CATTLE AND SHEEP SLAUGHTER
TECHNICAL NOTES
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANIMAL WELFARE</td>
<td>7</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>7</td>
</tr>
<tr>
<td>ANIMAL WELFARE CONCEPTS</td>
<td>7</td>
</tr>
<tr>
<td>QUALITY OF DEATH</td>
<td>8</td>
</tr>
<tr>
<td>BEHAVIOR OF CATTLE AND SHEEP</td>
<td>10</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>10</td>
</tr>
<tr>
<td>INNATE BEHAVIOUR</td>
<td>11</td>
</tr>
<tr>
<td>LEARNED BEHAVIOR</td>
<td>13</td>
</tr>
<tr>
<td>SENSORY MODALITIES OF CATTLE</td>
<td>15</td>
</tr>
<tr>
<td>PRE-SLAUGHTER HANDLING OF CATTLE AND SHEEP</td>
<td>24</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>24</td>
</tr>
<tr>
<td>THE FLIGHT ZONE</td>
<td>25</td>
</tr>
<tr>
<td>POINT OF BALANCE</td>
<td>27</td>
</tr>
<tr>
<td>UNLOADING CATTLE</td>
<td>30</td>
</tr>
<tr>
<td>HANDLING AID TOOLS – CATTLE TALKERS</td>
<td>32</td>
</tr>
<tr>
<td>HEALTH AND SAFETY WHEN HANDLING CATTLE</td>
<td>35</td>
</tr>
<tr>
<td>LAIRAGING OF CATTLE AND SHEEP</td>
<td>45</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>45</td>
</tr>
<tr>
<td>LAIRAGE HOLDING TIMES</td>
<td>45</td>
</tr>
<tr>
<td>DESIGN PRINCIPLES</td>
<td>49</td>
</tr>
<tr>
<td>PHYSICAL CONDITION (FITNESS) AND ANTE MORTEM INSPECTION</td>
<td>54</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>54</td>
</tr>
<tr>
<td>ANTE MORTEM DURING UNLOADING</td>
<td>54</td>
</tr>
<tr>
<td>ANTE MORTEM INSPECTION IN THE LAIRAGE</td>
<td>55</td>
</tr>
<tr>
<td>PROCEDURES FOR EMERGENCY SLAUGHTER</td>
<td>59</td>
</tr>
</tbody>
</table>
ANIMAL WELFARE

INTRODUCTION

Animal welfare is widely defined as physical and mental well-being of animals. It can be measured by indicators that include behavior, physiology, longevity, and reproduction.

The term animal welfare can also mean human concern for animal well-being or a position in a debate on animal ethics or expressed via standards and regulations supported by science to certain extent.

Concerns for animal welfare are usually based on ethics, awareness that non-human animals are sentient and that consideration should be given to their well-being, especially when they are used by humans. These concerns can include how animals are killed for food, how they are used for scientific research, how they are kept as pets, and how human activities affect the survival of endangered species. First societal rules, how to treat animals were reflected in religions.

An ancient object of concern in some civilizations, animal welfare began to take a larger place in Western public policy in 19th-century Britain. Today it is a significant focus of interest in veterinary science, animal sciences, bio-medical research and has growing meaning globally.

In Western culture and philosophy animal welfare and use of animals is based on so called utilitarianism. Translated to practical language it means animals use by humans is morally justifiable if the overall benefits are larger than losses. In that case benefits include those to humans (animal products) and animals (protection, care, food, shelter) as well. Based on that view Killing animals (e.g. for food) may be justified if the farming conditions are not detrimental to animal welfare and the killing is humanely performed.

ANIMAL WELFARE CONCEPTS

In 20th century there were attempts to express animal welfare more precisely in general definitions and concepts. The most known concept is covering basic animal needs is concept of Five freedoms. The Five freedom concept has been modified to assess animal welfare at certain point of its life.

The newer more recent concept of “life worth living” introduced by British Farm Animal Welfare Council looks at the welfare of an animal during its entire life. A life worth living is a statement about an animal’s quality of life (in an animal life context) during its lifetime, including the manner of its death i.e. life of chicken broiler in certain production system taking account all phases of production chain.

According to that concept – the balance of an animal’s experiences must be positive over its lifetime. Any pain, suffering, distress or lasting harm must be necessary (or unavoidable), proportionate and minimal. The system of husbandry and care should provide animals’ needs (basic) and certain wants (animal’s preferences).
The notion of a life not worth living is one with which veterinarians and many livestock farmers are familiar in the context of disease or injury. How can we usefully determine when an individual animal – rather than a group of animals - has a life that is not worth living? The term ‘worth’ is a measure of value to the animal so the guiding principle should be to determine the extent and balance of an animal’s quality of life.

Of particular relevance are the following. Does the system or practice induce severe negative mental states, frustrate normal behaviour, preclude positive experiences or cause physical debilitation? Does the system fail to meet the physiological and mental needs of the animal? Examples of a life not worth living are an animal suffering a severe debilitating disease that is untreatable, a severe physical state such as starvation or dehydration, and severe negative mental states, such as chronic, intense pain, fear or distress. In each case, a good stockman would either treat the animal swiftly or euthanize it promptly and humanely.

**Image:** Social behavior of cattle.

**Image:** Cattle reared on a pasture-based system. Source: Steps

**QUALITY OF DEATH**

Whilst majority in the global society continues to accept that animals can be killed for food, there is a responsibility on that society to ensure the process causes no unnecessary pain, injury, distress or suffering.
Historically much of the focus when addressing animal welfare at slaughter has been on the method of killing. However, from the animal’s perspective this may only be the final stressor in a sequence of equally or more stressful events such as transport and handling of animals to the slaughterhouse, unloading into a new environment inspection, further handling and restraint.

In 2003 the Farm Animal Welfare Council in their review of welfare at slaughter in the UK identified that in addition to the Five Freedoms, welfare of animals at slaughter should take into account the whole process. The basic principles that must be observed to safeguard good death are:

- Pre-slaughter handling methods and facilities which minimize stress
- The use of competent, well trained and caring personnel
- Appropriate equipment that is fit for purpose
- An effective process that induces immediate unconsciousness and insensibility, or an induction to a period of unconsciousness without distress; and
- A guarantee of non-recovery from that process until death

This framework is important in ensuring that when assessing any slaughter system the whole process is considered, rather than just the killing method.
BEHAVIOR OF CATTLE AND SHEEP

INTRODUCTION

Pre-slaughter handling greatly influences the welfare of animals. If a design of slaughter premises does not go hand in hand with good handling practices, there will be a significant challenge in safeguarding good welfare for the animals. According to the OIE standards “Animal handlers should be experienced and competent in handling and moving farm livestock, and understand the behaviour patterns of animals and the underlying principles necessary to carry out their tasks”.

Understanding of cattle behavior is fundamental to recognizing signs of stress and pain, and thus handling them efficiently during this stage. In addition, recognizing the needs of cattle and their relation with rearing environment is essential to providing them with resources in the facilities and during handling that improve welfare. Consequently, there will be equilibrium between ethical production and economic profitability.

![Image 1: Shade is important for a thermal comfort of cattle](image1.png)

![Image 2: Auroch](image2.png)

Cattle originate from the Auroch (Bos primigenius) which inhabited Europe and large parts of Asia and North Africa. The Auroch are thought to have been domesticated about 9000 years ago. In India a subspecies of the Auroch was domesticated to give rise to cattle with the characteristic hump and dewlap – Bos indicus or zebu type cattle. The hump-less cattle that originated elsewhere are known as Bos taurus.

Cattle, like their Auroch ancestors, are grazing animals with a diet that would naturally consist of grasses and grass like plants; herbs, leaves and bushes.

Bos indicus and Bos taurus breeds have adapted to cope with very different environments and have been selected by man for hundreds of years for different characteristics.

But with common ancestors most basic behaviours are the same. As such it is always shaped to safeguard animal’s survival. Animal’s behaviour is usually distinguished as:
• **Innate behavior** – pre-programmed reactions: a calf is born with the potential to express these types of behaviors, as they do not depend on experience and are species-specific;

• **Learned behavior** – depends on experiences lived by each animal, originating from individual experiences.

Animals' behavior is very much influenced by capacity or limitations of their senses and therefore we talk about **sensual modalities** too.

**INNATE BEHAVIOUR**

Cattle are ruminant animals and in extensive conditions graze for approximately 9 hours a day. This period can be influenced by season, grass height, animal category and breed. Cattle's diet in extensive conditions basically consists of grasses. Rumination takes around 75% of time spent grazing (6 - 7 hours), and it is interchanged with regurgitation when the bolus returns to the mouth, is chewed and swallowed again. Daily, cattle ingest between 25 and 80 liters of water, and this volume may vary with environment, animal, diet (the greater the percentage of concentrate ration the more water is ingested).

**Social (group) living**

Cattle are social animals. This trait is a result of ancestral natural selection for benefits such as predator protection. If cattle are alone, the probability of one of them being attacked by a predator is greater than when it is in a group. Escaping is another advantage of group living as several animals running at the same time are difficult for predators to chase.

Cattle raised extensively (on pasture) tend to form groups of cows and their calves, while bulls gather in small groups separately from female cattle. Cattle tend to synchronize their activities and do things together to some extent; they eat, walk, rest, and sleep together. Cattle can recognize up to 70 other animals in the herd and their position in the social rank.

![Image: Cattle gathering in groups. Source: Steps](image)

To follow that natural pattern of togetherness cattle should be handled in groups. Segregating one animal from the group is stressful. When cattle are socially isolated this tends to alter their behavior and reactivity. They are becoming restless, nervous, more agitated or even aggressive.
Social dominance

Cattle always tend to establish a social order within the group. This hierarchy is established through fights among animals, with strength and aggressiveness determining dominance order; although, subtle flee-submissive behaviors contribute to the group’s social organization. Height, weight, age, gender, temperament and horns are among the factors that also interfere with dominance formation and maintenance.

In free-range, adult herds of cattle there are several hierarchies among adult males females and juveniles. As they age, young males fight adult females and eventually dominate them.

The hierarchy tends to be linear and large herds probably break down into a series of smaller hierarchies. There is evidence that dominance hierarchies in young beef steers are formed soon after weaning and that they remain stable even when the groups are moved to other pens. Dominance and eating behaviour have been observed in beef cattle where only one animal at a time could eat, and it was found that high-ranking cattle had fewer meals but tended to spend more time per day eating.

Aggressive interactions in cows appear to be ritualised. Once the dominance relationship of any pair of animals is learned, it eliminates the need for further combat. The subordinate animal retreats from the dominant at the slightest threat and physical contact is of minor importance as long as the animals can see each other’s posture.

With time, social order may change among a few animals in the herd. If a dominant animal suffers some sort of injury that compromises its state, soon it loses social position within the group and a new social order is established. Mixing unfamiliar cattle results in fights that intend to determine a new hierarchy status among the newly introduced animals. Reinstatement of social organization of new groups may take several days. Therefore, if possible groups of cattle transported to slaughterhouses must be formed by animals that were raised or lived together (familiar), and mixing of unfamiliar animals must be avoided. Attention to this characteristic can minimize fights and improve welfare of cattle, as fights lead to stress and injuries.
Leadership

Leadership is a feature in groups of cattle. The lead animal is the one followed by other animals in the group when moving to seek water, shade, a grazing area or another resource. Normally, leaders are mature female cattle, though group movement can be initiated by different animals in different circumstances.

An illustration to distinguish dominance and leadership is that a lead animal is the one followed by the group to a water trough; while the dominant animal is the one displacing animals already in the trough in order to access and drink water.

One study looked at patterns of leadership during grazing movements which were divided into following, independence and leading. It was found that high-ranking animals tend to lead, medium ranks tend to follow and low-ranking animals tend to be independent. An interesting suggestion was that it was the active movement of high-ranking animals and the independent movement of low-ranking animals that governed the voluntary formation in grazing patterns. When cattle are driven, the least dominant animals will be first and last, with the dominant animals in the middle of the herd.

LEARNED BEHAVIOR

Cattle have good short- and long-term memories, as they can remember events that happened during rearing and can be conditioned to a handling routine. They learn abilities in the environment where they live and can be trained with rewards. Cattle’s response to handling at the slaughterhouse is directly related to the type of handling they experienced during their lives at the farm.
Cattle that had limited human contact at the farm or that were subjected to aggressive handling tend to show strong fear reaction and this can interfere with handling at the slaughterhouse. Therefore, we must promote changes in handling practices at the farm, providing more frequent positive human-animal interactions between handlers and cattle, which can lead to better quality of life for the animals and ease pre-slaughter handling.

The rearing environment influences cattle behavior significantly. Animals reared in extensive systems, independently of their breed, tend to be more reactive than those reared in enclosed environments or confined systems. Lack of human contact in the initial rearing phase results in more fearful animals, which at times are also aggressive toward humans. It is better if calves receive special care and positive stimuli from humans immediately after birth in so called imprinting period as that directly affects their behavior when adults.

Herds from some farms may be more difficult to handle than others, and this is due to the way animals were cared for during rearing. At the slaughterhouse, cattle from the same breed but from different herds can be more difficult to handle than others.

Cattle have the ability to recognize and distinguish positive from aggressive handlers. For this reason, it is better if only a small number of people carry out more aversive procedures at the farm, while the others are in charge of daily farm duties.

