Practical guidelines for the humane killing of animals, the disposal of animal carcasses and contaminated materials, and the cleaning and disinfection after disposal

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1. Humane slaughter of animals

1.1. Basic principles

The eradication of an infectious disease in a livestock population is basically a three-step process:

1. the humane slaughter of animals,
2. the disposal of animal carcasses and contaminated materials,
3. cleaning and disinfection after disposal.

Humane killing is the process of killing animals for public health, animal health, animal welfare or environmental reasons under the supervision of the competent authority, where the methods used to kill the animals result in the immediate death or immediate unconsciousness of the animal until death. The process must not cause avoidable distress, pain or suffering.

When we have to cull animals to control disease, we should aim to meet all of the following objectives:

- the use of killing methods or procedures that comply with legal and environmental requirements;
- the competent authorities should monitor procedures to ensure that they are consistently effective in terms of animal welfare, operator safety and biosecurity;
- ensure that adequate handling and killing staff, supplies, materials and equipment are available before an outbreak occurs;
- all staff involved in the humane killing of animals must have the appropriate skills and competences. Competence may be acquired through formal training and/or practical experience;
- where necessary, procedures should be adapted to the specific circumstances of the site and should address costs, personnel safety, biosecurity and environmental concerns in addition to animal welfare;
- the killing of animals must be carried out with the minimum possible suffering, and the methods used must result in immediate death or immediate loss of consciousness until death. If the loss of consciousness is not immediate, the induction of loss of consciousness must be non-obnoxious or as unpleasant as possible and must not cause avoidable distress, pain, distress or suffering to the animals.
- animal movements should be kept to a minimum and, if they do occur, should be carried out in accordance with the recommendations;
- kill operations must be completed as soon as possible;
- for animal welfare reasons, young animals should be killed before older animals; for biosecurity reasons, infected animals should be killed first, followed by contact animals, and only then other animals;
- prevent the spread of the disease with minimal impact on the environment and the community;
- the killing of livestock for disease control purposes should only be carried out if an appropriate and fair compensation mechanism is in place to compensate the losses suffered by the keeper. If animals are killed without compensation, this will create a

serious lack of confidence in the veterinary authority and may lead to concealment of cases, which will ultimately facilitate the spread of the disease;
- the general principles should also apply when animals are to be killed for other purposes, such as after natural disasters or for the purpose of culling livestock.

As the first step in eradication is to kill animals gently, any delay in killing animals risks further spreading the disease.

The animal may be killed gently:

- mechanically (e.g. by using firearms)
- electrically (e.g. passing an electric current through the heart, after stunning, to induce ventricular fibrillation)
- using gases
- by lethal injection

Some techniques such as firearms, electric stun-killing or prolonged exposure to gas mixtures are considered stunning and killing methods that cause the death of the animal in one step. These methods cause unconsciousness and then lead to death without further action.

The same animal welfare rules must be observed when animals are killed in a humane way as when they are slaughtered. It is important to:

- after stunning, the animal must be checked for unconsciousness before slaughter;
- after slaughter, before disposal, it must be checked that the animal is dead.

Stunning is a procedure that causes the animal to immediately lose consciousness. Stunning is a reversible process and therefore the stunned animal may regain consciousness if it is not killed (or slaughtered). It is important that the method of stunning used ensures immediate loss of consciousness, avoiding any discomfort or pain caused by the stunning.

Depending on the stunning method used, signs of successful stunning may vary. Standard checks include examination of the animal's posture, respiration, corneal reflex, vocalization and eye movements.
After successful stunning, the animal should be killed as soon as possible. While the animal is unconscious, it feels no pain and therefore does not suffer during the killing procedure. Successful killing results in the death of the animal. Death is defined as an irreversible loss of brain activity, as evidenced by the loss of brainstem reflexes (WOAH, 2022). The same criteria for determining death should be used as for euthanasia of the animal. Note that some of these criteria, such as checking the pulse or heart rate, may not be feasible in field conditions.

Signs of death:

- no corneal reflex (involuntary blinking of the eyelids by stimulation of the cornea),
- no (rhythmic) breathing,

- no heartbeat,
- rigor mortis (rigor mortis).

1.2. Planning

1.2.1. Organisational structure

You should bear in mind that the killing of animals to control disease is a unique situation that is very different from normal farming routines. For many people, this will probably be the first time they have been involved in such work. If everyone is clear about who is responsible for what, the chances of confusion in the process can be minimised. It is recommended that the roles of individuals and groups are defined and agreed before the outbreak. It is very important that the right people are selected for each role.

Operational activities must be managed by an incident commander (official veterinarian), who is authorised to appoint the staff of the teams and ensure that they comply with the required animal welfare and biosecurity standards.

The Incident Commander should be responsible for all activities at one or more of the sites concerned and should be supported by coordinators in planning (including communications), operations and logistics to facilitate efficient operations.

The Incident Commander should provide overall guidance to staff and logistical support for operations at all relevant sites to ensure consistent compliance with WOAH animal welfare and veterinary recommendations.

Each group must have a veterinary officer, or at least access to veterinary advice at all times. The team must be composed of persons with the necessary competence to carry out all the necessary operations. In certain situations, staff should perform more than one function.

Event Commander (EP):

a) Tasks:

- plan the general operations of the sites concerned;
- identify, monitor and manage animal welfare, personal safety and biosecurity requirements;
- organise and manage a team to promote the humane killing of the animals concerned on the premises in accordance with national rules and these recommendations;
- determine the logistics required;
- report on progress and problems;
- submit a written report at the end of the killing, describing the practices used and their impact on animal welfare, personal safety and biosecurity outcomes.

b) Competences:

- knowledge of standard animal husbandry practices;

- understanding the behavioural, anatomical and physiological processes underlying the animal slaughter process;
- the skills needed to manage all activities on the site and deliver results on time;
- awareness of the psychological effects on the farmer, group members and the public;
- effective communication skills;
- assess the environmental impacts of their operations.

Team Leader (CSV):

a) Tasks:

- plan the general operations of the site concerned and draw up a culling plan;
- define, monitor and manage animal welfare, personal safety and biosecurity requirements;
- organise, inform and direct the team responsible for the humane slaughter of animals on the premises;
- determine the logistics required;
- report to the EP on both progress and problems encountered;
- submit a written report to the EP at the end of the slaughter, describing the practices adopted and their impact on animal welfare, personal safety and biosecurity.

b) Competences:

- knowledge of standard animal husbandry practices;
- understanding the behavioural, anatomical and physiological processes underlying the animal slaughter process;
- adequate skills to manage all activities on the site and deliver results on time;
- awareness of the possible psychological effects on the farmer, group members and the public;
- effective communication skills;
- assessing the environmental impacts caused by the process.

Veterinary surgeon (ÁO):

a) Tasks:

- determine and monitor the most appropriate method of killing to ensure that animals are killed without avoidable pain and suffering;
- define and implement additional animal welfare requirements, including the order of slaughter;
- ensure that the death of animals is confirmed by competent persons at appropriate times following the killing process;

- minimise the risk of disease spread on and off-site by monitoring biosecurity procedures;
- continuously monitor animal welfare and biosecurity procedures;
- prepare a written report, in collaboration with the CSV, on completion of the killing, describing the practices used and their impact on animal welfare.

b) Competences:

- the ability to assess animal welfare, in particular the effectiveness of stunning and killing, and to correct any deficiencies;
- the ability to assess biosafety risks.

Animal keepers (ÁG):

a) Tasks:

- review on-site facilities for adequacy;
- design and construction of temporary animal management facilities where necessary;
- move and restrain the animals if necessary;
- continuously monitor animal welfare and biosecurity procedures.

b) Competences:

- handling animals in emergency situations;
- knowledge of the principles of biosafety.

Animal slaughtering staff (SNE):

a) Tasks:

- ensure the humane killing of animals through effective stunning and killing.

b) Competences:

- if required by law, is authorised to use the necessary equipment;
- be able to use and maintain the appropriate equipment;
- has the necessary expertise to use the techniques for the species concerned;
- suitable for evaluating effective stunning and killing.

Personnel involved in the disposal of animal carcasses (AC):

a) Tasks:

- effective disposal of carcasses in accordance with biosecurity rules;
- ensuring that the disposal of carcasses does not interfere with/interfere with slaughter operations.

b) Competences:

- staff must be able to use and maintain the equipment available and apply the techniques for the species concerned.

Farmer/owner/operator (MT):

a) Tasks:

- the role of farm owners/managers and livestock workers in eradication for disease control purposes is to assist the team on request;
- be allowed to participate in the operation to the extent that is convenient for them.

b) Competences:

- special knowledge about animals;
- understanding biosafety;
- knowledge of the place and its environment.

1.2.2. Size of the killing team

The minimum group size is two people. In this situation, the leader of the group should be an official veterinarian who also carries out the humane killing of the animals, accompanied by an animal caretaker. Both should also take the role of carcass disposal staff.
However, this is only applicable in very limited circumstances, where the number of animals is very small and the facilities for handling animals are well structured. It is not recommended to overburden staff with multiple tasks as they are unlikely to be able to carry them out efficiently. This may cause problems later on, both in terms of animal welfare and staff safety.

1.2.3. Considerations for planning the humane killing of animals

Careful planning of a humane killing operation is crucial for smooth and efficient organisation, as well as for human safety and animal welfare. There are wide variations between livestock production systems, so each outbreak will be unique.

Before operations can begin, the team leader must prepare a written plan with the agreement of the EP and the MT. This plan is called **a kill plan or action plan.**

The culling plan must include the following:

1) minimise the handling and movement of animals;
2) the species, number, age and size of the animals to be slaughtered and the order in which they are to be slaughtered;
3) methods and costs of killing animals;
4) housing, housing, location of animals and accessibility of the farm;

5) the availability and efficiency of the equipment needed to kill the animals and the time required to kill the required number of animals by such methods;
6) the facilities available on site to assist the slaughter;
7) biosafety and environmental issues;
8) issues concerning the health and safety of staff carrying out the killing;
9) the competences and skills of staff handling and killing animals;
10) any legal issues that may arise (e.g. veterinary medicines, environmental protection);
11) the presence of other premises keeping animals nearby;
12) options for the removal, disposal and destruction of animal carcasses.

The plan should minimise the negative effects of killing, taking into account the different phases of the killing procedures (selection of killing sites, killing methods, etc.) and measures to restrict the movement of animals.

When designing a culling plan, it is essential that the method chosen is consistently reliable to ensure that all animals are killed humanely and quickly.

1.2.4. Specific design considerations

The order in which animals are killed:

For animal welfare reasons, **young animals** should be killed **before older animals**. In particular, young animals that have not yet been weaned should be killed immediately after weaning from their mothers.

For biosecurity reasons, **infected animals should be** killed **first**, preferably on the farm, followed by animals known to have been in contact with infected animals and finally animals remaining on the holding.

If **more than** one **species** is kept on the premises, they may be killed in the **following order**: pigs > cattle > goats > sheep > poultry > farmed game.

Personal security

In order to maintain the safety of the group, it is important to consider the human health risks arising from the process:

Zoonotic diseases:

During killing, humans can be exposed to zoonotic agents when handling and handling infected animals or when potentially infectious body fluids are released during the killing method. It is important to wear appropriate personal protective equipment and to follow personal cleaning and disinfection protocols.

Handling animals, restraining them if necessary, can lead to injuries if done incorrectly or with damaged/inadequate equipment. Animals should preferably be handled within their normal routine, restraining only when necessary.

Practical recommendations

- Use the farmer's knowledge of the farm, livestock and resources available on the farm. When talking to livestock farmers, **good communication is key**!
- During the operation, the number of animals planned to be slaughtered must be checked against the number of animals actually slaughtered. If there are discrepancies, the reasons should be identified.
- Killing animals is a physically and mentally exhausting process. Recognise when group members are tired. Clearly communicate to group members and CSV if anyone feels tired or overworked. Adequate breaks are essential to ensure that everyone can work effectively.
- It is crucial to maintain a professional environment and avoid personal clashes with colleagues.
- An appropriate, effective animal handling system should be in place to assist team members and minimise disruption when working with animals.
- Maintaining biosecurity during culling operations limits the spread of disease. Therefore, clear boundaries between 'clean' and 'dirty' areas should be established and disinfectants and personal protective equipment (PPE) should be provided. In cases where physical contact with animals and their excreta is unavoidable, the risks can be minimised by providing appropriate PPE.
- All persons involved in the killing operation are responsible for their own safety and that of their colleagues!
- A risk assessment should be carried out to assess potential risks on site and seek to mitigate them.
- Ensure that all animals are killed in a humane manner.

1.3. Implementation

1.3.1. Use of firearms

Firearms are mainly used to kill large animals such as cattle, pigs, horses, camels, deer and ostriches. When used properly, they are one of the best tools for killing livestock on farms. If shot successfully, death is instantaneous and there is no need to stun the animal before shooting. The method can be used at close range and at long range.

How does it work?

With proper aiming, when the weapon is fired, a free bullet from the muzzle of the firearm penetrates the skull, the free bullet destroys the brain stem, and in a split second the bullet should also penetrate the upper and middle brain stem, causing extensive damage and destruction. This damage, in addition to the concussive effect of the impact of the projectile, renders the animal immediately insensible, and the subsequent destruction of the brain stem

(the part of the brain that controls breathing and other vital functions) prevents the possibility of resuscitation.

Physiological effects

If an animal is shot correctly in the head with a free bullet, it is an animal:

- collapses immediately;
- stop breathing;
- may bleed profusely from the entrance wound, mouth and/or nose.

Immediately after the shot, the animal either appears completely relaxed or the muscles show exaggerated tonic activity. Up to one minute after the shot, the animal's body may start to twitch and in some cases (particularly in pigs) may convulse violently. Although this may appear visually worrying, it is normal in an animal that has been correctly shot. After a while (up to a minute), the spasms begin to subside and eventually cease, with the initially flaccid carcass showing signs of rigor mortis over time.

When to use it?

The use of firearms is recommended primarily for killing adult mammals, especially when they are difficult or impossible to control. It is also the preferred method for killing wild or farmed game.

The method is recommended in the following situations:

Species: cattle, sheep, goats, pigs, horses, camels, deer, fur animals (fox, rabbit)

Age: adult animal

Other: animals that cannot be restricted.

Animal welfare aspects, concerns

The main animal welfare concern with this method is the possibility of non-lethal injury to the animal. If in doubt about the effectiveness of the shot, check for the absence of rhythmic breathing or corneal reflex before deciding whether it is necessary to shoot the animal again.

Design

When using firearms, the following considerations should be taken into account:

- Is there a legal licence to use firearms?
- Are there staff who are competent (trained and experienced) in the use of firearms?
- What species of animals should be slaughtered on the farm, what is their number and age?
- Is the number and type of firearms and ammunition available for the species being hunted?

- Is the location and equipment of the farm suitable for the use of firearms?
- Are there other people present outside the group and can personal safety be guaranteed?

Health and safety:

The following health and safety advice should be followed when using firearms:

- Firearms should not be used in confined spaces or when animals are standing on solid surfaces, as this may result in the free bullets ricocheting.
- The pasture/meadow/field where the launching takes place must be isolated from all other places (e.g. roads, dwellings).
- Adequate background (e.g. manure piles, hay or straw bales) should be provided behind the animal to stop the projectile if it leaves the animal carcass or a misfire occurs.
- The shooter must take into account the safety of the people in the area where he is operating. All persons involved must wear appropriate vision and hearing protection. Accompanying personnel must stand behind the person carrying out the shooting.
- The shooter must make sure that the animal is not moving, is in the correct position for accurate aiming and the shooting distance should be as short as possible (5-50 cm for a shotgun), but the barrel should not be in contact with the animal's head.
- The right bullet, calibre and type of projectile should be used for different ages and sizes. Ideally, the projectile should expand on impact and dissipate its energy within the skull.
- Shot animals should be examined to ensure the absence of brainstem reflexes.

Further considerations:

In addition to the main aspects, there are other issues to consider:

- The shooting of animals causes a leakage of blood and body fluids, which contaminates the environment with pathogens. The carcasses and the killing site should be sprayed with disinfectant after killing, which reduces the pathogen's environmental burden.
- The firearm method destroys the brain, thus preventing the use of diagnostic methods that require a brain sample.

Advantages of the method:

- It can also be used on the farm.
- It requires minimal or no restraint of animals.
- A method that is both intoxicating and deadly.
- Fast, efficient.
- Hunting rifles can be used at a distance, while shotguns and handguns must be fired at close range.
- It is also suitable for killing excited animals and wild animals.

Disadvantages of the method:

- Legal restrictions on use.
- Qualified and competent people are needed.
- Potentially dangerous to humans.
- Not for use in confined spaces.
- You can only kill one animal at a time.
- Non-fatal injury to the animal may result.
- Leakage of blood and body fluids from slaughtered animals.

1.3.2. Use of a fixed bandwidth device

How does it work?

Fixed-barrel devices work in a similar way to firearms, but they do not fire a projectile, but a metal rod ("pin") that forms a permanent part of the device.
Fixed bar devices are either compressed air or cartridge operated.
A distinction is made between intrusive and non-intrusive fixed-gear devices. The difference is that in the case of a penetrating device, the "nail" penetrates the animal's skull, whereas in the case of a non-penetrating device, the "nail" is button-headed and therefore does not penetrate the brain.

In the case of large animals, the use of a penetrating fixed-bar instrument does not guarantee a one-step kill, so the destruction of the brainstem and upper spinal cord by means of a rod inserted through the gun barrel should be carried out as soon as possible or another lethal method of killing (e.g. lethal injection) should be used to ensure the death of the animal.

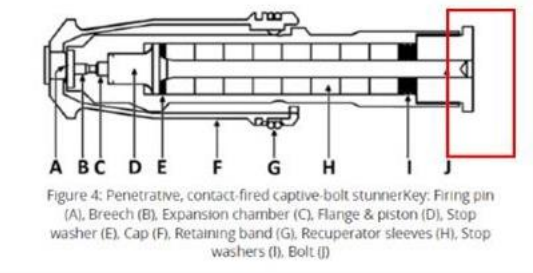
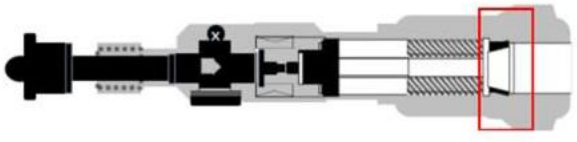


Figure 4: Penetrative, contact-fired captive-bolt stunnerKey: Firing pin (A), Breech (B), Expansion chamber (C), Flange & piston (D), Stop washer (E), Cap (F), Retaining band (G), Recuperator sleeves (H), Stop washers (I), Bolt (J)

When using a non-penetrating fixed-bar instrument, it must be applied to the front of the skull to deliver a percussive blow that causes unconsciousness in cattle (adults only), sheep, goats and pigs. Bleeding should be carried out as soon as possible after the blow to ensure death of

the animal. In small animals such as poultry and newborn sheep, goats, pigs, the instrument alone is sufficient to cause significant cranial and brain damage leading to immediate unconsciousness and death.



The physiological effects

A fixed pin from the device, usually operated by a cartridge, which penetrates the skull during operation, results in concussion and immediate loss of consciousness:

- the animal immediately collapses;
- rhythmic breathing stops;
- lack of corneal reflex;
- the animal does not respond to a painful stimulus.

These symptoms are accompanied by a tonic phase (stiffening) lasting a few seconds. The tonic phase is followed by a clonic phase (spasm), which can be recognised by the presence of kicking or rowing movements, usually lasting between about 15 and 45 seconds. In addition, there is a high probability that blood will flow from the hole made in the skull by the "nail" and from the animal's nose.

Subsequently, the loss of consciousness is prolonged by structural damage to the brain, resulting in significant subarachnoid and intraventricular haemorrhages, particularly near the entry wound and at the base of the brain. This causes a subsequent disintegration of brain tissue and contributes to prolonging the duration of loss of consciousness and unconsciousness. Depending on the extent of the brain injury, animals may not die immediately, so either the destruction of the brainstem and upper spinal cord by means of a rod inserted through the gun barrel should be carried out as soon as possible or another lethal method of killing (e.g. lethal injection) should be used to ensure the death of the animal.

When to use it?

It can be used to kill animals on the farm where the use of a firearm is impractical or not possible. The non-penetrating fixed-barrel device can also be used for poultry and newborn animals.

The method is recommended in the following situations:

Species: cattle, sheep, goats, pigs, horses, camels, deer, poultry

Age: adult animals, newborns (up to 10 kg)

Animal welfare aspects and concerns:

The main animal welfare concerns with this method are:

- incorrect use (positioning) of the device
- the use of inappropriate equipment.

If an animal is not properly stunned, it must be stunned again immediately. When the 'nail' penetrates the skull, it causes massive damage and swelling around the wound, the swelling absorbs most of the impact of the second shot and this means that the shockwave does not reach the brain as effectively. For this reason, the repeat shot should always be positioned to avoid the immediate area of the first shot.

Equipment

The tool can be used for many different species in many different situations (e.g. in abattoirs, on farms or in confined spaces).
Fixed-bar devices are either compressed air or cartridge-operated, and cartridge devices are more useful for killing animals on farm in the event of an infectious disease outbreak. It is important to use the correct cartridges according to the manufacturers' instructions.
To destroy the brainstem and upper spinal cord, a rod introduced through the bullet duct is a flexible wire or polypropylene rod, while disposable rods that remain in the animal's body are also available to protect against infectious disease.

Planning:

When preparing the plan, the following aspects should be taken into account:

- Do you have permission to use the device?
- Are there staff who are competent (trained and experienced) in the use of the tool?
- What species of animals should be slaughtered on the farm, what is their number and age?
- Do you have the right type of device with the right cartridges for the species? Have they been cleaned and maintained?
- Is there a sufficient number of tools available? Each group needs at least two devices to use alternately, as they overheat during use;
- Is it possible to control the animals? If not, is it necessary to build temporary pens on the site?

Health and safety:

The following health and safety advice should be followed:

- never point the muzzle of the device at yourself or anyone else;
- read the manufacturer's instructions on correct handling of the device and cartridges;
- in the case of a fired cartridge, do not remove the cartridge for 30 seconds as it may explode
- never leave a device unattended when it is unloaded.

Requirements for efficient use

- For cartridge and compressed air devices, the speed and length of the "nail" should be appropriate to the species and type of animal, according to the manufacturer's recommendations.
- The device should be cleaned frequently and kept in good condition.
- More than one gun may be needed to avoid overheating, and a spare gun should be available in case of an ineffective shot.
- Animals must be restrained.
- The operator must ensure that the head of the animal is accessible.
- In the optimal position, the operator should shoot the "pin" perpendicular to the skull.
- A maximum of 15 seconds should elapse between stunning and the application of the method of instantaneous death.
- Animals should be monitored continuously after stunning until death to ensure that no brainstem reflexes are present.

Further considerations:

- Before killing captive adult cattle, give them a sedative and let them rest in a pen or shed. After this, the killing can be carried out.
- Because of the skull structure of adult pigs, problems can arise when using the fixed-gear device, so all pigs should be carefully examined to ensure that they have died.
- Removing poultry from cages increases the killing time, so this method is not practical when emptying large commercial poultry houses.

Advantages of the method:

- It can also be used on the farm.
- It can also be used in tight spaces.
- The group can move freely around the farm.
- A relatively quick method.

Disadvantages:

- Some countries have legal restrictions on use.
- In some cases, further action, bleeding out, is necessary after stunning.
- Poor maintenance and misfiring of devices and inaccurate positioning of the device can lead to poor animal welfare.
- Repeated use of the cartridge device may result in overheating.
- The animals must be restrained.
- You can only kill one animal at a time.
- Squealing animals can injure members of the group.
- Difficult to use on excited animals.
- The leakage of blood and body fluids from slaughtered animals can pose a biosecurity risk.
- The destruction of brain tissue can rule out the diagnosis of certain diseases.

1.3.3. Use of electricity

Electricity can be used to stun and kill animals.

We distinguish between single-step and two-step applications.

In the one-step application, animals are stunned and killed in one step, while in the two-step application, animals are first stunned and then killed in a second step.

How does it work?

During electrical stunning (electronarcosis), an electric current passes through the brain and interrupts normal brain activity, causing the animal to lose consciousness. This is a reversible process as the current only disrupts brain function for a short period.
During electrocution (electrocution), an electric current is passed through the animal's heart, causing cardiac arrest, stopping the heart and blood flow. This results in the brain not receiving oxygen.
Animals contain a high proportion of fluid, which is a good conductor of electricity. However, skin, fat, bone and hair are poor conductors, so animals with heavy fur, thick skin, thick layers of fat or thick skulls have a high electrical resistance and need higher voltages to achieve the same effect.

Physiological effects

If the stunning (electronarcosis) is carried out effectively, the body will show first tonic and then clonic activity and complete loss of consciousness. If the animal is not killed after stunning, the third phase begins when the animal starts to regain consciousness. Once the killing (electrocution) occurs, the animal's body becomes rigid, with a slight tremor, and then gradually relaxes. No further movement should be experienced after a successful kill.

Tonic phase: the animal collapses and rhythmic breathing stops. The forelegs are extended rigidly and the hind legs are bent towards the body.

Chronic phase: the muscles relax and involuntary kicks are observed.

Recovery phase: in the recovery phase, the first sign is that the animal is breathing rhythmically again. It then becomes visually aware and attempts to stand up.

The table below shows the expected stunning time after head-only electrical stunning.

Species	Tone phase (seconds)	Chronic phase (seconds)	Recovery phase (seconds)
Pigs	10-20	15-45	30-60
Sheep/goat	10-20	15-45	30-60
Cattle	5-20	10-60	45-90
Calf	8-14	8-28	40-70

When is this method recommended?

Species: pig, calf, poultry, sheep, goat

Age group: calves and pigs over 1 week old

Although sheep and goats can be killed using this method, the thick wool can cause high electrical resistance, so stunning and killing may not be effective.

Animal welfare aspects and concerns

The main animal welfare concern associated with the use of electric shock is the risk that, if incorrectly stunned, the animal will remain conscious before being killed by the electric current.

Possible causes of faulty cabling:

- incorrect placement of electrodes,
- bad electrical connection,
- short exposure times and use of inappropriate parameters (wrong voltage settings).

If an animal is not properly stunned, it must be stunned again immediately.
Care should be taken to clean electrodes regularly (after 20-25 animals) to minimise electrical resistance and ensure efficient stunning and killing.
Wetting the skin, fur or wool of animals increases conductivity.
The use of the equipment is a physically demanding process and regular breaks for operators should be provided. If the operator is tired, the electrical contact may be inadequate and the exposure time may be shorter than necessary.

