. bison, water buffalo)~~mature cattle and pigs [Finnie, 1993 and Finnie~~ *~~et al.~~*~~, 2003]~~.

Water buffaloes should be stunned with penetrative captive bolt in the occipital position using a heavy-duty contact-fired captive bolt gun directed at the nose or using large-calibre firearms and deformation ammunition (e.g. 0.357 Magnum).

Article 7.5.18

Electrical stunning in free moving animals

1~~.~~) Animal welfare concerns:

Electrical *stunning* involves application of an electric current across ~~to~~ the brain of sufficient magnitude to induce immediate unconsciousness [EFSA, 2004; Grandin, 1980]. The main *hazards* preventing effective electrical *stunning* are: incorrect electrode placement, poor contact, electrical arcing, high contact resistance caused by wool or dirt on the animal surface, dirty or corroded electrode, low voltage/current or high electrical frequency [EFSA, 2004]. Excessively wet hides or fleeces may result in ineffective stunning due to electrical current taking the path of least resistance and flowing around the outside of the body rather than through the skull. This may paralyse the animal, or cause pre-stun shocks, rather than stunning the animal. If electrodes are energized prior to ensuring they have good contact with the animal, this results in pain from the shock.

2~~.~~) Animal-based and other measures:

~~Electrical~~ *~~stunning:~~*

Animal-based measures of an effective stun are: ~~An effective stun is characterised by the presence of all the following signs:~~ tonic-clonic seizures; loss of posture; apnoea; and absence of corneal reflex; or palpebral reflex.

Animal-based measures of ineffective stun or recovery of consciousness are: ~~The presence of any of the following signs may indicates an high risk of ineffective stun or recovery of consciousness:~~ absence of tonic-clonic seizures; vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex; palpebral reflex; rhythmic breathing.

3~~.~~) Recommendations:

When a two-step electrical stun-kill method is used, the electrical current should ~~reach~~ be applied to the brain before it reaches the heart otherwise the animal will experience cardiac arrest while still conscious.

Slaughterhouses/abattoirs should have standard operating procedures that define key operating parameters and follow the manufacturer’s recommendations for stunning the species and age group concerned, such as*:*

~~When a two-step electrical stun-kill method is used, the electrical current must reachbe applied to the brain before it reaches the heart otherwise the animal will experience cardiac arrest while still conscious.~~

~~Electrical:~~

‒ shape, size and placement of the electrodes [AVMA, 2016];

‒ ~~pressure~~ contact between electrode and head;

‒ wetting point of contact;

‒ minimum exposure time;

‒ electrical parameters (current intensity(A), waveform type (AC and DC), voltage(V) and frequency(Hz));

‒ maximum stun to stick interval;

‒ visual or auditory warning system to alert the operator to proper or improper function such as a device that monitors and displays duration of exposure, voltage and applied current.

4~~.~~) Species-specific recommendations:

The *Competent Authority* should determine effective electrical parameters, based on scientific evidence for different types of animals.

For head-only stunning, minimum parameters are recommended for the following species:

‒ 1.15 [AVMA] to 1.28 A for bovines [EFSA 2020b],

‒ 1.25 A for slaughter (finished) pigs [AVMA],

‒ 1.8 A for sows and boars [AVMA],

‒ 1 A for small ruminants [EFSA 2013c, and EFSA 2015, AVMA].

The minimum parameters above are recommended to be used with an electrical frequency of 50Hz. Where higher ~~electrical~~ frequencies ~~is~~ are used, the amperage should also be increased.

Article 7.5.19

Controlled atmosphere stunning in free moving animals

1~~.~~) Animal welfare concerns:

Controlled atmosphere *stunning* methods involve the exposure to high concentrations of carbon dioxide (hypercapnia), low concentration of oxygen (hypoxia) or a combination of the two (hypercapnic hypoxia). Loss of consciousness is not immediate following exposure of animals to controlled atmosphere *stunning*. The main *hazards* causing increased distress during induction of unconsciousness are irritant or aversive gas mixtures (e.g. CO2 in high concentrations), low gas temperature and humidity. The main *hazards* causing ineffective controlled atmosphere *stunning* are incorrect gas concentration and too short gas exposure time [Anon, 2018; EFSA, 2004; Velarde *et al.*, 2007].

~~Gases or gas mixtures that are painful to inhale should preferably not be used to stun or kill pigs.~~

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include.~~:

~~Gas~~ *~~stunning~~*~~:~~

Animal-based measures of an effective stun are:~~An effective stun is characterised by the presence of all the following signs:~~ loss of posture; apnoea; absence of corneal reflex; absence of muscle tone.

Animal-based measures of an ineffective stun or recovery of consciousness are:~~The presence of any of the following signs may indicates an high risk of ineffective stun or recovery of consciousness:~~ vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex; rhythmic breathing.

3~~.~~) Recommendations:

~~c)~~~~Controlled atmosphere:~~

Slaughterhouses/abattoirs should have standard operating procedures that define key operating parameters and follow the manufacturer’s recommendations for stunning the species and age group concerned, such as*:*

‒ gas concentrations and exposure time;

‒ temperature and humidity;

‒ ~~rate of decompression (law atmospheric pressure system for~~ *~~stunning~~*~~);~~

‒ animal-based measures should be monitored during the induction phase, if possible, because this can be a point of highest welfare risk for animals;

‒ since animal-based measures are difficult to monitor and adapt during the induction phase, resource-based measures should be used such as monitoring of gas concentration(s) and exposure time. Gas concentrations and exposure time, temperature and humidity ~~must~~ should be monitored continuously at the level of the animal inside the chamber;

‒ visual or auditory warning system to alert the operator to proper or improper function such as a device that monitors gas concentration and temperature.

~~‒~~ ~~gases or gas mixtures that are painful to inhale should preferably not be used to stun or kill pigs~~

4~~.~~) Species-specific recommendations:

Gases or gas mixtures that are painful to inhale should ~~preferably~~ not be used ~~to stun or kill pigs~~. However, if such methods allow animals to be stunned in groups and it has a short induction phase, they could present a certain animal welfare benefit compared to methods requiring individual restraint.

Article 7.5.20~~17~~

Bleeding of free-moving animals

1~~.~~) Animal welfare concerns:

The main *animal welfare* concern at the time of bleeding following *stunning* is the recovery of consciousness due to prolonged stun-to-stick interval or due to incomplete severance of the main blood vessels.

Bleeding without prior *stunning* increases the *risk* of animal suffering because the incision to sever blood vessels results in substantial tissue damage in areas well supplied with nociceptors. The activation of these nociceptors causes the animal to experience pain [Gregory, 2004; Gibson *et al.*, 2009]. Loss of consciousness due to bleeding is not immediate and there is a period during which the animal can ~~feel~~ experience fear, pain and distress [Gregory, 2004; Johnson *et al.*, 2015]. This period will be reduced by applying stunning immediately after neck cutting.

Absence of or ineffective *stunning* may result in animals being released from the *restraint*, shackled, and bled and or further processed while they are still conscious or have the potential to recover consciousness.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

The main animal-based measurable is the blood flow (rate and duration). For animal-based and other ~~measurables~~ measures of return of consciousness after *stunning*, see Article 7.5.16.

In cases of bleeding without *stunning* the animal-based and other ~~measurables~~ measures that indicate loss of consciousness include all the following: absence of muscle tone; absence of corneal reflex; absence of rhythmic breathing. Unconsciousness should be reassessed until death is confirmed. In addition, cessation of bleeding after a continuous and rapid blood flow can be used as an indicator of death.

3~~.~~) Recommendations:

a) both carotid arteries or the blood vessels from which they arise should be severed;

~~a~~ b) continuous and rapid blood flow should be assured after bleeding;

~~b~~ c*)* ~~cessation of blood flow~~ death should be assured before further processing;

~~c~~ d) bleeding knives should be sharpened for each animal as necessary to fulfil recommendation a) and b).

In addition, the following should be considered:

*Slaughter* with *stunning*:

1. the stun-to-stick interval should be short enough to ensure that the animal will ~~die before~~not recover~~ing~~ consciousness before it dies;

b) unconsciousness should be confirmed before bleeding.