Cattle can also habituate to non-painful recurring procedures, such as weighing, but not to repetitive painful events. Positive handling procedures must be carried out from the time of calf’s birth, preventing it from becoming averse to human presence.

The following is a brief summary of recent research findings related to learned behavior of cattle and is useful to bear in mind:

• Aversive procedures, such as restraint, will make subsequent handling more difficult
• Early handling experiences are important; early gentle and positive handling events produce calmer cattle
• Cattle handled at two sensitive times, after birth and after weaning, both effect subsequent response, so there is some evidence of “imprinting times” but they have not yet been fully established
• There is ability in cattle to recognize people who have treated them positively or negatively in the past
• On the farm, as few individuals as possible should be responsible for the most aversive procedures, make others responsible for day to day procedures
• It takes about 30 minutes for a cow’s heart rate to return to normal baseline levels after an intensive handling stress
• Cattle adapt well to repeated non-painful procedures, such as moving through a race for weighing, but not to repeated painful events
• There are genetic differences in temperament, and temperament is heritable
• Cattle with “excitable” genetics need to be introduced more gradually to novel experiences than cattle with “calm” genetics

• Highly reactive herd animals will have behaviors such as constantly rotating ear positions, raising the head quickly from the ground when grazing, excessive tail flicking even when no flies are present, flinching when touched, or moving away when approached by people

• Mixing known calm leaders in to a group improves overall handling

Image: Cattle handling at the farm. Source: Steps

SENSORY MODALITIES OF CATTLE

Cattle rely mainly on senses of vision, olfaction and hearing to assess stimuli, and thus respond to different events such as changes in the environment and threats; for example, when exposed to a sudden noise, cattle’s first reaction is avoidance or escape. After assessing the situation, if it is not perceived as dangerous, the animal will lose interest in it.

Vision

Cattle have slit-shaped pupils and weak eye muscles, which inhibits their ability to focus quickly on objects. Cattle can distinguish long wavelength colors (yellow, orange and red) much better than the shorter wavelengths (blue and green), which may have aided their response and survival when a herd member was attacked and blood was spilt.

Cattle are dichromats i.e. they have only two of the three main types of neural cells in retina. Dichromatic vision may provide better night vision and aid in detecting motion. Because of dichromatism and poor perception of depth, cattle need to lower their head to see clearly. Because of this poor depth perception and lack of definition, cattle will often balk and refuse to cross a shadow or drain grate (perhaps seeing it as a physical objects) and are best moved through diffuse light.

Binocular vision – Cattle’s eyes are located laterally on the head, and only see with both eyes (binocular vision) in a narrow area straight ahead (30°–50°), where they have clearer sight and better depth perception.
This is the reason cattle turn and lower their heads to see clearly handler, or some objects in details. An unloading ramp, a trailer entrance or a drain in the alley at the slaughterhouse can have different flooring that attracts cattle to observe these in details.

**Monocular vision** – Cattle do have with their eyes positioned on the side of the head panoramic vision of 300 - 320° which allows for good predator awareness. Despite the wide set of their eyes, however, they do have a blind spot directly behind them.

This panoramic lateral vision, achieved by each eye independently, does not provide depth perception. However, cattle can sense movement even with their heads lowered, while grazing, which helps detect the presence of predators in their natural habitat.
Blind area – This blind spot is located straight behind cattle’s body and a small area in front of their nose, where they cannot see. These areas must be avoided to optimize handling, preventing cattle from getting distracted while trying to situate the handler (details described in the chapter on Handling).

Cattle have good night vision that helps detect movements. Uniformity of colors (walls and floor) in areas of high circulation of animals can facilitate handling.

**Image:** A cow redirecting its visual angle to maintain visual contact. Source: Steps

**Image:** Cattle’s vision – summary diagram, Source: Steps

**Olfaction**

Cows identify their calves using smell, although visual and sound recognition become more important as calves grow older. Adult cattle also smell each other during social behavior.

Communication by olfaction is important for sexual activity of cattle. In addition, olfaction contributes to social hierarchy (dominance) information exchange, where submission pheromones are released from a subordinate to a dominant animal. Cattle exposed to alarming situations tend to group and may release pheromones through urine, saliva or other mechanisms, to warn others about the condition they are exposed to; cattle may become fearful of these signs thus promoting difficult handling.
Hearing and communication

Cattle are very sensitive to high frequency sounds when compared to humans. When hearing, cattle move their ears searching for source of noises, positioning them in the same direction as the source of sound, even when not turning their heads directly towards the source. One can determine the direction of cattle’s focus by assessing the position of their ears. This characteristic is easily observed during handling, when animals alter ears position between handlers and other cattle in the group frequently.

Cattle in the process of evolution lived in open fields where they could always see the rest of the group around. That resulted to very limited need to use vocal communication. Limited vocalization within the herd has been important for survival as vocalization would always attract attention from predators.

At the slaughterhouse, vocalization among cattle is associated with aversive events, such as prodding (especially when using high voltage), stunning failure, and excessive pressure during handling. Therefore, cattle vocalization in pre slaughter and slaughter is an important parameter in an assessment of practices.

At the slaughterhouses excessive particularly high pitch noise i.e. compressors’ discharge, whistling should be avoided. There are noises that even at the same intensity are more adverse than others; for example yelling, disturbs cattle more than sounds from banging of metal.
Behavior and genetics

Animal behavior is determined by the interaction between environments and genetics, with differences among breeds. In general, *Bos taurus indicus* is more reactive than *Bos taurus taurus*. Likewise, crossbred zebu cattle may be more reactive during handling than pure blood or crossbred European cattle.

However, Brahman or Zebu cattle are the most inquisitive and will investigate or follow a person or a dog. A common practice used in Australia to move groups of Brahmans is allowing them to follow a person. The tendency to follow a person is greater in Brahman compared to British or European Continental breeds. Nevertheless, some studies found that if Brahmans are handled gently they can become extremely docile. The breeds that are the most reactive had the strongest tendency to approach novel objects. This is only true when the animals voluntarily approach the novel object. During forced movements where the animals are being driven toward a novel object just the opposite is true. The excitable flighty individuals will be most fearful and they will be more likely to freeze or balk.

The rearing environment can however influence cattle behavior more significantly than genetics. Animals reared in extensive systems, independently of their breed, tend to be more reactive than those reared in enclosed environments or confined systems.

Behaviour and age

Most beef cattle handled to slaughter will be under 30 months, most dairy cattle will be at least 5 years and bulls can be even older depending on whether they are raised for beef or used as sires. Nearly all cattle will be coming from highly socialised groups. Older cattle are vastly more experienced but this also means they are more accustomed to a routine. Being loaded onto transport and taken to an unfamiliar Mart or Lairage is a major change for them and it is little surprise that sometimes they will exhibit antagonistic behaviour.

Social behavior of young bulls and common misbehaviors

The most dangerous dairy bull is a bull that has not been properly socialized to his own kind. When a young bull calf becomes mature at age two, he needs to challenge the top bull in the herd. If the bull calf has been raised alone and has not had the opportunity to interact with other cattle, he thinks he is a person and he wants to exert his dominance over the "herd". This can result in dangerous attacks on people.

Scientists found that bull calves raised in groups were much less likely to attack people than bull calves raised in individual pens. Bull calves raised on a cow were the least likely to attack. When they are raised with their own kind, they know who they are and they are less likely to think that people are part of the herd.

The major causes of bull attacks are mistaken identity or improper behavior that has been learned. A bull will perform a broadside threat prior to attack. He will stand sideways so the person or other bull can see how big and powerful he is. Sometimes a person can make a bull back off by responding with the human variation of a broadside threat which for people is
a frontal stance. Alternatively, the person may just back slowly away from the bull. NEVER RUN away and do not turn your back on him.

REMEMBER

- Recognizing the behavior of cattle is essential to improve handling practices;
- Cattle perceive their surroundings mainly using vision, hearing and olfaction;
- Cattle see clearly and have depth perception only in a narrow area in front of their heads (binocular vision), and have ample and panoramic lateral vision to detect movements although without details (monocular vision);
- Cattle have a blind area where they cannot see or recognise movements;
- Cattle are sociable animals and therefore should be handled in groups;
- The type of rearing has a larger influence on cattle behavior than genetics;
- Cattle from some farms are more difficult to handle than others and this outcome is a consequence of the way animals were cared for at the farm.

BEHAVIOUR OF SHEEP

Social (group) living

Like other animals, sheep react to the situations they are placed in according to instincts that have been developed over thousands of years. While it can be argued that domestication has decreased their instinctive behavior, they still show their instincts in many ways, daily.

The dominance hierarchy of sheep and their natural inclination to follow a leader to new pastures were pivotal factors in sheep being one of the first domesticated livestock species. Their only means of survival for thousands years was to run from danger and to band together in large numbers for protection – to flock.

Image: Sheep on a pasture

Even with domestication, sheep retain these defense mechanisms, they run from perceived danger, and they band together for protection. Exploitation of these instincts is what makes a shepherd dog valuable. Sheep see the dog as a predator, or danger, so they band together
for protection and move away from the danger. By controlling the dog, a shepherd controls
the flock.

During flocking, sheep have a strong tendency to follow. A leader may sometimes be the first
individual to move. Flock behavior in sheep is generally only exhibited in groups of four or
more sheep; fewer sheep may not react as you would expect if they were in a larger group.

Flocking and running away behaviour changes in ewes immediately after they give birth. A
ewe, docile and scared of a dog all year long will become extremely aggressive toward a dog
right after birth. Sometimes, although not often, the ewe will also be aggressive towards a
shepherd.

Because of their instinct to stay close together, sheep will move toward another sheep or a
perceived friend. They learn that a farmer can be a friend, particularly if he feeds them. By
using this combination of **instinctive and learned behaviour** (a) follow the friend, (b)
shepherd is a friend, shepherds have controlled sheep movement for centuries. In this case
the sheep will follow other sheep that are actually moving to see a friend (the shepherd who
feeds them). The secret is to allow the sheep that come to you to actually eat grain. If they
are not provided with any feed they will soon figure out that they are being fooled and will not
respond. An unknown handler unloading and handling sheep at the slaughterhouse would be
seen as predator.

Interestingly, in regions where sheep have no natural predators, none of the native breeds of
sheep exhibit a strong flocking behavior

**Dominance hierarchy and leadership**

Sheep establish a dominance hierarchy through fighting, threats and competitiveness.
Dominant animals are inclined to be more aggressive with other sheep, and usually feed first
at troughs. Horn size is a factor in determining flock hierarchy, especially among rams. Rams
with different size horns may be less inclined to fight to establish the dominance order,
while rams with similarly sized horns are more inclined to fight. In sheep, position in a moving
flock is highly correlated with social dominance, but there is no definitive study to show
consistent voluntary leadership by an individual sheep.

Anecdotal information and observations of leader sheep suggest that leadership ability runs
in bloodlines and is equally distributed between males and females.

It is assumed that these are more intelligent animals that have the ability and instinct to lead
a flock in difficult conditions. They have an exceptional ability to sense danger. For example
there are many stories in Iceland of leader sheep saving many lives when blizzards
threatened shepherds and flocks.

**Learned behavior**

Sheep can remember the faces of more than 50 other sheep for up to two years. They can
even recognize a familiar human face. The hidden talents of sheep revealed by a study in the
journal *Nature* suggest they may be nearly as good as people at distinguishing faces in a
crowd.
According to researchers in Australia, sheep can learn and remember. Researchers have developed a complex maze test to measure intelligence and learning in sheep, similar to those used for rats and mice. Using the maze, researchers have concluded that sheep have excellent spatial memory, and they can retain this information for a six-week period.

That supports use of certain designs (i.e. 180 degrees curved races to create the impression of returning) when constructing large throughput slaughterhouses.

**Vocalization when in danger**

When in imminent danger sheep rarely vocalize. They bulk together and run or in some situations stay quiet. Keeping quiet and not moving (i.e. pretending to be dead) helped to confuse some hunting predators used to chasing moving prey. Sheep also have an amazing tolerance to pain. Because they do not show pain they are less vulnerable to predators that look for those who are weak or injured.

Separation of one animal from the flock causes a high level of stress. An isolated sheep removed from a flock vocalizes in order to locate the rest of the flock and find its way back as soon as possible.

**Sensory modalities**

**Vision**

Sheep depend heavily on their vision. They have horizontal slit-shaped pupils, and good peripheral vision. With visual fields of approximately 270° to 320°, sheep can see behind themselves without turning their heads. Many breeds have only short hair on the face with facial wool (if any) confined to the poll and or the area of the mandibular angle. However, they have poor depth perception. They cannot see immediately in front of their noses. Some vertical vision may also have been sacrificed in order to have a wider field of vision. For example, it is doubtful that a sheep would be able to see something in a tree.

Contrary to previous thought, sheep perceive colors, though their color vision is not as well-developed as it is in humans. Sheep will react with fear to new colors.
**Vocalization and hearing**

Sheep have excellent hearing. They can direct their ears in the direction of a sound. Sound arrives at each ear at slightly different times, with a small difference in amplitude. Sheep are frightened by high-pitched and loud noises, such as barking dogs or firecrackers. When in imminent danger sheep rarely vocalize. They bulk together and run or in some situation stay quiet. Pretending to be dead (quiet and not moving) helped to confuse some hunting predators, usually chasing moving prey. Sheep have an amazing tolerance to pain. They do not show pain, because if they do, they will be more vulnerable to predators who look for those who are weak or injured.