Equipment

The equipment consists of the control device (transformer) and the gripper.

Modern equipment controls the voltage (V), the frequency (Hz) and the duration of the current (A). The voltage and amperage are indicated on the control box, and audible and visual signals are audible and visual to warn the operator if the duration of the stun has been shorter than the prescribed duration.

Most modern stunning control equipment operates at voltages above 200 volts (V), but some automatic equipment can go up to 1000 V. Older electrical stunners operate at 150 V, but these do not result in instantaneous stunning and are not recommended. The frequency of the current used should not exceed 80 Hz. This is because, as the frequency increases, ventricular fibrillation is less likely. The optimal frequency of the equipment is 50 Hz.

The control box must be protected from physical and water damage. Therefore, it should be positioned far enough away from the unloading point, but not too far away that the operator can see the gauges and display and hear the machine's warning signals.

It is recommended to use scissor-type pliers, as the angle of grip can be adjusted to suit your needs. Fixed position tongs (forks) are not suitable for on-farm killing.

In a two-step application, the forceps should be applied in the appropriate positions at the head for at least three seconds and then at the chest for a further three seconds. A minimum of two team pads per team is required.

The following table shows the minimum electrical parameters for stunning and killing livestock.

Species	Intoxication (head only)	Killing (heart)
Cow	1,28 A	>1,51 A
Calf	1,25 A	1,25 A
Adult sheep/goats	1,00 A	1,00 A
Lamb/Gida	1,00 A	1,00 A
Pigs over 6 weeks	1,30 A	1,30 A
Pork in 6 weeks	0,50 A	0,50 A
Chicken	400 mA	---
Turkey	400 mA	---
Duck	600 mA	---

Note: These parameters were developed for clean animals with relatively low resistance. High resistance caused by thick wool or dirt may affect the effectiveness of stunning, so the parameters should be adjusted according to Ohm's law to ensure that animals are properly stunned/killed.

Design, health and safety and other considerations

If you plan to use electricity as a method of killing, you should consider the following when preparing your killing plan:

- Is there a reliable power source on site? If not, is there a generator?
- Are the necessary cable inspection equipment and scissors available? Have these been cleaned and maintained?
- Are there staff who are competent (trained and experienced) in using the equipment?
- Is personal protective equipment (rubber boots/gloves) available to protect staff against possible electric shock?
- Can you protect your control equipment from water damage?
- What species of animals should be slaughtered on the farm, what is their number and age?
- Is a water bath system feasible for poultry?
- Is it possible to capture the animals and, if not, is it necessary to build a temporary pen on the site?

The following health and safety advice should be followed:

- Have the equipment tested and checked regularly by a qualified electrician.
- Care should be taken to ensure that the cable control box is installed in a dry environment.
- Built-in safety switches and releases must be used.
- Handlers and animal carers should wear protective clothing such as rubber boots and rubber gloves to minimise the risk.
- The operator must take regular breaks.
- Between killing operations, the pliers should be stored in a dry environment, protecting the electrodes from damage.

Advantages of the method:

- It can also be used on the farm.
- It can also be used in tight spaces.
- No need for prior sedation.
- Stunning and killing in one method.
- It is a non-invasive method, so there are minimal biosafety concerns.

Disadvantages:

- Requires electricity.
- Potentially hazardous to humans, protective clothing required.
- It requires animals to be restrained.
- Physically demanding for the operator.
- You can only kill one animal at a time.
- The equipment is moderately expensive.

1.3.3.1. One-step application

1.3.3.1.1.1. method 1.

Method 1 is the single application of sufficient electrical current to the head and back to stun the animal and cause cardiac fibrillation. If sufficient current is applied in a position that encompasses both the brain and the heart, the animal will not regain consciousness. Method 1 can be used for calves, sheep, goats and pigs (over one week old).

Requirements for efficient use

- The stun control shall generate a low frequency current (30-60 Hz) with a minimum real effective voltage of 250 volts under load.
- Wear appropriate protective clothing (including rubber gloves and boots).
- Animals should be individually and mechanically restrained in the vicinity of the electrical network, as physical contact between the stunning electrodes and the animal is necessary to maintain effective use.
- The back electrode is placed behind or above the heart, and the front electrode is applied in the position in front of the eye, using a current for at least 3 seconds.
- Electrodes should be cleaned regularly between animals and after use to maintain optimal electrical contact.
- Water or saline solution may be needed to improve the electrical connection to the sheep.
- Effective stunning and killing must be justified by the absence of brainstem reflexes.

Benefits:

- Method 1 stuns and kills at the same time.
- It minimises post-stunning convulsions and is therefore particularly effective in pigs.
- Only one group member is required.
- The non-invasive technique minimises the biosafety risk.

Disadvantages:

- Method 1 requires the individual mechanical restraint of animals.
- The electrodes must be applied and maintained in the correct position to ensure effective stunning and killing.
- Method 1 requires a reliable power supply.

1.3.3.1.1.2. method 2

Method 2 stuns and kills the poultry by pulling the inverted and handcuffed poultry through an electrified water bath stunner. An electrical connection is made between the "live" water

and the grounded clamp and, if the correct current is applied, the poultry is simultaneously stunned and killed. Method 2 is suitable for large numbers of poultry.

Requirements for efficient use:

- You need a mobile waterbath stunner and a short loop overhead track.
- To stun and kill birds, a low-frequency current (50-60 Hz) applied for at least 3 seconds is required.
- Poultry must be removed from their cage by hand, turned around and tied to an overhead track that will lead them into a water bath stunner with their heads fully submerged.
- The minimum currents required to stun and kill dry birds are:
    - Quails - 100 mA/charger
    - Chickens - 160 mA per bird
    - Ducks and geese - 200 mA/bird
    - Turkeys - 250 mA/bird.
- For wet birds, a higher current is needed.
- Effective stunning and killing must be demonstrated by the absence of brainstem reflexes.

Benefits:

- Method 2 stuns and kills at the same time.
- It is capable of processing large numbers of birds reliably and efficiently.
- This non-invasive technique minimises the biosafety risk.

Disadvantages:

- Method 2 requires a reliable power supply.
- Birds must be handled, turned and handcuffed.

1.3.3.1.1.3. method 3.

Method 3 consists of a single application of sufficient electrical current to the head of the poultry to cause unconsciousness in a position over the brain, followed by the killing method. Method 3 is suitable for small numbers of poultry.

Requirements for efficient use:

- The device that controls the cable must produce sufficient current (more than 600 mA/duck and more than 300 mA/bird) for the cable.
- Wear appropriate protective clothing (including rubber gloves and boots).
- Birds must be at least manually secured near the electrical grid.
- Electrodes should be cleaned regularly and after use to maintain optimal electrical contact.
- Birds should be monitored continuously after stunning until death to ensure that they do not develop brainstem reflexes.

Advantage:

- The non-invasive technique (combined with cervical dislocation) minimises the biosafety risk.

Disadvantages:

- Method 3 requires a reliable power supply and is not suitable for large-scale operations.
- Electrodes should be applied and maintained in the correct position for effective stunning.
- Birds must be individually recorded.
- Slaughter method to be followed.

1.3.3.2. Two-step application

The two-step application of electric current involves first applying the current to the head with scissors forceps, followed immediately by applying the forceps to the chest in a position over the heart. Sufficient electric current applied to the head induces "tonic/clonic" epilepsy and loss of consciousness. As soon as the animal loses consciousness, the second phase induces ventricular fibrillation (cardiac arrest), leading to death. The second stage (application of a low frequency current through the chest) should only be used on unconscious animals to avoid unacceptable pain.
The method is suitable for calves, sheep and goats, and especially pigs (over one week old).

Requirements for efficient use:

- The stunning control device shall generate low frequency (50 Hz sinusoidal AC) current with the minimum voltage and current specified in the following table:

Animal	Minimum voltage (V)	Minimum current (A)
Cattle	220	1.5
Sheep	220	1.0
Pigs over 6 weeks old	220	1.3
pigs less than 6 weeks old	125	0.5

- Wear appropriate protective clothing (including rubber gloves and boots).
- Animals must be restrained, at least in a free-standing pen, near an electricity supply.
- Two team members are needed, the first to apply the electrodes and the second to manipulate the position of the animal so that the second application can take place.
- The stunning current shall be applied with scissors-type stunning forceps in the brain-hugging position for at least 3 seconds; immediately after application to the head, the

electrodes shall be moved to the heart-hugging position and the electrodes shall be applied for at least 3 seconds.
- Electrodes should be cleaned regularly and after use to maintain optimal electrical contact.
- Animals should be monitored continuously after stunning until death to ensure that no brainstem reflexes are present.
- The electrodes should be applied firmly for the intended duration and the pressure should not be released until the stunning is complete.

Benefits:

- The second stage minimises post-stunning convulsions and is therefore particularly effective in pigs.
- The non-invasive technique minimises the biosafety risk.

Disadvantages:

- The method requires a reliable power supply.
- The electrodes must be applied and maintained in the correct position to ensure effective stunning and killing.
- Most stunning control equipment uses low-voltage impedance sensing as an electronic switch before applying high voltages; for unhorn-coupled sheep, the contact impedance may be too high to switch on the required high voltage (especially in the second stage).
- The procedure can be physically demanding, which can lead to operator fatigue and poor electrode placement.

1.3.4. Use of gases

Anoxic gas mixtures (air with very low oxygen content) are routinely used to kill animals at the end of the production cycle. Examples include pigs, poultry and small fur animals. This method can also be used on farms to kill animals. The gases used for the method are carbon dioxide (CO2), nitrogen (N2) or inert gases such as argon (Ar) and mixtures of these. A major advantage of the method is that a large number of animals can be killed with relatively little human labour.

How does it work?

The brain needs oxygen to function normally. When other gas mixtures are introduced into the air in a controlled environment, such as a tank or chamber, oxygen is displaced and the amount of oxygen is reduced. If an animal cannot take in enough oxygen (hypoxia), it loses consciousness. In addition, the inhalation of carbon dioxide causes respiratory and metabolic acidosis, which lowers the pH of cerebrospinal fluid and nerve cells, resulting in loss of consciousness. If the animal is left in this environment for long periods of time, brain death occurs after prolonged exposure

Physiological effects

Hypoxia causes normal abilities to be impaired, the animal becomes confused, loses posture and muscle control, convulses and loses consciousness. When oxygen runs out, the animal dies. An important consideration is the CO2 resistance of the animal. While pigs and poultry do not show a strong resistance to low CO2 concentrations, high concentrations (30-40% or more) cause them to try to escape and pigs will attempt to escape. Pigs exposed to high CO2 concentrations may show respiratory distress in the first 30 seconds. When a mixture of CO2 and N2 or inert gas(es) is used, the animals suffer less, and therefore gas mixtures are preferable from an animal welfare point of view to the use of CO2 alone.

When is this method recommended?

This method can be advantageous for killing large numbers of pigs or poultry.

Species: pigs, poultry, mink
Age group: adult animals, young animals, newborns
Other: large number of animals

Methods

There are three main methods for killing animals with gas:

Method 1: animals are placed in a gas-filled tank.

This method is mainly used for poultry. First, the tank is filled with the desired concentration of gas and then the birds are manually placed in the tank. Care must be taken not to injure the animals during this step. The pace of placing the animals in the tank should be set to avoid overcrowding and allow sufficient time to induce unconsciousness. Birds shall be placed in the tank until the tank is full and all animals are dead.
The death of animals is difficult to determine and some animals that are not killed may go unnoticed. A critical aspect is the continuous monitoring of the gas concentration as the volume of the tank changes during the process.

Method 2: animals are placed in a tank into which gas is introduced

This method is used for pigs, poultry and mink. The animals are first placed in the container. Poultry in cages can be moved by hand or forklift, and pigs may occasionally walk into the container. Oxygen and CO2 levels are normal at the start of the operation, so there is no nervousness. As the volume of the chamber is known, the amount of gas required can be calculated in advance. Once the tank is filled with animals, gas is introduced into the chamber until the desired concentration is reached. After a sufficient exposure time, the animals die. The chamber is opened, the gas is dispersed and the dead animals are either removed from the tank for on-site disposal or transported to the disposal site.

Method 3: whole-barn methods

3.a.: gas introduced into a closed poultry house

The animals are left in the poultry house and the gases are gradually introduced directly. The advantage of this method is that the birds do not need to be handled. The house must be closed immediately before the gas is introduced to avoid overheating and accidental suffocation. The most common method is to use a liquid source of CO2, which is passed through an evaporator before being introduced into the house.

3.b.: nitrogen foam injected into poultry house

The advantage of adding foam containing anoxic gas bubbles is that the shed does not need to be hermetically sealed. It is a much more flexible and time-saving method, as the foam can "plug" small holes in the barn structure.
Two types of foam are used: a fire-fighting foam approved in the USA and a foam containing nitrogen. The nitrogen foam is recommended because birds do not suffocate due to airway obstruction

Equipment

The following equipment is needed:

- In the case of the first or second method, a container or vehicle with a removable top. The container must be airtight. If necessary, polyurethane foam can be used to fill cracks and holes.
- Gas source (cylinder, tanker).
- Quality hoses with antifreeze coating.
- Tools, ladders and connectors for gas cylinders.
- Gas concentration monitoring equipment.
- Where possible, a viewing window so that operators can visually inspect the animals while they are in the container. For method 3, install cameras in the poultry house to check the animals.
- The third method is evaporator.
- They are equipped with a fixed barrier to kill any animal that still shows signs of life.

Design

If gas killing is planned, the following should be taken into account when preparing the killing plan:

- What species of animals should be slaughtered on the farm, what is their number and age?
- Can you deliver CO2 (dry ice or gas cylinder), inert gas or nitrogen foam to the farm?
- Can animals be killed in their enclosures?
- If not, can they create or bring a chamber (container) to the farm?

- Is there a suitable place to set up a slaughter site near the dwelling?
- Do you have the necessary tools such as hoses, tubes and wrenches?
- Are there staff who are competent (trained and experienced) in setting up the equipment?

Health and safety

The following health and safety advice should be followed when using gas:

- While low concentrations of CO2 or inert gas do not cause serious side effects, high concentrations (above 30%) are toxic to humans. Effects of exposure include respiratory irritation, shortness of breath, cyanosis and loss of consciousness.
- If a person is exposed to high levels of CO2, they should be taken outside immediately to breathe fresh air and given oxygen.
- CO2 released from gas cylinders can cause frostbite to the operator.

Advantages of the method:

- It can also be used on the farm.
- It does not require animals to be restrained.
- It can kill several animals at once (group killing).
- No need for prior sedation.
- It is both a stunning and killing method.
- It is a non-invasive method, so there are minimal biosafety concerns.

Disadvantages of the method:

- It requires the purchase of monitoring equipment.
- Transport of gas to the economy.
- Potentially dangerous to humans.

1.3.4.1. Use of CO2/air mixture

Controlled atmosphere culling is carried out by exposing the animals to a predetermined gas mixture, either by placing the animals in a gas-filled tank or apparatus (Method 1) or by placing transport modules or crates containing the birds in a gas-tight container and introducing a gas mixture (Method 2). Method 3 should be used whenever possible, as it avoids animal welfare problems arising from the need to remove live birds manually. Although Method 2 requires handling and caging of the birds, it has an overall welfare benefit compared to Method 1 by reducing the risk of death by suffocation or drowning. Inhalation of carbon dioxide (CO2) induces respiratory and metabolic acidosis, thereby lowering the pH of cerebrospinal fluid (CSF) and neurons, causing unconsciousness and death after prolonged exposure. Exposure to carbon dioxide does not cause immediate loss of consciousness, and therefore the aversive nature of the gas, mixtures containing high concentrations of CO2 and respiratory distress during the induction phase are important considerations for the welfare of the animals.

Method 1: Animals are placed in a gas-filled tank or apparatus

Method 1 can be used for poultry and newborn sheep, goats and pigs.

Requirements for efficient use in a tank or apparatus:

- The containers or apparatus must allow the required gas concentration to be maintained and accurately measured.
- When animals are exposed individually or in small groups, in tanks or apparatus, the equipment used must be designed, constructed and maintained in such a way as to avoid injury to the animals and to allow their observation.
- Animals can be introduced at low concentrations (since low concentrations are not averaging) and the concentration can be increased later, and then the animals can be kept at the higher concentration until death is determined.
- Team members must ensure that each batch of animals has sufficient time to die before the next batch is placed in the tank or apparatus.
- Containers or apparatus should not be overcrowded and measures should be taken to avoid animals suffocating by climbing on top of each other.

Benefits:

- CO2 is readily available.
- The application methods are simple.
- The amount of gas required is easy to calculate.
- As the appliances are operated outdoors, the gas dissipates quickly when the door is opened at the end of each cycle, which is beneficial for the operator's health and safety.
- The system uses skilled grab teams and equipment used daily in the industry.
- Metal containers are easy to clean and disinfect.

Disadvantages:

- The need for a properly designed tank or device.
- The aversive nature of high CO2 concentrations.
- No immediate loss of consciousness.
- Risk of suffocation due to overcrowding.
- Difficulties in proving death while animals are in the tank or apparatus.

Method 2:

In this method, boxes or modules containing birds are placed in a chamber into which gas is introduced. A containerised gassing unit (CGU) typically consists of a gas-tight chamber designed to contain poultry crates or a single module. The chamber is equipped with gas lines and diffusers, with silencers connected to gas cylinders through a system of manifolds and gas regulators. A hole in the top of the tank allows displaced air to escape when the tank fills with gas. The procedures for operating the CGU are as follows:

1. the tank must be placed on level, solid, open ground
2. connect the gas cylinder to the tank
3. put the birds in the tank

4. close and lock the door
5. feed the gas until a carbon dioxide concentration of 45 % vol. is reached at the top of the container
6. allow time for the birds to lose consciousness and die
7. open the door and let the gas disperse into the air
8. remove the module
9. check each account for survivors
10. kill the survivors mercilessly

Method 2 can be applied to a wide range of poultry systems and to newborn sheep, goats and pigs, provided that suitable vehicles are available to transport the containers and equipment.

Requirements for the efficient use of Container Gasification Units (CGU):

- The birds should be carefully captured and placed in crates or modules of appropriate size and stocking density so that all birds can perch.
- Crates or modules full of birds should be placed in the tank and the door closed only when the operator is ready to inject the gas.
- Ensure that the tank door is closed and feed the gas until a carbon dioxide concentration of at least 45% is reached at the top of the crates.
- A suitable gas meter should be used to ensure that the correct carbon dioxide concentration is achieved and maintained until it is confirmed that the birds have died.
- Allow enough time for the birds to die before opening the door. In the absence of an inspection hatch to allow direct observation of the birds during killing, the cessation of vocalisation and the sounds of spasmodic wing flapping, which can be heard when standing near the tank, can be used to determine that the birds are unconscious and on the verge of death. Remove crates or modules from the tank and leave them in the open.
- Each crate or module should be inspected and the birds checked to make sure they are dead. Dilated pupils and lack of respiration indicate death.
- Survivors must be killed humanely.
- Ducks and geese are resistant to the effects of CO2, so they need at least 80% CO2 and prolonged exposure to die.

Benefits:

- Gas is introduced quickly and quietly, resulting in less turbulence and less disturbance to birds.
- Gradually increasing the CO2 concentration minimises the aversion of the method used to induce unconsciousness.
- The use of transport crates or modules for transporting birds minimises handling. Birds should be handled by trained, experienced handling teams when emptying poultry houses.
- The modules are mechanically loaded into the CGU and immediately after sealing, a lethal gas mixture is injected into the chamber.
- CO2 is readily available.

- The birds are exposed to the gas more evenly than in method 1 and do not strangle each other.
- The amount of gas required is easy to calculate.
- As the appliances are operated outdoors, the gas is quickly dispersed when the door is opened at the end of each cycle, which is beneficial for the operator's health and safety.
- The system uses skilled grab teams and equipment used daily in the industry.
- Metal containers are easy to clean and disinfect.

Disadvantages:

- It requires trained operators, skilled animal handlers, transport modules and forklift trucks. However, this equipment and suitable hard surface areas are usually available.
- The main limiting factor is the speed at which birds can be captured.
- In the absence of a spyhole, it is difficult to visually confirm the death of birds while they are still in the tank. However, the cessation of vocalisation and the sounds of spasmodic wing flapping can be used to confirm death.

Method 3: The gas is introduced into a poultry house

Method 3 is suitable for use with poultry kept in confined poultry houses. However, CO2 is likely to cause distress in the birds for some time before they lose consciousness.

Requirements for efficient use in poultry houses:

- Before CO2 is introduced, the poultry house must be properly sealed so that the gas concentration can be checked. The interval between sealing and gas injection should be as short as possible to avoid overheating. Ventilation systems, if fitted, should only be switched off immediately before the gas is injected.
- The main water supply to the poultry houses may need to be shut off and the water drained to avoid freezing and cracking of the water pipes. Feeders and troughs should be raised to avoid blocking gas ingress and injuring birds.
- Gas delivery pipes must be positioned properly so that birds are not directly exposed to very cold gas delivered at high pressure. It may be necessary to exclude birds from the area in front of the transport pipes, at a distance of about 20 metres, by separating the barn with netting, wire mesh or similar perforated materials.
- The shed should be progressively filled with CO2 so that all birds are exposed to >40% concentration until they die; an evaporator may be needed to prevent freezing.
- Instruments should be used that accurately measure the gas concentration at the maximum height at which the birds are placed.

Benefits:

- Applying the gas to birds in situ eliminates the need for manual removal of live birds.
- CO2 is readily available.

Disadvantages:

- It is difficult to determine the amount of gas needed to achieve the correct CO2 concentration in some poultry houses.
- It is difficult to control mortality while the birds are in the poultry house. The extremely low temperature of liquid CO2 entering the coop and the formation of solid CO2 (dry ice) are a concern for the welfare of the birds.

1.3.4.2. Nitrogen or inert gas mixed with CO2

CO2 can be mixed with nitrogen or an inert gas (e.g. argon) in varying proportions, and inhalation of such mixtures leads to hypercapnic hypoxia and death if the oxygen concentration by volume is <2%, or <5% in chickens. Methods 1 and 2, different mixtures of CO2 and nitrogen or inert gas can be administered to kill birds. Complete house gassing with a mixture of CO2 and nitrogen or inert gas has not been investigated due to the complex problems associated with mixing large quantities of gases. However, such mixtures do not cause immediate unconsciousness and therefore the aversion of different gas mixtures containing high concentrations of CO2 and respiratory disturbances during the induction phase are important animal welfare considerations. Pigs and poultry do not appear to find low CO2 concentrations highly inversive, and a mixture of nitrogen or argon containing <30 vol% CO2 and <2 vol% O2 can be used to kill poultry, newborn sheep, goats and pigs.

Method 1: Animals are placed in a gas-filled tank or apparatus

The method is suitable for poultry and newborn sheep, goats and pigs.

Requirements for efficient use:

- The tanks or apparatus must allow the maintenance of the required gas concentrations and the accurate measurement of O2 and CO2 concentrations during the killing process.
- Where animals are exposed individually or in small groups, in containers or apparatus, the equipment used must be designed, constructed and maintained in such a way as to avoid injury to the animals and to permit their observation.
- Animals should be placed in the tank or apparatus after filling with the prescribed concentration of gas (<2% O2) and kept in this atmosphere until death is determined.
- Team members must ensure that each batch of animals has sufficient time to die before the next batch is placed in the tank or apparatus.
- Containers or appliances should not be overcrowded and measures should be taken to avoid animals suffocating by climbing on top of each other.

Advantage:

- Low concentrations of CO2 have little aversive effect and, when combined with nitrogen or inert gas, rapidly induce unconsciousness.

Disadvantages:

- A properly designed container or device is needed.
- It is difficult to check for death while the animals are in the tank or apparatus.
- No immediate loss of consciousness.
- The exposure time required for killing is significant.

Method 2:

In this method, crates or modules holding the birds are placed in a tank and gas is introduced into the tank. As shown in the example below, each containerised gassing unit (CGU) typically consists of a gas-tight chamber designed to contain the poultry crates or modules. The container or chamber is equipped with gas lines and diffusers, with silencers, which in turn are connected to gas cylinders through a system of manifolds and gas regulators. A hole in the top of the container allows displaced air to escape when the container fills with gas. The procedures for operating the CGU are as follows:

1. the tank must be placed on level, solid, open ground
2. connect the gas cylinder to the tank
3. load the module of birds into the tank
4. closes and locks the door
5. deliver the gas to a point where there is less than 2 % oxygen by volume at the top of the container
6. gives the birds time to lose consciousness and die
7. open the door and let the gas disperse in the air
8. removes the module
9. checks all accounts for survivors
10. survivors, if any, must be humanely killed

Method 2 is suitable for use in newborn sheep, goats and pigs. It is also suitable for use in a wide range of poultry flocks, provided that containers and vehicles for transporting equipment are available.

Requirements for the efficient use of Container Gasification Units (CGU):

- Birds should be carefully captured and placed in crates or modules of appropriate size and flock density to allow all birds to perch.
- The bird boxes or module should be placed in the tank and the door closed only when the operator is ready to inject the gas mixture.
- Ensure that the tank door is closed and feed the gas mixture until <2% oxygen is left at the top of the crates.
- An appropriate gas meter should be used to ensure that the oxygen concentration is <2% and maintained until it is confirmed that the birds have died.
- Allow sufficient time for the birds to die before opening the door. In the absence of a spyhole allowing direct observation of the birds during killing, the cessation of vocalisation and wing flapping sounds may be observed while standing near the tank and used to determine when the birds have died.

- Remove the crates or modules from the container and leave them in the open air.
- Each crate or module should be inspected and the birds checked to make sure they are dead. Dilated pupils and lack of respiratory movements are signs of death.
- Survivors must be killed humanely.
- Ducks and geese do not appear to be resistant to the effects of a mixture of 20% carbon dioxide and 80% nitrogen or argon.

Benefits:

- The gas mixture is introduced quickly and quietly, resulting in less turbulence and less disturbance to birds.
- The use of transport crates or modules for transporting birds minimises handling. Birds should be handled by trained, experienced handling teams when emptying poultry houses.
- The modules are mechanically loaded into the CGU and immediately after sealing, a lethal gas mixture is injected into the chamber.
- Mixtures containing up to 20% carbon dioxide in argon are readily available as welding gas cylinders.
- The birds are exposed to the gas more evenly than in method 1 and do not strangle each other.
- It can be operated in tandem with two CGUs and can produce up to 4000 chickens/hour.
- The amount of gas required is easy to calculate.
- As the appliances are operated outdoors, the gas dissipates quickly when the door is opened at the end of each cycle, which is beneficial for the operator's health and safety.
- The system uses skilled grab teams and equipment used daily in the industry.
- Metal containers are easy to clean and disinfect.

