

Practical recommendations for equid welfare at slaughter

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**World Horse
Welfare**

RVC

Royal
Veterinary
College
University of London



Humane Slaughter Association

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1.1. Introduction

Equid welfare at slaughter has been scarcely researched [1], despite millions of equids being slaughtered around the world each year in a myriad of contexts. Evidence of the different methods used and the various risks to welfare are limited [1]. Current research has focused on identifying transport-related risks [2; 3; 4; 5; 6], with no clear picture as to the risks presented to equids upon arrival at the abattoir or the effectiveness of different slaughter methods used across the world. Additionally, with a high proportion of equids slaughtered in low- and middle-income countries (LMIC's), welfare could be further compromised with restricted resources, and inadequate or insufficiently enforced policy and legislation. This lack of knowledge, understanding and compliance means that equid welfare could potentially be compromised during all stages of the slaughter process in a range of countries and contexts. This can also pose risks to human safety, particularly where the meat is for public consumption.

This report provides draft guidelines which can be used as a basis for the development of future recommendations for those in charge of the commercial slaughter of equids. The purpose of such recommendations are to outline the minimum standards that should be adhered to in order to minimise stress and maximise welfare prior to slaughter and achieve humane and effective stunning or slaughter. All persons responsible for the commercial slaughter of Equidae should be appropriately trained to equal or exceed these minimum standards.

These guidelines draw on empirical observations from the field and from published literature, to make practical recommendations for where policy, legislation and general conduct should be improved for the slaughter of equids. The primary focus of these guidelines is to outline and promote best practice for humane slaughter of equids, minimising pre-slaughter stress and ensuring a quick, effective and irrecoverable loss of consciousness. Specific considerations for both pre-slaughter management of animals and for various methods of slaughter are outlined hereon.

1.1.1. Legislative background

These guidelines are not intended to replace any specific legislation or policy, and do not provide an exhaustive list of legislative requirements in any particular country. These guidelines are intended to provide information and advice for those responsible for the commercial slaughter of equids, including governments and policy-makers seeking to introduce, improve or implement policy and legislation on this topic.

1.1.2. Glossary of terms

Abattoir: Facility where animals are slaughtered to produce food for human consumption.

Affective State: The experience of positive or negative emotions, such as pain, fear and/or frustration, resulting from pleasant or aversive situations.

Biosecurity: Preventative measures designed to reduce the risk of introducing, spreading or transmitting infectious disease.

Bleeding: The process of exsanguination, severing the major blood vessels that supply the brain, resulting in a rapid death.

Captive-bolt device: Mechanical device to induce death or insensibility by firing retractable projectiles (bolt) into (penetrating) or against (non-penetrating) an animal's cranium.

Commercial slaughter: refers to the killing of animals to produce animal products where a business transaction takes place or for the purpose of a business, reward or trade.

Equid: includes a horse, pony, mule, ass, hinny and donkey.

Emergency killing: The rapid, humane killing of animals that are injured, severely ill, or in severe

distress.

Fall: A loss of balance, causing any part of the body (other than hooves) to touch the ground.

Free Bullet Firearm: Rifle, shotgun or dispatch pistol, which fire a projectile that exits the muzzle of the firearm.

Lairage: The period, or area in which animals go, after being unloaded until animals are moved to prepare for stunning or slaughter.

Low and middle-income countries: As per World Bank classification.

Restraint: The application to an animal of any procedure designed to restrict its movements sparing any avoidable pain, fear or agitation in order to facilitate effective stunning or slaughter.

Slaughter: The killing of an animal primarily intended for human consumption.

Slip: A loss of balance, without any part of the body (other than hooves) touching the ground.

Stress: The animal experiences stress, physiologically and/or psychologically, resulting from an aversive situation.

Stun box: An enclosed space to confine and/or restrain an animal to prevent movement to assist with accurate placement of a stunning device.

Stunning: Any mechanical, electrical, or chemical procedure that causes an immediate loss of consciousness in an animal.

Thoracic Sticking: Severance of the large blood vessels, such as the common brachiocephalic trunk, common carotid arteries, subclavian arteries, and vertebral arteries in the chest in front of the sternum.

Ventral Neck Incision: Severance of the carotid arteries and jugular veins in the neck.

1.2. Pre-slaughter

This section outlines ante-mortem recommendations to reduce stress for equids, including appropriate lairage conditions and human-animal interactions. Prior to an animal's arrival at the abattoir, their welfare and behaviour can be affected by transport stress [2; 3; 4; 7], with many animals likely to have travelled long distances [5; 8]. They might then arrive with injuries obtained during transport [9; 6; 10; 11]. Animals must therefore be assessed upon arrival at the abattoir for fitness for holding, with emergency slaughter or killing performed immediately for injured animals, or those in severe pain [12; 13]. This includes if an animal shows any of the following signs [13]:

- stumbling, staggering or falling;
- inability to stand or remain standing;
- inability to maintain balance or move without pain or difficulty,
- inability to weight-bear on any one leg;
- an open wound exposing a body cavity or structure, such as the chest, abdomen or skull;
- damage to skin or mucous membranes that exposes muscle, deeper tissues or bone;
- a large, deep, and/or infected wound, possibly accompanied by discharge, pus or maggots;
- a large healing wound (including surgical wounds) that has reopened;
- a wound involving a joint;
- constant bleeding;
- colic signs;
- fitting; paralysis or collapse;
- high temperature (above 38.5°C / 101.3°F);
- poor general health.

These guidelines do not replace the need for appropriate knowledge and experience in the handling of equids. Abattoir managers or owners must ensure that personnel have the required knowledge, training and supervision to ensure that the welfare needs of equids in their care are met and that they understand how this can be influenced by their actions and behaviour.

1.2.1. Species-specific considerations

During commercial slaughter, equids are generally treated as livestock and slaughtered at abattoirs designed for other livestock species. However, these facilities might not be suitable for equids, with their species-specific needs, such as being a social prey species that ethologically require locomotion, the ability to forage, and the company of their own species [14]. An equid's ability to adapt when these needs are restricted can depend upon their differing temperaments and individual resilience levels or coping styles [15]. Their prior experience with humans and handling will also affect their behaviour and familiarity with movement, e.g. if they are accustomed to being led by a halter or driven from behind. It is important that slaughter operatives familiarise themselves with species-specific behaviour and welfare needs, and, where possible, individual animals and herd dynamics, to mitigate stress and behavioural escalation.

1.2.1.1. Horses

Horses have wide-angle, almost 360° vision. A flight zone refers to the space around a horse within which they feel safe. An approximation of the flight zone can be made by approaching the animal and noting at what distance the animal moves away. Horses have a large zone of monocular vision but a narrow zone of binocular vision, with a widening blind spot located right behind them and a narrowing one in front [12]. Handlers must avoid positioning themselves in the horse's blind spot (Figure 1).