![Image: Sheep tries to identify source of sound, Source HSA](image)

**Smell**

Sheep have an excellent sense of smell. They are very sensitive to the scent of different predators. Smell helps rams locate ewes in heat and ewes locate their lambs. Sheep also use their sense of smell to locate water and determine subtle or major differences between feeds and pasture.
PRE-SLAUGHTER HANDLING OF CATTLE AND SHEEP

INTRODUCTION

Welfare of animals in pre-slaughter handling as well as in other procedures depend on three key components: These are understanding of animals and their behavior or staff knowledge, environment – or design of slaughter premises and tools that are fit for purpose.

Good pre-slaughter handling relies upon people having a basic knowledge of the animals they handle, but more importantly an understanding of how their own behavior can influence the effectiveness of the handling process. Aggressive attitudes can trigger even more aversive reactions from animals and make handling more difficult.

CATTLE:

A good handler is also a good observer! Prior to handling, ideally, one should observe the agitation level and temperament of animals, and use this as an indicator of how to approach each group of cattle. The way animal will respond to handlers, and move in the desired direction (and how fast) will vary very much.

To each slaughterhouse, cattle from variety of rearing systems are supplied. These animals tend to have different previous experience. Some cattle are easily to handle because they experienced good handling at the farm and learned to respond adequately to handlers.

However, some animals can be more difficult to handle which is usually associated with cattle’s genetics, poor handling or fact that they were reared in free range conditions with seldom interactions with handlers.

Both research studies and anecdotal observations suggest that cattle’s responses to being suddenly placed in a novel environment or the reaction to sudden novel stimulus are two of the most accurate behavioral tests of nervous system reactivity.
It can be observed that the most reactive animals of a group will appear more sensitive to changes in the environment and are usually the first animals to orient toward novel sights or sounds.

**Animals and Activity Levels**

In the farm environment an animal’s activity or arousal level ranges from sleep at one end, to fight or flight reactions at the other.

When cattle have to be handled the objective is to raise activity levels to the point where they are moving in the right direction at the right speed.

If handlers increase arousal levels significantly, cattle become alarmed, fearful and perhaps even aggressive. They are more difficult to direct and therefore control; handling takes longer and stress levels increase. **Awareness is a basic handling principle**, even in situations where animals are in a low state of agitation.

![Image: Calm handling reduces stress for both animals and handlers. Source: Steps](image)

**THE FLIGHT ZONE**

We have learned in chapter on behaviour that behavioral features related to handling include the flocking instinct, visual field, social hierarchy and genetics. Flight zone, and previous experience also influence the response of animals.

Cattle protect an area around themselves, called the “**flight zone**”. The flight zone is defined as the distance in which an animal can tolerate the presence of an unfamiliar individual or a threat prior to initiating escape. Whenever the flight zone is invaded, the animal tends to re-establish a safe distance from the threat. But under critical circumstances, when there is not enough space to escape, cattle may freeze or fight.
The size of the flight zone is variable and depends on species, breed, previous experience and way of handling.

The flight zone can vary from 1.5 m to 30 m. It can be easier observed when cattle are in a penned area. In holding pens at slaughterhouses, cattle (particularly flighty) form a group and keep a safe distance - flight zone from by passing handlers.

Contrary to those, cattle from smallholdings or backyards exposed to daily contact with owners, dairy cattle or draught animals including buffaloes can have a very little or no flight zone at all.

An understanding of the flight zone is essential in handling and controlling cattle’s movement. In practice following hints are to be used:

- Handler should be positioned outside or on the edge of the flight zone avoiding standing in the animal's blind area;
- To move animal ahead he should step forward - just within the flight zone boundary
- As the animal walks forward, he should walk along remaining inside the animal's flight zone;
And observe when moving **outside the animal’s flight zone** and standing calm animal also stops.

Since cattle are handled in the groups, it is not always possible to enter the flight zone of an every animal. However, the handler must be positioned in a way that all cattle in group can see him.

As soon as the handler enters an animal’s flight zone, its reaction is to flee - run. If there is not enough space ahead, the animal will try to pass the handler and escape.

If handler moves too deep and too quickly into the animal’s flight zone animal will run away faster If it has nowhere to go it will turn and attempt to run back past the handler.

If cattle are confined, and feel threatened, they may attack when the handler gets too close.

 Handlers can increase or decrease the size of the flight zone, and to some extent control the response of the animal, by their approach and body posture. Being quiet and calm reduces the size of the flight zone; increasing levels of noise or activity from the handler will increase the size of the flight zone.

**POINT OF BALANCE**

Point of balance is defined as an imaginary line drawn through the animal’s shoulder, dividing it to two. The point of balance is used by the handlers to control and direct movement. An animal moves forward if the handler is positioned behind the point of balance. If the handler is positioned front of the point of balance an animal it will move backwards.

The handler will use this point of balance to control movement and direction of cattle guiding them in the desired way. Cattle move back and forward, depending on the handler’s position in relation to point of balance:

- If handler is **ahead of the point of balance and inside the flight zone** (position 1), the animal will move backward;
- If handler is **behind the point of balance and inside the flight zone** (position 2), the animal will move forward;
- If handler is **outside the flight zone** (position 3), the animal will stop. See image below.
The point of balance principle is widely used in handling cattle in a narrow races or chutes, where cattle movement is limited to forward and backward. In such situation to avoid handlers, cattle always move in opposite direction to moving handlers. The sequence of numbers in the figure below demonstrates handler’s positions moving cattle in desired direction:

- The handler enters the flight zone of animals in chute (position 3 to 1) and stand aside in front of the first animal in line (position 1);
- handler than walks from position 1 to position 2 passing the point of balance of each animal from front to back, prompting animals to escape and to move forward;
- When at the end of chute, the handler exits the flight zone (walking from position 1 to position 3)
Image: Handler’s positions to move cattle in the single file chute. Adapted from T. Grandin (2008)

Same principles are used when getting animals out of holding pens or stockyards.

1) Group’s flight zone
2) Handler enters the flight zone.
3) Passes first 5 animals’ point of balance
4) Splits the group to two


Occasionally, animals are resistant to exiting the pen. Moving animals in small groups i.e 2-3 animals often helps to solve the problem,

After splitting the group in the holding pen, the handler must walk them to the alley, keeping the handling flag up so all animals see it. This approach encourages animals to advance, avoiding returns. Using voice during handling helps to keep animals moving, but yells and abrupt movements must be avoided.

It is always easier to move smaller groups, it is important to remember that the handling flag must not be used to hit animals. Handling of cattle must be done in calm manner, without too much noise, rush or sudden movements. Animals must be aware to handler’s commands. Excessive agitation may lead to panic and loss of control. Calm and confident these are core qualities of a good handler.

UNLOADING CATTLE

At the arrival to the slaughterhouse any paper work has to be sorted out as soon as possible so unloading of animals is carried out without delay. It is recommended that slaughterhouse facilities provide a shaded and well-ventilated area to park loaded vehicles prior loading to minimize risk of heat stress while waiting for unloading.

The lorry must be well parked not allowing gaps between load compartment and unloading ramp, which can hinder animals passing by.
Handlers should observe whether there are any cattle lying in the load compartments. It is necessary to make sure that prior unloading all animals are standing to avoid cattle stepping over each other.

- Handlers should verify whether there is space ahead of the animal prior to persuading it to stand up;
- They should use voice and noise, clap hands or slap vehicle’s wall to encourage cattle to stand up. When needed, make use of handling flag or rattle;
- When an animal is not in a condition to stand up, handlers should inform veterinarian or manager to decide further steps.

For better unloading, if there are compartments in the lorry these shall be opened in the ramp-to-cabin sequence (positions 1 to 3). When opening the first gate, allow sufficient time for the nearest animal to recognize the new environment and lead the remaining cattle. It is important to observe these animals exiting and open gate in the second compartment while animals from the first compartment are still leaving (position 2). Cattle will pay attention to the exiting animals and will feel encouraged to follow. This procedure shall continue until unloading is finished. Ideally, animals should be unloaded walking, with no rushing and keeping visual contact among themselves. Thus, handling equipment aids must only be used when really necessary.
Special care must be provided when handling cattle in double deck trailers with unleveled flooring.

**HANDLING AID TOOLS – CATTLE TALKERS**

These are tools that aid handling of cattle. When used correctly, they encourage cattle to move in the desired direction.

Some groups of cattle may require more persuasion than others to move. Essentially, the level of persuasion must be increased when not achieving a response from the animal, and this is the appropriate moment to use handling aids, such as:

A. ........................................................................................................................................... Sound stimuli (rattle pad and noise) – Use of combination of movement and noise in handling is a common practice at farms and most animals respond to it. Associated to sound, handler’s movement and position strengthen cattle’s response. Importantly continuous constant noise will not alert animals as much as intermittent noise. If animals are already moving there is no need to use pad rattle. When handling highly reactive animals the rattle (especially one made of metal) is not recommended.

B. ........................................................................................................................................... Handling flag – it encourages movement, directs animals, it can increase the threat and also helps to block cattle’s vision. Because the flag is flexible, its movement catches the animals’ attention. The flag is perceived by cattle as an extension of a handler’s body that enlarges the threat. The flag must not touch the animal and importantly it must be positioned high up in a way, so handled cattle can see it. The combined use of voice and flag is ideal for moving cattle.
The flag can be used to turn an animal in the desired direction by moving flag alongside animal’s head (position 1) and body (positions 2 and 3) in desired direction.
Ideally flag is adjusted to type of cattle handled. Large flags are used to handle less reactive cattle or larger herds, while small shorter flags are used for flighty cattle.

C. Bare hands handling – touching animals back by bare hands helps move less flighty cattle. The intensity of the force applied must be adequate.

D. Electric prod – It shell be used ONLY as a last resort, when all other handling aids failed. The use of prod is regulated in many countries and it is always limited only to emergency handling in the raceways leading to the restraining box or area in situations when:

- animals refuses to move, and there are no distractions ahead of it
- on the rear limbs of adult cattle, above the ankle to avoid kicking and risks of accident;
- for a maximum period of one second, with intervals between prod applications.

The use of electric prod must NEVER be used on sensitive parts such as the anus, genitals, nose, eyes and udder.
An electric prod **MUST NEVER** be:

- used repeatedly, if the animal does not respond
- connected directly to the main power supply

The use of electric prod must be controlled to promote minimum stress and pain to cattle.

**HEALTH AND SAFETY WHEN HANDLING CATTLE**

**Skilled** stockman should always recognize the signs and sounds of the cattle they are handling. These signs include body postures, agitation and arousal, head and tail positions. Seriously distressed cattle often vocalize.

**Higher risk of injury occurs when handling**

- Cattle are not handled frequently.
- Cattle that are alone, isolated and away from their herdmates.
- Cattle with bad past experiences.
- Bulls
- When cattle are being loaded and unloaded for transport.
- Cattle in unfamiliar surroundings.
- Some specific breeds.
- Bad tempered or fractious cattle

and where the handler lacks the necessary experience, agility or ability to assess the possible risks.

Be aware of:

- Vocalisation
- Highly agitated and aroused cattle
- Head and Tail Position
- Bulls
- Cows with calves at foot
- Horned cattle
TIPS FOR GOOD HANDLING:

- Observe the group’s reactivity to define the way animals should be handled;
- Be calm and keep control during handling;
- Move slowly into the cattle's flight zones;
- Pay attention to your positioning in relation to the animals’, using the point of balance and avoiding the blind area;
- Handle small groups at a time. A smaller number of cattle allows for more control over the group, avoiding accidents;
- Avoid isolating an animal;
- Turn the water off prior to moving the animals through the sprinklers, as water reduces cattle’s visibility and irritates their eyes (chloride);
- Avoid leaving animals for long periods in the alleys (e.g. lunch break, changing handlers’ group). This condition causes unnecessary agitation;
- Working synchronically with slaughter throughput rate avoids interruption of animals' movement.
Image: Statistics of fatal accidents caused by bulls

REMEMBER:

- Cattle must be unloaded as soon as they arrive at the slaughterhouse;
- Take advantage of the flight zone and point of balance to influence, move and control cattle movement;
- Move cattle in the group
- The use of any handling tool must be cautious;
- The electric prod is only acceptable as a last resort, used only when the animal has space to move forward, for a period of maximum 1 second and on the rear limbs above hock;
- NEVER apply an electric prod on sensitive parts of cattle, such as genitals, anus, nose, eyes, among others.
SHEEP HANDLING AND TRANSPORT

Introduction

A thorough understanding of sheep behavior is the first step towards developing an effective method of handling sheep. Their strong flocking and following behavior tends to make sheep easy to handle, relative to other livestock species. Conversely, sheep will prove difficult to handle if you force them to act in ways that are not natural for them. When handling sheep the same basic principles of flight zone and point of balance apply as in handling of cattle.

Being a prey species, the primary defense mechanism of sheep is to flee from danger when their flight zone is entered. Cornered sheep may charge and butt, or threaten by hoof stamping and adopting an aggressive posture. This is particularly true for ewes with newborn lambs.

Most sheep are flighty animals so it is best to handle them carefully moving on the edge of their flight zone. If the flight zone is penetrated too deeply, they will run away fast.