*Slaughter* without *stunning*:

1. bleeding should be carried out by a single incision; any second intervention should be recorded and analysed to improve procedures.
2. Further processing may only be carried out when the death of the animal has been ascertained ~~and no movement can be detected~~.

4) Species-specific recommendations:

~~None identified.~~

~~Cattle~~ Bovines are at risk of prolonged bleed out times and regaining consciousness as the bilateral vertebral arteries are not cut during a neck cut. ~~If As they are not cut, t~~The vertebral arteries will continue to provide blood to the brain. Furthermore ~~and~~ ~~can cause~~ any occlusion of the cut major arteries~~,~~ will slow~~ing~~ exsanguination. Therefore, bleeding with a cut of the brachiocephalic trunk should ~~always~~ be preferred in ~~cattle~~ bovines.

Article 7.5.21~~18~~.

Slaughter of pregnant free-moving animals

1~~.~~) Animal welfare concerns:

Foetuses in the uterus are considered not to ~~cannot~~ achieve consciousness [EFSA, 2017; Mellor, D. J. *et al.*, 2005~~Diesch~~ *~~et al.~~*~~, 2005~~]. However, if removed from the uterus the foetus may perceive pain or other negative impacts.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

~~None identified.~~ Signs of consciousness in the ~~foetus~~ neonate after removal from the uterus, such as breathing [Mellor, 2003; Mellor, 2010; EFSA, 2017].

3~~.~~) Recommendations:

Under ~~normal circumstances~~ WOAH recommendations (Chapter 7.3. Animal transport by land), pregnant animals that would be in the final 10% of their gestation period at the planned time of *unloading* at the *slaughterhouse/abattoir* should be neither transported nor slaughtered. If such an event occurs, an *animal handler* should ensure that pregnant females are handled separately.

The foetus should be left undisturbed in utero for at least 30 minutes after the *death* of the dam [EFSA, 2017; Anon, 2017]. The uterus could be removed as a whole, clamped and kept intact such that there is no possibility for the foetus to breathe.

In cases where the foetus is removed before 30 minutes has elapsed *euthanasia* ~~(captive bolt followed by bleeding)~~ should be carried out immediately.

~~4.) Species-specific recommendations:~~

~~None identified.~~

Article 7.5.22~~19~~.

Emergency killing of free-moving animals

This article addresses animals that show signs of severe pain or other types of severe suffering before being unloaded or within the *slaughterhouse/abattoir*. These animals may correspond to animals unfit to travel as listed in Article 7.3.7. Principles described below should be described in the emergency plan and may also apply to animals that are not suitable for *slaughter* for commercial reasons, even if they do not present signs of distress, pain or suffering.

1~~.~~) Animal welfare concerns:

Some animals can arrive at *slaughterhouses/abattoirs* with injuries or severe illnesses that can cause ~~undue~~ distress and pain and suffering. ~~This is more likely in animals of low economic value.~~

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

Animals requiring emergency *killing* are unable to walk independently or present severe injuries such as fractures, large open wounds, or prolapses. They may also present clinical signs of serious illness or being in a state of extreme weakness. New-born animals or animals that gave birth within the last 48 hours may also belong to this category.

3~~.~~) Recommendations:

Animals should not be moved unless it can be done without causing ~~further~~ pain or suffering.

*Animal handlers* should euthanise the animal as soon as possible.

Emergency *killing* should be systematically recorded and analysed in order to improve procedures and prevent recurrences.

~~4.)~~ ~~Species-specific recommendations:~~

~~None identified.~~

Article 7.5.23~~20~~.

Methods, procedures or practices that should not be used ~~unacceptable on animal welfare grounds~~ for free-moving animals

1) ~~None of tT~~he following practices for handling animals ~~are unacceptable and~~ should not be used under any circumstances:

a) crushing, twisting or breaking tails of animals;

b) applying pressure using an injurious object or applying an irritant substance to any part of an animal ~~to sensitive areas such as eyes, mouth, ears, anogenital region or belly~~;

c) hitting animals with instruments such as large sticks, sticks with sharp ends, ~~metal~~ piping, stones, fencing wire or leather belts;

d) kicking, throwing or dropping animals;

e) grasping, lifting or dragging animals only by some body parts such as their tail, head, horns, ears, limbs, wool or hair;

f) dragging animals by any body part, by any means, including ~~with~~ chains, ~~or~~ ropes or by hand;

g) forcing animals to walk over other animals;

h) interfering with any sensitive area (e.g. eyes, mouth, ears, anogenital region, udder or belly).

2) ~~None of t~~The following practices for restraining conscious animals are unacceptable and should not be used under any circumstances:

a) mechanical clamping of the legs or feet of the animals as the sole method of [*restraint*](http://www.oie.int/index.php?id=169&L=0&htmfile=glossaire.htm#terme_immobilisation), including tying limbs together or lifting one or more limbs off the ground;

b) breaking legs, cutting leg tendons or blinding animals;

c) severing the spinal cord, by using for example a puntilla or dagger;

d) applying electrical current that does not span the brain;

e) suspending or hoisting ~~conscious animals~~them by the feet or legs;

f) severing brain stem by piercing through the eye socket or skull bone;

g) forcing animals to ~~the ground~~sit or lay down by one or more handlers jumping on and lying across the animal’s back~~.~~;

h) trip floor boxes that are designed to make animals fall.

3) Breaking the neck while the animal is still conscious during bleeding is also an unacceptable practice.

Article 7.5.24~~21~~.

Arrival of animals in containers

On arrival at the *slaughterhouse/abattoir*, animals will already have been exposed to *hazards* that may have negative impacts on their welfare. Any previous *hazards* will have a cumulative effect that may impair the welfare of the animals throughout the *slaughter* process. Therefore, animals should be transported to the *slaughterhouse/abattoir* in a manner that minimises adverse animal health and welfare outcomes, and in accordance with Chapters 7.2. and 7.3.

1~~.~~) Animal welfare concerns:

Animals in *containers* have smaller space allowances than on farm, undergo water and *feed* deprivation, may have suffered from injury and may be exposed to thermal stress due to adverse weather conditions and stress from social disturbance, noise, vehicle vibration and motion. In addition, stationary *vehicles* may have insufficient ventilation. Delays in *unloading* *containers* will prolong or exacerbate the impact of these *hazards*. Under these circumstances, injured or sick animals requiring urgent attention will not be identified and therefore the duration of their suffering will be increased.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

It can be difficult to assess animal-based measures while animals are in the *containers* and especially whenthe *containers* are on the vehicle or when many containers are stacked on top of each other*.* Some ~~measurables~~ measures that may be assessed include animals with injuries, or those that are sick or have died. Panting, reddening of the ears (heat stress in rabbits), shivering and huddling may indicate thermal stress. In rabbits drooling and licking may indicate prolonged thirst.

Time from arrival to *unloading* and slaughter, the environmental temperature and humidity (e.g. ambient, inside the vehicle) can be used to establish relevant thresholds for corrective action.

3~~.~~) Recommendations:

Animals should be slaughtered as soon as they arrive at the *slaughterhouse/abattoir*. If not possible, *containers* should be unloaded, or vehicles should be placed in lairage or in sheltered and adequately ventilated area, promptly on arrival. This is facilitated by scheduling the arrival of the animals at the *slaughterhouse/abattoir* to ensure that there are sufficient personnel and adequate space in the *lairage* area. Time at lairage should be kept ~~at~~ to a minimum.

Consignments of animals assessed to be at greater risk of compromised *animal welfare ~~hazards~~* (e.g. from long journeys, prolonged lairage, end-of-lay hens) should be unloaded first or should be considered for prioritised *slaughter*. When no available space is immediately available, creating space should be a priority. Provisions should be made to provide shelter, shade, cooling or heating systems or additional ventilation during waiting periods, or animals should be transported to an alternative nearby location where such provisions are is available. ~~Mortalities and injuries should be reported to the competent authority.~~

4~~.~~) Species-specific recommendations:

~~Poultry is especially sensitive to extreme temperatures and therefore special attention should be taken when dealing with delays in~~ *~~unloading~~* ~~this species in extreme temperatures.~~

Birds may get trapped or their wings or claws may get caught in the fixtures, mesh or holes in poorly designed, constructed or maintained transport systems. Similarly, rabbits may trap their paws in the fixtures mesh or holes in poorly designed, constructed or maintained transport systems. Under these situations, operators *unloading* birds or rabbits should ensure gentle release of trapped animals.