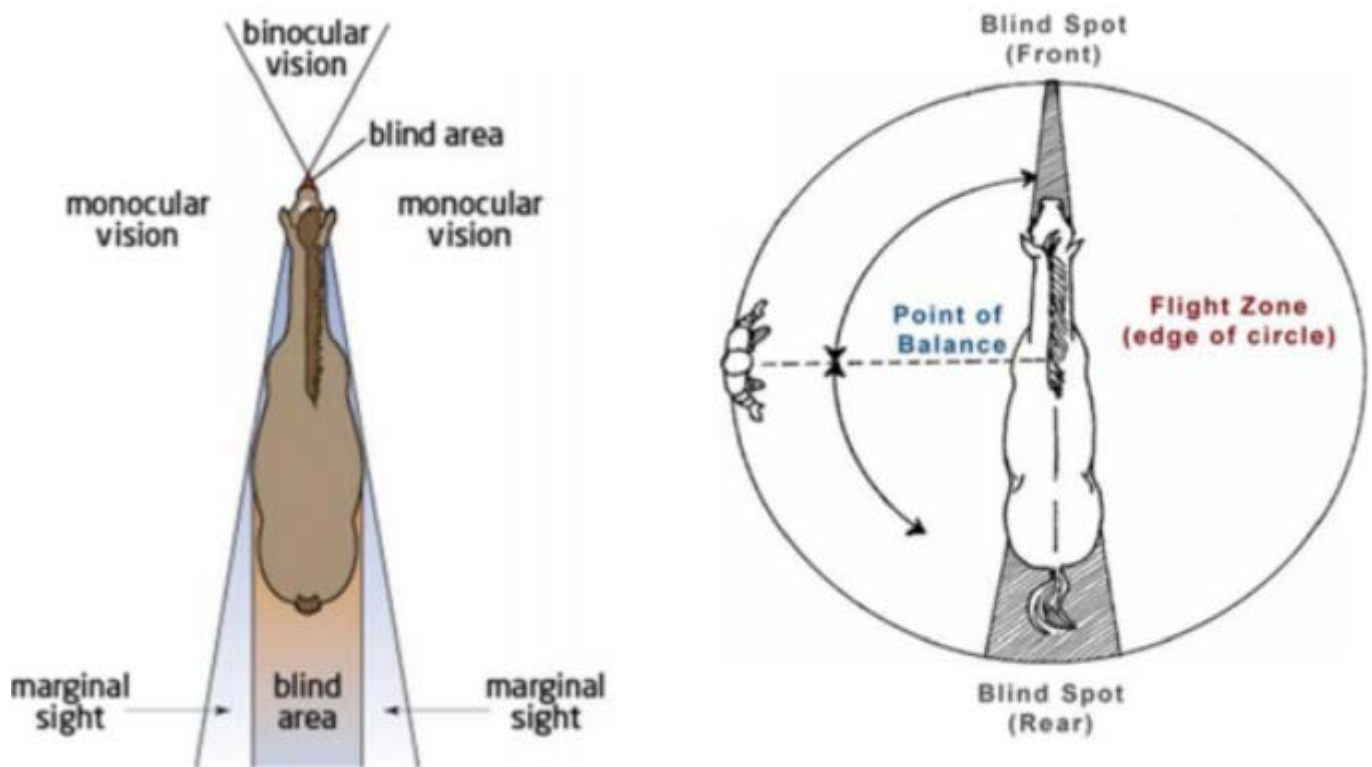


Figure 1: Horse vision and flight zone [16]

Animal's behaviour can also be influenced by demographic factors, including age, breed, and previous experiences with human handling [17; 18]. As a neophobic, prey species, horses can be fearful of new environments and can display a flight or fight response in situations where they feel stressed, for example when isolated from conspecifics [19]. This can then present a risk to both the animal and abattoir staff. Research has reported that where an animal is demonstrably more stressed or more avoidant of the operator, this can increase their likelihood of slipping in the holding pen or stunning box [20]. This can be exacerbated by personnel using force or shouting and can impact stunning effectiveness, including an increased requirement for repeat shooting [20].

Like humans, skin is the horse's largest organ, meaning that they are extremely sensitive to tactile stimulation such as electric prods and aversive equipment [21]. Horses are known to have a well-developed olfactory system [21]. They have shown a stress response to the blood of conspecifics even when presented in containers in a familiar environment alongside food [22]. Novel visual, auditory or olfactory stimuli have all been found to increase stress in horses, even in familiar environments, through raised heart rate and increased hypervigilance [23]. They rely on head and neck position for visual ability, due to no central fovea, but are able to adapt their vision to low level light [21]. They also have higher frequency hearing abilities to humans [21] making them potentially more sensitive to loud noises in the abattoir environment. Being exposed to aversive auditory and olfactory stimuli simultaneously has been shown to increase horse's heart rates significantly more than a single stimulus [23; 24]. Restricting forage for even four to five hours can lead to gastrointestinal discomfort and behavioural distress in horses [25].

1.2.1.2. Donkeys

Restricting forage for donkeys can accentuate metabolic problems and lead to hyperglycaemia [26]. Donkeys can generally be much more subtle in their behaviour and are more likely to display a freeze response where horses display flight or fight [27]. This can make it difficult to interpret the level of stress or pain that they might be experiencing [27]. However, donkey-specific ethograms have been developed [27; 28; 29] that outline behaviours expressed by donkeys that can indicate stress, e.g. tail tuck, refusal to walk, kick or bite threat, tail swishing, and a dull demeanour.

1.2.2. Unloading

Upon arrival at the abattoir, animals must be unloaded as soon as possible, without delay, to allow for assessment of welfare after transport and prioritise any injured or ambulatory animals for immediate slaughter or emergency killing. Details should be checked and recorded regarding the animal's origin and demographic details to enable traceability checks to be conducted prior to the animal being slaughtered and entering the food chain. Animals should be moved into suitable holding facilities unless they are being slaughtered immediately. Transport and abattoir facilities must have suitable unloading facilities and equipment, including non-slip ramps, such as non-slip knurled metal with foot battens or wire mesh covers as used for horse transport vehicles [2; 30], lateral protection, and no sharp edges or hazards upon unloading. Animals should be assessed on arrival by a competent person and any animal found to be injured or non-ambulatory upon arrival must be slaughtered immediately in-situ and not transferred to holding or lairage facilities. Any animal found to be suffering from illness, or disease must be separated immediately into an isolation facility, with advice sought immediately from an official veterinarian, and must not be slaughtered for human consumption [31]. Biosecurity must be prioritised at all times.

1.2.3. Lairage

Lairage areas, also known as holding pens, should be of sufficient size to allow for appropriate stocking density, with 4.75 m²/horse as a broad recommendation [32]. Animals should have the space to stand up, lie down and turn around fully in the pen and to move away from other animals if desired. Overcrowding should be avoided, and each individual animal should be able to turn fully in the pen. Mixing of unfamiliar animals should be avoided and, if unavoidable, they should be monitored for signs of distress or conflict. Any aggressive, hostile or unsocial animals should be separated immediately. Familiar or bonded animals should be kept together wherever possible, along with foals and their dams.