Disadvantages:

- It requires trained operators, trained animal handlers, transport modules and forklift trucks. However, such equipment and suitable outdoor areas with hard surfaces are usually available.
- The main limiting factors are the speed of bird capture and the availability of gas mixtures.
- In the absence of a spyhole, it is difficult to visually confirm the death of birds while they are still in the tank. However, the cessation of vocalisation and spasmodic wing flapping can be used to confirm death.
- The CGU can be used on small and medium sized farms, e.g. on a single farm to kill up to 25,000 birds.

1.3.4.3. Use of nitrogen or inert gases

In this method, animals are placed in a tank or apparatus containing nitrogen or an inert gas such as argon. The controlled atmosphere created leads to unconsciousness and hypoxic

death. Research has shown that hypoxia does not cause aversion in pigs and poultry and does not trigger signs of respiratory distress before loss of consciousness.
The method is suitable for poultry and newborn sheep, goats and pigs.

Requirements for efficient use:

- The tanks or apparatus must allow the required gas concentrations to be maintained and the O2 concentration to be measured accurately.
- Where animals are exposed individually or in small groups, in containers or apparatus, the equipment used must be designed, constructed and maintained in such a way as to avoid injury to the animals and to permit their observation.
- Animals should be placed in the tank or apparatus after filling with the prescribed concentration of gas (<2% O2) and kept in this atmosphere until death is determined.
- Group members must ensure that each batch of animals has sufficient time to die before the next batch is placed in the tank or apparatus.
- Containers or apparatus should not be overcrowded and measures should be taken to avoid animals suffocating by climbing on top of each other.

Advantage:

- Animals cannot sense nitrogen or inert gases, and inducing hypoxia by this method does not cause aversion in animals.

Disadvantages:

- A properly designed container or device is needed.
- It is difficult to check for death while the animals are in the tank or apparatus.
- No immediate loss of consciousness.
- The exposure time required for killing is significant.

1.3.5. Use of lethal injection

Lethal injections are special drugs that are given to kill the animal. This method minimises pain and suffering if the animals can be easily handled and restrained for injection. In some cases, the administration of a separate sedative prior to lethal injection is recommended.

The method is suitable for killing cattle, sheep, goats, pigs, horses and poultry. It can be used only for a small number of animals because of the time needed to carry out the method and the cost of the drugs.

How does it work?

If specific drugs (usually barbiturates in combination with other drugs) are administered intravenously in the correct dosage, the animal will lose consciousness, followed by loss of heart and respiratory function and death.

Physiological effects

Intravenous administration of euthanasia drugs allows rapid delivery to the heart and central nervous system (CNS), where they cause rapid and uniform loss of consciousness. The barbiturates initially cause CNS depression of the cerebral cortex, followed by a decreasing depression of the rest of the CNS, eventually leading to anaesthesia. At sufficient doses, respiratory depression leads to apnoea and eventually cardiac arrest.

When can you apply?

Lethal injection can be used in all species and at all ages, but is most appropriate in a small number of animals that can be easily fixed and in which vascular access can be secured.

This method is recommended in the following situations:

Species: cattle, sheep, goats, pigs, horses, camels, deer, poultry

Age: adult animals, newborns

Animal welfare aspects and concerns

Problems may include inappropriate route of administration, sub-lethal dosing and lack of prior sedation before pain medication is given. Manufacturers' instructions for administration and dosing should always be followed and the effects of the drugs monitored until the animal is pronounced dead.

Equipment

The medicines needed to administer lethal injections can be difficult to obtain due to legal restrictions.

The operator must have the following to administer the lethal injection:

- appropriate veterinary medicines
- appropriate syringes and needles

There are several veterinary medicines that can be used as lethal injections.

Here we would like to highlight two:

T-61 solution for injection A.U.V.

T-61 is a combination of embutramide, mebesonium iodide and tetracaine hydrochloride and can be used for livestock euthanasia. However, due to animal welfare considerations, it should only be used in unconscious animals and should only be administered intravenously.

Barbiturates

Barbiturate derivatives (barbiturates) are one of the most commonly used euthanasia drugs. Pentobarbital is a compound commonly used alone or in combination with other drugs. Barbiturates are administered intravenously, but other routes of administration may be used in unconscious animals.

Design

The use of these products requires special authorisation and monitoring, including records of the animals euthanised, the dose administered and the person administering the medicine. In addition, the nature of these preparations means that they must be kept locked away and only personnel who are familiar with their safe use should have access.

In addition, the following should be taken into account:

- Is there a licence for lethal injections?
- Are there staff who are competent (trained and experienced) to administer lethal injections?
- What species of animals should be slaughtered on the farm, what is their number and age?
- Is it possible to restrain animals to ensure that euthanasia is carried out properly?
- Is there sufficient veterinary medicine and other equipment to carry out the culling operation?

Health and safety

The products are developed and designed to be used to kill animals in a specific context, so they can cause serious harm to humans if accidentally injected, pricked with a needle or ingested.

The following health and safety advice should be followed when administering lethal injection:

- it is essential that medicine bottles are kept in a safe and secure place and only accessed by trained staff;
- protective equipment such as gloves and sleeved clothing is recommended to prevent accidental contact between the needle and the administrator;

- when dealing with excitable animals whose behaviour makes them dangerous to handle, it is advisable to restrain or sedate them effectively before administering the lethal injection.

Further considerations

The products used for euthanasia by injection remain in the carcass and can be ingested by scavengers, which can lead to the unintentional euthanasia of scavengers. Therefore, the disposal of animal carcasses euthanised by injectable preparations is of paramount importance and the procedure should only be used when proper control and disposal of the carcass is ensured.

Requirements for efficient use:

- Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used.
- Some animals may require prior sedation.
- Intravenous administration is preferable, but intraperitoneal or intramuscular administration may also be appropriate, especially if the agent is non-irritating.
- Animals must be restrained for effective administration.
- Animals should be monitored to ensure that they have no brainstem reflexes.
- The personnel performing the method must be trained and skilled in anaesthesia techniques.

Advantages of the method:

- It can also be used on the farm.
- It can also be used in tight spaces.
- The group can move freely around the farm.
- Death is easy to cause.

Disadvantages of the method:

- There are legal restrictions on its use in some countries.
- It requires animals to be restrained.
- Some combinations of the type of preparation and route of administration can be painful and should only be used in unconscious animals.
- A veterinarian or licensed staff is required.
- A time-consuming method.
- You can only kill one animal at a time.
- Particular attention should be paid to the disposal of animal carcasses.

1.3.6. Use of other methods

The following methods are of greater concern from an animal welfare perspective and are presented primarily for educational purposes.

Please note that the use of the methods discussed below is not recommended!!!

1.3.6.1. Milling/Pulping

Grinding/mashing, using mechanical equipment with rotating blades or handles, causes the immediate dismemberment and death of **day-old poultry and embryonated eggs.**

Requirements

- The method requires special equipment that must be kept in excellent working order.
- The pace of grinding/mashing day-old poultry should not allow the equipment to jam, birds to bounce off the blades, or birds to suffocate before being mashed.

Benefits:

- The procedure results in instant death.
- Large numbers of animals can be quickly killed.

Disadvantages:

- Special equipment is needed.
- Macerated tissues may pose a biosafety or human health risk.
- Cleaning the equipment can be a source of contamination.

1.3.6.2. Application of cervical dislocation

Cervical sprain means that pulling the neck to sever the spinal cord causes death by cutting off the oxygen supply to the brain. Cervical sprain does not always lead to immediate loss of consciousness. Overall, this method should not be used routinely, but rather as a back-up to other methods.
This method is used only for the killing of small poultry when the number of birds to be killed is small and no other killing method is available.
Birds can be killed manually, by hand if the birds weigh less than 3 kg, or mechanically, using a tool, if the birds weigh between 3 and 5 kg.

Requirements for efficient use:

- Strength and good technique are needed to ensure consistently reliable results, so team members should be given regular rest.
- Birds must be monitored continuously until death to ensure that they have no brainstem reflexes.

Benefits:

- Non-invasive killing method.
- Can also be done manually on smaller birds.

Disadvantages:

- It is tiring for the person carrying it out.
- The method is more difficult to implement for larger birds.
- It requires trained staff for humane implementation.
- Human health and safety concerns about the capture of birds.
- Additional stress for the animals from the capture.

Methods:

Manual cervical sprain

The correct way to do it: for adult chickens, hold the bird's legs (and wing tips if possible) in one hand, close to the hips, so that the lower part of the bird's body is flush with the thigh. With the first two fingers of the other hand, grasp the head just behind the skull with the thumb under the beak. Stretch the neck downwards, at the same time pressing your fingers into the cervical vertebrae and pulling the bird's head back. Dislocate the neck with one quick pull.

Application of a killing cone

The killing cone consists of a tension cone with a clamping device underneath to dislocate the neck. The bird is placed in the cone with its head hanging underneath. The neck is grasped in the clamp and the handle is pulled firmly downwards to dislocate the neck. Although not ideal, this method can be used to kill a small number of birds. **In the European Union, this method should not be used to kill birds weighing more than 5 kg live weight.**

Heavy stick application

The correct way to do this is to hold the bird by the feet (and if possible, by the tips of the wings) with the head and neck on the ground. An assistant should place a heavy stick (or metal rod) on the neck, behind the head. The person holding the legs should then apply firm pressure with their foot on the rod on either side of the head and immediately pull the bird's body upwards with enough force to dislocate the neck (this may cause some bleeding).
Two people are needed for this method, which, although not ideal, can be used to kill large birds such as turkeys and geese. **In the European Union, this method should not be used for slaughtering birds weighing more than 5 kg live weight.**

1.3.6.3. Decapitation

This method is used exclusively for the slaughter of poultry. Decapitation leads to death by cerebral ischaemia.

The requirement for efficient use:

- The necessary equipment must be kept in working order.

Advantage:

- The technique is effective and requires no further monitoring.

Disadvantages:

- The work area is contaminated with body fluids, which increases the biosecurity risks.
- It is painful if the animal does not lose consciousness immediately.

1.3.6.4. Bleeding

Exsanguination is a method of killing animals by cutting major blood vessels in the neck or chest, resulting in a rapid drop in blood pressure, leading to cerebral ischemia and death.

Requirements for efficient use:

- A sharp knife is required.
- Access to the neck or chest of the animal is required.
- Animals should be monitored continuously until death to ensure that they do not develop brainstem reflexes.

Advantage:

- The technique is effective in inducing death, after an effective method of stunning.

Disadvantages:

- Spasms can cause delayed or ineffective bleeding.
- The work area is contaminated with body fluids, which increases the biosecurity risks.

1.3.6.5. Addition of anaesthetics to feed or water

Anaesthetics such as chloralose can be mixed with poultry feed or drinking water for killing poultry in sheds. Birds that are not killed directly but are only euthanised should be killed immediately by other methods, such as neck dislocation.
This method requires relatively little human work. As the active ingredients are added to the feed and water, the birds can consume them themselves. The dose required to kill a flock is

difficult to calculate and there is no guarantee that the animals will ingest the active substances because of the change in taste. It is possible that animals that have been killed or have died may prevent other individuals from accessing feeding and drinking water points.
For this method to be successful, the birds need to ingest a sufficient amount of anaesthetic quickly. In order to encourage the birds to consume or drink the anaesthetic, they must be fasted for a period of time. Although this method is suitable for killing large numbers of poultry in houses, it is **not recommended because of animal welfare concerns.**

Requirements for efficient use:

- Sufficient anaesthetic must be administered quickly to ensure effective killing.
- Feeding the birds fasting or withholding drinking water will make it easier to get the right amounts.

Benefits:

- Fixing the birds is not necessary.
- There may be biosecurity benefits for large numbers of sick birds.

Disadvantages:

- Non-target animals may have unintended access to medicated feed or water if it is provided in an open environment.
- The dose administered cannot be controlled and variable results are obtained.
- Animals may refuse manipulated feed or drinking water because of illness or bad taste.
- The method may have to be followed by slaughter.
- Care is essential in the preparation and provision of treated feed or drinking water, and in the disposal of unconsumed treated feed/drinking water and contaminated carcasses.

1.3.6.6 Shutting down ventilation

Due to serious animal welfare concerns, this method is not recommended!

Ventilation is stopped by closing all windows, doors, air intakes and valves. Shutting off the air exchange circulation will cause oxygen starvation and an increase in CO2 levels. Temperatures also rise due to the body heat produced by the animals. Animals die from suffocation and hyperthermia. The anoxic environment is also lethal for humans, with staff not allowed to enter the building until all ventilation systems are turned back on.

1.4. What to do after killing

After the last animal has been killed, at least one person must remain on site for a further 30 minutes to ensure that all animals have been successfully killed. If any live animals are found, they must be killed immediately before the official veterinarian leaves the scene. When

leaving the site, care must be taken to ensure that all biosecurity requirements are met, and that all personnel and vehicles are properly cleaned and disinfected.
It is psychologically difficult to "switch off" after a day in such conditions. However, if everyone allows themselves some time to reflect, it can be beneficial for their own mental health and help them plan for a similar situation in the future.

Some questions we can ask ourselves:

- Were the tasks carried out safely and risks minimised?
- Were animals treated humanely, without unnecessary suffering?
- Have biosafety standards been respected?

In the case of someone acting as Event Commander (EP):

- Were you aware of any concerns, problems or difficulties that the teams were facing?
- Have these problems been solved?
- Have problems and solutions been recorded to ensure that the same problems do not occur in the future?

It is important that if animals are killed on the farm, the carcasses are disposed of properly and immediately. It is important to bear the following points in mind when disposing of carcasses:

- If a large animal, such as an adult cattle, is killed in an enclosed space, such as an indoor pen, the carcass must be removed immediately. If left in the killing area for too long, the animal will go into rigor mortis and will be difficult to remove.
- When transporting carcasses, do not load them onto trucks too soon before departure (bloating!).
- The carcasses are sprayed with disinfectant, and after they are removed, the soil underneath them should be thoroughly sprayed.
- If possible, avoid piling carcasses as this traps heat and accelerates rotting.
- If the carcasses cannot be disposed of immediately, care must be taken to cover them to prevent the introduction of wildlife, which could lead to further spread of the disease.

1.5 Guidelines per species - Methods of killing animals for disease control per species

1.5.1. Cattle

1.5.1.1.1 Killing of cattle with firearms

In this method, cattle are shot in the pasture/field at close range or from a distance.

Design

- Do local laws allow the use of firearms in the area?
- Is the shooter experienced and licensed?

- From what distance do you plan to shoot the animals? Can the firearm do this? Is it necessary to close the pasture/field?
- Does the animal have to be restrained to shoot at close range? If so, the animal must be restrained or confined in a narrow pen made of barriers or gates.
- If animals need to be sedated, can the sedated animal be easily moved to a safe area while the sedative lasts?
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions suitable (e.g. no strong winds)?
- How are carcasses collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?
- Do the adult animals have the babies? If so, shoot the calves first, as the mothers need to stay with them when they fall. This will also reduce the risk of serious injuries that can occur if an adult cow falls on a conscious calf.

Find a suitable location:

- Can the animals stay in the usual pasture/field with their usual breed mates, including the small ones?
- The site must be easily accessible for the collection of carcasses.
- If possible, killings in enclosed rooms with concrete walls and solid floors should be avoided. If fired in such an environment, safety measures should be implemented, e.g. the placement of hay bales to prevent projectile recoil.

Positioning

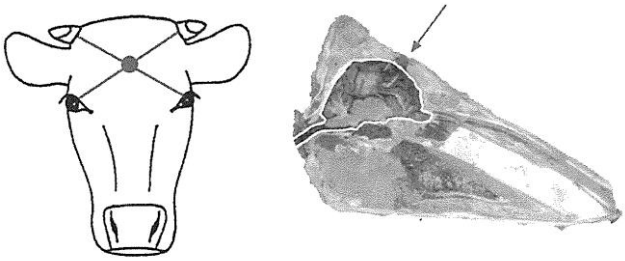
For instant death, aim for the right part of the skull - the front of the head. If a free projectile is used, the bullet should ideally stop at the top of the spine; if a shotgun is used, the bullet should be dispersed inside the skull, completely destroying the brain.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

Adult cattle

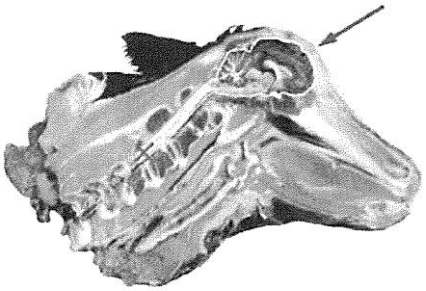
The brain of adult cattle is located high in the head. The ideal point of penetration is in the middle of the forehead - at the intersection of two imaginary lines drawn between the centre of the two eyes and the centre of the base of the horns (or where the horns would be). This point should be approximately 7 cm ± 1 cm above the line crossing the forehead at the back of the eyes. The projectile shall penetrate perpendicular to the skull.

Adult bulls can have a hard, thick frontal bone, often covered with thick hair. This is sometimes difficult to penetrate with small calibre projectiles, so a shotgun is a better option.



Borjak

Calves have a relatively larger brain than adult cattle, but the upper part is underdeveloped. The aiming point is slightly lower than in adult cattle and the gun must be tilted back to achieve the correct angle of incidence to destroy the brain stem.



Ammunition

The type of ammunition used to kill animals is critical. It must have enough energy to instantly shock the animal and penetrate deep enough to destroy vital areas of the brain that control breathing and circulation.

Implementation

1. Ensure that the shooter is licensed and competent for the task.
2. Careful selection of the right firearm and ammunition (not all animals on the farm may require the same approach).
3. Ensure that the environment around the animals is suitable for the task (e.g. soft soil or an area with hay bales etc. to catch stray balls).
4. Stand in a place where the animals are clearly visible.
5. Be patient and allow the animal to position itself at the right angle for the shot.
6. Shoot only when the animal is in the correct position.

Check

After shooting the animal, check that the shot was effective (arrhythmic breathing and absence of corneal reflex). After a maximum of one minute, the animal may start to twitch and in some cases may twitch quite violently. This is normal in an animal that has been correctly shot. The first sign of an ineffective shot is a return to normal rhythmic breathing. This is not to be confused with agonal breathing (intermittent gasping), which is spinal in origin and indicates a dying brain.

1.5.1.2. Killing of cattle by means of a fixed penetrating device

This method involves stunning the animal with a penetrating "nail" and then using a rod to kill it.

Design

- Do local laws allow the use of the device? In some countries they are considered firearms.
- Are the staff experienced and have the necessary licences?
- Animals will need to be tranquilized or restrained.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the place of slaughter?
- Do you have the necessary staff, equipment and supplies?

Recording of animals

Ideally, animals should be confined or restrained, the aim should be to be able to shoot accurately and to be able to easily destroy the brain immediately after the animal collapses.

Positioning

For immediate and effective stunning, the device should be positioned in the appropriate part of the skull - the front of the head.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

Adult cattle

The brain of cattle is located high in the head. The ideal stunning position is in the middle of the forehead - at the intersection of two imaginary lines drawn between the eyes and the centre of the base of the horns. This position should be approximately 70 mm ± 10 mm above the line crossing the forehead at the back of the eyes. The muzzle of the device shall be held

at right angles to the skull so that the tube is directed through the upper brainstem towards the brainstem.

Adult bulls can have a hard, thick frontal bone, often covered with thick hair. This can sometimes be difficult to penetrate with small calibre projectiles, so a shotgun is a better option.

Borjak

The target area is in the centre of the forehead, at the intersection of two imaginary lines drawn from the centre of the two eyes to the opposite hornbuds.

If an animal is not properly stunned, it must be stunned again immediately. When the 'nail' enters the skull, it causes massive damage and swelling around the wound, the swelling absorbs most of the impact of the second shot and this means that the shockwave does not reach the brain as effectively. For this reason, the repeat shot should always be positioned to avoid the immediate area of the first shot.

Ammunition

Bullets vary in strength and are classified according to the amount of propellant they contain. For on-farm killing of adult cattle, it is recommended to use the heaviest cartridge available.

Destruction of the brain

Penetration of the "nail" does not necessarily lead to death, so the destruction of the brain cord should be carried out as soon as possible to ensure the death of the animal. The laceration should be carried out by inserting a flexible wire or polypropylene rod through the hole in the head caused by the "nail". Disposable sticks that remain in the body of the animal are also available. Moving the rod destroys the brainstem and upper spinal cord, ensuring death and reducing the possibility of reflex kicking that may occur after stunning. The operation requires a skilled and confident performer.

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. You need to choose the right tool and cartridge carefully.
3. If preliminary sedation is needed, follow the advice of the veterinarian on the duration of the effect.
4. Let the animals calm down.
5. When the animal is in position, the "nail" should be fired in the correct shooting position.
6. Check the effectiveness of the stunning.
7. Brain damage must be carried out without delay.
8. The whole process should be followed for the animal before killing another animal.

1.5.1.3 Killing of cattle by electrocution followed by electrocution (calves only)

This method uses an electric current to stun by disrupting brain function and then kill by stopping the heart.

Design

- Do you have a reliable power source?
- Do you have the necessary staff, equipment and supplies? You will need scissor-type pliers.
- Two team members are required to carry out the two-step electrocution method. The first person is responsible for placing the electrodes on the animal and the second person can manipulate the position of the animal.
- Can animals be stunned in groups in their own pens?
- Is the environment as dry as possible?
- Is personal protective equipment such as rubber boots available?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions right (e.g. if you are doing it outdoors, is it not raining)?
- Equipment must be protected from water damage.
- How are animal carcasses collected from the place of slaughter?

Positioning

Stunning electrodes that only touch the head should be placed so that they reach the brain as directly as possible. Placing the electrodes elsewhere means that more of the current can flow through lower resistance pathways rather than completely through the brain, reducing the effectiveness of the stun.

When using scissor tongs on calves, the recommended position of the tongs is on either side of the head, between the eye and the ear.

The calf is turned on its back and the tongs are used to hold the heart.

Electrical parameters

The heart is particularly sensitive to low frequency currents, such as 50 Hz, but not to higher frequencies. It is therefore important to check that the frequency of the stunning equipment is set to 50 Hz. The frequency of the current should not be higher than 80 Hz, because the probability of ventricular fibrillation decreases as the frequency increases.

Phase 1: the head is electrically energised in the above position for at least three seconds.

Phase two: the animal is turned on its back and forceps are applied to the chest to hold the heart for 8-10 seconds. This must be done immediately after the first phase to prevent the animal from regaining consciousness, as electrocution is an extremely painful experience.

Electrodes should be applied firmly throughout the entire period and pressure should not be released until stunning or death occurs.

Species and age of animals	Minimum current (A) for cabling (head only)	Current applied to the heart (A) to stop the heart
Borjak	1.25	1.25

Note: These parameters were developed for pure animals with relatively low resistance. High resistance caused by thick hair or dirt may affect the effectiveness of stunning, so the parameters should be adjusted according to Ohm's law to ensure that animals are properly stunned/killed.

It is important that the contact resistance is as low as possible to maximise the current flow. The surface conductivity of the animal can be improved by wetting the skin. From the operator's point of view, contact resistance can be minimised by placing the electrodes in the correct position and maintaining a constant pressure throughout the application.

Very often, grease and dirt are deposited on the electrodes. This build-up increases the electrical resistance and must be removed regularly. Failure to clean the electrodes leads to corrosion, which further increases the resistance. Electrodes should be thoroughly cleaned regularly according to the manufacturer's instructions to maintain optimum electrical contact with the animal.

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. Testing the electrical supply and equipment.
3. One person should be ready to administer the stun and the other to restrain the animal.
4. Apply the device to the animal's head.
5. Make sure the stunning is effective and turn the animal on its back to show its chest.
6. Place the electrodes on the chest, holding the heart, and perform the second phase.
7. Check that the animal is dead.
8. Remove the carcass and continue with the other animals.
9. Over time, it may be necessary to resize the stun pen to make it smaller, using temporary gates or barriers.

1.5.1.4. Killing of cattle by lethal injection

This method involves intravenous injection of the veterinary medicinal product. The method is suitable for adult cattle, calves and neonatal cattle.

Design

- Do local laws allow lethal injection on the farm? In some countries its use is heavily restricted.
- Are the staff experienced and have the necessary licences?

- The animals must be restrained.
- Separating newborn babies from their mothers can be dangerous. Ensure that appropriate health and safety measures are taken to prevent serious injury to the operator.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the slaughter site and how is scavengers' access to the carcasses controlled until they are removed?
- Do you have the necessary staff, equipment and supplies?

Positioning

Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used, intravenous administration is preferred. Intracardiac injections should only be given if the animal has been previously anaesthetised by another method.

In cattle, the preferred site for injection is the jugular vein, as it is superficial under the skin and of adequate size. In most cases, the animal should be kept in a normal standing or lying position, with the head elevated and looking straight ahead, which is the best way to identify and access the jugular vein.

Veterinary medicinal products

There are a number of veterinary medicines that can be used appropriately to kill the animal. The most commonly used are barbiturates.

The correct dose depends on the species and size of the animal, check the packaging and dosage recommendations for the specific product. In newborns, the dose for most products is usually no more than a few millilitres, so the volume of injection is very manageable.

Implementation

1. Ensure that the person carrying out the task has the appropriate skills, is properly licensed and equipped with personal protective equipment.
2. Have the necessary veterinary medicines, syringes and needles ready.
3. Pre-insertion of an intravenous catheter can provide additional assurance that the product is administered entirely intravenously, which may be beneficial in fragile animals or if other people, the owners concerned, are also monitoring the procedure.
4. Fill the syringe with the correct dose of product.
5. Secure the animal as necessary.
6. Make sure the animal is in the correct position, with its head in the normal position.
7. Find the jugular vein or other vein used to give the injection. This is done by pinching the vein proximal to the injection site with your thumb or a tourniquet.
8. Once the animal's position is settled, insert the needle into the vein and draw blood into the syringe to check its correct position.

9. Administer the product intravenously using a uniform, continuous pressure. For injections of larger volumes of the product, the intravenous insertion may be reinforced by occasional blood aspiration into the syringe.
10. This can occur before the product is fully injected and the operator should be prepared for the animal to fall to the ground.
11. You must make sure that the animal is dead.
12. Remove the carcass and proceed with the slaughter of the other animals.

1.5.2. Pigs

1.5.2.1. Killing of pigs with firearms

This method involves shooting domestic pigs and wild boars at close range or from a distance.