Article 7.5.25~~22~~.

Moving of animals in containers

This article addresses the handling of containerised animals during *unloading* and *lairage,* and into the killing area.

1~~.~~) Animal welfare concerns:

During *unloading* and moving *containers,* animals can be exposed to pain, stress and fear due to tilting, dropping or shaking of the *containers*.

During *unloading* and moving *containers,* animals can be exposed to adverse weather or climate conditions and face heat stress, frost bite, or death.[EFSA, 2019].

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a) animals with broken limbs;

b) animals that strike against the facilities;

c) animals vocali~~z~~sing;

d) body parts (i.e. wings, limbs, feet, paws or heads) stuck between *containers*;

e) animalsinjured by sharp projections inside *containers.*

3~~.~~) Recommendations:

*Containers* in which animals are transported should be handled with care, moved slowly, and should not be thrown, dropped or knocked over. Where possible, they should be horizontal while being loaded or unloaded mechanically and stacked to ensure ventilation and prevent animals piling on one another. In any case, *containers* should be moved and stored in an upright position as indicated by specific marks.

Animals delivered in *containers* with perforated or flexible bottoms should be unloaded with particular care to avoid injury by crushing or jamming of body parts.

Animals that are injured, jammed or sick require immediate action and, when necessary, should be taken from the *containers* and euthanised without delay. Refer to Articles 7.5.8, 7.5.9., 7.6.8 and 7.6.~~17~~24.

Staff should routinely inspect the *containers* and remove the broken *containers* that should not be re-used.

~~4.)~~ ~~Species-specific recommendations:~~

~~None identified.~~

Article 7.5.26~~23~~.

Lairage of animals in containers

1~~.~~) Animal welfare concerns:

Animals ~~during~~ *~~lairage~~* may be exposed to several *hazards* to *animal welfare ~~hazards~~* during *lairage* including:

1. ~~food~~ feed and water deprivation leading to prolonged hunger and thirst~~,~~;
2. poor ventilation;

c~~b~~) absence of protection against adverse weather or climate conditions ~~extremes in climate~~ leading to thermal stress~~,~~;

d~~c~~) sudden or excessive noises, including from personnel, leading to fear~~,~~;

e~~d~~) insufficient space to lie down and move freely leading to fatigue and aggressive behaviour~~,~~;

f~~e~~) not being inspected or accessible for emergency killing when necessary.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a) thermal stress (e.g. panting, shivering, huddling behaviour)~~,~~;

b) space allowance~~,~~;

c) excessive soiling with faeces~~,~~;

d) injuries (e.g. splay leg, open wounds, fractures)~~,~~;

e)dead animals.

3~~.~~) Recommendations:

Animals should be slaughtered upon arrival at the *slaughterhouse/abattoir*.

Staff should routinely inspect and monitor containers while in the lairage to observe animals for signs of distress, fear and pain ~~suffering and distress~~ and take appropriate corrective action to address any concerns.

The *lairage* should provide animals with protection against adverse weather conditions.

Animals should be protected from sudden and excessive noise (e.g. ventilation fans, alarms, or other indoor or outdoor equipment).

~~4.)~~ ~~Species-specific recommendations:~~

~~None identified.~~

Article 7.5.27~~24~~.

Unloading animals from containers

1~~.~~) Animal welfare concerns:

Animals are removed manually or automatically by tilting ~~(poultry)~~ ~~from~~ the transport *containers*.

When the *containers* with ~~birds~~ animals are manually or mechanically emptied by tipping, animals fall on to conveyors. Dumping, piling up and shock ~~might happen~~ may occur, especially for the last ~~birds~~animals, which are often removed by manual or mechanical shaking of the *containers*.

Other *hazards* include:

a) narrow openings or doors of the *containers*;

b) *containers* placed too far away from the place of shackling or *stunning*;

c) handling and removal of animals from containers before stunning;

~~c~~d) incorrect design of manual or mechanical tipping ~~manually or using mechanical~~ equipment that cause animals to fall~~ing~~ from a height ~~and conveyor belts that are running too fast or too slow resulting in piling or injured animals~~;

e) conveyor belts that are running too fast or too slowly resulting in piling or injury.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a) animals falling;

b) struggling, including wing flapping;

c) escape attempts;

d) vocalisation;

e) injuries, dislocations, fractures;

f) pi~~l~~ling~~-off~~up of animals.

3~~.~~) Recommendations:

Removal of animals from ~~the~~ *containers* in a way that causes pain, e.g. by one leg, wings, neck or ears, should be avoided.

Animals should be removed from *containers* by the body or by both legs using both hands and one animal at a time. Animals should not be grabbed and lifted by one leg, the ears, wings or fur and they should not be thrown, sw~~i~~ung or dropped.

Animals should not be mistreated in the process of unloading and shackling prior to stunning (e.g. excessive force used when shackling, punching, kicking, or otherwise hurting).

Modular systems that involve tipping of live birds are not conducive to maintaining good animal welfare. These systems, when used, should ~~be~~ have an incorporated ~~with a~~ mechanism to facilitate birds sliding out of the transport system, rather than being dropped or dumped on top of each other ~~from heights of more than a metre~~.

It should be ensured that every animal is removed from the containers before they are returned.

4~~.~~) Species-specific recommendations:

Any animal ~~Birds~~ with broken bones ~~and/~~or dislocated joints should be ~~humanely~~emergency killed before being hung on shackles for processing.

Article 7.5.28~~25~~.

Restraint for stunning animals from containers

1~~.~~) Animal welfare concerns:

The purpose of *restraint* is to facilitate the correct application of the *stunning* and ~~or~~ bleeding procedures ~~equipment~~. Incorrect *restraint* and handling cause distress, fear and pain ~~fear and distress~~ and may lead to ineffective *stunning* and ~~or~~ bleeding.

Other *hazards* include:

1. Inversion can provoke compression of the heart and lungs or air sacs by the viscera and might compromise breathing and cardiac activity. This ~~might~~ will cause distress, fear and pain ~~and fear~~ in conscious birds and rabbits.
2. Shackling ~~hanging~~ birds upside down by inserting both legs into metal shackles. During shackling, the birds are also subjected to compression of their legs and wing flapping by their neighbour(s), leading to pain and fear.
3. Inappropriate shackling (e.g. shackles are too narrow or too wide, birds are hung by one leg, or when one bird is shackled on two different adjacent shackles) leads to pain and fear ~~when shackles are too narrow or too wide, when the birds are hung by one leg, or when one bird is shackled on two different adjacent shackles~~. Line speed, without a concomitant increase in workforce, can contribute to poor shackling outcomes.
4. Drops, curves and inclination of the shackle line or high speed of the shackle line create fear and possible pain due to the sudden changes in position as well as increased effects of inversion.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

a) ~~struggling (~~wing flapping for birds;

b) escape attempts;

c) high frequency vocalisations (distress calls)~~of high frequency(poultry)~~;

d) injuries and pain caused by excessive force of restraint or shackling~~;~~.

~~e)~~  ~~fear caused by prolonged restraint, which may exacerbate insecure or excessive restraint.~~

3~~.~~) Recommendations:

Stunning methods that avoid handling, shackling and inversion of conscious animals should always be preferred.

Where, this is not possible, ~~A~~animals should be handled and restrained to minimise ~~without provoking~~ struggl~~e~~ing or attempts to escape.

~~Avoid inversion of conscious animals.~~

~~Avoid shackling of conscious animals but there is no real way to prevent or correct shackling, however, as it is a part of some of the~~ *~~stunning~~* ~~methods most commonly used in slaughter plants.~~

Shackle lines ~~must~~ should be constructed and maintained so they do not jolt ~~birds~~animals ~~as~~ because this is likely to stimulate flapping (poultry) or struggl~~e~~ing. Shackle line speeds ~~must~~ should be optimised so that they do not cause the ~~birds~~animals to struggle. Shackling duration prior to stunning should be kept to a minimum.