Flooring should be designed to minimise slip risk, with extra care taken where shod horses are being moved. It should be kept dry and free from faeces and obstructions or hazards. Walkways should allow animals to move freely, accounting for equid's herd nature and for different sizes of horses, avoiding narrow corridors, sharp corners or animals needing to walk over drains [33].

Lighting should be sufficient and directional, with high luminance levels (> 4500 lux, also referred to as "daylight" lighting) found to have positive effects on horses [34]. Strong light contrasts should be avoided as, due to their dichromatic vision, horses struggle to adapt to sudden changes in light intensity [33; 35]. Abattoir personnel should be mindful of changes in lighting, reflections or shadows, and subsequent visibility when moving animals and aware of how this might provoke balking or resistant to movement, particularly when entering a dimly lit area. Ventilation should consist of good air quality and circulation, meaning that there is a natural airflow, with unpleasant odours such as ammonia kept to a minimum, aiming for ≥6 ACH [36]. Guidance for lairage and general abattoir design is summarised in Table 1.

Table 1: Factors to consider in the design of slaughter facilities for horses.

 Factors to consider in the design of slaughter facilities for horses		
Factor	 Risk	 Control measures
 Flooring	 Slips and falls due to urine, faeces, fluids or blood.	 Use non-slip, easily cleanable flooring.  Keep floors clean and wash down between animals.  Provide a firm, comfortable surface in lairage.  Provide bedding if animals are held for >12 hours.
 Wall height	 Stress or injury from unwanted contact.  Distress from visual exposure to processing areas.	 Allow visual contact with conspecifics where appropriate but prevent physical contact if needed.  Prevent sight of hoisting or processing areas.
 Lighting	 Poor inspection.  Stress or baulking due to sudden changes in light levels.	 Provide sufficient lighting for inspection (>4500 lux).  Use natural light where possible  Manage transitions between light and dark areas.
 Stocking density	 Stress, aggression, inability to rest or avoid other animals.	 Provide enough space to stand, lie down, turn around and move away from others.
 Air circulation/ventilation	 Respiratory discomfort; heat stress; exposure to ammonia or humidity.	 Ensure clean, circulating air.  Avoid drafts and harmful levels of humidity or ammonia.
 Hazards/cleanliness	 Injury from environmental hazards.	 Keep pens clean and free from hazards (e.g. hoses, sharp edges, debris).
 Provision for food and water	 Dehydration, hunger, stress.	 Provide fresh, clean water at all times in safe containers.  Ensure water levels allow visibility while drinking.
 Weather protection	 Heat stress or exposure to adverse weather.	 Maintain temperature <25°C  Provide shade and shelter from sun, rain and wind.
 Noise	 Stress, fear, baulking due to sudden or unfamiliar sounds.	 Keep noise levels low.  Minimise exposure to sudden or novel sounds (e.g. machinery, air hissing, hosing).
 Good facility design supports calm, safe handling and improves animal welfare. 		
All design and management should comply with applicable animal welfare legislation and codes of practice		

1.2.4. Conspecifics at slaughter

Pair-bonded animals should not be separated prior to slaughter, and foals should always be kept with their dam [39]. Dams and foals should be killed in quick succession, with the foal killed immediately after the dam. Having a conspecific present at slaughter, particularly where horses are semi-feral or unhandled, has been found to reduce stress and assist with the movement of these animals into the slaughtering area, where space allows [38]. However, for confined spaces, such as stunning boxes designed for individual animals, only one animal should enter the area at a time.

1.2.5. Emergency killing

Non-ambulatory, severely injured or down animals should not be moved and be killed immediately, without unnecessary delay to reduce further suffering. Animal welfare must be prioritised at all times and only once the animal is no longer suffering should decisions on food chain suitability be ascertained.

1.2.6. Handling and restraint

Animals must be moved with minimal interference, care and consideration of the species behaviour and previous experience, including familiarity with human handling. Operators must not handle equids aversively, in a way that could cause pain or distress. Operators must use minimal pressure when encouraging movement and must not apply pressure to any sensitive part of the animal, including their eyes, ears or tail.

Tethering of equids (where necessary):

- ✓ Use suitable equipment (e.g. a correctly fitted halter).
- ✓ Tie animals in a way that allows quick release if required.
- ✓ Prevent risk of strangulation.
- ✓ Allow sufficient space for the animal to stand up and lie down.

Do not:

- ✗ Hobble animals.
- ✗ Tether by the leg.
- ✗ Tether for prolonged periods (>8 hours).
- ✗ Move animals while tied or hobbled.

1.2.7. Use of equipment

Where animals are considered or known to be 'halter-broken', they may be lead with a halter and lead rope. The use of an object such as a flag or paddle to encourage movement (when the way ahead is clear) or guide animals into an area must be kept to a minimum and must not be physically applied to the animal. The animal must be given time to respond accordingly and if the animal fails to respond, the object must not be used repeatedly. If multiple animals are baulking or not progressing forwards through an area, then the design of the area should be reviewed. Operators must not hit, strike or kick an animal or use any equipment designed to be aversive, such as an electric prod, goad, whip, or sharp/pointed device/implement. Table 2 summarises considerations for the use of equipment and handling of equids.

Table 2: Factors to consider for the handling of equids prior to slaughter.

 Factors to consider for the handling of equids prior to slaughter		
Factor	Poor practice	Better practice
 Equipment/ use of aids	✗ Electrical prods, goads or sharp implements. ✗ Repeated or inappropriate use of sticks. ✗ Use of aids on sensitive areas (udder, anus, genitals, eyes). ✗ Excessive force during handling. ✗ Dragging, hoisting or shackling conscious animals. ✗ Use of dogs	✓ A stick must only be applied once to the muscular hindquarters and only to encourage movement when the way ahead is clear. ✓ Minimise use of force at all times. Move animals calmly.
 Presence/absence of conspecifics	✗ Isolation or unfamiliar grouping causes stress and fear. ✗ Separation of foals and dams. ✗ Fear responses from visual exposure to slaughter or carcasses.	✓ Keep and move animals in familiar groups or pairs. ✓ Move foals with their dams. ✓ Allow animals to see conspecifics.
 Competency of staff	✗ Failure to recognise signs of fear, agitation or abnormal behaviour. ✗ Poor handling leading to distress, injury or compromised welfare.	✓ Ensure personnel are trained and competent in equid behaviour. ✓ Monitor animals on arrival for signs of excitability, aggression, agitation or distress. ✓ Take appropriate action promptly to alleviate issues.
 Restraint	✗ Prolonged restraint causes stress or discomfort. ✗ Incorrect restraint methods leading to injury or distress. ✗ Use of appropriate restraint techniques.	✓ Use restraint for the minimum time necessary. ✓ Use correctly fitted halters where animals are accustomed to them. Use passive restraint prior to stunning where appropriate and keep duration minimal. ✓ Do not use active head restraint.
 Calm, skilled handling reduces stress and improves welfare.		