Design

- Pigs are among the most difficult animals to shoot because of the physiology of the head. Before you commit to shooting, consider the option of two-stage electrical stunning and killing.
- Do local laws allow the use of firearms in the area?
- Is the shooter experienced and licensed?
- Domestic pigs must be restrained before shooting. The necessary facilities and equipment must be provided. A temporary restraint system, such as a gate, may be effective, provided that the carcass can be easily removed after killing.
- To secure the head, a rope or nose clamp is passed around the upper jaw, behind the canines.
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions suitable (e.g. no strong winds)?
- How are carcasses collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?
- Do the sows have their babies? If so, the piglets should be killed or removed first, as the sows can crush them when they fall.

Positioning

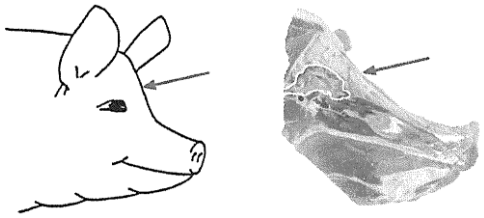
For instant death, aim for the right part of the skull - the front of the head. If a free projectile is used, the bullet should ideally stop at the top of the spine; if a shotgun is used, the bullet should be dispersed inside the skull, completely destroying the brain.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

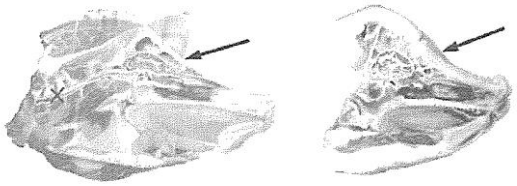
Pigs are among the most difficult animals to shoot. There are two reasons for this:

- the target area is very small, and this problem can be exacerbated by the 'dish' (concave) face shape of some breeds and older pigs;
- the brain lies quite deep in the head compared to other species, with a cluster of sinuses between the frontal bone and the brain cavity.

The ideal shooting position for pigs is one finger above eye level, on the midline of the forehead, aiming towards the tail.



Older pigs and some breeds often have thick bones in their foreheads, which can cause the bullet to get stuck in the sinuses and not penetrate the brain. In some older pigs, especially boars, there may be a bony ridge running down the middle of the forehead; in such cases the muzzle of the gun should be placed on one side of the ridge, aiming for the centre of the head.



Because of problems with adult pigs and heavier-headed breeds, it is recommended that they are killed with a shotgun if possible. If a shotgun is used, the target area is the same as described above, alternatively the animal can be shot through one eye or from behind the ear towards the centre of the head. If a shotgun is used, the barrel should always be held 5-25 cm from the animal's head.

Ammunition

The type of ammunition used to kill animals is critical. It must have enough energy to instantly shock the animal and penetrate deep enough to destroy vital areas of the brain that control breathing and circulation.

Implementation

1. Ensure that the shooter is licensed and competent for the task.
2. Careful selection of the right firearm and ammunition (not all animals on the farm may require the same approach).

3. Ensure that the environment around the animals is suitable for the task (e.g. soft soil or an area with hay bales etc. to catch stray balls).
4. Stand where the animals are clearly visible.
5. Be patient and allow the animal to position itself at the right angle for the shot.
6. Shoot only when the animal is in the correct position.

Check

After the animal is shot, check that the shot was effective (arrhythmic breathing and absence of corneal reflex). After a maximum of one minute, the animal may start to twitch. The first sign of an ineffective shot is the return to normal rhythm of breathing. This is not to be confused with agonal breathing (intermittent gasping), which is spinal in origin and indicates a dying brain.

1.5.2.2.2. Killing of pigs by means of a fixed penetrating device

This method involves stunning the animal with a penetrating "nail" and then using a rod to kill it.

Design

- Pigs are among the most difficult animals to shoot because of the physiology of the head. Before you commit to shooting, consider the option of two-stage electrical stunning and killing.
- Pigs must be restrained before shooting. The necessary facilities and equipment must be provided. A temporary restraint system such as a gate may be effective, provided that the carcass can be easily removed after killing.
- To secure the head, a rope or nose clamp is passed around the upper jaw behind the canines.
- Does local legislation allow the use of a fixed bandwidth device? In some countries they are considered firearms.
- Are the staff experienced and have the necessary licences?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are carcasses collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?

Recording of animals

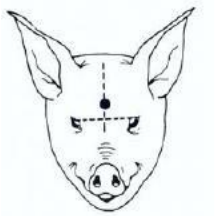
Ideally, animals should be confined or restrained, the aim should be to be able to shoot accurately and to be able to bleed out or damage the brain immediately after the animal collapses. To secure the head, a rope or nose clamp should be passed around the upper jaw behind the canines.

Positioning

Pigs are among the most difficult animals to shoot. There are two reasons for this:

- the target area is very small, and this problem can be exacerbated by the 'dish' (concave) face shape of some breeds and older pigs;
- the brain lies quite deep in the head compared to other species, with a cluster of sinuses between the frontal bone and the brain cavity.

The stunning point for pigs is 20 mm above eye level, on the midline of the forehead, directed towards the tail. If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk. The muzzle of the instrument should be placed pressed firmly against the head. A bone ridge may be drawn across the middle of the forehead of older sows and boars. This may prevent the 'pin' from penetrating the brain, so that the pig cannot be effectively stunned. For most pigs, it is recommended that the strongest cartridge available for the instrument be used and in all cases the animal should be bled immediately or the brain should be lacerated to ensure rapid death.



Ammunition

Bullets vary in strength and are classified according to the amount of propellant they contain. For on-farm killing of pigs, it is recommended to use the heaviest cartridge available.

Destruction of the brain

Penetration of the "nail" does not necessarily lead to death, so the destruction of the brain cord should be carried out as soon as possible to ensure the death of the animal. The laceration should be carried out by inserting a flexible wire or polypropylene rod through the hole in the head caused by the "nail". Disposable sticks that remain in the body of the animal are also available. Moving the rod destroys the brainstem and upper spinal cord, ensuring death and reducing the possibility of reflex kicking that may occur after stunning. The operation requires a skilled and confident performer.

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. You need to choose the right tool and cartridge carefully.
3. If preliminary sedation is needed, follow the advice of the veterinarian on the duration of the effect.
4. Let the animals calm down.

5. When the animal is in position, the "nail" should be fired in the correct shooting position.
6. Check the effectiveness of the stunning.
7. Brain damage must be carried out without delay.
8. The whole process should be followed for the animal before killing another animal.

1.5.2.3 Two-stage killing of pigs by electrocution followed by electrocution

This method uses an electric current to stun by disrupting brain function and then kill by stopping the heart.

Design

- Do you have a reliable power source?
- Do you have the necessary staff, equipment and supplies? You will need scissor-type pliers.
- Two team members are required to carry out the two-step electrocution method. The first person is responsible for placing the electrodes on the animal and the second person can manipulate the position of the animal.
- Can animals be stunned in groups in their own pens?
- If animals need to be moved, are there appropriate aids, such as handling equipment?
- Is the environment as dry as possible?
- Is personal protective equipment such as rubber gloves and boots available?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions right (e.g. if you are doing it outside, is it not raining)?
- Equipment must be protected from water damage.
- How are animal carcasses collected from the place of slaughter?
- Do the adult animals have the babies? If so, they need to be separated.

Positioning

The stunning electrodes, which only touch the head, should be positioned so that they reach the brain as directly as possible. Placing the electrodes elsewhere means that more of the current can flow through lower resistance pathways rather than completely through the brain, reducing the effectiveness of the stun. When using scissors-type forceps in pigs, the recommended position of the forceps is on either side of the head, between the eye and the ear. In practice, this position is difficult to achieve in pigs due to the shape of the head; therefore, an alternative solution may be directly under the ears or diagonally under one ear and over the other eye.

The pig is then turned on its back and the tongs are used to hold the heart.

Electrical parameters

The heart is particularly sensitive to low frequency currents, such as 50 Hz, but not to higher frequencies. It is therefore important to check that the frequency of the stunning equipment is set to 50 Hz. The frequency of the current should not be higher than 80 Hz, because the probability of ventricular fibrillation decreases as the frequency increases.

Phase 1: the head is electrically energised in the above position for at least three seconds.

Phase two: the animal is turned on its back and forceps are applied to the chest to hold the heart for 8-10 seconds. This must be done immediately after the first phase to prevent the animal from regaining consciousness, as electrocution is an extremely painful experience.

Electrodes should be applied firmly throughout the entire period and pressure should not be released until stunning or death occurs.

Species and age of animals	Minimum current (A) for cabling (head only)	Current applied to the heart (A) to stop the heart
Pigs over 6 weeks	1.3	1.3
pigs in 6 weeks	0.5	0.5

Note: These parameters were developed for pure animals with relatively low resistance. High resistance caused by thick hair or dirt may affect the effectiveness of stunning, so the parameters should be adjusted according to Ohm's law to ensure that animals are properly stunned/killed.

It is important that the contact resistance is as low as possible to maximise the current flow. The surface conductivity of the animal can be improved by wetting the skin. From the operator's point of view, contact resistance can be minimised by placing the electrodes in the correct position and maintaining a constant pressure throughout the application.

Very often, grease and dirt are deposited on the electrodes. This build-up increases the electrical resistance and must be removed regularly. Failure to clean the electrodes leads to corrosion, which further increases the resistance. Electrodes should be thoroughly cleaned regularly according to the manufacturer's instructions to maintain optimum electrical contact with the animal.

Species	Voltage (V)	Resistance (Ω)	Current (A)	Effective stunning?
Pig (clean electrodes)	250	150	1.7	Yes
Pig (dirty, worn electrodes)	250	350	0.7	No

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. Testing the electrical supply and equipment.
3. One person should be ready to administer the stun and the other to restrain the animal.
4. Apply the device to the animal's head.
5. Make sure the stunning is effective and turn the animal on its back to show its chest.
6. Place the electrodes on the chest, holding the heart, and perform the second phase.
7. Check that the animal is dead.
8. Remove the carcass and continue with the other animals.
9. Over time, it may be necessary to resize the stun pen to make it smaller, using temporary gates or barriers.

1.5.2.4 Killing of pigs by exposure to carbon dioxide gas or mixtures of carbon dioxide and argon gas in lethal concentrations

In this method, CO2 or a gas mixture is injected into a sealed tank, vehicle or chamber where pigs are already present (method 2).

Design

- How will the animals be transported to the container site?
- How many animals can fit in one container at a time?
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses removed from the container and collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?

- Do the adult animals have the babies? If so, a killing schedule should be developed to minimise stress.

Gas parameters

For a 100 m3 container (or trailer), the estimated capacity is:

- 20 - 24 sows, or
- 50 - 70 fatteners, or
- 120 - 200 piglets

The concentration of CO2 required to kill animals is between 70-90%, the recommended concentration for pigs is 80%. The density of CO2 is 1.9767 kg/m3, so it is easy to calculate that to fill a 100 m3 tank to 80% requires 158.136 kg of CO2 (volume of trailer (container) x density of CO2 - 20% (the concentration to be achieved in the trailer must be 80%) = (100m3 x 1.9767 km/m3) x (1 - 0.2) = 158.136 kg of CO2.

Implementation

1. Measure how deep the gas hose should be inserted so that it is as close to the bottom of the container as possible, but out of reach of the animals.
2. Remove the top of the tank, vehicle, container or chamber.
3. Move the pigs into the tank, vehicle, container or chamber.
4. Insert the gas hoses from above. You can use several cylinders and hoses at the same time, but in this case they must be inserted from different places.
5. Close the top of the tank, vehicle, container or chamber.
6. Secure the hose so that it cannot fall in and animals cannot reach it.
7. Check the sealing of the tank, vehicle, container or chamber to prevent CO2 leakage.
8. If possible, measure the CO2 concentration, which should be at least 80% inside.
9. After the gasification process is completed, the cylinders must be sealed to prevent further flow of CO2 gas. Remove the hoses, but do not open the gas-filled chamber until the waiting time has elapsed.
10. After all CO2 has been added to the tank, wait 15-20 minutes to allow all animals to die from exposure.
11. Open the tank, vehicle, container or chamber and allow the CO2 to escape;
12. To prevent CO2 toxicosis, wear a mask when entering a tank, vehicle, container or chamber.
13. Once the dead animals have been removed from the container or unloaded from the vehicle, check that they are all dead. If the pigs show signs of life, use a fixed trap to kill them.

Time needed to carry out the fumigation operation

For a 100 m3 container or vehicle, it takes about 1 hour to complete a turn:

- a maximum of 20 minutes is needed to place the animals in the tank,
- 15-20 minutes to fill the tank,
- 15-20 minutes exposure time for animals.

1.5.2.5. Killing of pigs by lethal injection

This method involves intravenous injection of the veterinary medicinal product. This method is used in pigs of all ages, but is most easily used in newborn piglets.

Design

- Do local laws allow lethal injection on the farm? In some countries its use is heavily restricted.
- Are the staff experienced and have the necessary licences?
- Animals must be restrained and secured.
- Weaning newborns from their mothers can be dangerous, especially when working with pigs. Ensure that appropriate health and safety measures are taken to prevent serious injury to the handler.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the slaughter site and how is scavengers' access to the carcasses controlled until they are removed?
- Do you have the necessary staff, equipment and supplies?

Positioning

Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used, intravenous administration is preferred. Intracardiac injections should only be given if the animal has been previously anaesthetised by another method.

In pigs, the preferred site for injection is the anterior vena cava, because of the size of the vein needed to administer the injection.

Veterinary medicinal products

There are a number of veterinary medicines that can be used appropriately to kill the animal. The most commonly used are barbiturates.

The correct dose depends on the species and size of the animal, check the packaging and dosage recommendations for the specific product. In newborns, the dose for most products is usually no more than a few millilitres, so the volume of injection is very manageable.

Implementation

1. Ensure that the person carrying out the task has the appropriate skills, is properly licensed and equipped with personal protective equipment.
2. Have the necessary veterinary medicines, syringes and needles ready.
3. Fill the syringe with the correct dose of product.
4. Secure the animal.
5. Make sure the animal is in the right position.

6. Once the animal's position is settled, insert the needle into the vein and draw blood into the syringe to check its correct position.
7. Administer the product intravenously using a uniform, continuous pressure. For injections of larger volumes of the product, the intravenous insertion may be reinforced by occasional blood aspiration into the syringe.
8. This can occur before the product is fully injected and the operator should be prepared for the animal to fall to the ground.
9. You must make sure that the animal is dead.
10. Remove the carcass and proceed with the slaughter of the other animals.

1.5.3. Small ruminants (sheep and goats)

1.5.3.1. Killing of small ruminants with firearms

In this method, small ruminants are shot in the pasture/field at close or long range.

Design

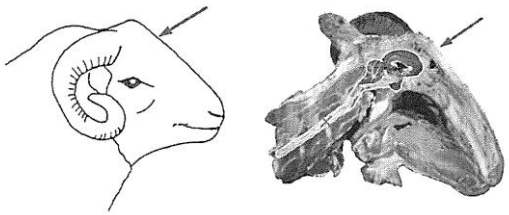
- Do local laws allow the use of firearms in the area?
- Is the shooter experienced and licensed?
- From what distance do you plan to shoot the animals? Can the firearm do this? Is it necessary to close the pasture/field?
- Does the animal have to be restrained to shoot at close range? If so, the animal must be restrained or confined in a narrow pen made of barriers or gates.
- If animals need to be sedated, can the sedated animal be easily moved to a safe area while the sedative lasts?
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions suitable (e.g. no strong winds)?
- How are carcasses collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?
- Do the adult animals have the babies? If so, they should be separated before the activity starts. The use of firearms is not an appropriate method for killing young small ruminants as the risk of the bullet penetrating the body and ricocheting is too high.

Positioning

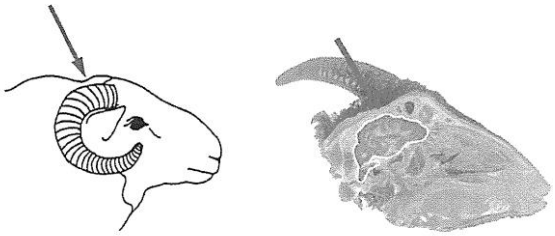
For instant death, aim for the right part of the skull - the front of the head. If a free projectile is used, the bullet should ideally stop at the top of the spine; if a shotgun is used, the bullet should be dispersed inside the skull, completely destroying the brain.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

When shooting sheep and goats with a free-fire rifle, the aiming point is on the midline, directly above the eyes, pointing down the ridge line. In practice, this can be difficult to achieve and the slightest error in the angle of fire or slight movement of the animal can result in the free projectile exiting through the animal's head or neck.



Sheep and goats with strong horns can be a problem as the horns leave little or no target area above the forehead. Such animals can be shot from behind the head and, where possible, the use of a shotgun is recommended for this type of shooting.



Ammunition

The type of ammunition used to kill animals is critical. It must have enough energy to instantly shock the animal and penetrate deep enough to destroy vital areas of the brain that control breathing and circulation.

Implementation

1. Ensure that the shooter is licensed and competent for the task.
2. Careful selection of the right firearm and ammunition (not all animals on the farm may require the same approach).
3. Ensure that the environment around the animals is suitable for the task (e.g. soft soil or an area with hay bales etc. to catch stray balls).
4. Stand in a place where the animals are clearly visible.
5. Be patient and allow the animal to position itself at the right angle for the shot.
6. Shoot only when the animal is in the correct position.

1.5.3.2. Killing of small ruminants by means of a fixed penetrating trap

This method involves stunning the animal with a penetrating "nail" and then using a rod to kill it.

Design

- Do local laws allow the use of the device? In some countries they are considered firearms.
- Are the staff experienced and have the necessary licences?
- It will be necessary to tranquilize or restrain the animals.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the place of slaughter?
- Do you have the necessary staff, equipment and supplies?

Recording of animals

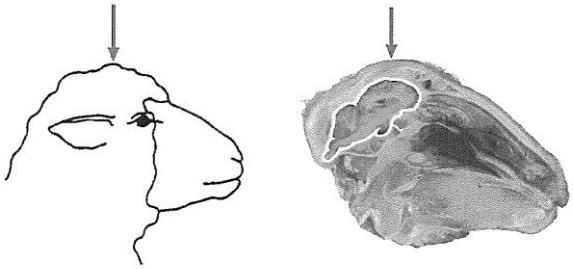
Ideally, animals should be confined or restrained, the aim should be to be able to shoot accurately and to be able to easily destroy the brain immediately after the animal collapses.

Positioning

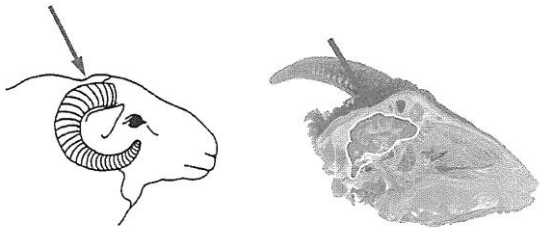
For immediate and effective stunning, the device should be positioned in the right part of the skull - on top of the head.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

In the case of sheep without horns, the muzzle of the gun should be placed at the highest point of the head, on the midline, and pointed straight down.



In the case of horned sheep, the muzzle of the weapon should be placed behind the line joining the horns and pointed towards the base of the tongue.



If an animal is not properly stunned, it must be stunned again immediately. When the 'nail' penetrates the skull, it causes massive damage and swelling around the wound, the swelling absorbs most of the impact of the second shot and this means that the shockwave does not reach the brain as effectively. For this reason, the repeat shot should always be positioned to avoid the immediate area of the first shot.

Ammunition

Bullets vary in strength and are classified according to the amount of propellant they contain.

Destruction of the brain

Penetration of the "nail" does not necessarily lead to death, so the destruction of the brain cord should be carried out as soon as possible to ensure the death of the animal. The laceration should be carried out by inserting a flexible wire or polypropylene rod through the hole in the head caused by the "nail". Disposable sticks that remain in the body of the animal are also available. Moving the rod destroys the brainstem and upper spinal cord, ensuring death and reducing the possibility of reflex kicking that may occur after stunning. The operation requires a skilled and confident performer.

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. You need to choose the right tool and cartridge carefully.
3. If preliminary sedation is needed, follow the advice of the veterinarian on the duration of the effect.
4. Let the animals calm down.
5. When the animal is in position, the "nail" should be fired in the correct shooting position.
6. Check the effectiveness of the stunning.
7. Brain damage must be carried out without delay.
8. The whole process should be followed for the animal before killing another animal.

1.5.3.3 Killing of small ruminants by electrocution

This method uses an electric current to stun by disrupting brain function and then kill by stopping the heart.

Design

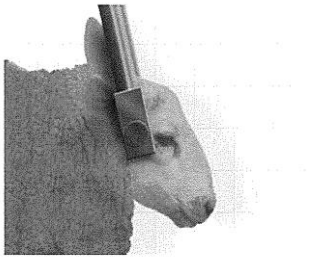
- Do you have a reliable power source?
- Do you have the necessary staff, equipment and supplies? You will need scissor-type pliers.
- Two team members are required to carry out the two-step electrocution method. The first person is responsible for placing the electrodes on the animal and the second person can manipulate the position of the animal.
- Can animals be stunned in groups in their own pens?
- Is the environment as dry as possible?
- Is personal protective equipment such as rubber boots available?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions right (e.g. if you are doing it outdoors, is it not raining)?
- Equipment must be protected from water damage.
- How are animal carcasses collected from the place of slaughter?

Positioning

Stunning electrodes that only touch the head should be placed so that they reach the brain as directly as possible. Placing the electrodes elsewhere means that more of the current can flow through lower resistance pathways rather than completely through the brain, reducing the effectiveness of the stun.

When using scissor tongs on sheep or goats on calves, the recommended position of the tongs is on either side of the head, between the eye and the ear. Due to the wool and horns, this position is very difficult or impossible to achieve and adjustments may need to be made to take this into account.

The sheep or goat is turned on its back and the tongs are used to hold the heart.



Electrical parameters

The heart is particularly sensitive to low frequency currents, such as 50 Hz, but not to higher frequencies. It is therefore important to check that the frequency of the stunning equipment is set to 50 Hz. The frequency of the current should not be higher than 80 Hz, because the higher the frequency, the less likely it is to cause ventricular fibrillation.

Phase 1: the head is electrically energised in the above position for at least three seconds.

Stage two: the animal is turned on its back and forceps are applied to the chest to hold the heart for 8-10 seconds. This must be done immediately after the first stage so that the animal does not regain consciousness, as electrocution is an extremely painful experience.

The electrodes should be applied firmly throughout the entire period and the pressure should not be released until stunning or death has ended.

Species and age of animals	Minimum current (A) for cabling (head only)	Current applied to the heart (A) to stop the heart
Adult sheep and goats	1.0	1.0
Gidas and sheep	1.0	1.0

Note: These parameters were developed for pure animals with relatively low resistance. High resistance caused by thick wool or dirt may affect the effectiveness of stunning, so the parameters should be adjusted according to Ohm's law to ensure that animals are properly stunned/killed.

It is important that the contact resistance is as low as possible to maximise the current flow. The surface conductivity of the animal can be improved by wetting the skin. From the operator's point of view, contact resistance can be minimised by placing the electrodes in the correct position and maintaining a constant pressure throughout the application.

Very often, grease and dirt are deposited on the electrodes. This build-up increases the electrical resistance and must be removed regularly. Failure to clean the electrodes leads to corrosion, which further increases the resistance. Electrodes should be thoroughly cleaned regularly according to the manufacturer's instructions to maintain optimum electrical contact with the animal.

Species	Voltage (V)	Resistance (Ω)	Ampacity (A)	Effective stunning?
Sheep (short, wet wool)	250	200	1.3	Yes
Sheep (long, dry wool)	250	1000	0.3	No

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. Testing the electrical supply and equipment.
3. One person should be ready to administer the stun and the other to restrain the animal.
4. Apply the device to the animal's head.
5. Make sure the stunning is effective and turn the animal on its back to show its chest.
6. Place the electrodes on the chest, holding the heart, and perform the second phase.
7. Check that the animal is dead.
8. Remove the carcass and continue with the other animals.
9. Over time, it may be necessary to resize the stun pen to make it smaller, using temporary gates or barriers.

1.5.3.4. Killing of small ruminants by lethal injection

This method involves intravenous injection of the veterinary medicinal product. This method may be used for both adult and neonatal small ruminants.

Design

- Do local laws allow lethal injection on the farm? In some countries its use is heavily restricted.
- Are the staff experienced and have the necessary licences?
- The animals must be restrained.
- Separating newborn babies from their mothers can be dangerous. Ensure that appropriate health and safety measures are taken to prevent serious injury to the operator.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the slaughter site and how is scavengers' access to the carcasses controlled until they are removed?
- Do you have the necessary staff, equipment and supplies?

Positioning

Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used, intravenous administration is preferred. Intracardiac injections should only be given if the animal has been previously anaesthetised by another method.

In small ruminants, the preferred site for injection is the jugular vein, as it is superficial under the skin and of a suitable size. In most cases, the animal should be kept in a normal standing or lying position, with the head elevated and looking straight ahead, which is the best way to identify and access the jugular vein.

Veterinary medicinal products

There are a number of veterinary medicines that can be used appropriately to kill the animal. The most commonly used are barbiturates.

The correct dose depends on the species and size of the animal, check the packaging and dosage recommendations for the specific product. In newborns, the dose for most products is usually no more than a few millilitres, so the volume of injection is very manageable.

Implementation

1. Ensure that the person carrying out the task has the appropriate skills, is properly licensed and equipped with personal protective equipment.
2. Have the necessary veterinary medicines, syringes and needles ready.
3. Pre-insertion of an intravenous catheter can provide additional assurance that the product is administered entirely intravenously, which may be beneficial in fragile animals or if other people, the owners concerned, are also monitoring the procedure.
4. Fill the syringe with the correct dose of product.
5. Secure the animal as necessary.
6. Make sure the animal is in the correct position, with its head in the normal position.
7. Find the jugular vein or other vein used to give the injection. This is done by pinching the vein proximal to the injection site with your thumb or a tourniquet.
8. Once the animal's position is settled, insert the needle into the vein and draw blood into the syringe to check its correct position.
9. Administer the product intravenously using a uniform, continuous pressure. For injections of larger volumes of the product, the intravenous insertion may be reinforced by occasional blood aspiration into the syringe.
10. This can occur before the product is fully injected and the operator should be prepared for the animal to fall to the ground.
11. You must make sure that the animal is dead.
12. Remove the carcass and proceed with the slaughter of the other animals.

1.5.4. Horses

1.5.4.1.1 Killing horses with firearms

This method involves shooting horses from a distance or at close range.