![Different levels of arousal of sheep; sleep, graze, walk, fright flight. Walk- an ideal level of arousal in handling sheep. Source: Eblex, UK](image)

Sometimes their behavior can be unpredictable and dangerous. Sheep are not large, but they are quick on their feet. Pile-ups can result in small enclosures, causing injury to the animals, especially the small or weak ones.

![Flight zone of flock of sheep moving in an opposite direction as shepherds. Source: Temple Grandin](image)

Catching sheep

There are situations in which you need to catch an individual sheep. If you do not have a handling system to assist you, you can use gates and panels to make a small catch pen.
Once the sheep are in the catch pen, manoeuvre them into a corner and use your arms or a portable gate to form a visual barrier. Always approach sheep calmly and slowly. Cup your hand under the jaw of the sheep you want. Grab the bony part of the jaw, not the throat. Point the sheep's nose upward to stop its forward motion. If you keep the sheep's head up, you will be able to maintain control of it. Sheep have a lot more power when their head is down.

If you cannot get close enough to the sheep to grab it under its jaw, you can reach for its hind leg or rear flank. Reach for the hind leg above the hock, then move your other hand up to control the head as soon as possible. Adult sheep are able to kick strongly, so this method works best for small sheep or young lambs. To catch an adult sheep, it is better to grab the rear flank. You should never catch a sheep by its wool. Not only is it painful to the sheep, but it can cause bruising to the carcass.

Restraining sheep

There are many different ways to restrain a sheep, depending upon what you need to do to it. Once you've caught the sheep, you can press it against a wall or straddle it to limit its movement. A halter is one of the easiest ways to restrain a sheep.

Sheep transport

According to research on transport, sheep are animals that cope with average transport conditions better than pigs and cattle. However there are risks associated with poor management of sheep transport. Loading and unloading can be problematic especially to and from lorries with 4 - 5 decks.
The maximum angle of loading and unloading ramps should be 20 degrees. The research on stress concludes that the highly variable results in research studies of transport may be due to different levels of “fear” stress. Sheep accustomed to loading and handling may be less stressed by transport, especially if trips are short where fatigue and physical stress would be lesser factors.

According to research and observations space allowances for sheep during transport in m²/animal should be: 0.2 to 0.3 m² for shorn lambs <55 kg liveweight, >0.3 m² for shorn lambs >55 kg, 0.3 to 0.4 m² for unshorn lambs <55 kg, >0.4 m² for unshorn lambs >55 kg, 0.4 to 0.5 m² for pregnant ewes <55 kg, and >0.5 m² for pregnant ewes >55 kg.

There is research that shows no difference in bruising when 35 kg sheep were transported at 0.22 m²/head vs. 0.40 m²/head; This evidence refutes the common belief that sheep must be packed in a truck to prevent bruising.

Roeber et al. (2001a) concluded that handling and transportation play a very important role in overall sheep management. They found that: (a) At-slaughter-plant condemnations for 1998 through 2000 revealed that injuries resulted in 3.7% and 7.8% of carcass condemnations in mature sheep and lamb/yearlings, respectively. (b) Improper handling or transportation can result in bruising, broken bones, condemnation and even death. (c) Proper handling facilities and techniques minimize stress to the sheep.

The US National Sheep Quality Audit determined that the third largest quality-defect loss ($6.00 per affected lamb) in the US market sheep population was carcass trim loss due to bruises. According to Blackwood and Hurst (2004), around 25% of sheep are bruised before slaughter. The main causes of bruising are sheep riding up onto the one in front because handlers are pushing them to move faster than they can go.

“Rest stops” during transport benefit lambs mainly by reducing the observable effects of food deprivation. Cortisol concentrations confirm transport to be a stressful event which is not lowered by rest. Immune function data suggest that “rest stops” help to maintain immune function.

Research on the effects of transport of sheep by road include the following:

- Knowles et al. (1993) studied the effects of 9 and 14 hr of road transport and subsequent recovery in lairage of hill lambs; and reported there were no measurable differences between the responses of the lambs transported for 9 vs. 14 hr; and that recovery after transport, in lairage, required 24 hr for rehydration and 96 hr for liveweight.
Knowles et al. (1996) studied lambs shipped from the UK to France by lorry and concluded that, for journeys longer than 24 hr, an 8-hr rest in lairage with access to water and food was beneficial, and allowed material re-alimentation and rehydration before further transport for up to 10 hr.

Broom et al. (1996) investigated the physiological effects of road transport of sheep and determined that loading and the start of driving produced large increases in cortisol and prolactin concentrations (in the first 3 hr of a 15-hr journey) but during the remaining 12 hr, the stimulatory effect of transport was small.

Cockram et al. (2004) videotaped, simultaneously, activities on a vehicle during transport of sheep and determined that “driving style” had a major influence on the welfare of the animals (e.g., risk of injury). Sharp braking, cornering and various other driving events that unbalance the animals increase the risk of injury.

Long distance transport (18 hr and 24 hr) of lambs from the UK to France was investigated by Knowles et al. (1994). They found: (a) High levels of plasma beta-hydroxybutyrate, free fatty acids and urea, both before and after the journeys, indicated that the animals were in a catabolic state. (b) The behavior of the sheep after the journeys indicated that they were all alert and physically fit; they showed great interest in any food that was available and were only secondarily interested in drinking, and then resting. Knowles (1998) reported that complete recovery from 14 hr of transport stress takes almost 5 days.

Most research indicates that a rest stop must last for at least 8 hr to provide enough time for sheep to eat and drink. Sheep will eat before they drink; so if the rest stop is too short, they will not have time to drink.

**Transport of lambs**

- Lambs of less than one week of age may only travel for a maximum of 100km (approximately 62 miles).
- Lambs less than 20kg must travel on suitable bedding for thermal comfort.
- A lamb with a navel which is not completely healed is considered unfit for transport.

Richardson in his factsheet “Avoiding heat and cold stress in transported sheep” emphasizes checking on the weather before transport, knowing what you can do to reduce the effects of severe weather on the sheep at any time during the trip, and changing the timing of the trip if necessary. He provides further recommendations on transport of sheep as follows:

- Ensure that all animals intended for transport are fit to be transported.
- Stop and check on the sheep after the first hour of the trip and every 2.3 hours afterwards.
- Protect sheep during transit from exposure to severe weather conditions.
- Sufficient ventilation must be available at all times.
• Appropriate measures must be taken to prevent engine exhaust from entering the area occupied by the sheep.

• Ventilation should be adjustable from the outside of the vehicle so that adjustments can be made without unloading the sheep.

• For trips in excess of 24 hours reduce loading density to 85% of maximum to allow room for sheep to lie down.

**Precautions in cold weather**

• Sheep need to be protected from freezing rain and wind blowing into the sides of the truck because it increases their heat loss and can cause death from hypothermia, even at temperatures above freezing.

• Young and recently shorn sheep are particularly susceptible to frostbite and loss of body heat during transportation.

• Remove wet bedding after each trip to prevent it from freezing onto the truck.

**Signs of Animal Discomfort (Cold Stress) During Transportation**

• Wet sheep

• Sheep eating available bedding

• Fluids frozen to the face or nostrils

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Source: Kansas State University and Livestock Conservation Institute

**During Winter Travel**

• Increased bedding or insulation is necessary in cold weather.
• Increased loading density beyond recommendations can predispose individual animals to frostbite if it prevents them from repositioning in the truck.
• Cover openings to protect sheep from cold winds caused by movement. Wind chill lowers the effective environmental temperature and can cause frostbite.
• Protect sheep on the side of the truck that is exposed to a cold crosswind.

Precautions in hot and humid weather

• Take precautions to avoid stress, suffering and possibly death caused by the combination of high temperature and high humidity.
• Sheep require sufficient floor space to allow for adequate ventilation and comfort
• Severe heat build-up may result from overcrowding. Reduce loading density to 85% of maximum in hot/humid weather.
• Keep frequency and length of stops where sheep are not off-loaded to a minimum during transit to prevent rapid build-up of heat inside the vehicle.
• Protect shorn sheep from prolonged exposure to direct sunlight to prevent sunburn.

Signs of Animal Discomfort (Heat Stress/Overcrowding) During Transportation

• An overcrowded load will not settle; sheep continue to scramble for footing and the load continues to be noisy for prolonged periods of time. Sheep involuntarily lie down and are then unable to get up.
• Sheep pant when overheated; animals standing with their necks extended and open-mouth breathing are in a dangerous situation.

During Summer Travel

• Handle sheep carefully because exertion in hot/humid weather is particularly stressful and increases the chances of heat stroke.
• Allow every animal to rest when over-exerted.
• Sufficient ventilation must be available at all times while the sheep are in the vehicle.
• Whenever possible, avoid trips during hot/humid periods.
• When high heat and humidity are forecast, schedule transportation at night and in the early morning.
• Avoid periods of intense traffic congestion.
• Do not park a loaded vehicle in direct sunlight.
• When necessary to stop, minimize the duration of the stop to prevent the buildup of heat inside the vehicle.
• Sheep can be cooled by watering the floor of the vehicle or by using a fine mist spray. If you have an overheated sheep, gently run cold water over the back of the head.

Image: Good practices in handling and slaughter produce high quality carcass

Unloading of sheep

Sheep have to be unloaded immediately upon arrival at the slaughterhouse. If that is impossible, the vehicle must be parked in a shady and well-ventilated area. Sheep have to be monitored frequently depending on the weather conditions and duration of previous transport.

Unloading ramps have to be of at least 2-3x the of animal width. They have to have non-slippery floors full side walls and there should be no obstructions or strange objects on the way. Sheep have to be allowed to get out of the lorry on their own way. Once the first animal moves out of the lorry the others will follow due to their following instinct.

Ramps fences, pens, must have no protrusions sharp edges or poorly maintained surfaces to avoid bruising and other injury.

When being unloaded, sheep must not be rushed or stressed to avoid panic, trampling, baulking and smothering. Each animal should be observed and those sick and injured penned separately in isolation pens for further observation/treatment.

Images: Unloading of sheep
LAIRAGING OF CATTLE AND SHEEP

INTRODUCTION

The main purpose of the lairage is to hold sufficient animals to allow the processing line to operate efficiently so that it never stops or slows down. Time in the lairage may give animals some opportunity to rest and recover from transport, but they are unlikely to fully adapt to the new environment in the short time they are there. The special requirements for dealing with unfit animals are covered in another information note.

LAIRAGE HOLDING TIMES

Time cattle spend in the lairage has usually focused on food hygiene and operational needs, but more recently the effect on the animal’s welfare has become an important consideration.

OIE standards require that cattle and sheep shall be rested before they can be slaughtered.

Research in South America (Chile) has investigated the impact on welfare parameters of long lairage conditions and to what extent cattle actually benefit from periods of “rest” in the lairage.

Lairage times of 3, 6, 12 and 24 hours were evaluated with transport times of 3 or 16 hours. In the variables studied, there was no indication that increasing the lairage time at the abattoir had a beneficial effect on the animals. As lairage time increased, energy levels were depleted if animals were not fed. There was also evidence to suggest that during longer lairage times cattle may become more dehydrated.

This study reflects similar findings from work carried out in Europe and North America, where minimum lairage times (i.e. 6 or 12 hours) are not required.

Long transport and lairage times (48 hours) are also associated with carcase weight loss and reduced killing out percentage, as well as elevated pH and increased shear values, which indicate muscle toughness.

Knowles et al. (1993) studied effects of 9 and 14 hr of road transport and subsequent recovery in lairage of hill lambs and reported there were no measurable differences between the responses of the lambs transported for 9 vs. 14 hr and that recovery after transport, in lairage, required 24 hr for rehydration and 96 hr for liveweight. Knowles (1998) also reported that complete recovery from 14 hr of transport stress takes almost 5 days. In practice such long lairaging times are not viable in most parts of the world. Therefore where feasible both cattle and sheep should be kept in lairages a few hours to drink and settle down.

In general the effect of lairage time on the cattle’s and sheep welfare will be variable depending on factors such as transport time, transport conditions, genotype, previous feed regime and general fitness. Given these variables, the way forward in the future is for lairage staff, management and veterinarians on site to be given the ability to increase or decrease
lairage times to optimize the cattle’s welfare based on the actual needs of the load, batch or indeed individual.

According to OIE standards waiting times in lairages should be minimized and animals should not be kept in lairages longer than 12 hours. They can be kept in lairages for longer periods under specific conditions i.e. when food is provided.

Image 1: Lairage at the Santori plant  
Image 2: Short period holding pens for sheep

**Space**

OIE standards state that all animals must have the minimum space required for all animals to freely lay down, stand up and turn around at same time.

In practice size of animal and also the length of time spent in the lairage should be taken into account.

As mentioned before in the lairage, cattle and sheep should be held for a relatively short period of time. They need space to carry out only a few basic activities e.g. thermoregulation, excretion, movements such as standing up, lying down walking to the water and feeding through and turning around.

Except that cattle also need space to avoid threats and aggressive behaviour from other cattle. There is little science that indicates what would be the optimum space for cattle within the lairage environment, and many recommendations have evolved through requirements either on farm or for transport.

However a number of formulas have been developed based on animal shape, size and weight. These have been adjusted to calculate space needed for basic body positions (see Table)

- **lateral recumbency**: animal lying on its side, legs fully extended
- **semi recumbency**: animal on its side with legs tucked close to the body
- **sternal recumbency / standing**: where the animal has its legs directly beneath it or is standing
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</tbody>
</table>

Animals need to be able to move between standing and lying. Cattle in particular need ‘lunging space’ to get up from a lying position. From field data on dairy cattle the approximate minimum space needed for cattle to rise is very similar to that for lateral recumbency and this has been verified with more sophisticated 3-dimensional modeling.