1.2.8. Stun boxes:

No conscious animal should be dragged, hoisted or shackled. Animals should not be moved into the raceway, stunning box or killing pen until such time as the operator is ready to slaughter them. Stunning boxes should only be operated by appropriately trained and licensed members of staff. The animal's head should be properly restrained [40] to ensure correct stun position. This can be achieved through a correctly fitted halter and lead rope for equids accustomed to wearing this. The use of 'head-yokes' or active head restraint (where the head is clamped by a mechanised device) on horses has not been sufficiently researched and thus should be avoided as could potentially cause more stress than full-body restrainers [39; 41]. Passive restraint, such as a tray or shelf to prevent the horse from lowering the head can be used but duration should be kept to a minimum [39; 42].

Recommended best practice for pre-slaughter

- ✗ Avoid aversive handling, as it increases stress, slip risk and can reduce stunning effectiveness.
- ✗ Do not mix unfamiliar animals.
- ✓ Keep bonded animals together and move them as a group.
- ✓ Ensure abattoir design is species-appropriate, with clean, dry, non-slip flooring and free from hazards, sharp corners, overcrowding and sudden light contrasts.

1.3. Methods of Slaughter

It is recommended that all animals are stunned before slaughter or the method used results in instantaneous death. Stunning renders an animal unconscious and insensible to pain, suffering or distress during the slaughter process (bleeding). Rapid blood loss after stunning ensures death before the animal regains consciousness. There should be no delay between stunning and bleeding. Animals must not be stunned until such time as they can be bled without delay. Stunning and slaughter equipment must be designed, used and maintained in such a way as to facilitate instantaneous stunning or killing. The equipment must be maintained according to specific manufacturer's guidance, on both a daily and weekly basis. Operators should have a back-up device on hand in case of failure. Two consecutive failures to stun with any specific device should immediately instigate a review of methods, identification and rectification of the fault, with appropriate adjustments made before stunning the next animal.

1.3.1. Captive-bolt device

A captive-bolt (Figure 2) is a mechanical device to induce death or insensibility by firing (either through .22 blank cartridges or pneumatically) retractable projectiles (a bolt) into (penetrating) or against (non-penetrating) an animal's cranium. It is a stunning method, and animals will need to be pithed or bled thereafter as a killing method to prevent the risk of recovery.

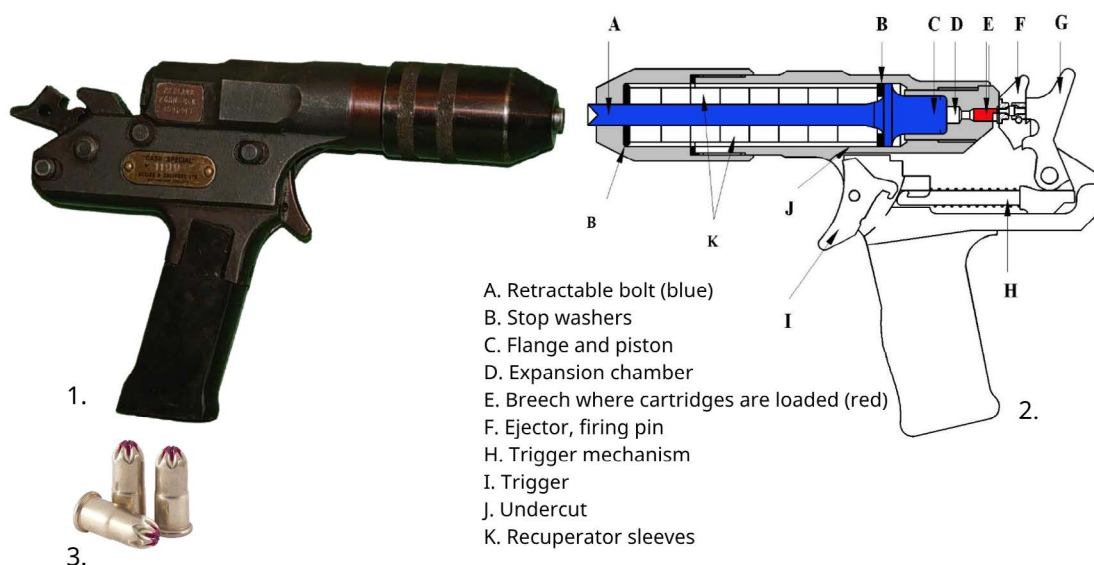


Image (1) and illustrative example (2) of penetrating captive-bolt device (Cash Special, Accles and Shelvoke, UK and image (3) of red tipped 4 grain .22 blank cartridges

Figure 2: Image (1) and illustrative example (2) of penetrating captive-bolt device (Cash Special, Accles and Shelvoke, UK and image (3) of red tipped 4 grain .22 blank cartridges. Image courtesy of the Humane Slaughter Association.

There is a lack of research into the use of non-penetrating captive-bolt devices for equids and, as such, these should not be used. The recommendations below are for penetrating captive-bolt devices (PCB).

1.3.1.1. Device and cartridge type

Cartridges vary in strength and are classified according to the amount of propellant they contain, measured in grains (gr) or milligrams (mg). It is important to refer to the individual manufacturers' instructions so that the correct cartridges are used for each model of stunner; they are identified by calibre and headstamp, with colour coding's in accordance with different manufacturers. Further research is needed to identify the most appropriate combination of captive-bolt device and cartridge power-load for stunning horses of different sizes/bodyweights and skull morphologies. It is inappropriate to extrapolate this information from other species, considering species-specific differences in physiology and morphology. Until such research has been conducted, it is advisable for slaughter operatives to use a higher grain cartridge (3-4 gr) [39].

Pneumatic captive-bolt device's must also be routinely maintained to ensure that airline pressure is reliably and uniformly able to transfer sufficient kinetic energy appropriate for the species and animal type. Airlines, regulators, compressors and compressor tanks must also be routinely maintained with back-up compressors in place. The air supply should be equipped with a filter and lubricator, and the compressor should have sufficient capacity to maintain the required pressure during peak production time [43].

1.3.1.2. Positioning

The recommended shot position for Equidae is in the middle of the forehead 10mm above the point where two imaginary lines drawn from the eyes to the opposite ears cross, with angle appropriately adjusted for downwards head alignment to avoid a shallow depth of shot, with the bolt directed through the upper brain towards the brainstem [42; 44] (Figure 3). Equidae must not be shot in the poll/back of the head [44].