To minimise wing flapping (poultry) or struggl~~e~~ing, breast support should be provided to the birds from the shackling point up to the stunner.

Inappropriate shackling, such as shackles that are too narrow or too wide ~~shackles~~, ~~birds~~animals being pushed into the shackles with force, ~~birds~~animals shackled by one leg, or shackled on two different adjacent shackles, should be avoided.

Inappropriate shackling can be prevented by training staff to handle ~~birds~~animals with care and compassion, by a~~n~~ competent professional~~,~~ shackl~~e~~ing ~~birds~~animals gently by both legs and killing injured ~~birds~~animals before shackling, by rotating staff at regular intervals to avoid boredom and fatigue and by using shackles that are appropriate and adjustable for ~~to~~ the species and size of the ~~birds~~animals.

4~~.~~) Species-specific recommendations:

*Rabbits*:

Restraining for head-only electrical *stunning* is manual and involves holding the rabbit with one hand supporting its belly, and the other hand guiding the head into the *stunning* tongs or electrodes.

Rabbits should not be lifted or carried by the ears, head ~~or~~, one leg or by the skin at the back of the neck without supporting the body.

*Poultry*:

Shackling should not be used with heavy birds ~~like~~ such as parent *flocks,* turkeys or with birds that are more susceptible to fractures ~~like~~ (e.g. end-of-lay hens).

Poultry should not be lifted or carried by the head, wings or one leg.

Article 7.5.29~~26~~.

Head-only electrical stunning

1~~.~~) Animal welfare concerns:

Electrical *stunning* involves application of an electric current ~~to~~across the brain of sufficient magnitude ~~magnitude current and intensity~~ to induce immediate unconsciousness [EFSA, 2004; Grandin, 1980]. The main *hazards* preventing effective electrical *stunning* are: incorrect electrode placement, poor contact, dirty or corroded electrode, electrical arcing, high contact resistance caused by wool or dirt on the animal surface~~,~~ and inappropriate electrical parameters (low voltage/current or high frequency [EFSA, 2004]).

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

~~Effectiveness of~~ *~~stunning~~* ~~should be monitored at different stages: immediately after~~ *~~stunning~~*~~, and just before and during bleeding until death occurs is confirmed [EFSA, 2013a; EFSA, 2013b; AVMA, 2016].~~

~~No indicator should be relied upon alone.~~ Multiple indicators should be used to determine whether a stun is effective and the animal is unconscious.

Animal based measures of an effective stun are: ~~An effective stun is characterised by the presence of all the following signs:~~ tonic-clonic seizures; ~~loss of posture~~; apnoea; ~~and~~ absence of corneal reflex and palpebral reflex.

Animal-based measures of ineffective stun or recovery of consciousness are:~~The presence of any of the following signs indicate a high risk of ineffective stun or recovery of consciousness:~~ vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex;~~or~~ palpebral reflex; rhythmic breathing~~.~~; spontaneous swallowing and head shaking.

3~~.~~) Recommendations:

Animals should be stunned as soon as they are restrained.

To minimise any disturbance to birds during shackling, where shackles are wet to improve conductivity, they should be wet only prior to birds’ legs being placed in them.

In the case of ineffective *stunning* or recovery, animals should be re-stunned ~~immediately~~ using a backup system ~~or~~ and be ~~immediately~~ killed immediately. Ineffective *stunning* or return to consciousness should be systematically recorded and the cause of the failure identified and rectified.

*Stunning* equipment should be used, cleaned, maintained and stored following the manufacturer’s recommendations.

Constant current stunners should always be preferred to constant voltage stunners ~~since~~ because the ~~first ones~~ former ensure that the minimum current is provided to the animal independently from individual impedance.

Regular calibration of the equipment according to the manufacturer’s procedure ~~are~~ is recommended. Effectiveness of the *stunning* should be monitored regularly.

*Slaughterhouses/abattoirs* should have standard operating procedures that define key operating parameters and~~or~~ follow the manufacturer’s recommendations for *stunning*, such as:

‒ shape, size and placement of the electrodes [AVMA, 2016];

‒ contact between electrode and head;

‒ electrical parameters (current intensity[A], waveform type [AC and DC], voltage [V] and frequency [Hz]);

‒ visual or auditory warning system to alert the operator to proper or improper function such as a device that monitors and displays voltage and applied current.

4~~.~~) Species-specific recommendations:

The *Competent* *Authority* should determine effective electrical parameters, based on scientific evidence for different types of animals.

For head-only stunning, minimum parameters are recommended for the following species:

‒ 240 mA for hens and broiler chicken [EFSA, 2019],

‒ 400 mA for turkeys [EFSA, 2019],

‒ 600 mA for geese and ducks [EFSA, 2019],

‒ 140 mA for rabbits (100V of a 50 Hz sine wave AC) [EFSA, 2020a]].

Article 7.5.30~~27~~.

Electrical water-bath stunning for poultry

1~~.~~) Animal welfare concerns:

In electrical water-bath *stunning* poultry are inverted and hung by the legs from a shackle line. The bird’s head has direct contact with the water-bath, and an electric current is passed from the water through the bird to the leg shackle. *Hazards* that may prevent effective electrical *stunning* are: lack of contact between head and water, differences in individual bird resistance pre-stun shocks due to wings contacting water before the head, and the use of inappropriate electrical parameters (low voltage/current or high frequency [AVMA 2016]).

*Hazards* that increase the likelihood of animals experiencing pre-stun shocks are: poor handling at shackling, line speed, physical contact between birds, incorrect angle of entry ramp, wet entry ramp, incorrect water-bath height, and shallow immersion.

Factors affecting individual bird resistance include the resistance between the shackle and the leg (leg/shackle interface), shackling on top of a severed foot, shackling by one leg, poor shackle position, incorrect shackle size, dry shackles, scale on the shackle surface, and keratinised skin on the legs (e.g. older birds).

Where inappropriate electrical stunning parameters (e.g. high frequency) are used, conscious animals are at risk of being electro-immobilized or paralysed causing pain and suffering.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

Effectiveness of *stunning* should be monitored at different stages: immediately after *stunning*, and just before and during bleeding until death occurs [EFSA, 2019; EFSA, 2013a; EFSA, 2013b; AVMA, 2016].

~~No indicator should be relied upon alone~~. Multiple indicators should be used to determine whether a stun is effective and the animal is unconscious.

Animal-based measures of an effective stun are ~~An effective stun is characterised by the presence of all the following signs~~: tonic-clonic seizures; ~~loss of posture~~; apnoea; and absence of corneal reflex or palpebral reflex.

Animal-based measures of ineffective stun or recovery of consciousness are ~~The presence of any of the following signs indicate a high risk of ineffective stun or recovery of consciousness~~: vocalisation; spontaneous blinking; righting reflex; presence of corneal reflex or palpebral reflex; rhythmic breathing; spontaneous swallowing; and head shaking.

3~~.~~) Recommendations:

The height of the water-bath stunner ~~must~~ should be adjusted so that the birds cannot pull themselves up and avoid the stunner. Avoid distractions such as people walking under the birds ~~as~~ because this can cause birds to pull up.

Personnel should watch for short or stunted birds as these birds will not be able to make contact with the water and will not be stunned. These birds should be stunned in the slaughter line (e.g. penetrative captive bolt) or removed and euthanised.

The rail of the shackle line should run smoothly. Sudden movement such as jolts, drops or sharp curves in the line may cause birds to flap and avoid the stunner.

To minimise any disturbance to birds during shackling, where shackles are wet to improve conductivity, they ~~could~~ should be wetted only prior to birds’ legs being placed in them.

Pre-stun shocks can be reduced by having a smooth shackle line and entry ~~in~~ to the water-bath and by adjusting the water level of the bath.

In the case of ineffective *stunning* or recovery, animals should be re-stunned ~~immediately~~ using a backup system and be killed immediately. Ineffective *stunning* or return to consciousness should be systematically recorded and the cause of the failure identified and rectified.

*Stunning* equipment should be used, cleaned, maintained and stored following themanufacturer’s recommendations.