Design

- Do local laws allow the use of firearms in the area?
- Is the shooter experienced and licensed?
- From what distance do you plan to shoot the animals? Can the firearm do this? Is it necessary to close the pasture/field?
- Does the animal have to be restrained to shoot at close range? If so, the animal must be restrained or confined in a narrow pen made of barriers or gates.
- If animals need to be sedated, can the sedated animal be easily moved to a safe area while the sedative lasts?

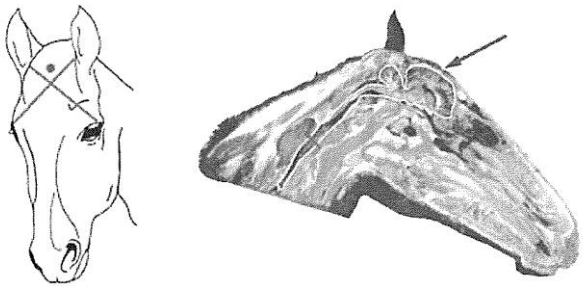
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions suitable (e.g. no strong winds)?
- How are carcasses collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?
- Do the adult animals have the babies? If so, shoot the foals first, as the mothers need to stay with them when they fall. This also reduces the risk of serious injuries that can occur when an adult horse falls on a conscious foal.

Positioning

For instant death, aim for the right part of the skull - the front of the head. If a free projectile is used, the bullet should ideally stop at the top of the spine; if a shotgun is used, the bullet should be dispersed inside the skull, completely destroying the brain.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

The horse's brain is located high in the head. The shot should be aimed at the centre of the forehead, but slightly higher than in cattle. Take two imaginary lines from the centre of each eye to the base of the ear between the eyes; shoot the animal about 2 cm above the intersection of the two lines. The muzzle of the gun should be slightly tilted so that the shot is directed through the cortex towards the brainstem. If the horse is sedated before the shot and has its head in a lower than normal position, care should be taken to adjust the angle of the shot accordingly.



Ammunition

The type of ammunition used to kill animals is critical. It must have enough energy to instantly shock the animal and penetrate deep enough to destroy vital areas of the brain that control breathing and circulation.

Implementation

1. Ensure that the shooter is licensed and competent for the task.
2. Careful selection of the right firearm and ammunition (not all animals on the farm may require the same approach).
3. Ensure that the environment around the animals is suitable for the task (e.g. soft soil or an area with hay bales etc. to catch stray balls).
4. Stand in a place where the animals are clearly visible.
5. Be patient and allow the animal to position itself at the right angle for the shot.
6. Shoot only when the animal is in the correct position.

1.5.4.2. Killing horses by means of a fixed penetrating device

This method involves stunning the animal with a penetrating "nail" and then using a rod to kill it.

Design

- Do local laws allow the use of the device? In some countries they are considered firearms.
- Are the staff experienced and have the necessary licences?
- It will be necessary to tranquilize or restrain the animals.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the place of slaughter?
- Do you have the necessary staff, equipment and supplies?

Recording of animals

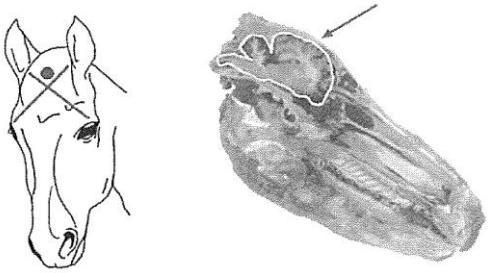
Ideally, animals should be confined or restrained, the aim should be to be able to shoot accurately and to be able to easily destroy the brain immediately after the animal collapses. The use of a bridle is justified for horses, especially those that have been used before.

Positioning

For immediate and effective stunning, the device should be positioned in the appropriate part of the skull - the front of the head.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

The horse's brain is located high in the head. The ideal place for stunning is in the middle of the forehead. Take two imaginary lines from the eyes to the opposite ears; stun the animal about 10 mm above the point where the two lines intersect. If necessary, the muzzle of the gun should be tilted so that the barrel is directed towards the brain stem.



Ammunition

The bullets vary in strength and are classified according to the amount of propellant in them, measured in the grains. It is important to use the correct cartridge for each device according to the manufacturer's instructions.

Destruction of the brain

Penetration of the "nail" does not necessarily lead to death, so the destruction of the brain cord should be carried out as soon as possible to ensure the death of the animal. The laceration should be carried out by inserting a flexible wire or polypropylene rod through the hole in the head caused by the "nail". Disposable sticks that remain in the body of the animal are also available. Moving the rod destroys the brainstem and upper spinal cord, ensuring death and reducing the possibility of reflex kicking that may occur after stunning. The operation requires a skilled and confident performer.

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. You need to choose the right tool and cartridge carefully.
3. If preliminary sedation is required, follow the advice of the veterinarian on the duration of the effect.
4. Let the animals calm down.
5. When the animal is in position, the "nail" should be fired in the correct shooting position.
6. Check the effectiveness of the stunning.
7. Brain damage must be carried out without delay.
8. The whole process should be followed for the animal before killing another animal.

1.5.4.3 Killing horses by lethal injection

This method involves the intravenous injection of a veterinary medicinal product . The method can also be used for adult horses and foals.

Design

- Do local laws allow lethal injection on the farm? In some countries its use is heavily restricted.
- Are the staff experienced and have the necessary licences?
- The animals must be restrained.
- Separating newborn babies from their mothers can be dangerous - Ensure that appropriate health and safety measures are taken to prevent serious injury to the operator.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the slaughter site and how is scavengers' access to the carcasses controlled until they are removed?
- Do you have the necessary staff, equipment and supplies?

Positioning

Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used, intravenous administration is preferred. Intracardiac injections should only be given if the animal has been previously anaesthetised by another method.

In horses , the preferred site for injection is the jugular vein, as it is superficial under the skin and of a suitable size. In most cases, the animal should be kept in a normal standing or lying position, with the head elevated and looking straight ahead, which is the best way to identify and access the jugular vein.

Veterinary medicinal products

There are a number of veterinary medicines that can be used appropriately to kill the animal. The most commonly used are barbiturates.

The correct dose depends on the species and size of the animal, check the packaging and dosage recommendations for the specific product. In newborns, the dose for most products is usually no more than a few millilitres, so the volume of injection is very manageable.

Implementation

1. Ensure that the person carrying out the task has the appropriate skills, is properly licensed and equipped with personal protective equipment.
2. Have the necessary veterinary medicines, syringes and needles ready.
3. Pre-insertion of an intravenous catheter can provide additional assurance that the product is administered entirely intravenously, which may be beneficial in fragile animals or if other people, the owners concerned, are also monitoring the procedure.
4. Fill the syringe with the correct dose of product.
5. Secure the animal as necessary.
6. Make sure the animal is in the correct position, with its head in the normal position.

7. Find the jugular vein or other vein used to give the injection. This is done by pinching the vein proximal to the injection site with your thumb or a tourniquet.
8. Once the animal's position is settled, insert the needle into the vein and draw blood into the syringe to check its correct position.
9. Administer the product intravenously using a uniform, continuous pressure. For injections of larger volumes of the product, the intravenous insertion may be reinforced by occasional blood aspiration into the syringe.
10. This can occur before the product is fully injected and the operator should be prepared for the animal to fall to the ground.
11. You must make sure that the animal is dead.
12. Remove the carcass and proceed with the slaughter of the other animals.

1.5.5. Pondweeds

1.5.5.1. Killing camelids with firearms

This method involves shooting camelids from a distance or at close range.

Design

- Do local laws allow the use of firearms in the area?
- Is the shooter experienced and licensed?
- From what distance do you plan to shoot the animals? Can the firearm do this? Is it necessary to close the pasture/field?
- Does the animal have to be restrained to shoot at close range? If so, the animal must be restrained or confined in a narrow pen made of barriers or gates.
- If animals need to be sedated, can the sedated animal be easily moved to a safe area while the sedative lasts?
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions suitable (e.g. no strong winds)?
- How are carcasses collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?
- Do the adult animals have the babies? If so, shoot the calves first, as the mothers need to stay with them when they fall. This will also reduce the risk of serious injuries that can occur if an adult camel falls on a conscious calf.

Positioning

For instant death, aim for the right part of the skull - the top of the head. If a free projectile is used, the bullet should ideally stop at the top of the spine; if a shotgun is used, the bullet should be dispersed inside the skull, completely destroying the brain.

If the operator is in doubt as to the correct target area, it should be determined in advance and, if possible, marked. This can be done with marker spray, marker pen or marking chalk.

Llama and alpaca

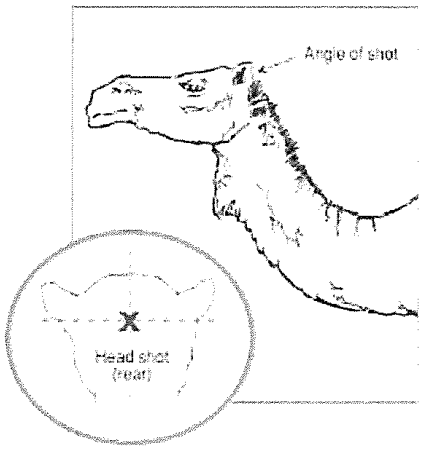
The positioning of llamas and alpacas is different from that of other livestock species. Above the head, imagine two imaginary lines running from the back of the eyes to the base of the opposite ears, with the intersection of these lines being the target. If the animal is standing, a shot aimed from behind the ears into the skull or from the back of the skull through the skull can be very effective.

Teve

Frontal brain shot is not recommended for camels, as the shape of the skull can cause the projectile to deflect.

Rearward position

The firearm should be pointed to the back of the head at the intersection of the skull and neck and directed towards the mouth (perpendicular to the line of the neck).



Temporal position

The camel is shot from the side, so that the bullet enters the skull halfway between the eye and the ear. The projectile must be aimed horizontally.

Ammunition

The type of ammunition used to kill animals is critical. It must have enough energy to instantly shock the animal and penetrate deep enough to destroy vital areas of the brain that control breathing and circulation

Implementation

1. Ensure that the shooter is licensed and competent for the task.
2. Careful selection of the right firearm and ammunition (not all animals on the farm may require the same approach).
3. Ensure that the environment around the animals is suitable for the task (e.g. soft soil or an area with hay bales etc. to catch stray balls).
4. Stand in a place where the animals are clearly visible.
5. Be patient and allow the animal to position itself at the right angle for the shot.
6. Shoot only when the animal is in the correct position.

1.5.5.2. Killing camelids by lethal injection

This method involves intravenous injection of the veterinary medicinal product. The method is suitable for both adult and young camelids.

Design

- Does local legislation allow lethal injection on the farm? In some countries its use is severely restricted.
- Are the staff experienced and have the necessary licences?
- The animals must be restrained.
- Weaning newborns from their mothers can be dangerous, especially when working with pigs. Ensure that appropriate health and safety measures are taken to prevent serious injury to the handler.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the slaughter site and how is scavengers' access to the carcasses controlled until they are removed?
- Do you have the necessary staff, equipment and supplies?

Positioning

Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used, intravenous administration is preferred. Intracardiac injections should only be given if the animal has been previously anaesthetised by another method.

In camelids, the preferred site for injection is the jugular vein, as it is superficial under the skin and of a suitable size. In most cases, the animal should be kept in a normal standing or lying position, with the head elevated and looking straight ahead, which is the best way to identify and access the jugular vein.

Veterinary medicinal products

There are a number of veterinary medicines that can be used appropriately to kill the animal. The most commonly used are barbiturates.

The correct dose depends on the species and size of the animal, check the packaging and dosage recommendations for the specific product. In newborns, the dose for most products is usually no more than a few millilitres, so the volume of injection is very manageable.

Implementation

1. Ensure that the person carrying out the task has the appropriate skills, is properly licensed and equipped with personal protective equipment.
2. Have the necessary veterinary medicines, syringes and needles ready.
3. Pre-insertion of an intravenous catheter can provide additional assurance that the product is administered entirely intravenously, which may be beneficial in fragile animals or if other people, the owners concerned, are also monitoring the procedure.
4. Fill the syringe with the correct dose of product.
5. Secure the animal as necessary.
6. Make sure the animal is in the correct position, with its head in the normal position.
7. Find the jugular vein or other vein used to give the injection. This is done by pinching the vein proximal to the injection site with your thumb or a tourniquet.
8. Once the animal's position is settled, insert the needle into the vein and draw blood into the syringe to check its correct position.
9. Administer the product intravenously using a uniform, continuous pressure. For injections of larger volumes of the product, the intravenous insertion may be reinforced by occasional blood aspiration into the syringe.
10. This can occur before the product is fully injected and the operator should be prepared for the animal to fall to the ground.
11. You must make sure that the animal is dead.
12. Remove the carcass and proceed with the slaughter of the other animals.

1.5.6. Poultry

1.5.6.1. Killing of poultry with non-penetrating fixed means of confinement

This method involves the stunning and killing of poultry (chickens and turkeys) and waterfowl. It is not recommended for birds with particularly thick skulls, such as guinea fowls.

Design

- Do local laws allow the use of the device? In some countries they are considered firearms.
- Are the staff experienced and have the necessary licences?
- There will be a need for safe restraint of animals.

- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are animal carcasses collected from the place of slaughter? The site must be easily accessible for the collection of carcasses.
- Do you have the necessary staff, equipment and supplies?

Recording of animals

Birds should be secured by hand or placed in a cone. The best method depends on the staff available and the size of the birds.

Positioning

The orifice of the instrument should be placed at the highest point of the head, on the midline of the skull. Viewed from the side, the muzzle should point towards the area between the bird's eye and ear, at 90 degrees to the head. When the instrument is fired, allow the "peg" to push the head out of your hand, do not try to hold it after the shot.

Equipment and ammunition

The non-penetrating fixed-bar tool has been proven to be very effective in killing poultry and waterfowl. For a smaller bird, such as a chicken, you can use either a flat or convex-headed tool. For larger birds (ducks, geese and turkeys), the convex head tool is recommended.

The bullets vary in strength and are classified according to the amount of propellant in the grains. It is important to use the correct cartridge for each device according to the manufacturer's instructions.

If there is any doubt about the effectiveness of this method, an alternative method, such as neck dislocation, should be used immediately. If carried out by properly trained personnel, death from cervical sprain can be instantaneous due to the severing of the spinal cord and blood vessels supplying the brain.

If the method is used for mass culling to control infectious diseases, access to more than one device may be necessary (overheating!) and a spare device should always be available.

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. Secure the animal.
3. Make sure the animal is in the right position
4. Apply the device to the animal's head.
5. Check that the animal is dead.
6. Remove the carcass and continue with the other animals.

1.5.6.2. Electro-stunning of poultry followed by cervical dislocation for the purpose of killing the poultry

This method involves applying an electric current to the head to stun the bird and then dislocating the cervical vertebrae by hand or with an implement. The method is suitable for killing chickens and turkeys up to 5 kg. The method is not suitable for waterfowl because of their feathered nature.

Design

- Do you have a reliable power source?
- Do you have the necessary staff, equipment and supplies?
- Birds must be trapped and secured. Are there enough staff? What personal protective equipment is needed? What handling and handling equipment is needed?
- Is the environment as dry as possible?
- Is personal protective equipment such as rubber boots available?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- Are the weather conditions right (e.g. if you are doing it outside, is it not raining)?
- Equipment must be protected from water damage.
- How are animal carcasses collected from the place of slaughter? The site must be easily accessible for the collection of carcasses.

Positioning

Electrical wiring

The stunning electrodes, which only touch the head, should be positioned so that they reach the brain as directly as possible. Placing the electrodes elsewhere means that more of the current can flow through lower resistance pathways rather than completely through the brain, reducing the effectiveness of the stun.

Check that the electrodes are the right size to fit over the head of each bird. Wearing a rubber glove, grasp the back of the bird's head with one hand and firmly place the electrodes on

either side of the head between the eye and the ear. The electrodes must be placed correctly so that the current flows through the brain and causes immediate loss of consciousness.

Electrical parameters

Electrical cabling installations must be tested beforehand. The output voltage must be at least 110 V under load, and it is recommended to use a dead bird for testing. The equipment should also be tested for proper earthing.

The current should be sufficient for effective stunning. The recommended levels are:

- For smaller birds (e.g. chickens): 300-400mA
- For large birds (e.g. turkeys): 400mA
- For ducks and geese: 600mA

The electrodes should be applied forcefully for the entire duration (at least seven seconds) and the pressure should not be released until stunning or death occurs. Electrodes should never be placed on the neck as this may cause paralysis while the bird is fully conscious and in pain.

It is important that the contact resistance is as low as possible to maximise the current flow. The overall resistance to current flow is due to two factors: the body tissues and the contact between the electrodes and the skin. The conductivity of the external surface of the animal can be improved by wetting the skin. From the operator's point of view, contact resistance can be minimised by placing the electrodes in the correct position and maintaining a constant pressure throughout the application.

It is important that the contact resistance is as low as possible to maximise the current flow. The surface conductivity of the animal can be improved by wetting the skin. From the operator's point of view, contact resistance can be minimised by placing the electrodes in the correct position and maintaining a constant pressure throughout the application.

Very often, grease and dirt are deposited on the electrodes. This build-up increases the electrical resistance and must be removed regularly. Failure to clean the electrodes leads to corrosion, which further increases the resistance. Electrodes should be thoroughly cleaned regularly according to the manufacturer's instructions to maintain optimum electrical contact with the animal.

The following methods are of greater concern from an animal welfare perspective and are presented primarily for educational purposes.

Please note that the use of the methods discussed below is not recommended!!!

Manual cervical sprain

If neck dislocation is to be performed, careful consideration should be given to the size and species of bird: the larger the bird, the more difficult it is to kill humanely by this method. The correct procedure is: for adult chickens, hold the bird's legs (and if possible the wing tips) in one hand, close to the hips, so that the lower part of the bird's body is flush with the thigh. With the first two fingers of the other hand, grasp the head just behind the skull with the thumb under the beak. Stretch the neck downwards, at the same time pressing your fingers into the cervical vertebrae and pulling the bird's head back. Dislocate the neck with one quick pull.

Application of a killing cone

The killing cone consists of a tension cone with a clamping device underneath to dislocate the neck. The bird is placed in the cone with its head hanging underneath. The neck is grasped in the clamp and the handle is pulled firmly downwards to dislocate the neck.

Heavy stick application

Two people are needed for this method, which, although not ideal, can be used for large birds. The correct procedure is to hold the bird by the legs (and if possible by the tips of the wings), with the head and neck on the ground. An assistant should place a heavy stick (or metal rod) on the neck, behind the head. The person holding the legs should then apply firm pressure with their foot on the rod on either side of the head and immediately pull the bird's body upwards with enough force to dislocate the neck (this may cause some bleeding).

Implementation

1. Ensure that the person carrying out the stunning and killing is competent.
2. Testing the electrical supply and equipment.
3. Fix the bird.
4. Make sure the animal is in the right position.
5. Place the device on the animal's head.
6. Check that the animal is sedated.
7. Perform the cervical dislocation method of your choice.
8. Check that the animal is dead.
9. Remove the carcass and continue with the other animals.

10. The whole process should be followed for the animal before killing another animal.

Remember: neck dislocation is not recommended without prior stunning, as its use does not guarantee immediate effective stunning!

1.5.6.3. Killing of poultry using an electric water bath

This method uses an electric current to stun by disrupting brain function and then kill by stopping the heart.

Design

- Do you have a reliable power source?
- Do you have the necessary staff, equipment and supplies? The method requires significant infrastructure!
- Birds must be trapped and secured. Are there enough staff? What personal protective equipment is needed?
- What gripping and fixing tools are needed?
- Control equipment must be located in an appropriate environment and protected from water damage.
- How are animal carcasses collected from the place of slaughter?
- How variable are the sizes of animals? Can batches of animals of similar size be handled at the same time?
- Contingency plans must be in place in the event of equipment failure, including the removal of birds from the equipment.

Using the electric waterbath

The method stuns and kills the poultry by pulling the inverted and handcuffed poultry through an electrified water bath stunner. The birds are simultaneously stunned and killed as an electrical connection is made between the live water and the grounded metal clamp. When the bird's head is placed in the electrified water, the electrical circuit is closed. The current flows from the electrode immersed in the water bath, through the water and the bird's head, body and legs, to the metal clamp in which the bird is fixed, and finally through the earth.

The electrical parameters of the water bath system (voltage, current, frequency and waveform) can be adjusted to stun or kill birds. The following table shows the recommended parameters for stunning and killing poultry with an electric waterbath for the purpose of killing for control of infectious diseases. In this case, meat quality is not a concern and the current must be increased to ensure that all birds are killed. The residence time should not be less than 10 seconds.

Species	Minimum current amplitude (mA)	Waveform
Chicken	400 RMS	Sinusoidal AC 50Hz
Turkeys	400 RMS	Sinusoidal AC 50Hz
Duck	400 RMS	Sinusoidal AC 50Hz
Liba	400 RMS	Sinusoidal AC 50Hz

Implementation

1. Equipment must be installed at the place of use.
2. Before the birds are handcuffed and placed in the equipment, the equipment must be tested to ensure that the correct parameters are met. Ensure that the parameters allow for the correct residence time for the birds to be killed.
3. Only handcuff birds when the equipment is properly calibrated and ready for use. The maximum handcuffing time is one minute for chickens, two minutes for turkeys and two minutes for waterfowl.
4. Let handcuffed birds through the equipment.
5. Examine each bird to make sure it has died. If in any doubt, use a back-up method such as a non-penetrating fixed-gear device.

1.5.6.4. Killing poultry with gas

These methods cause anoxia in birds by reducing the concentration of oxygen available around them. This can be done in a sealed tank, into which gas mixtures can be introduced before or after the animals are housed (Methods 1 and 2), or by pumping different gas mixtures/nitrogen foam (Methods 3a and 3b) into the pens.

Design

- Will the birds be moved to a container? Or will the gas mixture be fed into the coops?
- If necessary, how can animals be transported to the container site?
- How many animals can fit in one container at a time?
- If necessary, how should the lead be prepared before pumping in the gas mixture/nitrogen foam?
- Assess the local conditions and the proposed killing site. Is there an immediate threat to the population?
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?
- How are carcasses removed from containers or sheds and how are they collected from the slaughter site?
- Do you have the necessary staff, equipment and supplies?

Methods of killing

There are three methods:

1. Placing animals in a tank or apparatus filled with a predetermined gas mixture.
2. The animals are placed in crates or transport modules, which are placed in a sealed container. A gas mixture is introduced into this sealed tank.
3. The third method involves the introduction of a gas mixture/nitrogen foam into a closed shed:
    - 3a. Use of a gas mixture
    - 3b. Use of nitrogen foam

Recommended for animal welfare reasons:

- any mixture of argon, nitrogen or other inert gases (not more than 2 % total oxygen by volume) OR
- a mixture of argon, nitrogen or other inert gases and CO2 (provided that the CO2 content does not exceed 30 % by volume and the free O2 content does not exceed 2 % by volume). Some commercially available welding gas mixtures may be suitable.

Implementation

Method 1: birds are placed in a tank pre-filled with gas:

1. Measure how deep the hose should be inserted so that it is as close to the bottom as possible, but out of reach of birds.
2. Check that gas cylinders are safe to use (gas cannot leak).
3. Connect the hoses to the gas cylinders. You can use several cylinders and hoses at the same time, but in this case they must be inserted from different places.
   Note: They must remain connected until the cylinder is completely empty. The CO2 may freeze during use, so some of the gas may accumulate and solidify at the bottom of the cylinder. This is visible from the outside (usually 1/5 of the cylinder may freeze during use).
4. Check that the hoses are securely fastened.
5. Remove the top of the tank.
6. Place the birds in the container.
7. Close the top of the container.
8. Secure the hose so that it cannot fall in and animals cannot reach it.
9. Check that the tank is sealed to prevent gas leaks.
10. Measure the oxygen concentration:
    - 5% O2 for chickens and turkeys if CO2 is used, or 2% O2 for all species if pure inert gas is used.
    - 2% O2 for waterfowl if pure inert gas or a C02 mixture is used.

After the process is complete, the cylinders should be sealed to prevent further gas flow. The hoses should be removed, but the gas-filled chamber should not be opened until the waiting time has elapsed:

- It takes less than 2.5 minutes to kill chickens and turkeys, but they must be left for at least 5 minutes after the last bird is introduced for death to occur.
- Open the tank and allow the gas to dissipate.
- Once the dead animals have been removed from the container, it is necessary to check that all the birds have died. If any are suspected to be alive, a back-up killing method should be carried out immediately.

Method 2: the birds are placed in an empty tank into which gas is then introduced:

1. Check that gas cylinders and containers are safe to use - gas cannot leak out if everything is closed;
2. Connect the hoses to the gas cylinders.
   Note: They must remain connected until the cylinder is completely empty. The CO2 may freeze during use, so some of the gas may accumulate and solidify at the bottom of the cylinder. This can be seen from the outside (usually 1/5 of the cylinder may freeze during use). The cylinder can only be emptied after a few hours after defrosting;
3. Check that the hoses are securely fastened and that the gas is ready for transport.
4. Transport the birds in crates or modules to the containers.
5. Place the birds in the tank
6. Close the container door tightly and make sure it is secure and does not let air through.
7. Turn on the gas flow.
8. Check that the tank is sealed to prevent gas leaks.
9. Measure the oxygen concentration:
   - 5% O2 for chickens and turkeys if CO2 is used, or 2% O2 for all species if pure inert gas is used.
   - 2% O2 for waterfowl if pure inert gas or a C02 mixture is used.

After all the gas has been introduced into the tank, wait at least five minutes to allow all the animals to die from exposure:

- Open the tank and allow the gas to dissipate.
- Before entering the tank, make sure you wear a mask to prevent poisoning.
- After the dead animals have been removed from the container, check that all the animals have died. If the birds show signs of life, use, for example, a non-penetrating fixed-barrier device to kill them.

Method 3a: introduction of gas into a closed poultry house:

1. Ensure that CO2 monitors are installed outside the building and that measurement data are available.
2. Installation of gas pipelines for gas supply to the barn.
3. Close all the windows and doors of the shed.
4. Shut off the water supply to the shed because of the risk of frost.
5. Sealing all the gaps in the pit.

6. Turn off the ventilation systems.
7. Gradually pump the gas into the house until the desired concentration is reached.
8. Allow the animals to stay in the gas for an appropriate period of time.
9. Once animals are expected to die, open doors and windows to allow oxygen concentrations to rise before allowing staff into the building, unless they are wearing respirators.
10. Check that all birds are dead. If the birds show signs of life, use, for example, a non-penetrating fixed-barrier device to kill them.