As lairage time increases more cattle and sheep will tend to lie down and an estimated 80% of animals might lie at any one time, particularly overnight when there is less activity in the lairage. Therefore for cattle being held overnight in the lairage the minimum space area per head has to be close to the recommended space needed for lateral recumbency. Holding pens where sheep are kept overnight have to be filled up to 80 % of their normal capacity. In reality most of the lairages are designed more generously as human activities such as ante-mortem inspection, handling and sorting of animals as well as and cleaning have to be carried in the lairage too.

**Separation**

The need to separate out unfit animals is covered in chapter on fitness. As a general principle it is important that where cattle are likely to suffer pain, injury or distress by being penned with certain groups or individuals then they should be kept separate, for example, mature bulls or cattle of significantly different size.

Mixing cattle from different farm social groups is detrimental to the animals’ well being and increases the incidence of Dark Firm Dry - DFD meat (17.5% in steers and 23.5% in bulls) particularly when cattle are held for long lairage times (over 12 hours).

The impact of mixing will be influenced by sex, previous handling experience and possibly genotype. In cattle, it is the animal doing the mounting behaviour that is at greatest risk from fatigue and if possible very active animals should be removed from the group, or the group should be slaughtered as a priority.

*Image 1*: Isolation pen at the Santori plant

*Image 2*: Isolation pen for sheep
**Water**

Provision of water in holding pens in the lairage is a basic need, irrespective of how long the journey has been to the slaughterhouse or how long the animals are to be held. According to the OIE standard clean drinking water has to be provided to cattle at all times. Water is vital for life and it’s important to be aware that in the run up to the transport process, handling, penning before loading etc. cattle might not have had adequate opportunity or desire to drink. The slaughterhouse lairage is therefore the place where cattle that are thirsty can satisfy their need. When cattle are fasted or on severely limited rations (as is usually the case before transport and slaughter), they increase water intake to compensate.

The means of delivery (bowls or troughs), the number of drinking points, cattle stocking density and water quality will all affect the actual availability of water. For example water intake is generally higher if large troughs are used.

Lairage staff must be made aware that although water may be in the pen, there may be some cattle who are at greater risk of dehydration because of competition or lack of mobility.

The basic signs of dehydration in cattle are:

- Pale gums
- Reduced skin elasticity (the pinch test)
- Licking surfaces

Dehydrated animals should be slaughtered as a priority.

**Food**

It is stipulated in the OIE standards that cattle held in the lairage for more than 12 hours prior to slaughter, must be fed on arrival and in appropriate periods. Up to this point there are sound reasons why cattle need not be fed, if they are slaughtered soon after arrival as:

- The rumen acts as a reservoir of nutrients and water. Cattle can therefore go for relatively long periods without food before there is a significant impact on their welfare.
- For hygiene purposes cattle need to arrive at the evisceration point ideally without a full gut.
- Feeding in the lairage may lead to fighting, particularly if feed and space is limited.

**Shade and shelter**

Cattle and sheep are relatively hardy animals and can cope with a wide range of climatic conditions provided they are fit and healthy.

According to climate conditions in Turkey it could be assumed that heat stress is more likely to be a problem than cold stress.
Bos indicus cattle are naturally better adapted to the heat. Thin skin and a white colour are better at reflecting the sun rays. The hump and the dewlap increase the animals’ surface area over which heat can be lost and Bos indicus animals generally have larger sweat glands, which are more efficient.

Bos taurus types generally have darker coat colours and a thicker coat for insulation, therefore more prone to heat stress. However over longer period of time they will develop an adaptive response to increasing environmental temperatures.

Sheep particularly unshorn and well fed will suffer from heat stress significantly, therefore water has to be provided and these animals must be slaughtered as soon as possible after arrival at the slaughterhouse.

In the lairage when temperatures are high, cattle and sheep will benefit from shade, however there has to be good air flow around the cattle. Misting or water spray systems for cooling cattle may cause a greater welfare risk when there is high temperature, high humidity and poor air flow.

DESIGN PRINCIPLES

Lairages should be designed way that minimize the handling of the animal. The optimum outcome in terms of lairage layout is to be able to move animals from the unloading point to the holding pen and on to the point of slaughter as directly as possible. The number of turns and corners should be minimal and the route the animals take should encourage forward movement.

When designing or modifying the handling system it is essential that it is looked at from the animal’s point of view for two main reasons:

1. Handling systems look, sound and feel very different when walked where the cattle walk.

2. The cattle will move better when the system is physically within their capabilities; depending on the size of animals being handled there may be optimum dimensions for different parts of the system.
Inclines

Cattle and sheep have their centre of gravity at the shoulder; they find walking down a steep incline (such as an unloading ramp) or a large step difficult, as they naturally need to slow their pace to avoid falling forward. Moving up a steep incline is a physical challenge as weight needs to be pulled up and forward. To avoid animals slowing down, systems should be designed so that cattle are moving on level ground as much as possible.

Floors

Floors need to be non-slip. Cattle will slow down and be reluctant to move on a surface that does not give them confident footing. Good footing is essential in high traffic areas such as raceways and crowd pens, and areas of high risk such as inclines and gateways.

Grazing animals, like cattle and sheep, can see depth to some extent but because of their limited vision they have to stop and put their heads down to see clearly. Cattle also have vision that is sensitive to contrasts of light and dark. This is why they are often reluctant to cross changing light patterns, drains, steps, puddles of water, gutters and other areas where there is a high contrast change.

Image: Anti-slippery floor surfaces at the exposed areas. Source: Steps

Cattle and sheep are also less confident moving on floor surfaces they are not used to, i.e. concrete and metal. The floor surface needs to be visually uniform; cattle will slow down or stop to move over or around floor areas that look different to them.

Any changes need to be eliminated from the main cattle handling routes to make handling easier.

Passageways

Cattle and sheep move in groups and are motivated to move by the sight of other cattle moving forward. Passageways must be wide if groups of cattle or sheep are expected to be moved quickly.
Solid sides prevent cattle being distracted or alarmed by the sight of unknown animals, human activity, equipment or machines. As with floor surfaces, at key handling areas the wall surface should be the same throughout.

**Corners and Turns**

Cattle have long bodies and they need space to turn.

Tight right-angles and corners, for example out of the pen into the passageway, may be physically difficult for some cattle to negotiate.

Cattle need at least a cattle and a half-length directly in front of them to make the turn easy.

Sharp right-angles within handling systems can create apparent dead ends from the animal's point of view, they see no way forward and will stop. Pens that are angled improve cattle flow.

With curved raceways the curve must not be too tight. From the cattle point of view it should look like there is a way out just around the corner, not a dead end.

**Lighting**

Research has shown that cattle, like other animals, have a tendency to move towards more brightly lit areas. Experiments indicate that lighting should be even and diffuse. Strong contrasts of light and shade will stop forward movement, for example, as animals move from an outside area into a building. Artificial or natural lighting that shines right in the face of the cattle will also cause them to slow down or stop.

**Noise**

Cattle are able to detect sound that humans cannot. Both cattle and sheep have a very good sense of hearing and are very sensitive to certain high-pitched noise from machinery and equipment. Loud, intermittent noises close to handling areas can also produce a startle or panic response and should be eliminated.
Crowding Pens

Crowd pens for cattle and sheep that lead into the main race to the stunning pen are usually either rectangular or circular in shape. Both can work provided the cattle can see a clear way up the race and cannot jam at the race entrance. A funnel design works with cattle when using a circular handling pen. Solid sides prevent animals seeing, and wanting to go back towards the lairage and other animals.

![Image: Crowding pen for sheep. Source: HSA](image)

The crowding pens must not be overfilled, cattle need space to turn and see where they need to go. Cattle should not be pushed with the crowd gate.

Restraining box

Cattle can be reluctant to enter the restraining box. This is often because there is a sudden change of floor and wall material (concrete to metal) or lighting (outside to inside).

![Image: Dark entrance to the restraining box](image)

To encourage forward movement the contrast needs to be minimised as much as possible, such as making the floor the same material or introducing a metal panel side before the box.

The box should have non-slip, level and firm footing and there should be no gaps at floor level to distract cattle.
The design of the box needs to create the illusion to the cattle that there is a way out or at least enough length so that they are encouraged to walk forward and not stop short of the front of the box.

Similar principles would apply before getting sheep from chute into the V shaped conveyor restrainer. False floor of same or similar structure has to be installed at least one and half length of the body into the restrainer conveyor.
PHYSICAL CONDITION (FITNESS) AND ANTE MORTEM INSPECTION

INTRODUCTION

For animal welfare and public health reasons, it is of fundamental importance that cattle are not moved or transported unless they are in good physical condition and perfect health. Animals severely injured or thin, sick, fatigued or that cannot move without undergoing additional suffering are not suitable for transporting to the slaughterhouse.

It is essential that animals arrive at the slaughterhouse free of injuries, diseases and intense stress (distress). Cattle and sheep that are injured, shows signs of illness or severe distress should be segregated during unloading. The veterinarian and/or professional responsible should be consulted and a procedure for emergency slaughter is recommended to be carried out as soon as possible to prevent further suffering of the animal.

ANTE MORTEM DURING UNLOADING

Unloading of cattle and sheep must start as soon the truck arrives at the plant. Animals must not be kept waiting for unloading in the transport compartments, especially when exposed to sun. The unloading team must be trained and qualified to identify sick or injured animals and assess its severity upon arrival to provide differentiated care to these animals. When there is a sick or injured animal identified on the lorry, the lorry has to be unloaded first.

![Image: Unloading at the slaughterhouse](image)

Animals with minor lesions but able to walk with no signs of pain; have to be be calmly unloaded and moved to observation pens at the slaughterhouse. If isolation causes more stress to injured cattle, then such an animal may be held with others, as long as the group is provided with more space in the lairage and it is monitored.

Cattle unable to walk or that are non-ambulatory must be slaughtered under emergency slaughter procedures. According to the OIE standard Injured or sick animals, requiring immediate slaughter, should be killed humanely and without delay, in accordance with the OIE recommendations. Animals that cannot move must never be dragged, pushed or thrown as well as forced to move.
When removal of an animal from inside the trailer is not possible, emergency slaughter carried out at the place where the animal is found, has to be carried out. That option has to be considered only if it does not jeopardize operator’s safety. If stunning equipment is available such an animal has to be stunned first and then bled. Sheep unable to walk should be slaughtered on the spot or under certain conditions loaded onto trolley and moved to the place where they are slaughtered immediately.

Emergency slaughter equipment must be maintained in good condition and at a location of easy access, nearby the unloading area.

The slaughterhouse must have a written animal welfare policy describing adequate procedures to handle non-ambulatory cattle. It must also have adequate equipment to carry out these procedures in a humane manner and competent personnel to identify and execute these tasks promptly.

An animal, regardless of its condition, must never be dragged by the horns, ears, head, tail, legs or other body parts. These procedures are unacceptable.

![Image: Unacceptable handling practices that cause suffering to cattle. Source: Steps.](image)

**ANTE MORTEM INSPECTION IN THE LAIRAGE**

The *ante mortem* inspection must be performed daily at the slaughterhouse with to check health and welfare of animals and required documentation. Official veterinarian has the responsibility for inspection of cattle welfare and taking adequate action in case of sick or injured animals. In addition, continuous monitoring of animal welfare must be carried out by staff working in the holding area.
If an animal is injured or showing signs of sickness in the lairages - holding pens, the team must segregate an animal into an observation pen. An alternative is to remove healthy cattle from the pen and carry out emergency slaughter of the ill or injured animal where it is penned.

Keeping a trained team at the unloading area is essential for assessment and identification of animals showing signs of disease and injuries at the arrival at the slaughterhouse, as well as for separating cattle humanely.

A good observer does not need to agitate the cattle or to push them to stand up and inspect in order to observe bruises or injuries. A comprehensive assessment of the pens is sufficient. It must be remembered that the main purpose of lairage, in addition to performing the ante mortem inspection, is resting the animals prior to slaughter.

**Signs of health:**

- Head up and alert;
- Clear eyes, wet nose and no excessive salivation;
- Manure of normal consistency with no blood;
- Urine with a yellow-straw color;
- No apparent locomotion problems;
- Normal and quiet breathing;
- Interaction and activity with the environment;
- Pin and healthy gums and mucosa;
- Absence of continuous mooing or bellowing of cattle, or bleating of sheep, teeth grinding, convulsion or spine (back) arching;
- Absence of signs of pain, abscesses, wounds, contusions, fractures.
- Absence of heat or cold stress signs.

**Image:** Healthy bull

<table>
<thead>
<tr>
<th>Heat stress signs</th>
<th>Cold stress signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweating</td>
<td>Shivering</td>
</tr>
<tr>
<td>Altered heart rate and breathing frequencies</td>
<td>Erected hair</td>
</tr>
<tr>
<td>Restlessness and agitation</td>
<td>Arched posture</td>
</tr>
<tr>
<td>Salivation</td>
<td>Lethargy</td>
</tr>
<tr>
<td>Exhaustion</td>
<td></td>
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</tbody>
</table>

**Casualty cattle and sheep**

A casualty animal is one that is walking but is otherwise in good health except for a minor, non-acute condition; this may include conditions such as minor wounds, minor lameness and animals that are small or lack condition.
For public health and operational reasons, these animals may need to be slaughtered and dressed at the end of a shift and therefore specific periods should be set aside during the day’s kill for them to be dealt with.