Constant current stunners should always be preferred to constant voltage stunners ~~since the first ones~~ because the former ensure that the minimum current is provided to the animal independently from individual impedance.

Regular calibration of the equipment according to the manufacturer’s procedure ~~are~~ is recommended. Effectiveness of the *stunning* should be monitored regularly.

*Slaughterhouses/abattoirs* should have standard operating procedures that define key operating parameters or follow the manufacturer’s recommendations for *stunning*, such as:

‒ water level;

‒ number of birds in the water-bath;

‒ contact between water and head, as well as between the legs and the leg shackle;

‒ electrical parameters (current intensity [A], waveform type [AC and DC], voltage [V] and frequency [Hz]);

‒ visual or auditory warning system to alert the operator to proper or improper function, such as a device that monitors and displays voltage and applied current.

Ensure an optimum combination of voltage and frequency during electrical water-bath *stunning* practices, to maximize the effectiveness of *stunning*.

*Hazards* to *animal welfare* ~~hazards~~ such as inversion of conscious ~~inversion of~~ birds, pre-stun shocks, and variability in electrical current delivered to each bird are inherent risks of electrical water-bath stunning. The use of electrical water-bath stunning should be avoided and replaced by stunning systems which avoid these associated ~~animal welfare~~ hazards.

4~~.~~) Species-specific recommendations:

The *Competent Authority* should determine effective electrical parameters, based on scientific evidence for different ~~types and~~ species of birds.

For water-bath stunning depending on the frequency, minimum parameters are recommended for the following species [EFSA, 2019]:

‒ Frequency below 200 Hz:

‒ 100 mA for chicken,

‒ 250 mA for turkeys,

‒ 130 mA for Ducks and geese,

‒ 45 mA for quails.

‒ For frequency from 200 to 400 Hz:

‒ 150 mA for chicken,

‒ 400 mA for turkeys.

‒ For frequency from 400-600 Hz:

‒ 200 mA for chicken,

‒ 400 mA for turkeys.

Ducks, geese and quails should not be stunned at frequencies higher than 200 Hz.

Chicken and turkeys should not be stunned at frequencies higher than 600 Hz.

Article 7.5.31~~28~~.

Mechanical stunning

The mechanical methods described here are penetrative and non-penetrative captive bolt systems, ~~percussive blow to the head, cervical dislocation and decapitation~~. Effective mechanical *stunning* requires a severe and immediate damage to the brain caused by the application of mechanical force. For that reason, cervical dislocation and decapitation cannot be considered as *stunning* methods.

1~~.~~) Animal welfare concerns:

Mechanical methods require~~d~~ precision and often physical strength to restrain and stun the animals. ~~A~~ ~~c~~Common causes ~~for~~ of the misapplication of these methods ~~is~~ are ~~the~~ a lack of proper skill and ~~the~~ operator fatigue.

*Penetrative and non-penetrative c~~C~~aptive bolt*

An incorrect shooting position or incorrect captive bolt parameters (not hitting the skull with sufficient force) will mis-stun~~ned~~ the animal, leaving it conscious and leading to serious wounds and consequently distress, fear and pain~~, suffering, and fear~~.

Improper captive bolt parameters may be linked to: the use of an inappropriate~~improper~~ gun (bolt diameter); inappropriate~~improper~~ cartridges~~,~~; or an overheated or badly maintained gun.

*~~Percussive blow to the head~~*

~~An incorrect application of the blow, by not hitting the brain with sufficient force will also mis-stunned the animals leading to serious wounds and consequently pain and fear.~~

~~In addition, the blow might not be consistently effective when delivered to an animal held upside down by its legs (part of the energy is dissipated by the movement of the body instead of damaging the brain).~~

*Cervical dislocation ~~and decapitation~~*

~~Because neither method applyies to the brain, t~~The loss of consciousness may be delayed. ~~is not immediate and, in some cases,~~W ~~w~~hen the method is not properly applied there is a risk of neck crushing and the distress fear and pain ~~and fear~~ of the animal might be prolonged.

Decapitation

~~In addition, d~~Decapitation is associated with an open wound ~~leading to intense pain~~ and delayed loss of consciousness, leading to intense distress, fear and pain [EFSA, 2019].

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

*Penetrative and non-penetrative ~~C~~captive bolt ~~and percussive blow to the head~~*

~~With birds, s~~Severe convulsions (wing flapping [poultry] and leg kicking i.e. uncontrolled muscular movements) occur immediately after shooting or percussive blow. This is due to the loss of control of the brain over the spinal cord. Since mechanical *stunning* is applied ~~on~~ to individual animals, its efficacy can be assessed immediately after the stun [Nielsen *et al.*, 2018].

Effectiveness of stunning should be monitored at different stages: immediately after stunning, and just before and during bleeding until death is confirmed ~~occurs~~ [EFSA, 2019; EFSA, 2013a; EFSA, 2013b; AVMA, 2016].

Animal-based measures of an effective stun are:~~An effective stun is characterised the following signs:~~ the absence of corneal reflex;~~or~~ palpebral reflex, apnoea~~,~~; ~~the absence of rhythmic breathing and the presence of immediate collapse~~ loss of posture; presence of tonic-clonic seizure.

Animal-based measures of ineffective stun or recovery of consciousness are:~~The presence of any of the following signs indicates a high risk of ineffective stun or recovery of consciousness:~~ vocalisations; spontaneous blinking; righting reflex; presence of corneal reflex; ~~or~~ palpebral reflex; rhythmic breathing.

*Cervical dislocation ~~and decapitation~~*

Death can be confirmed from several indicators: complete severance between the brain and the spinal cord (i.e. gap between neck vertebrae and base of skull), permanent absence of breathing, absence of corneal or palpebral reflex, dilated pupil, or relaxed carcass [EFSA, 2013a].

*Decapitation*

~~ABM for death by decapitation:~~ ~~d~~Death can be confirmed by complete severance between the head and the body

3~~.~~) Recommendations:

Penetrative and non-penetrative *~~C~~*captive bolt ~~and percussive blow to the head~~ should only be used as backup or for small-scale slaughtering as in small *slaughterhouses/abattoirs* or on-farm slaughter or for emergency killing.

*Penetrative and non-penetrative* *~~C~~captive bolt*

The captive bolt gun should be used, cleaned, maintained and stored following the manufacturer’s recommendations.

Effectiveness of the *stunning* should be monitored regularly.

Because it requires precision, this method should only be applied with proper restraint of the head of the animal~~s~~. In addition, in the case of birds, they should be restrained in a bleeding cone to contain wing flapping.

The captive~~-~~bolt should be pointing perpendicularly on the parietal bones of birds.

Placement is different for birds with ~~or~~ and without combs:

*Without comb*

The placement of the device should be directly on the midline of the skull and at the highest/widest point of the head with the captive bolt aimed directly down towards the brain [AVMA, 2020].

*With comb*

As far as captive bolt i~~I~~n chickens (and other poultry with comb development) ~~is concerned~~, the placement of the device should be directly behind the comb and on the midline of the skull with the captive bolt aimed directly down towards the brain of the bird [AVMA, 2020].

The power of the cartridge, compressed air line pressure or spring should be appropriate for the species and size of birds. Cartridges should be kept dry and the gun regularly inspected and maintained.

~~This method should be dealt with a single sufficiently strong hit the frontoparietal region of the head and should resulted in loss of auditory evoked potentials when using an EEG in broilers and broiler breeders.~~

~~Fatigue of the operator can lead to inconsistency in application, creating concern that the technique may be difficult to apply humanely to large numbers of birds. It should not be done with the animal’s head hanging down since inversion is stressful and part of the energy of the blow will be dissipated by the movement of the body.~~

~~It should not be used as a routine method and should be limited as a back-up method limited to small animals (e.g. up to 3kg liveweight manually and up to 5 kg mechanical).~~

*Rabbits*

The device should be placed in the centre of the forehead, with the barrel in front of the ears and behind the eyes. The device should be discharged twice in rapid succession at the pressure recommended for the age and size of the rabbit. [Walsh *et al.,* 2017].

The power of the cartridge, compressed air line pressure or spring should be appropriate for the animal ~~species~~ ~~and size of birds~~. Cartridges should be kept dry and the gun regularly inspected and maintained.