Method 3b: introduction of nitrogen foam into poultry house:

Ensure that there are cameras inside the pen and monitors outside the pen so that the presence of foam can be seen from a distance.

1. Remove feeders and anything else in the pen that could hinder foam development.
2. Install the foam inlet pipes in the shed.
3. If possible, close all windows and doors of the shed.
4. Turn off the ventilation systems.
5. Gradually pump the foam into the pit until the desired concentration is reached.
6. Allow the animals to stay in the gas for an appropriate period of time.
7. Once animals are expected to die, open doors and windows to allow oxygen concentrations to rise before allowing staff into the building, unless they are wearing respirators.
8. Check that all birds are dead. If the birds show signs of life, use, for example, a non-penetrating fixed-barrier device to kill them.

1.5.6.5 Killing chickens, turkeys, waterfowl and ostriches by lethal injection

This method involves injecting the veterinary medicinal product into the animal and can be used for all bird species. While intravenous injection is preferred in awake animals, injection of the product into the liver or coelomic cavity of birds is a commonly used method, effective and humane, provided that the animal is unconscious at the time of injection. It should be noted that injections into air sacs or into the larger bones (humerus and femur), as these spaces are all connected to the respiratory system of the birds, lead to asphyxiation

Design

- Do local laws allow lethal injection on the farm? In some countries its use is heavily restricted.
- Are the staff experienced and have the necessary licences?
- Animals must be restrained.
- Ensure that appropriate health and safety measures are taken to prevent serious injury to the operator.
- Will the public be able to see the scene of the killing? Should additional measures be taken to exclude the public?
- Should anyone in the area be informed about the planned activity?

- How are animal carcasses collected from the slaughter site and how is scavengers' access to the carcasses controlled until they are removed?
- Do you have the necessary staff, equipment and supplies?

Positioning

Intravenous administration is preferable, but coelomic administration or injection directly into the liver may be used if the birds are unconscious (due to tissue irritation) before injection. Doses and routes of administration that cause rapid loss of consciousness and subsequent death should be used.

Pharmaceutical solutions

There are a number of veterinary medicines that can be used appropriately to kill the animal. The most commonly used are barbiturates.

The correct dose depends on the species and size of the animal, check the recommendations for the specific product on the packaging and in the dosage recommendations

Implementation

1. Ensure that the person carrying out the task has the appropriate skills, is properly licensed and equipped with personal protective equipment.
2. Have the necessary veterinary medicines, syringes and needles ready.
3. Fill the syringe with the correct dose of product.
4. Secure the animal as necessary. Several people may be needed to restrain ratites and larger birds.
5. Make sure the animal is in the right position. Fixation and positioning depends on the species of bird and should only be carried out by personnel who are experienced in fixation methods appropriate to the species.
6. Find the jugular vein or other vein used to give the injection. This is done by pinching the vein proximal to the injection site with your thumb or a tourniquet.
7. Once the animal's position is settled, insert the needle into the vein and draw blood into the syringe to check its correct position.
8. Administer the product intravenously using a uniform, continuous pressure. For injections of larger volumes of the product, the intravenous insertion may be reinforced by occasional blood aspiration into the syringe.
9. This can occur before the product is fully injected and the operator should be prepared for the animal to fall to the ground.
10. You must make sure that the animal is dead.
11. Remove the carcass and proceed with the slaughter of the other animals.

2. Disposal of animal carcasses and contaminated materials

2.1. Introduction

Animal disease outbreaks pose a number of challenges that can have a significant impact on food security and the environment. The proper disposal of carcasses of animals killed or slaughtered during an outbreak is a key element of a successful outbreak response, as it helps to prevent or reduce further spread of pathogens and, in the case of zoonotic diseases, protects human health.

The mass disposal of dead animals associated with animal disease outbreaks is often the subject of intense public and media scrutiny, which obliges the veterinary authorities of the Member States to carry out disposal operations not only to destroy the pathogen in accordance with acceptable scientific principles, but also to take into account public and environmental concerns.

The recommendations in this chapter are of a general nature. The choice of one or more of the recommended methods should be in line with relevant local and national legislation and the available resources should be within reach. Furthermore, the guidelines contribute directly to the "One Health" approach by protecting the health of animals, humans and the environment.

2.2. Aims of disposal, strategy development

The main overall objective of disposal is to protect agriculture and the national economy by controlling and reducing animal diseases, by carrying out operations in a timely, safe, biologically safe, aesthetically acceptable and environmentally responsible manner.

The specific aim of disposal is to ensure the appropriate disposal of contaminated and potentially contaminated materials, including animal carcasses, as soon as possible, while reducing pathogens, protecting the environment, public acceptance and maximising cost-effectiveness.

Strategies for the disposal of dead animals (whole or parts) should be developed well in advance of the emergency:

- develop disposal protocols or procedures that meet regulatory, legislative and environmental requirements before an outbreak occurs;
- appropriate disposal personnel, supplies, materials and equipment should be identified before the outbreak occurs;
- prevent the spread of pathogens with minimal or zero impact on the environment, taking into account community preferences;
- all executive staff must be adequately trained to carry out the tasks assigned, in particular biosecurity measures. The type of personnel required to respond shall be determined in advance. For each type of personnel, the duties of the position should be outlined. Consideration should be given to the type and level of training required for the individual to perform the tasks and ensure that documentation of successfully completed training is provided.

- the legislation governing animal health and the organisation of the veterinary authority must give the veterinary services the powers and legal authority to carry out the activities necessary for the efficient and effective disposal of fallen stock. Cooperation between the veterinary services and other relevant governmental bodies is necessary in order to develop a coherent package of legal measures for the disposal of fallen stock in advance of any emergency. In this context, the following aspects should be regulated:
    - the powers of inspection and instruction of the veterinary services (inspectors, veterinarians, etc.) and the right of access to the establishment for the veterinary services and related staff;
    - the control of movements and the power to grant exemptions under certain biosecurity conditions, for example in the case of movement of dead animals to another location for disposal;
    - the obligation for the farmer and the keepers concerned to cooperate with the veterinary services;
    - the need to transfer ownership of the animals to the competent authority;
    - determination of the method and location of disposal and the equipment and facilities required by the veterinary service, in consultation with other relevant authorities, including national and local government bodies responsible for the protection of human health and the environment. Where the chosen method of disposal of fallen stock is applied near the border of a neighbouring country, the competent authorities of that country shall be consulted.
- success is determined by the structures, policies and infrastructure put in place beforehand:
    - 1. Relationship with industry: liaising with industry organisations such as farmers' associations, animal welfare organisations, safety services, the media and consumer representatives is essential to achieve compliance with animal health policies;
    - 2. Standard operating procedures: standard operating procedures should be developed (including documented decision-making processes, staff training);
    - 3. Financial preparedness: financial preparedness means a compensation or insurance mechanism, access to emergency funding and access to staff through agreements with the veterinary service providers.
    - 4. Communication plan: information exchange with officials involved in the outbreak, affected farmers, professional organisations, politicians and the media is essential. An informed spokesperson should be available at all times to respond to enquiries.
    - 5. Resources: resource management should address items such as personnel, transport, storage facilities, equipment (e.g. mobile animal handling equipment, disinfection equipment), fuel, protective and disposable equipment and logistical support.
    - 6. Special equipment: special equipment such as trucks, tractors, bulldozers and front-end loaders must be available.

2.3. Planning procedures

An on-site visit to the farm concerned is required to draw up a plan for the disposal of animal carcasses. This on-site survey may be combined with the outbreak investigation or may be carried out after the investigation, following confirmation of the animal disease. Failure to quickly develop a plan for the disposal of carcasses may delay eradication activities or result in inappropriate treatment of infected carcasses.

Animal health officials should develop a standard operating procedure (SOP) for animal carcasses. When developing the SOP, the following should be taken into account:

- all feasible disposal alternatives;

- key contacts, such as officials from local, regional and national animal health and environmental government agencies, farm staff and other stakeholders;

- equipment and materials necessary for disposal activities; and

- Resources:

  - lorry drivers and lorries;
  - workers and tools;
  - experts in the disposal of animal carcasses; and
  - materials and supplies.

- site information:

  - the name of the owner and the address of the premises;
  - records of the types, numbers and sizes of livestock; and
  - an inventory of stocks, equipment and personnel (e.g. persons handling the stock on a daily basis) available on site to facilitate disposal.

The SOP may contain some or all of the following sections:

2.3.1. Role and responsibilities of the staff concerned

This section of the SOP details all emergency response activities and the organisation/person responsible for each activity. If more than one organisation/person is responsible for an activity, the primary and secondary organisation/person should be identified to avoid confusion.

It is important to find people who are able and willing to carry out the necessary tasks, and to deal with all administrative and operational functions, such as training, controls and management.

The members of the disposal team should consider the following coordination activities:

- consultation with epidemiological experts to select the most appropriate disposal method for the specific pathogen, geographical location and local situation;
- coordinating public compensation to livestock farmers, if available, before disposal begins;

- coordinate with the supplier on supply requirements and the place, time and date of delivery;
- agreeing access to the site and staffing requirements with the property owner;
- coordinate activities with the slaughter staff to ensure that:

    - the slaughter rate does not exceed the disposal rate;
    - there should be a minimum delay between the determination of death and disposal;
    - if disposal is delayed, have a place to store carcasses that will absorb various liquids and can be covered.

- coordinate with biosafety experts to ensure that the disposal process is carried out in a biosafety manner and that disposal personnel are aware of and comply with strict biosafety measures;
- identify and coordinate the necessary stockpiling with cleaning and disinfection and killing activities.

2.3.2. Staff training and information

The authority must identify the disposal personnel with the necessary expertise. If appropriate personnel are not immediately available, assistance should be sought from a partner organisation or jurisdiction. Authorities should consider keeping up-to-date contact details - names, postal, express mail and e-mail addresses, and mobile, office and home telephone numbers - of staff willing and qualified to serve on disposal teams.

Before starting work, the authorities must inform staff of the safety requirements, site conditions and tasks, including the use of appropriate personal protective equipment. Personnel entering the site must comply with the following requirements:

- meet the safety requirements set by the various authorities;
- wear the required personal protective equipment;
- all biosecurity procedures required by the authorities must be followed.

2.3.3. Site characteristics

This section of the SOP includes an inventory of livestock farms in the jurisdiction, including location, number and age composition of animals, and other general information. Documentation shall be provided for each species:

- number of animals;
- the average weight of the animals in each group;
- the types of animals kept (laying hens, breeding sows, fattening sows, etc.);
- in addition, any information that would affect the transport of animals to the evacuation or disposal sites, such as information on animals unable to walk, must be documented.

These location and contact details should include all the information needed to identify the site and communicate with farm staff (e.g. farm name, address, latitude and longitude, telephone numbers, etc.). It is also very important to collect more detailed site information to

enable decisions on disposal methods to be made. Even if an off-site method of disposal of animal carcasses is to be used, it is necessary to collect the necessary information to implement either off-site or on-site methods. Initial disposal plans change frequently and you should be prepared to implement multiple disposal options without significant delay. This section includes, for example, a site map, regional characteristics such as climate, topography, road accessibility and availability of resources such as water, coal and labour. In selecting a disposal site, the following should also be taken into account:

- sufficient topsoil to cover the area;
- soil type (sandy, clay, etc.);
- drainage;
- prevailing wind conditions;
- the separation from sensitive public spaces and the impact on future use.

Your site map should include (this list is only an example and not necessarily exhaustive):

- locations of livestock operations, information on the internal structure of stables (location and size of doors and windows, ceiling height, internal layout of the building, etc.);

- proximity to services and access to roads;

- water supply wells, wetlands, water bodies, waterways such as streams, rivers and lakes;

- areas for the central storage and handling of animal carcases;

- general drainage patterns and depth to groundwater; and

- access points and areas of biosecurity control zones.

The best way to record a location map is to make notes on a printout of an aerial photograph.

2.3.4. Animal by-products and/or types of waste

The best disposal options for different materials depend on the type of material, so it is necessary to identify in advance all the classes and types of waste materials likely to be generated and then the best disposal methods for each. Environmental authorities can often provide technical assistance in this process. Disposal options for each animal by-product and/or waste type will depend on local regulations, so it is important to consult the relevant regulatory authorities before planning disposal.

Once the different types of animal by-products and/or waste have been identified, the expected amount of each type from the outbreak should be estimated to assist in planning transport and disposal.

The most common types of animal by-products and/or waste:

- animal carcasses;
- animal products (e.g. meat, eggs, milk, wool);
- litter and manure;
- feed and feedingstuffs;
- contaminated equipment, supplies and materials (e.g. veterinary products, vaccination or diagnostic syringes, PPE, garbage);
- debris;
- municipal waste.

Disposal personnel must perform the following operations on animal by-products and/or waste:

- define the classification of all animal by-products and/or waste for disposal
- where appropriate, identify animal by-products and/or waste materials and check with the authorities that all designated materials are to be disposed of
- sort materials by type, depending on how the materials will be disposed of
- the various animal by-products and/or waste materials must be transported to the appropriate places, with decaying or wet materials collected in containers to avoid leaching into the environment. Depending on the circumstances, animal by-products and/or waste materials may need to be covered with a tarpaulin or stored under a roof or in an enclosed space.
- estimate the quantity of each type of animal by-product and/or waste and record the information.

2.3.5. Disposal options

The SOP should detail how all disposal options for a given site and situation will be implemented to facilitate flexibility in response.

Disposal options for different types of animal by-products and/or waste:

The first disposal method of choice for all types of animal by-products is transport to an authorised animal by-products plant. In addition, other disposal methods may be necessary in an emergency, subject to specific authorisation.

Animal carcasses: animal by-products of type 1 (ruminants) or type 2 depending on the species of animal

For a detailed description of disposal options, see sections 2.6.1 and 2.6.2.

Manure, slurry, bedding, fodder, hay and straw:

In addition to animal carcasses, a large amount of other animal by-products (hereinafter 'AMP') may be generated during the depopulation of a herd due to an infectious disease, including potentially infectious animal products and by-products, manure and slurry, bedding, litter, fodder, hide and/or wool. The biosecure disposal of these materials is critical as these materials can contain high levels of virus and can be a significant source of infection for susceptible animals.

Manure and slurry can have a high water content depending on the animal species and source. For relatively dry manure, burial or burning with carcasses may be effective. For liquid or slurry manure, burial and burning are unlikely to be effective. In this case, a relatively long period of resting or treatment with heat or chemicals may be effective, although these may be logistically challenging.

Viruses for some animal diseases are highly contagious, and improperly treated bedding, feed, hay and straw can be a source of transmission. Disposal of these materials by burial or incineration can be effective.

Sharp or pointed instruments and vaccines:

Various types of veterinary waste, such as sharps (e.g. needles, syringes), vaccine vials and other disposable vaccine-related equipment, are also generated during the eradication of a herd due to an infectious disease, if vaccination is carried out. These wastes should not be incinerated in open areas as they produce dioxins and the materials are not biodegradable and therefore do not compost. The best solution is to dispose of them in a special incinerator. Otherwise, burial in a safe place should be considered, if approved by the competent authority.

Personal protective equipment (PPE):

To reduce the biosecurity risk, disposable personal protective equipment worn by personnel involved in the clean-up effort should be properly destroyed. The materials are non-biodegradable and therefore cannot be composted, while their incineration in open areas may

produce dioxins. The best solution is to dispose of them in a special incinerator. Otherwise, burial in a safe place should be considered, if approved by the competent authority.

Milk, eggs and egg products:

Large quantities of milk cannot be effectively incinerated, buried or composted, but milk can be ultrapasteurised to minimise the risk of pathogen transmission.

Eggs can be composted or buried, provided sufficient absorbent material is available to avoid excessive leaching.

Disinfectants:

In the event of animal disease outbreaks, response teams use significant quantities of disinfectant concentrates and solutions. Small quantities of disinfectant are used by surveillance, assessment or other support staff to clean and disinfect footwear, vehicle tyres or small packages when travelling from one site to another. Large quantities of disinfectant are used to disinfect vehicles, at roadside checkpoints and at burial sites.

- **Disinfectant concentrate:**

  Any unused disinfectant concentrate should be disposed of according to the label instructions. If large quantities of waste disinfectant concentrate are generated, the substance may contaminate soil, groundwater and surface water and should not be released into the environment.

- **Small amounts of disinfectant solution:**

  A small amount of disinfectant should be mixed at a central point each morning and then transported to the points of use using hand-held sprayers. At the end of each day, the residual solution should be disposed of according to the instructions on the label and the employer's regulations. Disinfectant solution sprayed on footwear, vehicle tires, or small packages may drip off small items, but the over-splash and run-off may not be in sufficient quantity to be collected or post-treated. Therefore, no special disposal procedures are required in this case.

- **Large quantities of disinfectant solution:**

  The disinfectant is used in large quantities to disinfect vehicles, at roadside checkpoints and at burial sites. In these cases, the disinfectant solution must be collected and stored before disposal. Where possible, the disinfectant solution may be filtered and recycled; otherwise, the waste disinfectant solution should be tested, characterised and disposed of in a manner determined by the relevant jurisdiction.

- **Pesticides or insecticides:**

  Pesticides or insecticides can be used to control vectors in and around the affected premises. Ideally, only the minimum quantity of these chemicals should be mixed and all should be used to avoid the generation of additional waste. Recommended guidelines are given below:

- To prevent damage to soil, groundwater and surface water, the services of an experienced pesticide or insecticide applicator should be used.
- Sufficient quantities of pesticide or insecticide should be prepared to treat the area needed, but no more than necessary to avoid disposal problems.
- If the remaining pesticide or insecticide cannot be used properly, the competent authorities can provide information on local requirements for the disposal of pesticide or insecticide residues.
- Before disposing of pesticide or insecticide containers, it is essential to check with public health authorities for the regulations. If the container is empty, do not reuse it unless the label specifies a different procedure.
- Do not pour leftover pesticide or insecticide down the sink, toilet, drain or sewer! Pesticides or insecticides can contaminate groundwater and surface water, which can harm fish, plants and other organisms.

2.3.6. Authorisations and approvals

For any disposal method, you must determine whether there are regulations in the jurisdiction that prevent or restrict the disposal method.

Disposal protocols or procedures that comply with regulatory, legal and environmental requirements should be used.

In addition to the regulations, you must obtain the necessary approvals, including from the landowner.

Licences can be issued by different organisations and for different purposes. Typical activities requiring a licence include:

- the storage and transport of infectious or hazardous waste;
- the operation of a treatment or disposal site;
- implementation of the chosen disposal method (e.g. fire permits, land use permits);
- discharges of liquid waste (e.g. disinfectant solution or leachate);
- digging in an area where there may be utilities.

2.3.7. Materials, supplies and equipment

The SOP should specify in detail the equipment and materials required for disposal activities and

- the resources:

  - lorry drivers and lorries;
  - the availability of fuel;
  - workers and tools;
  - experts in the disposal of animal carcasses;
  - availability of communications - mobile phone reception; protection of staff (e.g. vaccination);
  - materials and supplies;

- the rendering capacity of rendering plants;
- weapons and ammunition, additional cold stores and storage facilities in animal by-product processing plants and slaughterhouses.

- the site information:

- an inventory of stocks, equipment and personnel (e.g. persons handling the stock on a daily basis) available on site to facilitate disposal;
- the availability of disinfection tents for staff;
- storage and disposal of protective clothing;
- staff accommodation to minimise the spread of infection;
- facilities for controlling entry and exit;
- the availability of electricity for night-time operation;
- personal equipment for staff, such as toilets and drinking water.

The US Department of Agriculture's Carcass Management Dashboard (https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/carcass-management/carcass) has an automated calculator for estimating land, time, cost and materials required *(Note: Data are in Anglo-Saxon units, but can be easily converted to metric units using web-based conversion calculators).*

The authorities must have the necessary equipment and facilities for the collection, sorting, sorting, transport, treatment and disinfection of the various types of waste. These facilities must be transported to the site.

2.3.8. Storage

In cases where animals die or are slaughtered faster than they can be disposed of, it may be necessary to plan for the temporary storage of carcasses. The standard rendering operation should provide where carcasses can be collected and stored until disposal can commence. Inappropriate storage of carcasses may result in health or biosecurity risks, disease transmission.

When choosing a storage site, the following should be taken into account:

Liquid leakage:

- Are the carcasses stored in a way that prevents leakage of liquid?
- Is it possible to regulate the drainage of waste water and rainwater from the storage site?
- What precautions are taken to protect the soil and groundwater against leachate discharges? Do the safeguards comply with all relevant requirements?

Security:

- Can unauthorised access to the storage area be prevented and scavengers kept away?
- Prevent access of biological vectors to carcasses by covering them with tarpaulin, soil, hydrated lime or absorbent material such as wood shavings or straw. Leaking fluids should be contained by absorbent material.
- Animal carcasses should not be stored in unlined/uncovered piles or pits to avoid the introduction of vectors and/or scavengers and contamination of soil and groundwater.

Capacity:

- Is there sufficient capacity to accommodate the difference between the maximum kill rate and the maximum disposal rate? If not, avoid killing animals at a rate that exceeds disposal and storage capacity. When the maximum disposal and storage capacity is reached, limit the slaughter rate until the appropriate capacity is available.

Disinfection:

- Can the storage room be properly cleaned and disinfected after use?

Below are some **additional design considerations:**

- Will the carcasses be stored by refrigeration or by other stabilisation methods such as grinding and preservation in containers? If so, are the equipment, supplies and materials necessary to carry out the chosen method(s) available?
- Is there a record system in place to identify and trace all carcasses and other material entering and leaving the storage site?
- Is there enough space for the heavy machinery needed to move heavy loads?
- Will the storage method be able to avoid uncontrolled releases of gases and pathogens?
- The temporary storage place should be located in a dry, cool place, away from other agricultural and non-agricultural operations, sheltered from the wind and preferably away from property lines or roads.

2.3.9. Monitoring and enforcement

All disposal activities must ensure that the work is carried out in strict compliance with the conditions of the official permits and approvals obtained at the design stage and in accordance with the instructions of the official officials. Authorities must ensure strict compliance with all biosecurity measures and prescribed disposal protocols. All inspections must be documented and spot checks must be carried out.

The documentation should include:

- date, time and location;
- the name and contact details of the inspector;
- the name and contact details of the responsible party involved in the activity;
- the activity observed; and
- the result of observations.

The authorities must take immediate action to remedy significant non-compliance.

2.4. Critical design and implementation elements

The critical elements to be considered in the design and implementation are:

Timeliness 1: It is important to detect new infections early, kill infected animals immediately and remove dead animals quickly by inactivating the pathogen. The spread of the pathogen from dead animals and their environment must be prevented as quickly and effectively as possible.

2. Occupational health and safety: Disposal must be organised in such a way that workers are protected from the risks arising from handling decomposing animals. Particular attention should be paid to zoonosis aspects. Workers should be adequately trained and protected against infection by protective clothing, gloves, face masks, effective respirators, goggles, vaccination and effective medication. Workers should also receive regular health checks.

3. Inactivation of the pathogen: The disposal procedure must be chosen to inactivate the pathogen.

4. Environmental concerns: different methods of disposal of fallen stock have different impacts on the environment. For example, incineration produces smoke and unpleasant odours; burial can lead to the production of gas and leachate, resulting in potential contamination of air, soil, surface water and groundwater.

5. Capacity availability: an assessment of the capacity of the different disposal methods should be carried out before any emergency. Temporary storage of dead animals in cold stores can alleviate the lack of processing capacity.

6. Adequate funding: adequate funding for the selected options should be identified and committed at the earliest possible stage.

7. Human resources: ensure the availability of sufficient and well-trained human resources, especially for large-scale and/or large-scale operations. This is particularly important for technical and inspection staff.

8. Social acceptance: social acceptance is an important consideration when choosing a disposal method.

9. Farmers' acceptance: Farmers are sensitive to the safety measures taken to prevent the spread of the disease in relation to the disposal method chosen and the transport of dead animals to the disposal site. Adequate compensation of owners for the loss of animals or for burial or cremation sites will improve acceptance.

10. Equipment: Equipment used for the disposal of dead animals may spread the infection to other premises. Particular care must be taken to clean and disinfect the external surfaces of equipment such as cranes, containers and trucks and to ensure that vehicles are removed from the holding. Trucks carrying fallen stock must be leak-proof.

11. Scavengers and vectors: When disposing of dead animals, full care must be taken to prevent scavengers and vectors from gaining access to the dead animals, which could cause the spread of the pathogen.

Economic impact (short and long term, including remediation): the disposal method used has a significant impact on the economic impact.

13. Disinfection: all disposal equipment must be thoroughly cleaned and disinfected after completion of all disposal activities. In addition, all personnel involved in the disposal of animal carcasses must also be thoroughly cleaned and disinfected before leaving the premises.

2.5 Recommendations for decision-making on the disposal of fallen stock

The disposal of large numbers of dead animals is costly. The fixed and variable costs vary depending on the choice of disposal method. Each method used has direct and indirect costs for local farms, producers and the livestock sector. In addition to biosafety considerations, decision-makers need to be aware of the economic, social, environmental and aesthetic impacts of different disposal technologies. The hierarchy of disposal options may not fully capture and organise these relevant dimensions and decision-makers may be forced to choose the least preferred option. Therefore, a comprehensive understanding of the technologies for the disposal of fallen stock is needed and should reflect the balance between the scientific, economic and social issues at stake. Timely slaughter, maintaining safety and preventing further spread of disease are essential aspects of disease control.

Below is a possible process that can help decision making by comparing the suitability of different disposal options with the factors considered relevant to a given disposal event:

Step 1 - Identify the factors to consider:

Include all relevant factors and leave enough flexibility to allow for adjustments for different situations and locations. Possible factors include, for example, operator safety, community concerns, international acceptance, availability of transportation, industry standards, cost-effectiveness, and speed of resolution. These factors can be modified or changed to best fit the situation or event.

Step 2 - Assess the relative importance of the factors (F) by weighting each factor according to how important you consider it to be in dealing with the event in question. The sum of all the weightings, regardless of the number of factors, should be 100.

Step 3 - Identify and list all disposal options to be considered.

Evaluate each disposal option on the basis of each factor and assign a utility rating between 1 and 10 to each comparison. The **utility rating (U)** is a number between 1 and 10 assigned according to how close the option is to the ideal for each factor (e.g. 1 = least ideal; 10 = most ideal).

Step 4 - For each factor and disposal option, multiply the relative importance (F) x the utility (U) of the factor to obtain a numerical **balanced value (V)** (e.g. V = F x U).