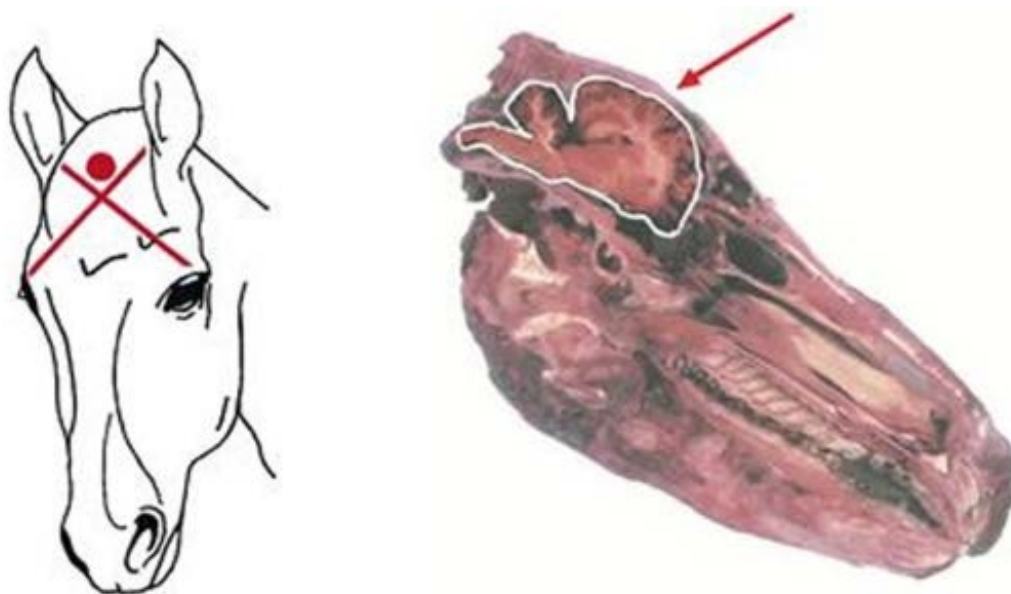


Figure 3: Suggested captive-bolt device stunning position for horses and cross-section of horse head in the sagittal plane with stunning position indicated by an arrow. Copyright Humane Slaughter Association, 2016. www.hsa.org.uk.

This should then ensure that the bolt enters the cerebral cortex and successfully target the areas of the brain most aligned with maintaining consciousness, specifically the thalamus, pons, midbrain and medulla (Figure 4) [44].

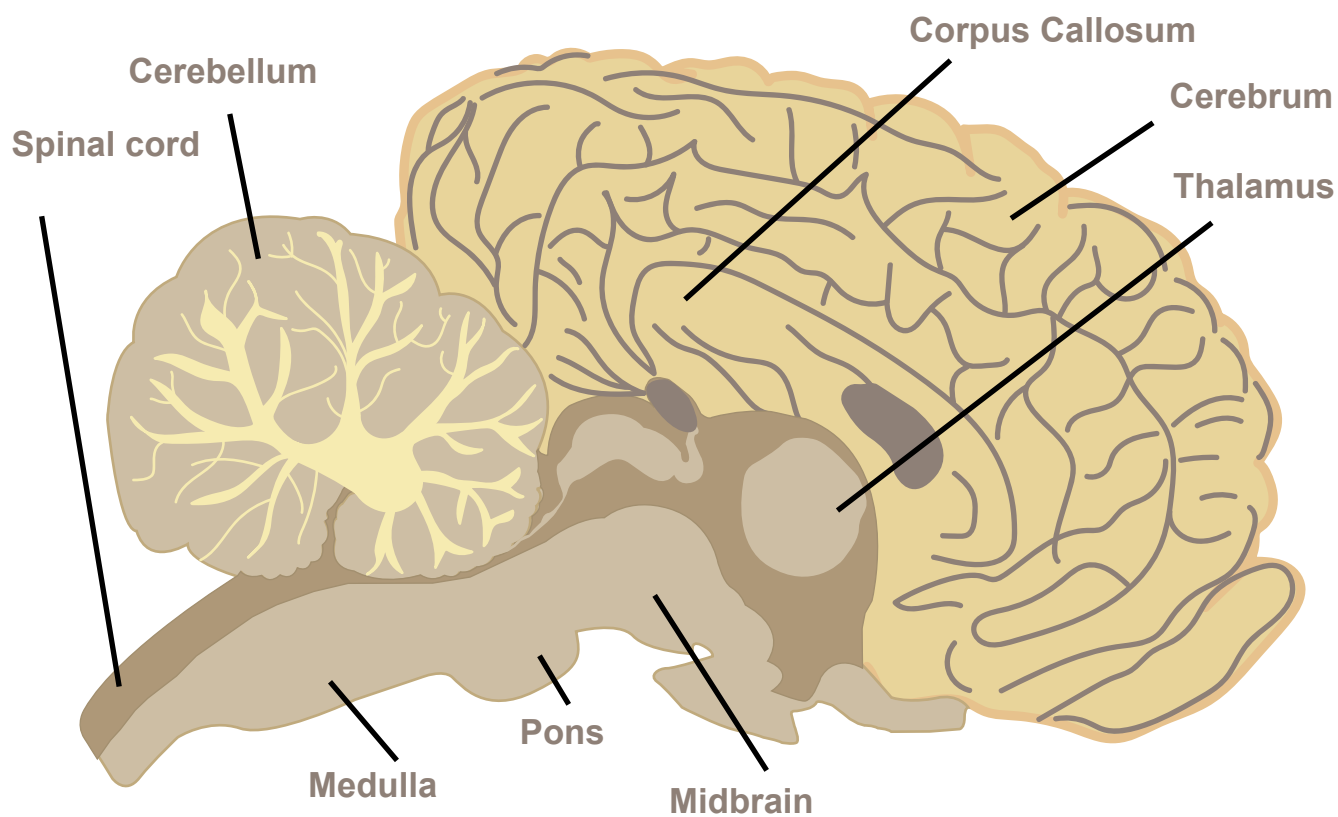


Figure 4: Diagram of a horse brain (produced by HSA), with critical brain structures (thalamus, midbrain, pons and medulla) and the cerebellum labelled.

Table 3 outlines the factors to consider for the use of PCB on horses at slaughter and recommendations for appropriate angle, positioning, power load, airline pressure and maintenance considerations.

Table 3: Factors to consider for the use of penetrating captive-bolt device (PCB) on horses at slaughter.

 Factors to consider for the use of penetrating captive-bolt device (PCB) on horses at slaughter		
Factor	Risks/poor practice	Control measures /good practice
 Angle	 Incorrect angle (too shallow) resulting in failure to penetrate critical brain structures.	 Position the muzzle angled towards the neck.  Adjust angle according to head position to ensure adequate depth of shot.
 Position	 Incorrect shot placement leading to ineffective stunning.	 Apply the shot point-blank, 10mm above the intersection of lines drawn from the middle of each eye to the base of the opposite ear.
 Power load	 Insufficient cartridge power resulting in ineffective stunning.	 Use a minimum of 3-4 grain cartridges.
 Air pressure	 Inconsistent or insufficient air pressure leading to ineffective stunning.	 Ensure air pressure is consistent and routinely checked in line with manufacturer's guidelines.  Use ≥90 psi as a minimum.
 Maintenance	 Poorly maintained and cleaned devices are more likely to fail, misfire or have reduced effectiveness due to carbon deposits, moisture or defects.	 Check devices routinely and clean after each day of use.  Follow manufacturer's maintenance guidelines.  Ensure a back-up device is immediately available in case of failure.  Keep cartridges dry.
 Correct use and maintenance of PCB devices is essential for effective, humane stunning.		
 Follow manufacturer's instructions and relevant legislation at all times.		