~~As an indication for broiler chickens, the appropriate specifications for captive bolt~~ *~~stunning~~* ~~are a minimum of 6-mm bolt diameter driven at an air pressure of 827 kPa to a penetration depth of 10 mm [Raj and O’Callaghan, 2001].~~

There should be sufficient bolt number of guns such that they are allowed to cool between operations~~, and they should be cleaned and maintained according to manufacturer’s instructions~~.

*~~Percussive blow to the head~~*

~~This method The blow should be dealt with a single sufficiently strong hit placed in the frontoparietal region of the head resulted in loss of auditory evoked potentials in broilers and broiler breeders.~~

~~Fatigue of the operator can lead to inconsistency in application, creating concern that the technique may be difficult to apply humanely to large numbers of birds. It should not be done with the animal’s head hanging down since inversion is stressful and part of the energy of the blow will be dissipated by the movement of the body.~~

~~Considering that the application of this method is entirely manual and prone to error, percussive blow might be used only when no other~~ *~~stunning~~* ~~method is available and, by establishing a maximum number of animals per operator in time to avoid errors due to operator fatigue.~~

~~It should not be used as a routine method and should be limited as a back-up method limited to small size animals (e.g. up to 3kg liveweight manually and up to 5 kg mechanical).~~

~~This method should not be used in rabbits because of the difficulties to apply this method efficiently.~~

*Cervical dislocation*

Cervical dislocation is not recommended in conscious animals and should only be used when there are no other options available.~~should not be used in conscious birds under any circumstances.~~ ~~avoided since it does not render the animal unconscious immediately~~.

It should not be used as a routine method and should be limited to use as a back-up method ~~limited to~~ for small ~~size~~ animals (e.g. up to 3kg liveweight manually and up to 5 kg mechanically).

Mechanical dislocation should be preferred to manual dislocation ~~as~~ because the efficiency of the ~~first~~former is less dependent on the operator’s strength than the latter.

Cervical dislocation should not be ~~undertaken~~performed with ~~tools such as pliers as they cause neck~~ crushing tools (e.g. pliers),~~rather than concussion, and consequently pain and fear~~. These tools may not cause complete severance between the brain and the spinal cord.

*Decapitation*

Decapitation should not be used in conscious rabbits ~~because it does not render the animal unconscious immediately~~.

4~~.~~) Species-specific recommendations:

~~Because of their size, heavy animals such as turkeys, geese or mature rabbits should not be stunned through percussive blow to the head or cervical dislocation.~~

Turkeys, ducks and geese may be also properly stunned by non-penetrative captive bolt. [Walsh *et al.*, 2017; Woolcott *et al.*, 2018; Gibson *et al.*, 2019, Stiewert *et al.* 2021]

Article 7.5.32~~29~~.

Controlled atmosphere stunning for animals in containers ~~poultry~~

Animals may be exposed to controlled atmosphere *stunning* methods either directly in crates or after being unloaded on a conveyor belt. Animals are not subject to restraint. Controlled atmosphere *stunning* includes exposure to carbon dioxide, inert gases, mixtures of carbon dioxide with inert gases or low atmosphere pressure (LAPS). The effectiveness and animal welfare impacts of LAPS are still being evaluated~~as it is a newer form of controlled atmosphere stunning in comparison with other methods,~~ ; so far it has only been demonstrated to be effective for the stunning of chickens ~~been studied in poultry~~ and therefore is not suitable for use in rabbits or other animals without further study.

1~~.~~) Animal welfare concerns:

A common concern of all controlled atmosphere *stunning* methods is the risk of insufficient exposure of animals to the modified atmosphere, which can result in animals recovering ~~returning to~~ consciousness before bleeding and ~~cause~~causing respiratory distress ~~respiratory~~, fear and pain ~~and fear~~. The insufficient exposure to the modified atmosphere may be due to either ~~a~~ too short exposure time, a too low concentration of gas or a combination of these variables.

These variables are critical because animals being stunned in large groups need special attention to ensure unconsciousness prior to neck cutting. For this reason, the duration of unconsciousness induced needs to be longer than required by other *stunning* methods to ensure that animals do not recover prior to being killed.

Furthermore, *hazards* causing increased distress during induction of unconsciousness are irritant or aversive gas mixtures, low gas temperature and humidity. In the case of exposure to carbon dioxide, there is a risk that animals are exposed to ~~a~~ too high a concentration of this gas, leading to pain. Exposure of conscious animals to more than 40% carbon dioxide (CO2) will cause painful stimulation of the nasal mucosa and aversive reactions.

Low atmospheric pressure systems (LAPS) should not be confused with decompression~~.~~ : LAPS utilise a slow removal of air where animals exhibit minimal to no aversive behaviours. Decompression is a fast process that is associated with induction of pain and respiratory distress.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

It may be difficult to monitor the effectiveness of controlled atmosphere *stunning* ~~due to~~ because of limited access to observation of animals during the *stunning* process. All chamber-type systems should have either windows or video cameras so that problems with induction can be observed. If problems are observed, there is a need to take immediate~~ly any~~ corrective measures that could alleviate the suffering of the animals concerned.

Therefore, it is essential that the death of animals is confirmed at the end of the exposure to the controlled atmosphere.

Death can be confirmed from by permanent absence of breathing, absence of corneal or palpebral reflex, dilated pupils and relaxed carcass.

Since animal-based measures are difficult to monitor, resource-based measures should also be used such as monitoring of gas concentration(s), exposure time, gas displacement rate, and ~~decompression~~ rate of air removal (for LAPS ~~low atmosphere pressure~~).

3~~.~~) Recommendations:

Conscious animals should not be exposed to carbon dioxide concentrations exceeding 40%. Any compressed gas should also be vaporised prior to administration and humidified at room temperature to prevent the risk of animals experiencing thermal shock.

The duration of exposure and the gas concentration should be designed and implemented in such a way that all animals are rendered unconscious until death ~~dead before being shackled~~.

Gas concentrations and exposure time, temperature and humidity ~~must~~ should be monitored continuously at the level of the animal inside the chamber.

Stunning systems should have visual and auditory warning system to alert the operator to improper function, such as inappropriate gas concentration or decompression rate.

In the case of low atmosphere pressure *stunning* ~~decompression~~ the rate of air removal should be monitored continuously. The decompression rate should not be greater than or equivalent to a reduction in pressure from standard sea level atmospheric pressure (760 Torr) to 250 Torr in not less than 50 s. During ~~a~~ the second phase, a minimum atmospheric pressure of 160 Torr shall be reached within the following 210 s.

In the case of ineffective *stunning* or recovery, animals should be re-stunned immediately using a backup system. Ineffective *stunning* or return to consciousness should be systematically recorded and the cause of the failure identified and rectified.

4~~.~~) Species-specific recommendations:

Low atmosphere pressure *stunning* has only been scientifically studied on ~~commercial broilers~~ chickens [Gurung *et al.*, 2018, Jongman and Fisher, 2021] and therefore should not be used for other animals until further information is available.

The recommended CO2 displacement rate for rabbits is 50-60% of the chamber or cage volume/min as this results in a significantly shorter time to insensibility and death [Walsh *et al.*, 2016, AVMA 2020]. Exposure to CO2 at high concentrations can reduce pre-stun handling and produce irreversible *stunning* in rabbits. With a stun-to-stick interval of up to 2 min, 200 s of exposure at 80%, 150 s at 90% and 110 s at 98% are recommended [Dalmau *et al.*, 2016]. While there are advantages to high CO2 exposure in rabbits, it is not without welfare concerns (aversion, vocalisation).

Article 7.5.33~~30~~.

Bleeding ~~in~~ of animals arriving in containers

1~~.~~) Animal welfare concerns

~~In poultry,~~ ~~t~~The most common animal welfare concern at the time of bleeding is recovery of consciousness due to ineffective ~~electric water bath~~ *stunning* practices. There are ~~a lot~~ many of factors that determine the efficacy of a *stunning* procedure such as type of ~~chicken~~ animal ~~(broiler, breeder, layer)~~, animal weight, voltage, frequency, impedance and duration of *stunning* or gas (mixture) concentration and exposure [Zulkifli *et al.*, 2013; Raj, 2006; Wotton & Wilkins, 2004].