Step 5 - By adding **the sum of the balanced values** to each disposal option, it is possible to **compare the** suitability of the disposal options by numerically ranking the sum of the balanced values for each disposal option. **The highest sum indicates that the disposal option is the most ideal choice.**

2.6. Recommended methods for the disposal of fallen stock

2.6.1. On-farm disposal methods for animal carcasses

On-farm methods of carcass disposal are often preferred to off-farm methods because they avoid the need to transport infected carcasses off the premises and prevent the spread of disease during transport. Many of these methods are relatively easy and inexpensive to implement.

2.6.1.1.1. Deep burial

Deep burial has been used for centuries to dispose of animal carcasses. In deep burial, soil is removed from the ground to a depth of three to five metres, the soil is stockpiled nearby for later use, the carcasses are placed in the excavated area and then the carcasses are covered with the previously removed soil. Once buried, the carcasses undergo anaerobic decomposition, decomposing into minerals and organic matter. This is a slow process that can take decades. The anaerobic decomposition process produces body fluids (leachate) that can slowly percolate into the natural soil beneath the burial site and reach groundwater.

Burial pits are traditionally unlined or partially lined. Lined pits range in complexity from simple plastic sheeted pits to complex designs with leachate collection systems.

Determining whether deep burial is appropriate on a given site requires an assessment of national legislation (in particular ***Decree 45/2012 (8 May 2012****) laying down animal health rules concerning animal by-products not intended for human consumption*) and environmental requirements. A number of factors need to be assessed, including the depth of groundwater and bedrock, the amount of animal carcasses, and the proximity of wells and surface water bodies. Depending on soil type and water table depth, groundwater contamination can pose a risk to human health and the environment. For example, carcass leachate has been shown to contain more than 12 000 milligrams per litre (mg/l) of nitrogen in the form of ammonium. Excessive levels of nitrate can cause methemoglobinemia, which is potentially fatal for infants, and eutrophication, which is destructive to fish. Under favourable conditions, a number of physical, chemical or biological processes can reduce the mass, toxicity, mobility, volume or concentration of contaminants in soil or groundwater. The decomposition of carcasses also produces methane, an explosive gas that can pass through the soil into confined spaces such as sheds and houses, where it can replace air and cause asphyxiation or accumulate in explosive concentrations in the presence of sparks/flames. Methane is also a greenhouse gas that contributes to global climate change.

This method requires on-site monitoring to assess and address problems such as sedimentation, methane production and leachate. Groundwater monitoring may also be

required in some countries. Burial is most appropriate for small numbers of animals in sites with deep groundwater.

2.6.1.1.1.1. Planning

1. Determine whether burial is feasible:

- Do the competent authorities allow on-site or off-site burials?
- The suitability of the soil should be taken into account on the basis of the instructions of the authorities.
- The possibility of groundwater contamination by leachate should be taken into account.
- All possible pathways for groundwater movement, including the presence of drainage pipes, soil characteristics, groundwater depth and groundwater use, should be taken into account.
- Consideration should be given to whether the burial site could pose a stability or explosion hazard to nearby structures due to methane production.

2. Find a suitable location.

- Is there sufficient land available for burial - 1.5 cubic metres per adult cow, 0.3 cubic metres per adult pig or sheep, 1.0 cubic metre per 200 adult broiler chickens/laying hens?
- Check that groundwater and bedrock are at least 60-120 cm below the bottom of the trench, or as recommended by a qualified soil specialist. If so, will the landowner accept the deep burial on site, the associated environmental liabilities and the potential loss of property value or use?
- Do the soil properties (texture, permeability, water table depth and depth of rock layers) protect public health, according to the guidelines of health authorities?
- Is the site suitable for burial in terms of slope/topography?
- Are the wells or springs at least 60 metres away?

- Is there a minimum distance of 30 metres from surface water bodies, property boundaries, gullies, buildings and drains?
- Is the site accessible for staff carrying supplies and equipment?
- Will the burial prevent the future use of the site for its intended purpose?

3. Determining material and equipment needs.

- Personal protective equipment
- Materials and equipment for the disinfection of personnel, vehicles and other objects
- Excavating and loading equipment, other tools
- Trucks (with driver) or trolleys for transporting carcasses from pens/pastures/laying places to burial sites
- Truck liners, such as plastic sheeting or special bags, or absorbent material to prevent leakage from the truck when the carcasses are removed from the site.

4. Ensure that personnel operating the equipment are adequately trained to use the equipment.

5. Ensure that all employees working in disposal are trained in occupational health and safety, biological safety and operational procedures.

2.6.1.1.2. Implementation

1. Ensure that all workers involved in the operation wear personal protective equipment in accordance with the assessment of potential hazards.

2. All appropriate permits, including landowner permission and long-term environmental liability, must be obtained before burial can begin.

3. Calculate the space requirements: 1.5 cubic metres per adult cow, 0.3 cubic metres per adult pig or sheep, 0.005 cubic metres per adult broiler/laying hen (200 birds/cubic metre).

4. Mark or mark out the selected burial site and ensure that the necessary personnel, equipment and facilities for excavation are accessible.

5. Get the tools you need for digging.

6. Based on the above calculations, dig the right size trench.

7. Ensure that no-one enters a trench deeper than 1.5 metres without stabilising the side walls to prevent collapse.

8. Do not excavate near existing structures, such as buildings and roads, as this may undermine the stability of the structure and cause collapse.

9. Place the carcasses in the ditch. Consider puncturing/venting the carcasses before placing them in the trench to minimise the likelihood of gas-laden carcasses being released from below the soil. If multiple layers of carcasses are placed in the trench due to the number of animals killed, a layer of forage, straw or hay (bedding material to be destroyed) should be placed between each layer of carcasses. Alternatively, 0,5 m of soil should be placed over the carcasses in the trench to allow methane to disperse during the first week, and then the trenches should be filled to the ground level.

10. Cover the carcasses with the excavated soil, taking care to level the surface soil to facilitate drainage.

11. Stabilize the excavated area surface to minimize soil erosion in accordance with local requirements.

12. Thoroughly wash, clean and disinfect all disposal equipment.

13. Regularly inspect and maintain the site, with additional backfilling if necessary to prevent water from collecting.

14. Highly recommended: groundwater quality monitoring (probing) downgradient of the burial site(s) to ensure continued groundwater safety; fencing off the area and visibly marking restricted access.

2.6.1.1.3. Advantages, disadvantages

Benefits:

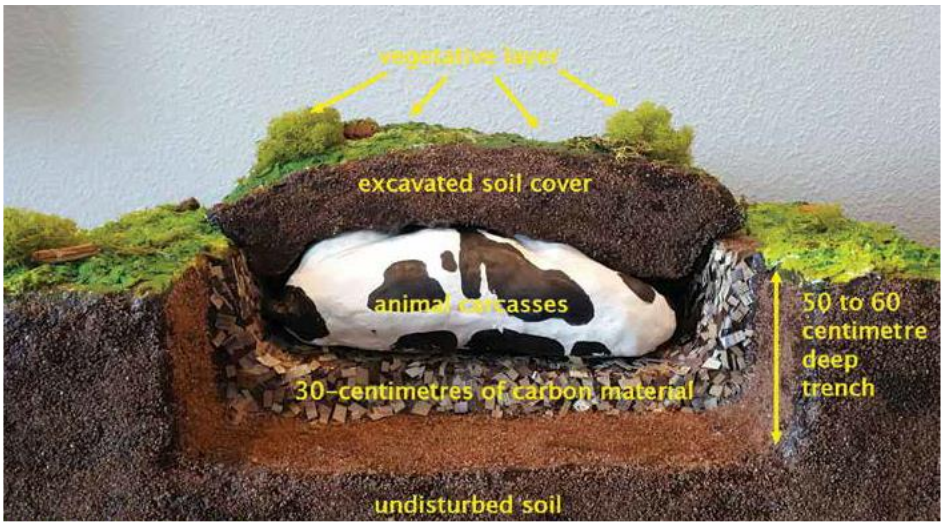
- Method within a farm
- Easy and quick to implement
- Low cost

Disadvantages:

- Public health risk
- Biological safety risk
- Pathogens can survive
- Not sustainable
- Regulatory restrictions
- Restrict future land use
- Requires heavy equipment or excessive labour

2.6.1.2. Shallow burial

A near-surface burial (also known as a shallow burial) involves a shallow trench dug up to 60 cm into the natural ground. This provides 2-3 metres more distance from the water table than deep burial. A layer of carbonaceous material (wood chips, sawdust, rice husks, etc.) 30 cm thick is placed at the bottom of the trench, followed by a layer of animal carcasses. The excavated soil is then placed back into the trench and a mound is formed on which the vegetation cover is established. The cover crop should be of a species that is readily available and appropriate both regionally and seasonally.



Once the carcasses have decomposed, the above-ground burial ground can be levelled and returned to its previous use. In most environments this takes 9-12 months. Although no exposure studies have been carried out on near-surface burial, it is expected to pose less risk than deep burial because of the greater distance of the carcasses from the water table. Preliminary studies suggest that pathogens are inactivated during shallow burial.

2.6.1.2.2.1. Planning

1. It must be determined whether shallow burial is feasible:

- Do the competent authorities allow shallow burials on site?
- The suitability of the soil should be taken into account on the basis of the instructions of the authorities. Caution should be exercised in areas where the soil has low permeability and where large amounts of rainfall can occur in 1 year.
- The possibility of groundwater contamination by leachate should be taken into account.
- All possible pathways for groundwater movement, including the presence of downpipes, soil characteristics, groundwater depth and groundwater use, should be considered.

2. Find a suitable location:

- Is there sufficient land available - 1.5 cubic metres per adult cow, 0.3 cubic metres per adult pig or sheep, 1.0 cubic metre per 200 adult broiler chickens/commercial laying hens?
- Check that the water table and bedrock are at least between 120 cm and 240 cm below the ground surface, or as recommended by a qualified soil specialist (between 60 cm and 120 cm below the trench bottom).
- Do the soil properties (texture, permeability, water table depth and depth of rock layers) protect public health, according to the guidelines of health authorities?
- Are the wells or springs at least 60 metres away?
- Is there a minimum distance of 30 metres from surface water bodies, property boundaries, gullies, buildings and drains?
- Is the site accessible for staff carrying supplies and equipment?
- Is the site not at risk of flooding and does it lie in low-lying areas?

3. Determining material and equipment needs:

- Personal protective equipment
- Materials and equipment for disinfecting personnel, vehicles and other objects
- Excavating and loading equipment, other tools
- Carbon material for lining trenches, such as wood chips, rice straw or similar materials. To estimate the quantity of carbon material: use 0,75 cubic metre per adult cow, 0,15 cubic metre per adult pig or sheep, or 0,5 cubic metre per 200 adult broiler chickens/commercial laying hens.
- Trucks (with driver) or carts for transporting carcasses from the pens/pastures/laying places to the burial site.
- Truck liners, such as plastic sheeting or special bags, or absorbent material to prevent leakage from the truck when the carcasses are removed from the site.

4. Ensure that personnel operating the equipment are properly trained in its use.

5. Ensure that all employees working in disposal are trained in safety, biosafety and operational procedures.

2.6.1.2.2. Implementation

1. Obtain all appropriate permits, including permission from the landowner to start the burial.

2. Provide all necessary personal protective equipment based on an analysis of the hazards present on site.

3. Use stakes or flags to mark the burial site.

4. Dig the trench to a depth of 50-60 cm and place a 30 cm deep layer of coal in the trench.

5. Place the carcasses in the ditch.

6. puncture/ventilate the carcasses by puncturing the area behind the ribs and the thorax and abdomen.

7. Cover the carcasses with the excavated soil, taking care to level the surface soil to facilitate drainage.

8. stabilise or fill the excavated area to minimise soil erosion in accordance with local requirements.

9. If necessary, place plastic or metal netting on top of the piles to prevent scavengers from entering.

10. Thoroughly clean and disinfect all disposal equipment.

11. If necessary, fence off the area to restrict access by scavengers and unauthorised persons.

12. Regularly check and maintain the area, if necessary by additional backfilling to prevent water from collecting.

13. After about a year, restore the area to its original state.

14. Highly recommended: Before use, check that the technique has been proven to inactivate the pathogen.

2.6.1.2.3. Advantages and disadvantages

Benefits:

- A method that is beneficial for the environment and agriculture.
- Quick to implement.
- Low cost.
- Generally acceptable to the public.
- It inactivates most pathogens.

Disadvantages:

To prevent scavenging, carcasses should be evenly covered with soil.

2.6.1.3. Open burning

Incineration is a process whereby a "bed" is built from combustible materials such as wood, animal carcasses are placed on the bed, additional combustible material is placed on top of the carcasses, and the whole pile is then set alight. More wood or other combustible material is added to the pile until the carcasses are completely burnt. Before using this method, you must obtain all the fuel necessary to completely burn the infested carcasses. Appropriate biosecurity procedures must be implemented when transporting the fuel to the site.

2.6.1.3.3.1. Planning

1. It must be determined whether incineration is feasible:

   - Do the authorities allow open burning on the site?
   - Does open burning emit air pollutants in excess of public health standards?
   - Is it possible to maintain measures to prevent the spread of fire and an adequate distance from inhabited buildings?
   - Will environmental testing (e.g. water, ash, soil) be necessary and how often? How and where would the ash be disposed of?
   - Are the weather conditions (e.g. no strong winds or drought) suitable for open burning?
   - Will burning be publicly acceptable?
   - Do you have the necessary staff, equipment and supplies?
   - Do you have enough fuel and wood (not tyres!) to maintain the combustion?

2. Find a suitable location:

   - The location is within or in the immediate vicinity of the infected site.
   - The site is suitable for truck traffic and allows for biosecurity around the site.
   - Smoke from combustion does not cause poor visibility for drivers.
   - The site will not be adversely affected by the possible release of incineration or nutrient-laden leachate, and will not cause community complaints if smoke, odours, flies or scavengers start to appear on the site.
   - The site poses no risk of grassland or forest fire.

3. Calculate the material requirements to include enough dry fuel such as straw, wood and kindling to completely burn the animal carcasses. To burn the carcasses of one adult cattle, or 5 adult pigs, or 5 adult sheep/goats, or 200 chickens, the following are required:

- 3 bales of dry straw or hay;
- 3 untreated logs;
- 23 kg of kindling wood (dry, low moisture; not from green vegetation);
- 46 kg of coal, 15-20 cm in diameter;
- 4 litres of liquid fuel, such as diesel. Do not use petrol. The type and quantity of fuel used for combustion will depend on local fuel availability and conditions;
- sustainable fuel supply;
- adequate space for unloading, storage and continuous burning;
- other equipment, such as lifting equipment and fire protection equipment;
- personnel properly trained to use the equipment.

2.6.1.4.2. Implementation

1. Ensure that all workers involved in the operation wear personal protective equipment in accordance with the assessment of potential hazards.

2. Calculate the space requirements, assuming that the length of the firebox is at least 1 metre for each adult flock of cattle, five flocks of pigs, five flocks of sheep or 200 flocks of chickens.

3. Prepare the bed. The list below is one method of preparing the bed, other techniques that will give the desired result are also acceptable:

- Designate the selected burn site for the fire pit and ensure that the necessary personnel, equipment and facilities to maintain the burn are accessible.
- Lay three rectangular rows of straw or hay bales lengthwise along the line of the fireplace. The rows should be 30 cm apart and each bale should be separated by 30 cm.
- Place loose straw in the spaces between rows and bales to allow natural air circulation.
- Place large pieces of wood lengthways on top of each row. Distribute the large and medium sized pieces of wood on the hearth, leaving 15-30 cm between them.

- Place small kindling on the fireplace and cover loosely with straw.
- Coal with a diameter of 15-20 cm should be spread evenly at a rate of 270 kg per square metre; the use of liquid fuels such as diesel can cause soil and groundwater contamination and is not recommended unless a small amount is needed to light the bonfire. Solid fuels should be used to maintain combustion.
- This process must be approved by the relevant authorities.
- Lay the carcasses on the fire.
- Place the carcasses on their backs, with their heads alternately turned towards their tails if possible.
- Two carcasses of goats, sheep or pigs can be placed on top of one carcass of cattle and burned without additional fuel.
- Place loose straw on top of the carcasses and in the spaces between them.
- Spray liquid fuel on the firebox with a pump or use spray cans or buckets.
- Soak rags in kerosene oil or fatigue oil and place them every 10 metres along the firebox for a better and more even ignition.
- Make sure that people and equipment are at least 10 metres away from the burning pile.
- Have firefighting equipment readily available.
- Light the fireplace; when it is safe, stir the burning pile. Add additional fuel as needed.

4. Thoroughly clean and disinfect all contaminated equipment after open burning is complete.

5. Dispose of the ashes in accordance with legal requirements after all carcasses have been completely burnt and the fire extinguished. It may take several days for the ashes to cool down enough to be moved. If authorised by the authorities, the ashes can be used in agricultural fields, otherwise dispose of them in accordance with the relevant legislation.

6. Restoring the open burning site to its original condition.

WARNING:

- DO NOT incinerate carcasses with explosive or highly volatile substances such as petrol (check with your local fire authorities for acceptable accelerants).

- DO NOT burn carcasses with tyres, rubber, plastic or similar materials!

- DO NOT allow personnel to approach the place of incineration opposite the windward edge without proper personal protective equipment!

2.6.1.4.3. Advantages and disadvantages

Possible problems associated with burning include human and environmental impacts (stench; airborne particulate matter can cause asthma and respiratory diseases; the practice of pouring liquid fuels such as diesel on bonfires can lead to soil contamination, which can damage crops and drinking water) and forest fires. In some countries, environmental regulations also prohibit the open burning of animal carcasses. The most significant routes of exposure to burning are:

- inhalation of chemicals in the air, deposition on plants and in surface water;
- leaching of chemicals from ash burial into groundwater;
- pathogen pathways were not found to be significant.

Benefits:

- A method that can be done on the spot.
- Inactivates pathogens.
-

Disadvantages:

- Not sustainable.
- Public opposition.
- It's difficult to do.
- Regulatory restrictions.
- Environmental pollution.
- A slow and expensive method.

2.6.2. Off-farm disposal methods for animal carcasses

2.6.2.1. Introduction

On-farm disposal of animal carcasses eliminates the need to transport contaminated carcasses. This minimises the risk of disease transmission. However, there are a number of circumstances that may favour off-farm disposal:

- **Lack of space**
- **Environmental considerations**
- **Communication advantage**
- **Farmers' preferences:** animal disease outbreaks often have significant financial and social consequences for individual farmers. The needs of the farmer must be taken into account when choosing the most appropriate disposal method. In some cases, off-farm methods may be more effective.
- **Loss of value for return to production:** following the death/slaughter of herds or flocks, farmers may prefer to dispose of animals off-site to focus on other activities, such as cleaning and disinfection, necessary to return their farm to production.
- **Efficient use of resources**: off-site disposal can mean better use of limited resources. If there are several infected farms in a region, it may be more efficient to operate a single regional rendering plant than to operate several separate on-farm disposal plants. Many activities, such as access control and cleaning and disinfection of equipment, are more efficient at a single site.

The first disposal method of choice for all types of animal by-products is transport to an authorised animal by-products plant. In addition, other disposal methods may be necessary in an emergency, subject to specific authorisation.

2.6.2.2.2. Transport of animal carcasses

The off-site disposal of carcasses requires the transport of infected carcasses from the holding to the place of disposal. This often means that infected carcasses must be transported alongside non-infected farms on roads used by other vehicles. This activity creates an additional opportunity for the pathogen to spread to non-infected farms. For this reason, when infected animal carcasses and material are transported from the affected premises to off-site locations, disposal personnel must follow special procedures to prevent the spread of pathogens.

To ensure safe transport, the following must be carried out:

1. Contact the receiving authorised disposal site well in advance of the outbreak to:

- Check that the site can accommodate potentially infected carcasses and make sure they are aware of the conditions and costs.
- Ask for written documentation that site personnel are trained, equipped and certified to handle infectious waste in a biosafety manner.
- Before sending the first consignment, check that the off-site disposal facility you have chosen is authorised to handle the type of waste you are sending.
- Ensure that the off-site disposal site is prepared to safely accommodate transport vehicles or provide alternative storage if there is a delay of more than one day.

2. Coordinate with the relevant authorities to check transport restrictions and obtain the necessary permits.

3. Contact the transport companies:

- Check that you are equipped to transport animal carcasses safely in accordance with the relevant requirements.
- Ensure that vehicles are in good mechanical condition, designed or built to prevent leaks, able to carry cargo without difficulty and that vehicles are covered with tarpaulins if they are not closed top.
- Ensure that drivers receive appropriate biosecurity training and are equipped with personal protective equipment.
- Make sure that the supplier has an emergency plan in case of an accident and check that it is adequate.
- Do you need a police escort for your shipments?

4. Designate and approve primary and secondary transport routes from the site to the disposal site. Avoid road construction, neighborhoods and densely populated areas. Designate alternative routes.

5. Determine whether the carrier needs an escort, such as a designated official to accompany the vehicle.

6. Ensure that a responsible official is available to supervise and control the processing and transport system for animal carcases.

7. Before loading, check that the transport vehicles:

- are leakproof and meet all relevant requirements;
- can be disinfected;
- are properly lined, if they are not inherently leakproof;
- are properly marked;
- whether the load can be safely covered.

8. Ensure that the driver is trained to operate the type of vehicle entrusted with the transport of waste.

9. Load the contaminated material into the vehicle. If possible, reduce the number of times the vehicle passes through the biosafety lines.

10. Document each shipment, documentation should include:

- the identity and contact details of the supplier;
- the source, quantity and type of waste;
- the name, location and contact details of the disposal site.

11. Check with the transporter that the communication equipment is operational during transport so that the transporter can contact the authorities in case of an emergency on the way to the landfill.

12. Thoroughly clean and disinfect the loaded, sealed vehicle before leaving the affected site and again after emptying when leaving the landfill site.

2.6.2.3. Adapting on-farm methods for off-farm use

Many of the disposal methods used for on-farm use can be adapted for off-site locations, such as a central disposal site. This can provide the benefits of on-site methods (simplicity, cost-effectiveness, etc.) while also eliminating some of the limitations.

The first disposal method of choice for all types of animal by-products is transport to an authorised animal by-products plant. In addition, other disposal methods may be necessary in an emergency, subject to specific authorisation.

2.6.2.3.1. Deep burial outside the farm

Deep burial on the farm is often limited by the site conditions:

Environmental conditions:

- on an infested farm, you have no control over the depth of groundwater or bedrock, proximity to rivers, etc. For an off-site burial site, you can assess these conditions in several locations and choose the most suitable one.

Real estate property:

- property ownership is an important consideration when choosing a regional carcass disposal site. For an off-site burial site, publicly owned sites may be chosen. These may be forest land, landfill sites, etc.

Access control and monitoring:

- restrict access to burial sites for animal carcasses to prevent the spread of infectious disease. Access to a single regional site is easier to control than access to sites on individual farms. In addition, burial sites may require long-term monitoring to assess leachate and gas production, sedimentation and scavenger activity.

2.6.2.2.3.2. Off-farm burial above ground

The considerations for off-farm burial above ground are similar to those described for off-farm deep burial.

2.6.2.3.3 Open burning outside the farm

The considerations for off-farm open burning are similar to those described for off-farm deep burial. However, due to the larger volume and longer duration, several factors become more important:

Location:

- how close is the site to a residential area?
- what is the prevailing wind direction?

Sources:

- do you have access to sufficient fuel?
- is there adequate staff and equipment to control access and to clean and disinfect vehicles transporting animal carcasses to the site?

2.6.2.4. Other methods of disposal of animal carcasses outside the holding

2.6.2.4.1. Disposal of animal by-products in an approved plant

The first disposal method of choice for all types of animal by-products is transport to an authorised animal by-products plant. In addition, other disposal methods may be necessary in an emergency, subject to specific authorisation.

Carcass processing is a process whereby carcasses are ground into cubes of 5 cm^3 or less, broken down by heat treatment and then sterilised by pressure and steam. The process produces 60% water, 20% fat and 20% meat and bone meal from the carcasses. The process has been shown to be effective in inactivating pathogens responsible for many animal diseases.

In applying this method, the following should be considered from an operational point of view:

Availability:

- Is there a suitable plant near the farm?
- Are they able and willing to receive infected animal carcasses?

Costs:

- The costs of this method can vary, but are generally significantly higher than the on-farm options. Transport can be a significant cost.

Removal:

- Will the establishment be able to sell the by-products (fat, bone meal, etc.)? If not, the by-products must also be disposed of in the future.

Delivery:

- Carcases must be transported to the establishment in secure, leak-proof vehicles or containers.

3. Cleaning and disinfection after disposal

3.1. Basic principles

Disinfecting the environment, equipment, materials and buildings in contact with infected animals reduces the risk of spreading infectious diseases to other susceptible animals. It is therefore an important part of the control and eradication of major exotic or emergency animal diseases.

Disinfection should involve close cooperation between farmers and all staff involved in the cleaning and disinfection process. If it is carried out quickly and successfully, the time taken to authorise the restocking of infected holdings will be shortened (if there is no timeframe for restocking infected holdings in the legislation).

In order to eliminate disease agents from clothing, vehicles, tools, carcasses or the environment, it is necessary to have a good understanding of the general characteristics of each infectious agent and the subtle ways in which they can persist in the environment and infect other animals.

3.2. Definitions

Cleaning is a process designed to remove coarse dirt, organic matter and debris. This is done by mechanical means such as sweeping (dry cleaning) and/or using water and soap or detergent (wet cleaning). The aim is to minimise the amount of organic matter so that disinfection can be carried out effectively.

Disinfection is a combination of physical and chemical processes that destroy or remove pathogenic microorganisms. It can be applied to any structure, vehicle or other object that may be directly or indirectly contaminated.

Eradication is a recognised and proven strategy for the rapid eradication of exotic diseases or other infectious animal diseases. The crucial elements of eradication are the slaughter/scrapping/killing of animals, the safe disposal of animal carcasses and other potentially infectious materials, and the cleaning and disinfection of the infected farm.

A biocidal product is any substance or mixture, in the form in which it is supplied to the user, consisting of, containing or generating one or more active substances, intended to kill, deter, render harmless, prevent the action of, or otherwise have an inhibitory effect on harmful organisms by any means other than by purely physical or mechanical action. Treated articles with a primary biocidal function are considered biocidal products.

3.3. Critical steps

All cleaning and disinfection processes should follow the critical steps outlined below:

Cleaning

The first step is to remove all organic matter. This is best done with a broom, shovel or scraper. Remove as much solid material as possible. The time spent on this step will reduce the overall time of the process. If dirt remains visible, it will need to be cleaned again.