During the day lairage staff must inspect casualty animals frequently and where the condition of any individual is deteriorating, these animals should be moved for immediate slaughter or killed in the pen.

**Immediate emergency slaughter**

Animals suffering from severe open injuries must be killed humanely as soon as possible.

It is recommended that the emergency slaughter is carried at the sanitary slaughter room, or depending on the severity of animal’s injury at the place where animal is (i.e. on the lorry) The veterinarian is responsible for proper situational assessment.
PROCEDURES FOR EMERGENCY SLAUGHTER

Image: Dragging animal that is unable to walk is unacceptable. Source: Steps
Animal to be slaughtered under emergency slaughter procedures should be slaughtered on the spot or moved to sanitary slaughter room. Animal can be moved only if the suitable trolley is available and the moving would not cause any additional pain or suffering to sick or injured animal. Any dragging by rope or pushing is unacceptable.

When conditions impose safety risks for the operator, animal restraint must be performed as quickly as possible using ropes or other restraining devices. It is important to eliminate any risks of injuring and strangulating the animal.

Emergency slaughter shall be carried out by bleeding. If stunning gun is available animal should be stunned prior bleeding.
RESTRAINING OF CATTLE PRIOR STUNNING

INTRODUCTION

For stunning to be effective the shooting position must be accurate. With large animals, such as cattle, basic methods of confining or restraint have been in existence for many years.

The simplest method of restraint is to fix the head using a head collar or halter, however this is only practical where the throughput of the slaughterhouse is very small and where the cattle can be easily roped.

In most slaughterhouses the minimum that is required is some form of stunning box or pen that confines the cattle for shooting, this is a legal requirement in many countries in the world. In addition to simple confinement of the animal, many boxes are now fitted with fixed or moveable devices which restrict movement of the body, neck and head.

PRINCIPLES

When cattle are restrained for stunning the aim is to:

• Reduce, forward and backwards movements of the animal
• Reduce sideward and vertical movements of the head
• Present the head in an ideal position for stunning
• Keep the stress levels of the animal to a minimum

Since restraint is not normal for any animal it can be a very stressful process. In practice there is a need to balance the risk of distress, injury and suffering to the animal through the restraint process, and the risk of distress and suffering that might occur through inaccurate stunning position.

Cattle will also be isolated from other animals when confined within the stunning box and this period of isolation on its own can cause distress even in relatively placid animals. It is important that cattle are never allowed into the stunning box or restrained until everyone is ready and that cattle must never be left waiting in the stunning box.
TYPES OF BOXES AND RESTRAINT DEVICES

Stunning boxes can be supplied direct through a manufacturer or designed and built by the slaughterhouse themselves and fall into four basic categories.

1. **Simple box**

   The cattle are confined within a concrete or metal pen and there is an exit door to eject the animal once it has been stunned. The exit doors either slide vertically upwards or pivot round. Such boxes are acceptable but the operators need to be highly skilled to consistently and accurately stun animals, as the animal's head is free and fully mobile.

![](image)

*Image: Simple box. Source: WSPA*

2. **Passive restraint**

   Passive restraint is where the box has no moving parts but there is a fixed shelf or similar which prevents the animal putting its head down and encourages the animal to put its head in an accessible position for the operator. There are some boxes that have fixed wedges within the box to reduce body movement.

![](image)

*Image: Passive shelve keeping head up. Source: Elders*

3. **Semi-passive restraint**

   Part passive restraint is where there is a combination of moving and non-moving parts to help position the head. For example stunning box is equipped with moving side neck yoke that prevents animal to move its head to sides.

4. **Active restraint of the head**
Active restraints of the head work in two stages; a yoke that catches the neck and a chin lift that raises the head and jaw upwards. Because they hold the animal rigid they must be used in conjunction with other body restraint devices such as a side push or belly lift to prevent animals “hanging” once they are restrained.

5. **Active restraints of the body**

Both rump pushers and side pushers are mechanically operated and reduce the space in the box either in width or in length. A box fitted with a rump and side pusher can also be made longer and wider than would otherwise be possible, this extra space encourages cattle to enter more freely. These devices are essential when the slaughterhouse deals with cattle that differ significantly in size and type, and are useful with all types of boxes whether they are fitted with head restraint devices or not.

![Image: Active restraint of head and body. Source: Steps](image)

**REDDUCING STRESS AND IMPROVING RESTRAINT**

If the stunning box and any restraint is working well the majority of cattle should enter the box willingly and there will be little need for the use of electric goads. Whilst in the box cattle should not vocalise and the total time from entry to stun should be short.

However, handling cattle at this point in the system is often the most difficult as effectively they are being separated from the herd, moving into the different environment of the slaughterhouse and into what may appear to them as a closed box.

To reduce the stress, animals must go into any box willingly. Stress levels increase if an animal stops and refuses to enter or several attempts are required to restrain it. Cortisol levels increase the longer it takes to restrain the animal.

**There are a number of key factors which need to be right:**

- The stunning pen needs to be fully enclosed. Solid sides all round so that cattle can see no movement or distractions from operators or activity in the slaughter hall. The most common problem is usually small gaps at the bottom of the pen where cattle roll out. Cattle will stop and put their head down rather than walking in.
• The floor of the box needs to be non-slip. Steps and slopes designed to improve roll out from the box can be counter-productive as cattle scramble to get their footing.

• Where there are additional devices to restrain or position the animal these must be operated and applied smoothly. Their principle action is to hold the animal in place once it has voluntarily stood in approximately the right position, not to force the animal into position.

• Controls can be pneumatic or hydraulic (the latter are quieter), but in either case it should be possible to apply the restraint smoothly rather than with jerky bumping movements.

• Cattle are calmer in restraint when only mild to moderate pressure is applied to hold the animal rather than to squeeze it tightly. Excessive pressure may cause injury and animals tend to fight against it.

• The box needs to be well lit, but not in a way that light shines directly into the animal’s eyes or creates reflections and shadows. In many slaughterhouses where there are natural lighting conditions these change through the day and during the seasons. Having a number of different lights on separate circuits which can be used by the slaughter team can help cope with the variation.

• When cattle move from the raceway to the box there is often too much contrast and change, for example moving from concrete floors and sides to an all metal stunning box. In this case simply running sheeting on one side of the race and on the floor will make the change less abrupt.

• The box must not look like a dead end. Field studies demonstrate that cattle will stop about 0.75m from a solid wall so the box needs to create an illusion to the animal that there is somewhere to go. A gap or a false front works, provided this is blocked off from activity in the slaughter hall.

• It is difficult to eliminate all noise from the environment around the stunning box but keep it to a minimum. Maintenance of the box is essential to reduce banging and noise from air leaks or similar.

• The box must be free of any sharp angles or projections that might cause injury. There should be no abrupt angles on any of the restraint devices that can create pressure points when applied.

**Inversion**

Methods which invert cattle and turn them on their back in order to limit movement are not acceptable methods of restraint. Positioning – turning an animal in the lateral – side position prior stunning or bleeding is stressful and as a method of restraint is not recommended. Cattle show reduced stress levels when held in a comfortable upright position. When held on their back or side they will struggle and attempt to right (stand up) themselves.
RESTRAINING OF CATTLE FOR SLAUGHTER WITHOUT STUNNING

INTRODUCTION

If animals are to be slaughtered without stunning and killed by exsanguination, proper restraint is more important than prior stunning.

The key principles are however same:

- Calm and confident handling that leads to efficient restraint followed by fast bleeding is essential.
- Unprofessional handling and poor restraint will very likely cause animal to struggle and fight back.
- Observations indicated that calm animals lose sensibility and collapse more quickly after bleeding than cattle with visible signs of agitation.

Cattle that fight restraint are more likely to have prolonged sensibility during bleeding, therefore it is important to keep it calm prior restraint as much as possible. Gentle operation of restraint devices facilitates rapid loss of sensibility.

There are several methods currently used for restraining of cattle prior slaughter without stunning. Many of them compromise welfare of cattle to some extent, or require very skilled handler or can be used on certain type of cattle only.

Some of them will cause animal struggling and fighting against the restraint. One such a method is casting of cattle with rope. The method require a combination of a very skilled handler and docile smaller size cattle that has got used to the practice, so the casting would not cause too much stress to it. Generally method should not be recommended for commercial slaughter.

Image: Casting of Cattle. Source: FAO
Cattle—particularly large ones who were kept most of their lives in free range conditions and not accustomed to handling should not be restrained by rope casting. Based on long-term observations and research, several key principles of low-stress restraint for slaughter without stunning were described.

**KEY PRINCIPLES**

They are already used at many slaughterhouses:

- The first principle is that animals are restrained in comfortable upright position before and during the slaughter. Usually in the box type of restrainer.
- Cattle movement in the box is restricted by mechanical adjustable rump pusher and head restrainer with the chin lift.
- Cattle neck is well exposed by the chin lift that prevents animal from moving its head on sides.
- Mechanical device that lifts an animal’s feet slightly off the ground by belly is a bonus that should ensure that animal is in comfortable position. It is however not an essential part of the restraining device. If the animal’s feet are lifted off the floor, the animal’s body must be fully supported.
- Using the concept of optimum pressure, the restraining device must apply sufficient pressure to provide the animal with the sensation of being held, but excessive pressure that would cause pain must be avoided.

![Image: ASPCA Upright restraining box. Source: T. Grandin](image)

Many existing upright restraint boxes apply excessive pressure. To prevent excessive bending of the neck, the head holder or chin lift should position the animal’s forehead parallel.
The animal should stand in the box with its back level. An arched back is a sign of excessive pusher-gate or rum pusher pressure.

Equipping the head holder with a rubber cover will make it more comfortable. The restraining box for slaughter without stunning has been designed based on these principles and it is used in the USA. It is named the ASPCA pen and well known expert Dr. Temple Grandin has been involved in its designing.

**Table:** behavior of cattle in two different restraining systems i.e Weinberg rotation pen and ASPCA pen. Source: (Dunn, 1990)

<table>
<thead>
<tr>
<th>Action / Behaviour</th>
<th>Weinberg pen (n= 18)</th>
<th>ASPCA pen (n= 50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean time from entering the pen until ready for cut</td>
<td>103.8 sec ± 18.4</td>
<td>11.1 sec ± 11.6</td>
</tr>
<tr>
<td>Total time of struggling before cut (means ± sd)</td>
<td>11.2 sec ± 7.0</td>
<td>1.2 sec ± 3.8</td>
</tr>
<tr>
<td>Number of vocalisations (means ± sd)</td>
<td>4.6 ± 6.1</td>
<td>0.3 ± 0.75</td>
</tr>
</tbody>
</table>

Many practical modifications of ASPCA pen that are built on the same principles while employing mechanical power instead hydraulic would be suitable to use. Moving parts of the restraint device should move with steady smooth motion. Sudden jerky motion causes animals to become agitated.

Some religious groups suggest that the cattle have to be bled in the lateral position while lying on the left side. Restraining an animal and its positioning to the lateral position requires more time, and according to observations causes more stress to animals. It is however still acceptable method of restraint, however not preferred or recommended. Positioning of an animal on the side requires more sophisticated hydraulics mechanisms and it may be more prone to failures.

**Image:** Detail of the chin lift and head restrainer. Source: T. Grandin
Methods of restraint of cattle involving suspending or hoisting it by the feet or legs, or by mechanical clamping of the legs or feet as the sole method of restraint must never be used as they cause animals too much stress and pain.

Immobilizing cattle by breaking their legs, cutting leg tendons or blinding animals in order to immobilize them; severing the spinal cord, for example using a puntilla or dagger, to immobilize animals using electric currents to immobilize animals, are unacceptable practices.

REMEMBER

1. The cattle vocalizing should be minimal. Vocalizing cattle are stressed.

2. Keep cattle calm, Calm cattle bleed out faster.

3. Avoid excessive pressure applied by the rear pusher gate that compresses the animal’s chest against the front of the box.

4. Minimize the time that the animal is fully restrained by the head holder, belly lift, and rear pusher. Time of restraint under 10 seconds is ideal.
**STUNNING**

**INTRODUCTION**

Ever since man learned to club an animal to immobilise it before delivering a lethal wound, stunning has often been the first step in the slaughter process in many parts of the world.

Stunning was at first adopted to produce immobility rather than insensibility, but with the emergence of the animal welfare movement the focus switched to the animal's welfare with the aim of producing insensitivity to pain as the priority.

Captive-bolt stunning equipment has been in existence for around 80 years and is a mechanised version of the first percussive instrument designed specifically for slaughter, the pole-axe.

Image: Pole-axe used for stunning of cattle 150 years ago in the UK

**PHYSIOLOGICAL EFFECTS**

Both types of captive-bolt stunning gun (penetrative and non-penetrative) are percussive in an action; that is they involve the striking of one body, the bolt, against another, the animal's head. If these percussive forces are strong enough they will produce concussion in the animal.