Improper *stunning* practice leads to the risk of animals suffering experiencing distress, fear and pain ~~fear, distress, and pain~~, during and after *slaughter* if they regain consciousness. There is ~~also~~ an additional risk of injury ~~on~~ to bones ~~(coracoid and scapula)~~, wings and joints due to ~~flapping~~ struggling if ~~birds~~ animals regain consciousness.

Bleeding without prior *stunning* increases the risk of animal suffering because the incision to sever blood vessels results in substantial tissue damage in areas well supplied with nociceptors. The activation of these nociceptors causes the animal to experience pain [Gregory, 2004; Gibson et al., 2009]. Loss of consciousness due to bleeding is not immediate and there is a period during which the animal can ~~feel~~ experience distress, fear~~,~~  and pain ~~and distress~~ [Gregory, 2004; Johnson *et* *al.*, 2015].

In case of bleeding without *stunning*, ~~higher~~ more cases of injury, bruis~~es~~ing, haemorrhage and broken body parts are expected to occur due to wing flapping and violent muscular contractions [McNeal *et al.*, 2003).

Bleeding duration also plays an integral part in processing, where animals that have not undergone a sufficient bleeding period ~~(a minimum 40 sec)~~, may still be alive upon reaching the scalding tank. Live and conscious birds, if not removed prior to scalding, will then be subjected to additional pain ~~stimulators~~ from the heat inside the scalding tank and death by drowning.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

The main animal-based ~~measurables~~ measure is the blood flow (rate and duration). For animal-based and other ~~measurables~~ measures of return of consciousness after *stunning*, (see ~~Article 7.5.16~~Article 7.5.26. to Article 7.5.29).

One of the most common parameters in determining bleeding efficiency is the percentage of blood loss, where the amount of blood loss is estimated ~~through~~ from the difference between pre-slaughter weight and post-slaughter weight [Velarde *et al.*, 2003; Sabow *et al.*, 2015].

For poultry, the presence of ‘red-skin’ carcasses may be the result of ineffective killing ~~and~~ with live birds entering the scalding tank.

~~The effectiveness of a~~ *~~stunning~~* ~~procedure on birds can be seen through the following signs: absence of corneal reflex, loss of posture tonic-clonic seizures and apnoea. Presence of one or more signs during bleeding may be the result of ineffective~~ *~~stunning~~* ~~procedure.~~

3~~.~~) Recommendations:

The *slaughterhouse/abattoir* operators should ensure that:

‒ both carotid arteries should be severed;

‒ qualified personnel take random samples of ~~birds~~ animals ~~between~~ after the end of *stunning* and before bleeding to ensure ~~birds~~ animals are not showing signs of consciousness;

‒ immediately after bleeding, qualified personnel ~~right after bleeding~~ check that the jugular veins, carotid arteries~~y~~ and trachea ~~windpipe~~ were cut thoroughly, guaranteeing ~~a well~~ an efficient bleeding process ~~afterwards~~.

~~‒~~ ~~the slaughter line speed allows a minimum bleeding period of 90 seconds (for chickens) so that there is minimum blood loss of 60 % percent before reaching the scalding tank or other potentially painful operation;~~

~~‒~~ ~~qualified personnel check that at the bleeding line, especially before scalding, birds are completely dead. Birds that are still alive need to be euthanised immediately removed from shackle.~~

Decapitation should ~~not~~ be applied only ~~in~~ to unconscious ~~birds~~ animals.~~used as a bleeding technique because it does not allow monitoring possible return of consciousness.~~

4~~.~~) Species-specific recommendations

‒ for chicken, the slaughter line speed should allow a minimum bleeding period of 90 seconds ~~(for chickens)~~ so that there is minimum blood loss of 60 % before reaching the scalding tank or other potentially painful operation;

‒ qualified personnel should check that at the bleeding line, especially before scalding, birds are completely dead. Birds that are still alive need to be euthanised immediately and removed from shackle.

~~None identified.~~

Article 7.5.34~~31~~

Emergency killing of~~n~~ animals arriving in containers

This article addresses animals that show signs of severe distress or pain ~~or other types of severe~~ ~~suffering~~ before being unloaded or within the *slaughterhouse/abattoir*. These animals may correspond to animals unfit to travel as listed in Article 7.3.7. Principles described may also apply to animals that are not suitable for *slaughter* for commercial reasons, even if they do not present signs of pain or suffering.

1~~.~~) Animal welfare concerns:

Some animals can arrive at *slaughterhouses/abattoirs* with injuries or severe illnesses that can cause undue pain ~~and suffering~~.

2~~.~~) Animal-based and other ~~measurables~~ measures ~~include~~:

Animals requiring emergency *killing* are those~~, among others that present with~~ with severe injuries such as fractures, bone dislocations, and large open wounds.

They may also present clinical signs of serious illness or be~~ing~~ in a state of extreme weakness.

3~~.~~) Recommendations:

*Animal handlers* should euthanise the animals as soon as they are identified at arrival, during lairage or at the time of shackling.

Emergency *killing* should be systematically recorded and analysed to improve procedures and prevent recurrences.

~~4.)~~ ~~Species-specific recommendations:~~

~~None identified yet.~~

Article 7.5.35~~32~~.

Methods, procedures or practices that should not be used ~~unacceptable on animal welfare grounds~~ for animals arriving in containers

1) ~~None of~~ ~~t~~The following practices for handling animals ~~are unacceptable and they~~ should not be used under any circumstances:

a) applying pressure using an injurious object or applying an irritant substance to any part of the body of ~~the~~ an animal;

b) hitting animals with instruments such as large sticks, sticks with sharp ends, ~~metal~~ piping, stones, fencing wire or leather belts;

c) kicking, throwing or dropping animals;

d) stepping on or crushing animals;

~~d~~e) grasping, lifting or dragging animals only by ~~some~~ body parts such as their tail, head, ears, limbs, hair or feathers.

~~e)~~ ~~dragging animals by any body parts.~~

2) ~~None of~~ ~~t~~The following practices for restraining animals ~~are unacceptable and~~ should not be used:

a) mechanical clamping of the legs or feet of the animals as the sole method of [restraint](http://www.oie.int/index.php?id=169&L=0&htmfile=glossaire.htm#terme_immobilisation);

b) breaking legs, cutting leg tendons or blinding animals;

c) applying electrical current that does not span the brain; ~~such as the use of the electrical~~ *~~stunning~~* ~~method with a single application leg-to-leg~~;

d) severing the brain stem by piercing through the eye socket or skull bone;

e) crushing the neck ~~crushing~~.

In poultry, electro-immobilisation for neck-cutting or preventing wing flapping during bleeding, or the method of brain piercing through the skull without prior *stunning* should not be used under any circumstances ~~are unacceptable~~.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**References**

~~Anonymous (2017). Animal welfare aspects in respect of the slaughter or killing of pregnant livestock animals (cattle, pigs, sheep, goats, horses). EFSA Journal 15:4782.~~

~~Anonymous. (2013). Scientific Opinion on monitoring procedures at slaughterhouses for bovines. EFSA Journal 11:3460.~~

Anonymous. (2018). Technical Note No 19 Carbon Dioxide cx and Killing of Pigs. Humane Slaughter Association, UK. <https://www.hsa.org.uk/downloads/technical-notes/tn19-carbon-dioxide-stunning-and-killing-of-pigs.pdf>.

AVMA Guidelines for the Humane Slaughter of Animals. (2016). Available from: <https://www.avma.org/KB/Resources/Reference/AnimalWelfare/Documents/Humane-Slaughter-Guidelines.pdf>

Barton-Gade P and Christensen L. (1998). Effect of different stocking densities during transport on welfare and meat quality in Danish slaughter pigs. Meat Science, 48, 237–247.

Blokhuis, H., Keeling, L., Gavinelli, A. and Serratosa, J. (2008). Animal welfare’s impact on the food chain. Trends in Food Science & Technology, 19 (2008), 79-88.