Recommended best practice for use of penetrating captive-bolt device (PCB)

-  Animals must be restrained to prevent excessive movement.
-  The muzzle of the PCB must be at point-blank range against the animal's head.
-  The appropriate PCB cartridge and power load combination must be used.
-  The correct stunning position must be adhered to (HSA, 2016), with the bolt angled towards the neck to maximise damage to the brainstem.
-  Spare cartridges and a back-up PCB must be immediately and readily accessible.

1.3.2. Free bullet rifle

1.3.2.1. Abattoir shooting

Until such time as further research into alternative ammunition/firearm combinations has been conducted, $\geq .22$ calibre hollow point rounds should be used in free bullet rifles, at either point-blank or up to 2m distance to achieve a successful kill [48]. Subsonic hollow point bullets are designed to deform into a mushroom shape and fragment upon impact. This causes greater damage to the brain through increased surface area, tissue expansion and contrecoup injury. The risk of the bullet exiting the animal or causing ricochet is therefore reduced, thereby is safer for the operator, in comparison to higher velocity or jacketed rounds [48]. However, at close range, compared to a shotgun with steel or porcelain shot, rifles can have disadvantages to operator safety through the risk of over-penetration [49].

Shooting position should be 20mm above the point where two imaginary lines drawn from the eyes to the opposite ears cross [50], with angle appropriately adjusted for downwards head alignment to avoid a shallow depth of shot. In the absence of specific ammunition/calibre comparison research in equids, studies in cattle have determined that accurate shot placement is of greater importance than specific calibre, although for operator safety it is crucial that the projectile does not exit the cranial cavity [51].

1.3.2.2. Field shooting

Shot effectiveness largely depends on shooter skill and competency [52]. There has been limited research into shooting equids beyond a distance of 1-2m, such as for ground/field-based shooting, on-farm, or aerial shooting. Whilst slaughter in an animal's familiar environment can remove the stressors associated with transport to the abattoir and the novel abattoir environment, there are potential risks to welfare from shooting in this manner alongside potential risks to public health through transporting carcasses, but this requires further research. Research in cattle has shown that rifle shooting from up to 15m has ambiguous results, with effectiveness affected by operator skill, facility design, and adequacy of ammunition, with .22 Magnum ammunition most effective [53; 54].

Research in Australia has concluded that aerial shooting should only be conducted by highly skilled, appropriately licensed, accredited operators [55]. There must be a minimum of two shots, with a chest shot generally preferable unless conditions are ideal for a head shot. Shooting outside of these target zones is unacceptable [55]. The minimum firearm and ammunition requirements for the ground shooting are: .308 inch calibre, 150 grain bullet weight and 2649 ft-lbs (3592 joules) muzzle energy [55]. Pursuing horses over distance can cause heat stress, exhaustion, fear, pain, severe injury and exertional (or capture) myopathy [55]. Shooting can also increase the stress and welfare compromise experienced by surviving animals in social groups by severing crucial bonds and leaving dependent foals without their dams.

Recommended best practice for use of firearms

- ✓ Animals must be restrained to prevent excessive movement and be positioned in front of a suitable background that is able to absorb any exiting bullets.
- ✓ Operators must be behind the muzzle of the firearm and stand a short distance away from the animal in front or to the side with a direct line of sight of the muzzle and aiming position, securely holding the firearm to account for recoil.
- ✓ The muzzle of the firearm should not touch the animal, to prevent the risk of movement of the head, which could disrupt the aiming of the shot.
- ✓ The appropriate firearm and round combination must be used, alongside the correct shot position (HSA, 2016), with the firearm angled towards the neck to maximise damage to the brainstem.
- ✓ Spare rounds and a back-up rifle or PCB must be immediately and readily accessible.

1.3.3. Other methods

The recommended methods outlined above produce instantaneous unconsciousness (stun) or instantaneous death (firearm). Annex One makes specific recommendations for countries which have restricted resources and where alternatives are not feasible. Stunning an animal using any other method, including a non-mechanical percussive blow to the head should be avoided and is not permissible in countries/contexts where an alternative is available. Blunt force trauma has been found to have variable and limited success with achieving irrecoverable concussion [56], particularly where a wooden pole device is used, where 43% of animals required more than one attempt and animals took a mean time of 166.9 s (SD 21.1; range: 79–425 s) to lose consciousness, rather than it being instantaneous as expected through use of penetrating captive-bolt device.

In the absence of further research to explore its use, electrical stunning must not be conducted on equids, as the only known study on this found just 2.9% effectiveness in horses using a single electrode at 550 v [57].

1.3.4. Stun to stick interval

"Sticking" is the term for the act of severing the blood vessels to begin the bleeding process. As stunning could be recoverable, the time interval between stun and stick should be as short as possible to ensure a rapid death before consciousness returns. Animals should be constantly monitored for signs of return to consciousness throughout the stunning, shackling and bleeding process to prevent unnecessary suffering at any stage. Best practice should involve minimal delays between stunning and bleeding, with an absolute maximum time of 50 seconds [56], to minimise the chance of an animal regaining consciousness.

1.3.5. Slaughter without stunning

Slaughter without stunning should not be conducted on equids except in rare occurrences where there is no viable alternative (see Annex One). Animals should be restrained humanely (see above section on handling) and not tied down for slaughter.

1.3.6. Bleeding

Bleeding non-stunned animals is not recommended. All animals must be bled without delay following stunning. Ventral neck incision or thoracic sticking must be conducted rapidly and effectively before the animal regains consciousness. Bleeding methods must be adequate to allow rapid bleeding and to prevent occlusion of blood flow. Operators must be appropriately trained in the method used and identifying target anatomy. Ventral neck incision should aim to sever both carotid arteries and jugular veins. Thoracic sticking should aim to sever the brachiocephalic trunk which gives rise to the carotid arteries and vertebral arteries at the heart. Thoracic sticking used alone (instead of after ventral neck incision) has not been studied in horses. Success is largely determined by operator skill, along with other factors including carcass positioning, the size of the wound and clonic activity [58; 59].

Knives must be of sufficient size and sharpness to achieve either method. Knives should be undamaged and routinely checked and sharpened between animals using a purpose-built sharpening device, not using a second knife.

Death should be confirmed before skinning or dressing commences, and even where consciousness appears absent, skinning or dressing should not commence within 60 seconds of the first cut. If an animal shows signs of regaining consciousness during the bleeding process, appropriate action must be immediately taken to render that animal insensible. The stunning and slaughter of other animals must immediately cease until the incident has been evaluated and corrective action implemented to eliminate the risk of recurrence.