Cerebral concussion is usually a short lasting disturbance of neural function which results in:

- Sudden, often relatively brief impairment of consciousness
- Paralysis of reflex activity
- Loss of memory

There is information on the physical effects of stunning but the precise ways in which physical forces affect the neurological function of the brain are much less certain.
The brain is a relatively incompressible organ, a blow to the head sets up high velocity distortion waves. The frequency of these pressure waves will vary in different parts of the brain and this may be an important factor in inducing insensibility.

There may also be transference of pressure waves from brain to spinal cord and the ‘contra-coup’ effects of the brain making impact with the skull.

The exact position and angle of the head when a blow is delivered can also affect the mechanics of the impact and possibly the acceleration of the head, and the brain within the skull. This may account for the variation in how the brain might be affected.

There are several theories of why the state of concussion occurs (reviewed by Shaw 2002):

Currently the “Direct mechanical insult to the neurons” theory which says stunning leads to a sudden depolarisation of neurons followed by a short period of excitation (tonic/clonic) seizures and finally a quiescent phase due to neuronal paralysis is the most favored.

It supports the fact that in most cases concussion causes only functional damage and therefore it is reversible.

However where there is too much energy imparted to the brain by the impact, this will generate movement of the cerebral hemispheres and increase the chance of tissue damage, or deformation, between the cortex and the skull. Some believe it is this which produces global ischemia of the brain and permanent loss of brain activity.

**PHYSICS**

Not every blow to the head, to either a human or an animal, will produce a state of unconsciousness. To achieve the unconscious state relies upon transferring enough energy from a moving object, the bolt, to the animal’s brain.

The energy of a moving object is known as *kinetic energy* and the amount of energy produced is proportional to the *mass* of the moving body and its *velocity*. The relationship is expressed in the formula:

\[ KE = \frac{1}{2}mv^2 \]

- Kinetic energy is measured in joules (J)
- The mass of the object (m) is given in grams (g)
- The velocity of the object (v) is given in metres per second (ms\(^{-1}\))

A simple calculation *(see Table 1)* illustrates that it is the velocity of the projectile which has a much greater influence on the kinetic energy delivered, and therefore the effectiveness of the stun, than the mass of the object.
There has been a progressive improvement in the performance of many makes and models of captive-bolts compared to those available 20 years ago. However, even in a modern stunner, any factor which reduces the bolt velocity, such as poor maintenance, can seriously affect the performance and the likelihood of an effective stun.

**EQUIPMENT**

All captive bolts work along similar basic principles. There is a steel rod either with or without the mushroom type head with a flange and a piston which make up the bolt.

The bolt is contained within a barrel, with the piston fitting tightly into a combustion chamber and the bolt being surrounded by compressible recuperating sleeves.

When fired, the power source propels the piston forward.

The bolt then emerges through the opening at the muzzle and either strikes or penetrates the skull. The bolt is retained by the flange (hence the name “captive-bolt”) and the energy is absorbed by the recuperating sleeves.

Stunners can be fired with a trigger mechanism or fired on contact with the animal’s skull.
Power source

The power required to propel the bolt forward is from either a blank cartridge or compressed air.

a) Cartridge – these vary in strength and are classified by the amount of propellant they contain, measured in grams. It is essential that the correct cartridge is used for the make and model of stunner and appropriate for the size of animals to be stunned. Cartridges can be identified by calibre (e.g. 0.22 or 0.25), colour and head stamp.

b) Compressed Air – power is provided via a high-pressure air compressor. The equipment is heavy and not easily maneuverable and needs to be suspended by a counter-balance arrangement over the box.

The cattle need to be well restrained. However, a higher throughput of animals is possible and there is less maintenance.

Non-penetrating captive-bolt

Non-penetrating captive-bolt stunning produces a depression of the frontal tissue and bone as well as some haemorrhage, particularly beneath the impact site in the temporal and frontal lobes.

The use of a frontal non-penetrating captive-bolt results in immediate loss of consciousness in all animals and rhythmic breathing is absent.

Research work on the depth and duration of unconsciousness for adult cattle after a non-penetrating captive-bolt has not been reported; the duration of insensibility for calves is about 20 seconds. There is sufficient field evidence to demonstrate that concussion is immediate but not long lasting. If energy is insufficient there will be a high percentage of animals that will require a re-stun.

Non-penetrating captive-bolt stunning is not recommended for young calves and mature very old cows and bulls. It is thought that in young calves the skull is soft which absorbs energy and reduces efficiency. In the case of mature animals, the skull is brittle and the energy is dissipated over the frontal bone.

As there is no invasion of the skull and direct damage to the brain the period of unconsciousness can be short lived.

The stun to stick time is critical and animals must be bled without delay; within 20 seconds from stunning.

STUNNING POSITION

The stunning position for a non-penetrating captive-bolt is 2cm above the intersection of two imaginary lines drawn from the rear of the eyes to the opposite horn buds. The muzzle must be placed at right angles to the skull directing it to the centre of the brain.
SIGNS OF AN EFFECTIVE STUN

The outward signs in cattle that a stun has been effective are the same with both non-penetrating and penetrating captive-bolts.

Monitoring Points are:

• Immediate collapse and no attempts to stand up
• Immediate and sustained absence of rhythmic breathing
• Absence of righting reflex
• Fore legs and hind legs flexed initially; fore legs will then straighten and become extended
• Eyes must not be rotated; a rotated eyeball indicates a deep stun is not present and there is a risk of return to consciousness
• No reflex response to a nose prick or ear pinch
• Absence of corneal reflex

If the animal does not show these signs then it must be re-stunned immediately.
Failure to stun

In the practical situation there may be occasions when the animal is not effectively stunned this could be the result of:

- Incorrect stunning position
- Not enough power e.g. wrong cartridge size or drop in air pressure
- Stunner malfunction
- Poor maintenance

A back-up stunner should always be close to hand should the main equipment fail. If the first stun fails the next attempt should always be in a different position because the swelling and damage caused by the first attempt reduces the effect of a second impact in the same place.

General considerations (According to the Article 7.5.7) of the OIE standards

The competence of the operators, and the appropriateness, and effectiveness of the method used for stunning and the maintenance of the equipment are the responsibility of the management of the slaughterhouse, and should be checked regularly by a Competent Authority.

Persons carrying out stunning should be properly trained and competent, and should ensure that:

a) the animal is adequately restrained;

b) animals in restraint are stunned as soon as possible;

c) the equipment used for stunning is maintained and operated properly in accordance with the manufacturer's recommendations, in particular with regard to the species and size of the animal;

d) the equipment is applied correctly;

e) stunned animals are bled out (slaughtered) as soon as possible;

f) animals are not stunned when slaughter is likely to be delayed; and

g) backup stunning devices are available for immediate use if the primary method of stunning fails.

RECORDING PERFORMANCE

Regular objective measurements should be made to monitor accuracy of the stunning. Ideally this should be at roll-out from the box to record the effectiveness of the stun, and examination of the heads of the same group of animals that where observed.
Operators should not be judged purely on the level of double stuns seen at the head rail, otherwise there is a danger that they could be discouraged from delivering a second stun where there was some doubt about the effectiveness of the first. However, consistent high levels of second stuns should be investigated.

In European studies with bulls, approx 4% of a sample of 1100 bulls needed a second stun and in other studies the incidence of second stuns ranged from 4-6.6%. A second stun rate of 5% or less is seen as acceptable when auditing performance and less than 1% as excellent.

Provision of a manual inspection area and simple intervention like captive bolt or cervical dislocation for poultry would help prevent potential welfare problems. In addition, such persons should be able to recognize when an animal is not correctly stunned and should take an appropriate action.
BLEEDING AFTER STUNNING

INTRODUCTION

The use of non-penetrating captive bolt equipment in stunning cattle induces an unconsciousness for certain time period. Therefore, it is essential that bleeding be carried out immediately post-stunning to prevent any recovery of an animal. The bleeding should be carried out within 20 seconds from stunning.

Images: 1) An absence of rhythmic breathing, fixed and glazed eye 2) No corneal reflex. 3) Relaxed jaw with exposed tongue (protruding). Image: Steps

BLOOD LOSS AND DEATH

Blood loss deprives brain of oxygen and nutrients and causes its death.

Cattle’s anatomy of blood supply to brain is very different from one in other farm animals i.e. sheep. As we see on the picture (below) cattle brain blood supply is provided via carotid arteries running on both sides of the neck and vertebral arteries that are running in the spinal cord. It is estimated that more than 20% of blood supply to the brain is via the vertebral artery

In order to cut both vertebral and carotid arteries in many parts of the world bleeding is carried out by so called chest stick.

That is performed by cutting the large vessels that emerge from the heart (carotid and vertebral arteries), at the base of hearth; thus, excessive blood loss deprives the heart from pumping a sufficient blood volume to tissues, including the brain, leading to hypovolemic shock. The cerebral function is gradually lost until the animal’s death.
Although accepted, when performing transversal section of neck the vertebral arteries are not cut delaying onset of a death as blood supply to the brain is partially maintained; In transversal cut of the neck both carotids and jugulars have to be severed. 

When bleeding is carried out after the stunning it should be

a) rapid, profuse and complete

b) completed before animal regains consciousness

The time needed to reach unconsciousness and death of a cow only by blood loss depends on method of bleeding, previous handling, blood clotting, sharpness of the knife and positioning of the incision.

It is estimated that loss of consciousness starts within 20 seconds after sectioning the blood vessel emerging from the heart.

**Stun-to-stick time interval**

It is recommended that a maximum 20 second interval between stunning and bleeding occur when using **non-penetrating captive bolt guns**, causing cerebral concussion. Animal should be left to bleed at least for 30 seconds before any other procedures are carried out.
Before that it has to be assured that animal is death by checking negative corneal reflex and absence of rhythmic breathing.

Image: Bleeding cattle after the transversal neck cut

**BLEEDING PROCEDURE**

Bleeding should be performed by transverse cut of the neck at the C1 – C3 (cervical vertebra) level, and severe both carotids. Knife should be sharp and double size of the cattle’s neck. Cut across the neck of an animal should be made in one swift move. Reciprocal (forward and back) move is acceptable.

If a good flow is not observed, the blood vessels should be cut again as they may not be entirely severed.

No slaughter procedure subsequent to bleeding can be carried out until animal’s death is ascertained.

**REMEMBER WHEN BLEEDING IS CARRIED AFTER THE STUNNING:**

- All cattle must be unconscious at bleeding and must remain so until the moment of death;
- Verify whether an animal presents signs of insensibility prior bleeding. If in doubt re-stun an animal
- For a fast bleeding, severing the main large vessels at the base of heart is a preferred method; Bleeding can be performed by severing neck and both carotids at the C1-C3 level.
- Only after the animal is confirmed dead should skinning and other procedures be initiated;
- Stunning, verifying signs of insensibility and bleeding of cattle are procedures that must be carried out as soon as possible and follow each other as soon as possible.
KILLING OF CATTLE BY BLEEDING WITHOUT PRIOR STUNNING

INTRODUCTION

Slaughter without stunning is practiced according to specific requirements of religious groups. From practical point of view it often means that the animal is killed by bleeding or exsanguination only.

From an animal welfare standpoint, the major concerns are related to stressful and cruel methods of immobilization of animals that are used in some plants and bleeding carried out with blunt and short knife. Poor quality knife often requires multiply sawing movement of knife on the neck of an animal. When animal is restrained the bleeding has to be carried as soon as possible. A very sharp knife is essential.

Image: Bleeding knife has to be at least one and half ideally twice the width of the throat of cattle or sheep. Tip of the knife should point outwards as to prevent gouging into the wound. Photo courtesy of Judy Moses, Spirit of Humane (spiritofhumane.com)

BLEEDING

Size of the knife is very important too. The razor-sharp knife that has to be at least one and half or ideally twice the width of the throat of cattle. Tip of the knife should point outwards as to prevent gouging into the wound during bleeding. The sharpness of the knife is tested by easily cutting sheet of paper (A4 size) held by one corner by tips of fingers. Cut must be made in a single continuous motion. Reciprocal move (back and forward) is also acceptable. To avoid unnecessary pain the wound must be held opened during the bleeding and the knife must be long enough so that it's tip remains always outside the neck during the cut.

Slaughter performed with short blunt knives and multiple hacking cuts results in a vigorous reaction from cattle. Shorter knives, where the tip of the knife gouges into the wound during the cut, causes unnecessary pain to animal. The cut must severe both carotid arteries.

Calves and cattle take a longer period of time to become insensible than sheep and after bleeding without stunning they are more likely to have a prolonged period of insensitivity. The time from bleeding to loss of sensibility when good cutting technique is used ranges from 17 sec to 85 sec. Some cattle may have prolonged periods of sensibility lasting up to 385 seconds.
Loss of consciousness is usually observed by loss of posture. In situations where the loss of posture cannot be observed for example in the restraining box, a fixed fully dilated pupil can be used to determine complete loss of sensibility.

**WELFARE ISSUES**

Two major welfare problems can occur during slaughter without stunning. They are a prolonged period where the bovine remains sensible and aspiration of blood into the trachea (windpipe) and respiratory tract. Blood entering the respiratory tract is a welfare concern because the sensation caused by blood entering the respiratory system is likely to be very distressful.

Observations and research indicates that cutting cattle close to the jawbone would eliminate the transmission of unpleasant sensory signals associated with blood contaminating the upper and lower respiratory tract.