Dalmau, A., Pallisera, J., Pedernera, C., Muñoz, I., Carreras, R., Casal, N., Mainau, E., Rodríguez, P., Velarde, A. (2016). Use of high concentrations of carbon dioxide for stunning rabbits reared for meat production. World Rabbit Science, 24: 25-37.

Daly, C.C., Gregory, G. and Wotton, S.B. (1987). Captive bolt stunning of cattle: effects on brain function and role of bolt velocity. British Veterinary Journal 143 574-580.

EFSA. (2004). Welfare aspects of animal stunning and killing methods. Scientific Report of the Scientific Panel for Animal Health and Welfare on a request from the Commission related to welfare aspects of animal stunning and killing methods. Available from: <http://www.efsa.europa.eu/de/scdocs/doc/45.pdf>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare). (2013a). Scientific opinion on monitoring procedures at slaughterhouses for bovines. EFSA Journal 2013. 11, 3460. Available from: <http://dx.doi.org/10.2903/j.efsa.2013.3460>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare). (2013b). Scientific opinion on monitoring procedures at slaughterhouses for sheep and goats. EFSA Journal 2013. 11, 3522. Available from: <http://dx.doi.org/10.2903/j.efsa.2013.3522>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare). (2013c). Scientific Opinion on the electrical parameters for the stunning of lambs and kid goats. EFSA Journal 2013. 11(6):3249. <https://doi.org/10.2903/j.efsa.2013.3249>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare). (2015). Scientific Opinion on the scientific assessment of studies on electrical parameters for stunning of small ruminants (ovine and caprine species). EFSA Journal 13(2):4023. <https://doi.org/10.2903/j.efsa.2015.4023>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Animal Welfare). (2017). Scientific Opinion on the animal welfare aspects in respect of the slaughter or killing of pregnant livestock animals (cattle, pigs, sheep, goats, horses). EFSA Journal 2017;15(5):4782, 96 pp. Available from : <https://doi.org/10.2903/j.efsa.2017.4782>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Animal Welfare). (2019). Scientific Opinion on the Slaughter of animals: poultry. EFSA Journal 2019;17(11):5849, 91 pp. Available from : <https://doi.org/10.2903/j.efsa.2019.5849>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Animal Welfare). (2020a). Scientific Opinion on stunning methods and slaughter of rabbits for human consumption. EFSA Journal 2020;18(1):5927, 106 pp. <https://doi.org/10.2903/j.efsa.2020.5927>.

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare). (2020b). Welfare of cattle at slaughter. EFSA Journal; 18(11):e06275. <https://doi.org/10.2903/j.efsa.2020.6275>.

Finnie, J.W. (1993). Brain damage caused by captive bolt pistol. J. Comp. Patholo. 109:253–258.

Finnie, J.W, J. Manavis, G.E. Summersides and P.C. Blumbergs. (2003). Brain Damage in Pigs Produced by Impact with a Non-penetrating Captive Bolt Pistol. Aust. Vet. J. 81:153-5.

Gibson, T.J, Johnson, C.B, Murrell, J.C, Hulls, C.M., Mitchinson, S.L., Stafford, K.J., Johnstone, A.C. and Mellor, D.J. (2009). Electroencephalographic responses of calves to slaughter by ventral neck incision without prior stunning. New Zealand Veterinary Journal 57 77-83.

Gibson, T.J., Mason, C.W., Spence, J.Y., Barker, H. and Gregory, N.G. (2014). Factors Affecting Penetrating Captive Bolt Gun Performance. Journal of Applied Animal Welfare Science 18 222-238.

Gibson, Troy J., Emma King, Jade Spence, and Georgina Limon. (2019). Pathophysiology of Concussive Non-Penetrative Captive Bolt Stunning of Turkeys. Animals 9, no. 12: 1049. <https://doi.org/10.3390/ani9121049>.

Grandin, T. (1980). Mechanical, electrical and anesthetic stunning methods for livestock. International Journal for the Study of Animal Problems, 1(4), 242-263.

Gregory, N.G. (2004). Physiology and Behaviour of Animal Suffering. Blackwell Science, Oxford, p. 227. ISBN: 0-632-06468-4.

Gurung S, White D, Archer G, Zhao D, Farnell Y, Byrd J, Peebles E, Farnell M. (2018). Evaluation of alternative euthanasia methods of neonatal chickens. Animal 8, 37. doi:10.3390/ani8030037.

Johnson, C.B., Mellor, D.J., Hemsworth, P.H. and Fisher, A.D (2015). A scientific comment on the welfare of domesticated ruminants slaughtered without stunning. New Zealand Veterinary Journal 63 58-65.

Jongman, E. and Fisher, A. (2021). Euthanasia of laying hens: an overview. Animal Production Science, 61(10), p.1042.

Lara, L. and Rostagno M. (2018). Animal welfare and food safety in modern animal production, in Advances in Agricultural Animal Welfare, Food Science, Technology and Nutrition, Pages 91-108.

Mellor D. (2003). Guidelines for the humane slaughter of the foetuses of pregnant ruminants. Surveillance 30:26-28.

Mellor, D.J., Diescha, T.J., Gunn, A.J. and Bennet, L. (2005). The importance of ‘awareness’ for understanding fetal pain. Brain Research Reviews 49 (2005) 455–471.

Mellor D. (2010). Galloping colts, fetal feelings, and reassuring regulations: putting animal-welfare science into practice. JVME 37(1):94-100.

Micera, Elisabetta, Albrizio, Maria, Surdo, Nicoletta C., Moramarco, Angela M. and Zarrilli, Antonia. (2010). Stress-related hormones in horses before and after stunning by captive bolt gun, Meat Science, 84(4), 634-637.

Nielsen, S. S., Alvarez, J., Bicout, D. J.;,Calistri, P., Depner, K., Drewe, J. A., Garin-Bastuji, B., Rojas, J. L. G., Schmidt, C. G., Michel, V., Chueca, M. A. M., Roberts, H. C., Sihvonen, L. H., Stahl, K., Calvo, A. V., Viltrop, A., Winckler, C., Candiani, D., Fabris, C., Mosbach-Schulz, O., Stede, Y. van der and Spoolder, H. (2020), Stunning methods and slaughter of rabbits for human consumption. EFSA Journal, 18(1), e05927.

North American Meat Institute (NAMI). (~~2017~~2021). Recommended Animal Handling Guidelines & Audit Guide: A Systematic Approach to Animal Welfare. ~~Rev. 1.~~

Pleiter, H. (2010). Review of Stunning and Halal Slaughter. Meat and Livestock Australia.

Ritter MJ, Ellis M, Murphy CM, Peterson BA and Rojo A. (2008). Effects of handling intensity, distance moved, and transport floor space on the stress responses of market weight pigs. Journal of Animal Science, 8, 43.

Stiewert AM, Archer GS. (2021). Comparing two captive bolt devices on market age Pekin ducks. Journal of Applied Poultry Research 30(2), 100162.

Visser, E. Kathalijne, Ellis, Andrea D. and Van Reenen, Cornelis G. (2008). The effect of two different housing conditions on the welfare of young horses stabled for the first time. Applied Animal Behaviour Science, 114(3), 521-533.

von Holleben, K., von Wenzlawowicz, M., Gregory, N., Anil, H., Velarde, A., Rodriguez, P., Cenci Goga, B., Catanese, B., Lambooij, B. (2010). Report on good and adverse practices—animal welfare concerns in relation to slaughter practices from the viewpoint of veterinary sciences. Dialrel report. Deliverable. 1, 3. <http://www.dialrel.eu/images/veterinary-concerns.pdf>.

Walsh JL, Percival A, Turner PV. (2017). Efficacy of blunt force trauma, a novel mechanical cervical dislocation device, and a non-penetrating captive bolt device for on-farm euthanasia of pre-weaned kits, growers, and adult commercial meat rabbits. Animals (Basel) 7:100.

Woolcott CR, Torrey S, Turner PV, Serpa L, Schwean-Lardner K, Widowski TM. (2018) Evaluation of Two Models of Non-Penetrating Captive Bolt Devices for On-Farm Euthanasia of Turkeys. Animals (Basel). Mar 20;8(3):42. <https://pubmed.ncbi.nlm.nih.gov/29558419/>.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_