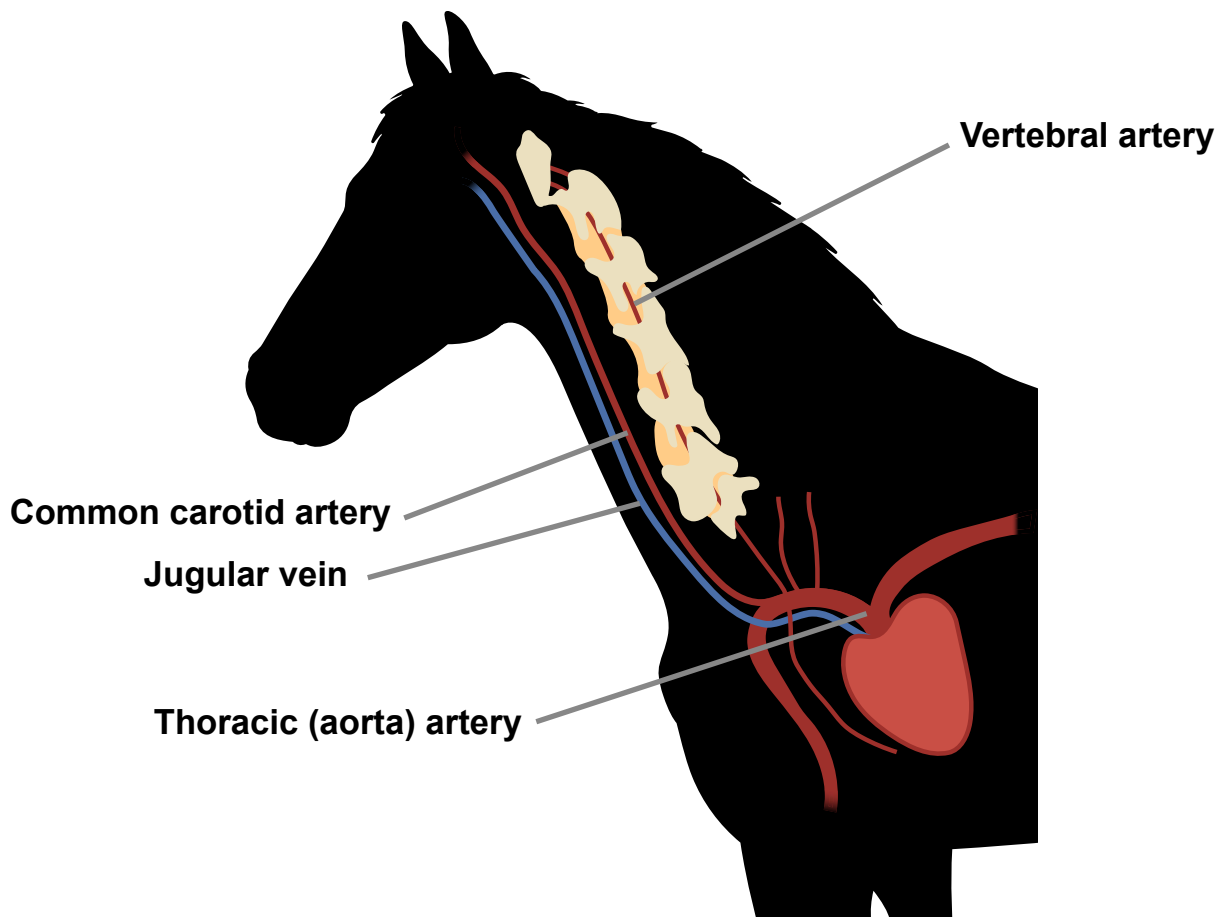
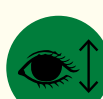


Figure 5: Diagram of a horse's head and neck to show the locations of the arteries and vein used during ventral neck incision or thoracic sticking

1.3.7. Assessing unconsciousness

Animals should be monitored throughout stunning and bleeding to check for signs of possible consciousness or a return to consciousness. Where such signs are observed, operators must intervene as necessary with a repeat shot. Table 4 outlines such signs. Signs should not be taken in isolation as indicators of consciousness, but absence of such signs should indicate an effective stun.

Table 4: Signs or indications of ineffective stunning.

 Signs or indications of ineffective stunning		
Signs to assess	Description	Action
 Failure to immediately collapse	 Animal does not collapse immediately after the shot.	 Sign of consciousness or return to consciousness. Re-stun immediately.
 Righting reflex	 Makes coordinated movements or efforts to stand or lift head.	
 Rhythmic breathing	 Ribcage continuously moves in and out rhythmically without pause.	
 Eyeball rotation	 Eyes rotated, not central, sclera visible.	
 Nystagmus	 Rapid involuntary movements of the eye	
 Corneal reflex	 Involuntary blink reflex when cornea is stimulated	
 Palpebral reflex	 Involuntary blink reflex when the medial canthus is stimulated.	
 Spontaneous blinking	 Opens/closes eyelid without stimulation.	
 Response to noxious stimuli (e.g. threat, noise, air, odour, pain)	 Following such stimulus, observing an eye or ear movement, nostril flare, localised skin response, or backwards movement of the head.	
Assess multiple signs before confirming loss of consciousness. If in doubt, re-stun immediately.		

The Physical Signs of an Effective Stun are:

- ✓ Animal collapses
- ✓ No rhythmic breathing
- ✓ Fixed, glazed expression in the eyes
- ✓ No corneal reflex
- ✓ Relaxed jaw

Following immediate collapse, the animal will undergo tonic and clonic phases of convulsive activity as the brain loses function and control [60]. The animal collapses, stops breathing and becomes rigid ('tonic' phase), with its head extended and its hind legs flexed towards the abdomen. This period of rigidity normally lasts for 10 to 20 seconds following stunning. The forelegs may be flexed initially and then gradually straighten out. However, this depends on the species and the severity of the blow. This tonic activity is followed by a period of involuntary kicking movements which gradually subside. If an animal immediately shows paddling or kicking movements on collapse, it is almost certain that it has not been effectively stunned and it should be re-stunned immediately.

1.3.8. Confirmation of death

Death must be confirmed before any skinning/dressing is ensured and not commenced until at least 60s has elapsed after loss of consciousness.

Recommended best practice for stunning and slaughter of equids

- ✓ Equipment must be maintained according to specific manufacturer's guidance, and such guidance must be followed to ensure appropriate device/cartridge combination.
- ✓ Animals must be shot or stunned frontally, with angle appropriately adjusted for downwards head position and positioned to target critical brain structures.
- ✓ Stun to stick time must be kept to a minimum, and an absolute maximum time of 50s.
- ✓ Knives should be routinely sharpened and maintained.
- ✓ Animals must be monitored for signs of consciousness throughout the stunning and bleeding process with operators intervening with a second shot if required and not commencing skinning/dressing until unconsciousness is ensured, or at least 60s has elapsed.