When the cut is made close to the jawbone in the C1 position - at the level of first cervical vertebra, the sensory nerve to the respiratory tract is severed. If the cut is made more caudal between C2 and C4, the sensory nerve remains intact and distressful sensations could be transmitted to the brain before the animal loses sensibility.

Cattle’s brain is supplied by blood via carotid arteries that are severed by neck cut and vertebral arteries that are not severed by ventral neck cut. According to research, up to 10% of cattle have delayed onset of insensibility due to clotting of blood in the arteries and formation of false aneurysms during bleeding.

Usually connective tissue would encapsulate the bleeding ends of the carotid arteries and help to form clotting. Carotids partially or completely obstructed by blood clots and continuous blood supply to brain via vertebral arteries creates situation where cattle is observed as conscious 3-4 minutes after cutting the neck.

Therefore it is crucial to pay particular attention to cattle during bleeding and if bleeding is not profuse another cut has to be made to ensure rapid and profuse bleeding. According to research cutting neck close to the jawbone at the level of first cervical vertebra - C1 position greatly reduces the formation of false aneurysms. When cattle throat is cut in the C1 position, only 1% of cattle would have arteries occluded.
BLEEDING TECHNIQUE

![Image: Bleeding technique with one transversal move of knife]

WOUND MANAGEMENT AND POST INCISION PERIOD

During bleeding wound must be kept intact and both edges kept apart. Disturbing the edges of the incision or bumping it against the equipment, will likely cause more pain. The head of an bleeding animal must be restrained in such a manner that the incision does not close back over the knife. Cattle and sheep struggle violently if the edges of the incision touch during the cut. The calm and confident approach during all stages of slaughter is essential as it facilitates rapid loss of sensibility. Immediately after the cut, the head restraining device and rear pusher should be loosened to allow the animal to relax. Often after the head restraint is released, the animal collapses in short while.
Within 17 to 60 seconds, cattle go into a hypoxic spasm and sensibility appears to be lost. There are several ways to assess loss of sensibility. In most cases it is possible to use loss of corneal reflex or rhythmic breathing. Rhythmic breathing can be sometimes confused with gasping and corneal reflex can be sometimes caused by muscle twitch or provoked as involuntary reaction in unconscious animal. Key sign of loss of sensibility is therefore a loss of posture.

**Remember the key aspect of the best practice**

1. Sharp and long knife is essential for fast bleeding
2. Rapid swift knife stroke with a minimum of sawing motions.
3. Deep cuts is essential
4. Immediately after the cut, COMPLETE release of the head holder, and rear pusher gate ensures that animal will relax.
5. Edges of the wound have to be held apart at all time. If the neck opening is too tight, it may restrict bleed out.
RERAINT STUNNING AND BLEEDING OF SHEEP

RERAINT PRIOR STUNNING

Sheep are usually restrained either a) in a group pens, or stunning rooms, b) in a restrainer conveyor or c) in a restraining box. As the isolation of an individual sheep is highly stressful, the most frequent methods of restraint are restraint in a group pen or in a restrainer conveyor.

The restraining pen/room is usually filled with sufficient sheep to restrict movement. The stunning operator then individually approaches sheep from a blind spot and carries out stunning. Another operator ensures immediate shackling and hoisting. When there are less sheep in a pen/room more sheep are moved in. This method of restraining is used in both electrical and mechanical stunning (by captive bolt).

However electrical stunning of sheep kept in groups in a pen has the following disadvantages:

• Sheep crowd together and often hide their heads (keep their heads low) under other animals; which makes it difficult to reach and correctly place the electrodes on the head.

• Sheep in a group standing close to the electrodes or the head of a sheep being stunned may receive electric shocks when they are accidentally in contact with that part of the stunned animal that is subject to electrical current.

Images: Restraint in restrainer conveyor. Source: HSA

The second most frequent way of restraining sheep and lamb is restraint in a V shaped restrainer-conveyor. Sheep are moved in groups to a crowding pen that feeds into a single file conveyor. When the first sheep enters the conveyor others simply follow. The speed of the conveyor is adjusted to suit the method of stunning. When electrical stunning is used with an application time of 3-4 seconds the belt needs to be adjusted to slower speeds than used for mechanical stunning.

The same basic rules regarding environment in and around a restraining pen / V restrainer conveyor apply (light, distractions, reduction of noise) as in restraint of cattle.
STUNNING

Electrical stunning (head only stunning)

Head-only electrical stunning methods have been in use for over 50 years and during that time equipment design and efficiency has improved substantially. However the majority of head-only stunning systems rely on manual application of tongs to the head and as such their effectiveness is under the direct control of the operator.

How does it work?

Electrical stunning (Electronarcosis) involves passing an electric current through the brain. This disrupts the normal electrical activity in the brain to the extent that the animal becomes unconscious and insensible to pain.

Electrical stunning involves stimulation of the whole brain and with sufficient current to cause repeat firing of nerve cells which is immediately followed by an exhausted brain state similar to ‘grand mal’ epilepsy in humans.

The effect on the animal is only temporary so the objective is to induce unconsciousness quickly and ensure that the duration of unconsciousness lasts until the main blood vessels in the chest to be cut and that the animal dies. The three key rules for effective electrical stunning are: correct electrical parameters, correct application position, and sufficient time of application.

Electrical principles

It is the current delivered to the brain which stuns the animal. At a constant voltage the amount of current flowing through the brain is inversely proportional to the total electrical resistance pathway. This is known as Ohm’s Law where: $I \ (amps) = V \ (volts) / R \ (ohms)$

The current is the rate of flow of the electricity, the voltage is the electrical pressure that drives the current through the head and through the brain, and the resistance is the reduction of flow of electric current caused by the wool, skin, connective tissue bone and brain that the current passes through.
The voltage must be high enough to overcome the resistance in the pathway between the electrodes and deliver enough current to produce an effective stun.

Resistance to current flow is affected by:

- Electrode material
- Skin and hair
- Thickness of the skull
- Brain tissue
- Distance between the electrodes.

In general terms the resistance can be reduced to improve current flow by ensuring electrodes are clean, the stunning site is wet (water is a good conductor of electricity) and there is little hair or dirt on the contact site. The resistance across the head of a short fleeced sheep can range between 150 to 400 ohms. In the case of heavy fleeced rams the resistance can range from 200 to 1000 ohms. As that is too high, wetting of the head or clipping hair is carried out to lower the resistance. A poor initial contact or a slow rise in current levels may not stun the animal immediately, and instead the animal could experience an electric shock. Therefore, good electrical contact is necessary to provide an effective stun. Wetting the contact places and the stunning electrodes with water will improve the effectiveness of stunning.

Images: Wetting heads of sheep before or at the time of stunning. Source HSA

**Equipment electrical parameters**

Research has shown that generalized epilepsy can be induced in the brain within 1 second of application of a minimum current of 0.6 amps. EU legislation and OIE standards do however require a minimum current of 1 amp to be delivered to the sheep brain in the stunning procedure. A minimum voltage of 150 Volts (50Hz current) is required to deliver this amperage level in 2 seconds. A minimum current of 0.7 amp is required when stunning lambs, and the recommended time of application of electric tongs is 3 seconds

In order to effectively monitor the stunning operation electrical equipment as a minimum, should:

- Be capable of measuring the resistance of the “load” (the animal being stunned)
- Not operate unless there is sufficient current to overcome the detected resistance
- Have audible or visible warning devices, which indicate the required duration of application
• Have a read-out which clearly indicates the current and voltage under load, positioned where it is clearly visible to the operator.

**Correct position of electrodes**

In order to be effective, stunning tong electrodes must be positioned firmly on the head so that they are on either side of the brain. The current can then flow through the skull to the brain by the most direct route. The only correct position of electric tongs/electrodes used in stunning of sheep and lamb is placing the electrodes between eyes and the base of the ears on either side of the head.

![Correct position of electric tongs](source/HSA)

**Signs of effective electrical stunning**

When sheep have been effectively stunned they go through two clear stages.

A *tonic* phase which lasts for between 10-20 seconds when:

• The sheep collapses and the whole body of the animal becomes rigid
• Breathing will stop
• The position of the eye becomes fixed
• When current flow stops the tonic seizure continues during which the head is raised and the hind legs are flexed under the abdomen
• Forelegs are usually partially flexed or straighten out.

![A tonic stage at the end of the application of electric current](source:HSA)
A **clonic** stage then follows lasting between 15-45 seconds when there is:

- Involuntary kicking of both fore and hind legs
- Hind legs kick
- Forelegs paddle
- Gradual relaxation.

If the animal is not bled the clonic seizures will gradually subside and finally end. The return of rhythmic breathing signals the start of return to consciousness and other reflexes that indicate recovery. With a stun application of 3 seconds the average time for the return of reflexes in sheep is:

- Rhythmic breathing: 30 seconds, followed by;
- Corneal reflex: (in practice this reflex is often difficult to elicit and also highly variable)
- Response to peripheral tactile facial stimuli
- Head righting reflex that indicates full recovery of consciousness and sensibility.

**Any of the following indicate an inadequate stun:**

- No tonic or clonic seizure
- Return to rhythmic breathing
- Focused eye movements
- Constricted pupils
- Return of the head righting reflex.

**Design of electrodes and their maintenance**

Pointed electrodes (electrodes with pins) give good grip and electrical contact, because they penetrate the wool and make better contact with the skin when compared to electrodes without pins. Electrodes with serrated edges may work effectively in shorn sheep if the area of application is wetted.

Though the heads of the sheep are small and the skin is woolly, often burning of electrodes occurs which leads to intensive carbonising of the electrodes. This, in turn, leads to poor electrical contact and increased electrical resistance in the pathway.

**Images:** Design of electric tongs and electrodes with pins
BLEEDING AFTER STUNNING

Introduction

The unconscious, insensible state following a stun is short. To ensure death without risk of recovery, stunned animals must be bled without delay. When blood vessels are cut, blood loss deprives the brain of oxygen and nutrients and consciousness will gradually be lost. Further blood loss will damage brain function and lead to death.

Blood loss unconsciousness and death

The time taken for an animal to become unconscious from blood loss and eventually die will depend on the number of vessels that are cut and the efficiency of cutting.

Experiments with sheep by Gregory and Wotton show that if sheep are bled by cutting both carotid arteries and jugular veins, unconsciousness occurs in around 14 seconds. If only one artery and vein are cut, it takes 70 seconds for the sheep to become unconscious. However if sheep are bled by chest stick it takes only 4 seconds to observe brain unresponsiveness.

The maximum stun-to-stick interval can be calculated as follows: Resumption of rhythmic breathing after electrical stunning (average 30 seconds) minus time to loss of brain responsiveness after cutting both common carotid arteries and external jugular veins (14 seconds). According to that calculation a maximum recommended stun to bleed time is 15 seconds.

![Phases following head-only electrical stunning](image)

Image: Post electrical stunning phases and time of bleeding;

Bleeding has to be done by making a deep, transverse cut across the throat close to the head to sever the four major blood vessels in the neck. See image below. This is an acceptable method of bleeding in sheep and goat.
RESTRAINT OF SHEEP PRIOR SLAUGHTER

Sheep when slaughtered by bleeding can be restrained in different ways. The simple methods include sheep standing on the floor and being manually restrained by lifting the head to stretch the neck with one hand and the other holds the knife and performs a transverse ventral cut. Sheep can also be placed on their side in a cradle and held manually by one operator while another stretches the neck and performs the cut. More sophisticated methods include less stressful restraint in a restraining chute (see images below) or restraint in a restrainer conveyor. When restraining sheep in a chute/pen or conveyor it is important that the sheep lies comfortably on its belly with its legs hanging freely from the pen or conveyor. The head is usually restrained by an operator. Upright restraint is the least stressful method as sheep are either automatically lifted by the conveyor belt or they are mechanically lifted in a restraining chute from the standing position. No other forceful manipulation or associated additional stress/distress is caused during restraint in the upright position.

Images: Sheep and goat in upright restraint; Photo courtesy of Judy Moses, Spirit of Humane (spiritofhumane.com)
BLEEDING

Bleeding has to be done by making a deep, transverse cut across the throat close to the head to sever the four major blood vessels in the neck. Cutting must be done in one swift continuous motion.

Reciprocal cutting (back and forward) is also acceptable. To avoid unnecessary pain the wound must be held opened during the bleeding and the knife must be long enough so that it’s tip remains always outside the neck during the cut.

Poor quality knives often require multiple sawing movement of the knife on the neck of an animal. A very sharp knife is essential. Sharpness of the knife can be tested by smoothly slicing a piece of standard A4 printer paper that is held by one corner.

Size of the knife is very important too. The razor-sharp knife that is used should be at least one and half or ideally twice the width of the throat of an animal. The tip of the knife should point outwards as to prevent gouging into the wound during bleeding.

Shorter knives, where the tip of the knife gouges into the wound during the cut, cause unnecessary pain to the animal.
REFERENCES


GRANDIN, T; www.grandin.com


Health and Safety Authority of Ireland www.hsa.ie


MAFF. Ministry of Agriculture, Fisheries and Food. The welfare of animals (slaughter or killing) regulations 1995. S.I n. 731.


NAWAC. National Animal Welfare Advisory Committee. Discussion paper on the animal welfare standards to apply when animals are commercially slaughtered in accordance with religious requirements. New Zealand, 2003.


REGENSTAIN, J; Spirit of Humane www.spiritofhumane.com


ndnumdoc=11997D/PRO/10andmodel=guichett>.


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