Washing

The aim is to remove all residual organic matter (manure, feed, blood, urine, etc.). This is usually done with a high pressure washer. The step is time-consuming but very important as washing removes most of the pathogens from the environment. To speed up the washing process, soaking and detergent agents and hot water should be used. After washing, the detergents should be rinsed off carefully with water and the surface should be allowed to dry before the disinfection process is started.

Disinfection

For disinfection to be effective, surfaces must be completely clean (no or minimal organic matter), as most biocidal products are inactivated when in contact with organic matter. No single biocidal product works in every situation!

Dehydration

After adequate contact time with the disinfectant, the area should be allowed to dry. Most biocidal products have sufficient time for extended drying. The purpose of this drying time is to allow all moisture to evaporate from the building and all its surfaces, as water is critical for the survival of all living organisms, including viruses and bacteria.

3.4. Biocidal products

A wide range of commercially approved and authorised biocidal products are available. These disinfectants and chemicals can be divided into six groups based on their active ingredients:

1. **Soaps and detergents** are essential ingredients in pre-disinfection cleaning procedures. In most cases, the primary objective is to remove organic matter, dirt or grease from the surfaces to be disinfected. Most industrial and household brands of soaps and detergents are satisfactory. Hot water, brushing and scrubbing will enhance the cleaning effect.

2. **Oxidising agents:** these disinfectants are recommended for most applications. Chlorine is released from solutions of sodium or calcium hypochlorite and is a powerful oxidising agent, effective in killing all groups of viruses.

3. **Alkalis:** alkalis have long been used as effective disinfectants against a wide range of pathogens. Both sodium hydroxide (caustic soda) and sodium carbonate (washing soda) are widely available in large quantities and cheaply, and both have a natural soap-detergent effect on grease and other types of organic matter, which aids the cleaning process. Because they are antiviral when heavily loaded, organic substances are ideal for disinfecting livestock farms, yards, sewers, septic tanks and sewage collection areas.

4. **Acids:** acids are usually highly antiviral. With the right choice of acids or acid mixtures, acids can be used in a wide range of conditions, from liquid sewage to personal disinfection. Hydrochloric acid is a strong acid, widely available in DIY stores and less toxic than other strong acids. Citric acid is a milder acid that is available in solid form.

It is active against acid-sensitive viruses and can be used safely to disinfect staff and clothing.

5. **Aldehydes:**

   - **Glutaraldehyde**: a very effective disinfectant, active against all families of viruses and other micro-organisms at concentrations of 1-2%.

   - **Formalin**: a 40% aqueous solution of formaldehyde gas is called formalin**.**

   - **Gaseous formaldehyde**: can be used to disinfect airspaces, equipment such as the interior of dry electronic equipment and vehicles.

6. **Insecticides**: in the case of vector-borne diseases, insecticides should be used in addition to cleaning and disinfection to kill the vectors or their breeding sites. Insecticides are pesticides that target specific organisms - insects. They can be any substance or mixture of substances intended to prevent the emergence of, kill or control the presence of insects, including vectors of human or animal diseases. Insecticides include ovicides, which target the eggs, and larvicides, which target the larval stages. Almost all insecticides have the potential to significantly alter ecosystems, many are toxic to humans and/or animals, and some can concentrate as they move through the food chain (e.g. dichlorodiphenyltrichloroethane, DDT).

   Insecticides fall into two main groups:

   - systemic insecticides that have a residual or long-lasting effect; and
   - contact insecticides that do not have residual activity.

3.5. Choosing the right biocidal product

To choose the right quality disinfectant, you need to:

- only use disinfectants authorised for veterinary use, as only these are tested for their efficacy in the conditions in which the animals are kept;
- modern disinfectants, developed by chemists from several components, are more effective with fewer hazardous ingredients than disinfectant ingredients alone;
- ask the distributor for the product specification, the safety data sheet and the registration of the disinfectant, and use the product at the highest concentration specified in the registration to kill all pathogens (e.g. bacteria or viruses), not just some of them;
- the product specification of the disinfectant should only include the information specified in the product specification;
- in addition to laboratory efficacy, other properties of the disinfectant that are important in practice should be considered: e.g. corrosivity (decomposition in the presence of rust), sensitivity to contamination;
- it is often the case that the situation in practice is much worse than the average animal husbandry conditions designed for testing the disinfectant (e.g. low temperatures, porous surfaces difficult to clean, epidemic situation, etc.). In such cases, the maximum

concentration in the master file can be doubled, but it is more effective to increase the amount of diluted disinfectant solution applied, almost soaking the surface:

1. concrete, asphalt: 0,4 litres/m^2
2. wood and whitewashed surfaces: 0,5 litres/m^2
3. brick surface: 1 litre/m^2
4. tamped clay surface: 1,5 litres/m^2
5. loose soil, sand, reeds: 3 litres/m^2

3.5.1. Know your "enemy"!

The most important thing to know when choosing a biocide is the pathogen that causes the animal disease, its basic characteristics. This includes an understanding of the epidemiological characteristics and how the infection occurred, for example by airborne, gastrointestinal, direct contact or animal vectors.

Most infectious animal diseases are viral diseases. Bacterial diseases are often approached in the same way as viral diseases, but insect-borne diseases or diseases caused by parasites or prions require a different strategy.

In the case of viral diseases, the most appropriate disinfectant is determined by the nature of the virus particles, for example, some viruses are rapidly inactivated at extreme pH levels. Commonly used disinfectants are very effective antibacterial agents, but their effectiveness against some viruses is limited. Prions are resistant to most disinfectants except strong alkalis. Special consideration will need to be given if this type of epidemic threat occurs. Knowing the "enemy" will help in determining which biocidal product to choose, some examples:

- the FMD virus is easily killed by high or low pH, but the disinfectants used may be corrosive or caustic in concentrated form;
- mycobacteria are highly resistant to disinfectants and high concentrations and long-lasting effects are needed to kill the organisms.

3.5.2. Choosing between several suitable biocides

There may be several biocides available that are effective against a particular pathogen. The properties described below should be taken into account when choosing the biocide that is most appropriate for the circumstances:

- the biocide must be **effective** against the virus, bacteria or fungus to which it is being applied.

- the biocides used must be **registered** and **authorised for** the purpose. EU Member States should implement legislation on biocidal products (e.g. Regulation (EU) No 528/2012), which categorises biocidal products and requires each country to keep a register of biocidal products on the market.

- The efficacy (**expiry date**) of disinfectants should be checked before use, as their effectiveness may be reduced by prolonged storage. For example, the very commonly used hypochlorite is considered a universal disinfectant, but its effectiveness

decreases with prolonged storage, so its activity should be checked before use: a concentration of 0.5% active chlorine is required for satisfactory disinfection.

- an important consideration when evaluating the effectiveness of disinfectants is the product's **contact time**. Some disinfectants are very fast acting, while others require a longer contact time to achieve the right effect. For commercially available products, the contact time indicated on the label should be used.

- to ensure microbial inactivation and to avoid the development of biocide resistance, it is recommended to use **concentrations** well above the minimum inhibitory concentrations for all major target micro-organisms. Commercially available products should be used at the concentrations indicated on the label.

- most biocides have an **optimum temperature range** above which rapid degradation occurs. Most are aqueous-based and freeze around O°C. For some disinfectants it has been shown that freezing can be prevented by the addition of propylene glycol or methanol. If in doubt, contact the product manufacturer (contact details are given in the safety data sheets).

  Although the effectiveness of disinfection decreases as temperatures fall, the use of external wheel and foot disinfectants is often unavoidable, as is the disinfection of contaminated external roads, machinery, transport equipment, driveways, etc., despite freezing weather.

  In this case, we first prepare the antifreeze solution, depending on the temperature: up to -5°C it should contain 15% of propylene glycol, up to -10°C 25%, up to -20°C 40%. This is not dangerous to human health and is non-volatile, its concentration does not change over time. This antifreeze solution should contain double the maximum concentration of the disinfectant as stated in the disinfectant's registration certificate or, if there is a test at 4°C, the concentration of the disinfectant.

  Modern multi-component disinfectants formulated by chemists are effective in cold conditions, but the required concentration must be increased.

- biocides have an **optimal pH range** above and below which rapid degradation of the biocide occurs.

- biocides must be **compatible with** other chemicals present, in particular corrosion inhibitors and glycols. The effectiveness of the disinfectant should not be compromised by interaction with other substances.

- the use of **ready-to-use or easily prepared** biocides helps to save time during disinfection preparation and prevents errors in the preparation of the biocide working concentration.

- the biocide **must not be harmful to the** people, animals or environment using it. Before using a biocide, read the instructions carefully and follow all health and safety precautions. When biocidal products are used, any adverse environmental and public health effects resulting from their use should be minimised.

- animal disease outbreaks often cause major economic losses, not only for the affected farm but also for the whole zone, region or country. Choosing a **cheaper product** may reduce the cost of eradicating the disease somewhat, but it may not be the cheapest! Efficiency must come before cost!

3.6. Design

The cleaning and disinfection plan should consider the following issues:

- What needs to be cleaned?
- How will the areas be disinfected?
- What resources and equipment will be needed?

The cleaning and disinfection plan should include details of how to carry out the following steps:

- identification of the disease agent;
- data on the infected farm, maps, hand drawings, etc.;
- preliminary disinfection;
- first cleaning;
- first disinfection;
- final cleaning and disinfection;
- inspection and monitoring.

To plan cleaning and disinfection, the following procedure is recommended:

- Inspect the infected farm and prepare or use a map of the farm, including all areas and buildings on the farm.
- Start keeping a diary to record all events, including the date of completion of preliminary and final cleaning and disinfection.
- Mark areas that do not require special cleaning and disinfection.
- Identify areas or locations that require special cleaning and disinfection.
- Consult the persons responsible for killing, disposal and epidemiology.
- Mark where disinfection starts. List the procedures to be carried out in each area in chronological order.
- Estimate the duration of the cleaning and disinfection programme.
- Ask the team leader to approve the proposed programme.
- Full documentation of the cleaning and disinfection process is highly recommended.
- Continuous and close contact with the owner or manager of the farm is essential to an efficient process.

The following general guidelines should also be included in the plan:

- **Thorough cleaning and disinfection:** all surfaces should be washed and cleaned, with careful brushing and scrubbing of floors, ramps and walls. Where possible, equipment should be dismantled or removed so that all surfaces can be cleaned. After cleaning is complete, cleaning agents shall be rinsed from all surfaces and the appropriate

disinfectant shall be applied for at least the contact time specified in the manufacturer's recommendations.

- **Official controls during cleaning and disinfection:** cleaning and disinfection operations and, where necessary, measures to kill rodents and insects must be carried out under official supervision and in accordance with the instructions of the official veterinarian.

- **Avoid re-contamination while working:** avoid re-contamination of previously cleaned areas, especially when washing with pressurised liquid. Contaminated water must not be reused on areas that have already been cleaned. After completion of the disinfection procedures, recontamination shall be prevented.

- **Proper disposal of fluids:** fluids used for cleaning operations should be disposed of in a way that avoids the risk of spreading infectious agents or harming the environment. Water used for cleaning operations must be contained and disposed of in such a way that any risk of spreading Category A disease agents is excluded.

- **Disinfecting litter:** if the litter is not disposed of, it must be thoroughly soaked in disinfectant. Even after disinfectant has been applied, manure should be handled and transported with care, as disinfection of materials with high organic loadings is generally ineffective.

- **Disinfection of equipment:** the plan must include the washing and disinfection of equipment or premises likely to be contaminated.

- **Disinfection of buildings: it** may be justified to consider the destruction of materials or buildings where the cost of cleaning and disinfection procedures significantly exceeds their value. Destruction should be carried out without harming the environment and should take into account the needs of the property owner, biosecurity and human safety. For certain holdings, the competent authority may lay down specific cleaning and disinfection procedures taking into account the type of holding and climatic conditions. The natural processes of warmth and direct sunlight help in pathogen clearance and ensure inactivation of many pathogens causing animal diseases.

- **Health and safety procedures:** common hazards include:

- unsafe infrastructure (farm buildings, machinery, terrain);
- the physical nature of the activities involved (e.g. lifting heavy objects, sliding on wet surfaces);
- use of chemicals.

    - **Use of chemicals:** chemicals used for cleaning and disinfecting are often toxic, can irritate the skin, irritate or burn the eyes (from splashing) and can cause respiratory problems if not used properly. The manufacturer must provide a safety data sheet for each chemical used, detailing the potential hazards and safety instructions. These instructions must be carefully followed to ensure safe

and effective use. Personnel involved in cleaning and disinfection procedures must be trained in the correct and safe use, handling and disposal of disinfectants. Although the exact instructions will vary depending on the product used, advice on the safe use of hazardous chemicals is given below:

- All staff should be trained in the safe use of chemical disinfectants before starting disinfection. These instructions should include how to properly wear the necessary personal protective equipment.
- Staff should be instructed not to eat, drink or avoid direct contact with cleaning and disinfecting agents during operations, as they can cause serious damage.
- Personnel mixing or applying disinfectants must wear appropriate personal protective equipment (PPE).
- Consult an occupational safety and health expert on the wearing of personal protective equipment appropriate to the hazards identified. This will probably include chemical clothing, waterproof and non-slip boots, gloves, eye, face and respiratory protection. PPE should be safely removed after use.
- The containers must be stored in a secure place where they cannot be accessed by unauthorised persons. The containers must be stored with a closed lid and protected from direct sunlight. Containers of disinfectant must be clearly labelled with legible pictograms.
- When diluting concentrated chemicals, always add the concentrate to the water, never the water to the concentrate! Care must be taken to avoid inhalation of disinfectants in powder form.
- Only the amount and concentration stated on the label should be used.
- Do not mix acidic and alkaline disinfectants: the resulting chemical reaction will destroy the effectiveness of both chemicals.
- To avoid inhaling chemicals:
  - do not apply fog spray;
  - everyone should wear appropriate respiratory protection;
  - ensure adequate ventilation (e.g. open windows and doors) when disinfecting a closed environment;
  - when decontamination is complete, the required waiting period must be observed before returning to the area and starting new procedures.

- **First aid: in** all places where cleaning and disinfection is carried out and/or where hazardous chemicals are used, first aid trained personnel and a first aid kit must be available. The designated first-aider(s) must be trained in first-aid procedures for the product. The safety data sheets for each product should include information on first aid measures and the contact details of the poison control centre in the country concerned. Some common first aid procedures in case of contact with hazardous chemicals:

- In case of contact with skin, wash immediately with plenty of water. In case of burns caused by strong acid or alkali, neutralising solutions may be used. Hospitalisation may be necessary if necessary.
- In the case of eye splashes, the eyes should be rinsed thoroughly with an eye wash and taken to hospital.

3.7. Implementation

The cleaning and disinfection plan should be followed step by step. Several stages are needed:

- preliminary disinfection;
- first cleaning;
- first disinfection;
- final cleaning and disinfection;
- inspection and control.

It is recommended to start from the most infested area and to treat one building at a time. The most severe contamination occurs in the following locations:

- where live infected animals were kept;
- at the place of slaughter, and when animals are physically examined and diagnostic samples are taken;
- the place of disposal of carcasses;
- when removing manure, bedding and debris from buildings in which infected animals have been kept.

While the preliminary disinfection is taking place, rodenticide baits can be put out if deemed necessary to limit the spread of the disease. The recommended sequence of cleaning is from the roofs to the walls and then to the floor. This sequence should also be applied to the interior and exterior of each building.

All cleaned and disinfected rooms or areas should be sealed with tape to prevent further contamination.

Disinfection must be completed at the farm entrance. The entire holding must then be temporarily closed for an appropriate period to allow time for the disinfectants to kill the pathogens.

3.7.1 Ensuring personal biosecurity

Apply strict personal biosecurity procedures to ensure that the disease is not spread to other farms by personnel, vehicles or equipment involved in cleaning and disinfection procedures and then leaving the premises.

A designated place for personal cleansing and disinfection must be established near the exit of the infected holding, at the choice of the designated person responsible. It must be possible to leave the infected holding directly from this personal cleansing and disinfection area without the person being reinfected. Ideally this should be a building with a water supply and drainage. The building must not have been previously used by animals and must not be heavily contaminated. If such a building is not available, a 10 x 10 m plastic mulch can be used. Each

person must have a change of clean clothes, which must be kept in plastic bags or in a vehicle or container outside the area.

The following procedures must be applied to all staff before leaving an infected holding or danger area, or any quarantined area that is heavily contaminated with the pathogen:

- buckets containing detergent and a disinfectant solution safe for skin contact must be available on site. Brushes, garbage bags and other cleaning equipment should also be readily available.
- solutions used to disinfect footwear have the same problems as those used to disinfect wheels: they quickly become contaminated and/or evaporate and/or are diluted by precipitation. These can be easily remedied by adding an openable lid to the foot disinfectant box. Of all footwear, high-soled rubber boots with a smooth sole (but at least with a grooved sole as rarely as possible) are the most easily cleaned and disinfected.
- the timely cleaned and disinfected cape, which extends down the shaft of the rubber boots, should be changed per lead and/or production group.
- not only hands must be disinfected when entering the sheds, but also hair, mouth and nose must be covered. Pathogens can pass from animal to human and from human to animal by clinging to tiny air droplets and dust particles, can settle on mucous membranes and hair for extended periods of time and can transmit infections and diseases.
- if reusable plastic coveralls are worn, the coveralls should be thoroughly washed to remove any rough materials, paying particular attention to the back, under the collar, zips and fasteners and inside the pockets. This should then also be double bagged and transported to the site for further cleaning and disinfection.
- plastic bags containing used overalls and equipment must be double-bagged, sealed, washed a second time with disinfectant and placed outside the perimeter of the area for collection by the courier. The bags must be clearly marked to indicate that they contain infectious substances. The bags shall be further cleaned and disinfected at a processing site.
- staff leaving the site should be instructed to shower and wash any undergarments worn at high temperatures and with disinfectants.
- depending on the nature of the infectious agent, they should be instructed not to visit holdings with susceptible livestock within a specified waiting period.

3.7.2. Vehicle disinfection

The simple wheel disinfection basins are replaced by modern disinfection gates, where not only the wheels but also the wheel arches, chassis and the whole vehicle around are disinfected through valves. In hot and windy weather, the speed of disinfection can be an advantage, but unfortunately most of these agents are also corrosive. As disinfection valves can usually only dispense low-pressure disinfectant sprays, it is important that vehicles can be

washed and dried of contamination beforehand. Muddy, heavily soiled surfaces cannot be disinfected here.

In the event of an outbreak, the cleaning and disinfection of wheels and wheel arches consists of the following steps:

- spraying the wheel and the wheel wells with a low pressure (approx. 3 bar) disinfectant solution, then waiting at least 5 minutes for the disinfectant solution to soak in (= soaking in disinfectant solution to prevent dispersion of pathogens);
- cleaning the wheel and wheel wells with a medium pressure (approx. 50 bar) water jet (= washing, cleaning);
- after the washing liquid has drained off, re-spray the wheel and wheel wells with a disinfectant solution, then wait at least 20 minutes for the disinfectant to penetrate (= actual disinfection).

3.7.3. Preliminary disinfection

When animals are killed, all necessary measures must be taken to avoid or minimise the spread of the animal disease agent. Infected surfaces and carcasses of killed animals must be sprayed with disinfectant to minimise the virus load. If carcases are to be removed from the holding for processing, covered and leak-proof containers must be used.

As soon as the carcasses of the slaughtered animals have been removed, disinfectant should be sprayed on the parts of the holding where the animals were kept and on other areas contaminated during the slaughter or post-mortem examination.

Tissues or blood spilled during killing or slaughtering, or gross contamination of buildings, yards, equipment, etc., must be carefully collected and processed with the carcasses. The disinfectant must remain on the surface for at least 24 hours.

Disinfecting surfaces before cleaning has the following advantages:

- some of the pathogens embedded in the dirt on the surfaces are already destroyed by soaking in the disinfectant, so that the cleaning process does not spread to places where they were not present before;
- the more porous a surface, the more difficult it is to dry after washing and before disinfection. As a result, the disinfectant solution applied after washing either does not penetrate the water-filled pores or is highly diluted, rendering it ineffective. It is therefore better to fill the pores, gaps and cracks with disinfectant solution before washing with water.

3.7.4. First complete cleaning and disinfection

This step involves a thorough cleaning, first by removing the litter and all dry organic matter, then cleaning with a detergent/ degreaser. Everything must be cleaned, including hard-to-reach areas, which may involve dismantling equipment or fixtures. Manure, including bedding and used bedding, must be removed and handled as follows:

(a) solid phase manure, including litter and used litter:

- subjected to a steam treatment at a temperature of at least 70 °C; or
- be destroyed by incineration; or
- buried at a depth that prevents access by animals; or
- shall be placed in a cassette for heat treatment, sprayed with disinfectant and left to stand for at least 42 days, during which time the cassette shall be covered or rotated to ensure that all layers are heat treated.

(b) the slurry must be stored for at least 42 days, or 60 days in the case of highly pathogenic avian influenza, after the last addition of infected material. This period may be extended if the slurry has been heavily contaminated or under unfavourable weather conditions. The period may be shortened if a disinfectant has been added to alter the pH of the material sufficiently to kill the virus.

The floors of livestock buildings, manure chutes, lagoons (slurry systems), driveways, animal driveways and animal stalls are regularly contaminated with animal faeces. In addition to the carcasses of dead animals, faeces is the medium in which pathogens remain viable in the external environment for a very long time. It is characterised by its ability to adhere strongly to surfaces, which should be loosened by soaking for several hours first. As it is not only water soluble, cleaning and disinfecting agents containing appropriate surfactants are preferable for this task.

In the case of a risk of infection, soaking should be carried out with a disinfectant rather than a cleaning agent, and the surface should then be cleaned using a strong mechanical action, e.g. a high-pressure washer. This is usually followed by an alkaline detergent, usually with tensides, which dissolves film-like contamination that is not visible to the eye. After a further rinse and drying, spray, foam and/or mist disinfection is applied, where it is also advantageous if the disinfectant can penetrate the film layers of dirt that may still be present in traces, in order to reach and kill the pathogens that may be hiding there.

In the case of earth-floored sheds and runways, the sheds are first soaked in a disinfectant solution (3 litres/m^2), then the top 10 cm layer is removed and disinfected again. A fresh layer of soil is then applied and thoroughly tamped down. The tilled layer is then disinfected again.

Equipment and other items to be removed from the premises must be cleaned and disinfected and then placed in heavy plastic bags for transport off site for further disinfection and cleaning.

Disposable items and rubbish can be buried or incinerated on site (to avoid environmental damage) or transported for safe disposal elsewhere.

Because of the risk of accidents, feed silos can be safely washed from above from a crane basket using a high-pressure water jet and then disinfected from below using a hot mist machine after drying.

Feeding pipes can only be washed and disinfected perfectly after the snail has been removed and pulled out, using a "snail scraper". A simpler, but less perfect, method is to pass a coarse, sharp-grit, so-called 'wash cloth' containing 0.5-1% disinfectant through the feeding system to

scrub deposits from the inner wall of the tube. Oxidising, fast-degrading disinfectants are not suitable.

Animal watering systems are generally less closed than human watering systems, as vitamins, probiotics, medicines, drinkable vaccines, etc. are often added. When it is hot and the water flow is slow (e.g. at night), microbes create a biofilm layer on the inside of the drinking tubes, in which they can embed themselves and even multiply. The best way to dissolve biofilms is to use a disinfectant formulation based on hydrogen peroxide, which is protected against rapid degradation. The corrosiveness of a sufficiently stabilised product is also negligible. A concentration of 2% can be used to fill the drinking system and then, after a day's standing time, the deposited internal contamination can be flushed out. When filling and rinsing, all the drinking valves must be pressed to allow the active ingredient to reach and drain out. And during the time of action, care must be taken to remove any oxygen gas that is produced, otherwise it could squeeze the lines.

The removal of dust, organic and inorganic (scale) deposits that rapidly accumulate on large surface cooling panels requires specially formulated cleaning and disinfection products: they must dissolve both organic and inorganic deposits, must not damage delicate paper elements, must inhibit foaming and must not volatilize with evaporation.

An outline of the cleaning and disinfection technology is as follows:

- low pressure washing with clean water,
- spraying the exterior and interior surfaces with the appropriate cleaning and disinfectant mixture,
- circulating the same mixture for 7-8 hours,
- low pressure flushing and circulation with clean water.

After the degreaser has been rinsed and dried, all surfaces should be sprayed with disinfectant. After the first complete cleaning and disinfection, any likely contaminated equipment, containers, equipment or material must be destroyed. Loose concrete areas should be thoroughly inspected and a cost estimate should be made as to whether they should be repaired or the area destroyed. Similarly, porous brick dirt roads and livestock building walls should be inspected and evaluated. These should be completed in such a way that they do not interfere with the final cleansing and disinfection process.

Contamination of wet, especially water-saturated soil can be treated by leaching lime, which can be saturated. This is a highly absorbent powder which, in contact with water, is converted by heat into so-called quicklime and later into lime by the action of CO_2 in the air. It can be spread by a fertilizer spreader in such quantities that the surface is completely covered with white powder (1-3 kg/m^2). It can be washed off paved roads after 30-60 minutes. It is an accident-prone solution and should only be carried out wearing suitable protective clothing and goggles.

3.7.5. Final cleaning and disinfection

The last cleaning and disinfection should be carried out seven days after the first complete cleaning and disinfection. Procedures similar to those used for the first complete cleaning and disinfection must be repeated. The holding must be treated with a degreasing agent, rinsed with water and sprayed with disinfectant. For the final disinfection, the disinfectant must be rinsed off the surfaces with water after a sufficient contact time.

3.7.6. Inspection and verification

The purpose of the audit is to ensure that all the tasks detailed in the plan have been carried out. The important aspects to be checked are:

- contaminated wood that could not be cleaned and disinfected was completely disposed of;
- where appropriate, fixtures and fittings have been dismantled so that no organic material remains;
- there is no observable deposition on any exposed surface;
- the contaminated feed was destroyed and the remaining material was rendered safe;
- heavily contaminated sites, in particular slaughter and disposal sites, have been effectively cleaned and disinfected;
- the disinfected liquids have been discharged into drains or containers or have been contained for safe disposal in accordance with environmental safety procedures;
- biosecurity conditions are respected, especially at exit/entry points, warning signs are posted.

3.7.7. Replanting the farm

The time between the final clean-up and disinfection and the authorisation to restock the farm depends on a number of factors. These factors include the nature of the pathogen, the local epidemiological situation and the cleaning and disinfection procedures used. The restocking requirements for EU Member States are laid down in Article 57 of Commission Delegated Regulation (EU) No 2020/687.