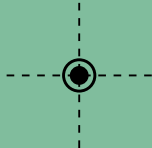
1.4. Training

Abattoir personnel should ensure staff do not use stunning or killing equipment without suitable knowledge and training. It is recommended that all operators seek appropriate training for the use of whichever slaughter method is being used. Abattoir personnel should be suitably knowledgeable regarding species-appropriate handling of equids and signs of either an insufficient or shallow depth of concussion that would require a secondary intervention. Where national or regional regulations apply, these must be complied with at all times.

Slaughter personnel working in countries without specific regulations should comply with the guidance outlined in this document and, where appropriate, with the World Organisation for Animal Health (WOAH) Terrestrial Animal Health Code (TAHC), Chapter 7.5 on slaughter [40].

Table 5 outlines training considerations for abattoir personnel.

Table 5: Training considerations for personnel involved in the slaughter of Equidae.

 Training considerations for personnel involved in the slaughter of Equidae		
Stage of process	Area or activity	Training considerations
Ante-mortem 	 Equine behaviour	 Recognising stress behaviour, being aware of equid's natural behaviour, flight response and herd nature, and being considerate of this when unloading, moving and handling.
	 Handling	 The use of appropriate positive or negative reinforcement when moving equids through the slaughter process (e.g. from lairage to stunning box) and appropriate application of equipment or force to achieve this in a considerate way.
	 Lairage	 Awareness of appropriate stocking density, lighting conditions, protection from extreme weather, requirement for food and water.
Stunning or slaughter 	 Restraint	 The use of appropriate restraint techniques to achieve successful stun without causing fear, pain or distress.
	 Stunning methods (captive-bolt)	 Competency using specific stunning methods (captive-bolt) and knowledge regarding appropriate angle and positioning and recognising target anatomy.
	 Killing methods	 Competency using specific stunning methods (firearms) and knowledge regarding appropriate angle and positioning and recognising target anatomy.
	 Equipment requirements	 Correct use of ammunition and/or power load for the device. Preparation of back-up stunning devices.
	 Safety and maintenance of devices or equipment	 Correct and recorded maintenance of devices in line with manufacturers instructions. Use of devices in such a way as to reduce risk to human safety.
	 Bleeding methods and anatomy	 Competency with knife skills and recognising target anatomy.
	 Recognising signs of consciousness	 Knowledge of the signs of consciousness to look for and what to do in the event of an animal not becoming unconscious or showing signs of returning to consciousness during stunning or bleeding operations.
	 Confirmation of death	 Competent to assess that the animal is dead and will not return to consciousness.
Correct use and maintenance of PCB devices is essential for effective, humane stunning.		
Follow manufacturer's instructions and relevant legislation at all times.		

Recommended best practice for training

- ✓ Staff must be appropriately trained in the relevant species, their natural behaviour and appropriate ways to handle.
- ✓ Staff must be competent in the specific method used.
- ✓ Staff must understand and recognise target anatomy and signs that an animal is still conscious or regaining consciousness.
- ✓ Operators must have appropriate knowledge of the legislation in their geographical location.

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Annex One: Additional guidance for Low-Middle-Income Countries/resource-restricted contexts

Pre-slaughter handling

Operators should be appropriately trained in recognising that equids are sentient beings, capable of feeling fear, pain and distress. They should be handled with sensitivity and compassion, minimising negative experiences throughout the slaughter process. Operators must be trained in handling and behaviour considerations.

The use of a stick to encourage movement or guide animals into an area must be kept to a minimum and only applied to the muscles on the animal's hindquarters. It should be applied only once, lightly, before allowing the animal to respond accordingly. If the animal fails to respond, the stick must not be used repeatedly or with excessive force. Operators must not hit, strike or kick an animal or use any equipment designed to be aversive, such as an electric prod, goad, whip, or sharp/pointed device/implement. Operators must not hit, strike or kick an animal around sensitive areas including the udder, genitals, anus or eyes. Where possible, equids should be moved through the use of a headcollar and lead rope. At no point should they be dragged or moved into position by their tail, ear(s), or leg(s). Dogs must not be used to move equids.

Slaughter Methods

Operators must be appropriately trained in the specific slaughter method used and identifying target anatomy alongside assessment/indicators of unconsciousness/death, as per section 1.4 of the main guidelines. The gold standard is free-bullet shooting or stunning by penetrating captive-bolt device (followed by immediately bleeding to ensure death). World Horse Welfare and The Humane Slaughter Association's position is that all animals should be humanely stunned before slaughter and do not support non-stun slaughter or blunt force trauma for the killing of equids, due to concerns regarding both equine welfare and humane safety. We recognise that currently there are such practices across the world and, in certain circumstances, access to appropriate equipment might be restricted and therefore, when no other option is available, the following methods are discussed as options.

Blunt force trauma

Blunt force trauma (BFT) can be conducted either manually or mechanically, with manual blunt force trauma not recommended except in emergencies or when it is the only option available. In the absence of specific literature into BFT, impact position should be the same as that used for penetrating captive-bolt. BFT has been found to have variable and limited success with achieving irrecoverable concussion [56]. Where a lightweight wooden pole device was used, 43% of animals required more than one attempt and animals took a mean time of 166.9 s (SD 21.1; range: 79–425s) to lose consciousness [56]. A sufficiently weighted object (large hammer, metal bar pipe, of sufficient mass) can be effective in achieving loss of consciousness, but this is dependent on factors including operator skill/competency, velocity, kinetic energy and target anatomy being struck with sufficient force on the first attempt, with the head secured over a hard surface. This method is not recommended without further research and specific training on use of this method. Optimal target position for BFT has not been researched in Equidae.

Bleeding

Animals will experience pain, suffering and distress by performing neck cutting or bleeding without pre-stunning. Rapid and effective bleeding that severs all the major blood vessels via ventral neck incision or thoracic stick is essential to induce or maintain unconsciousness and

ensure a rapid death. The method must be adequate to allow rapid bleeding and to prevent occlusion of blood flow. Ventral neck incision should aim to sever both carotid arteries and jugular veins.

Thoracic sticking should aim to sever the brachiocephalic trunk which gives rise to the carotid and vertebral arteries at the heart. Thoracic sticking used alone (instead of after ventral neck incision) has not been studied in horses. It is thought to decrease or prevent vertebral and carotid artery blood flow, decreasing the time to onset of unconsciousness and death, but success is largely determined by operator skill, along with other factors including carcass positioning, the size of the wound and clonic activity [58; 59].

Knives must be of sufficient size and sharpness to achieve either method. Knives should be undamaged and routinely checked and sharpened between animals using a purpose-built sharpening device, not using a second knife.

Death should be completely ensured before skinning or dressing commences, and even where consciousness appears absent, skinning or dressing should not commence within 60 seconds of the first cut.

If an animal shows signs of regaining consciousness during the bleeding process, appropriate action must be immediately taken to render that animal insensible and the stunning and slaughter of other animals must immediately cease. Stunning and slaughter of remaining animals on the line must not continue until the incident has been evaluated and corrective action implemented to eliminate the risk of recurrence.



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Veterinary
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