Enacted No. 5-Chikusan-1070 on July 26, 2023

# Technical Guidelines for On-Farm Euthanasia of Farm Animals

The “Technical Guidelines for On-Farm Euthanasia of Farm Animals” were developed and issued by the Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF-J), based on the standards for animal welfare in the Terrestrial Animal Health Code of the World Organisation for Animal Health. This document is the English version of the guidelines translated by MAFF-J. While every effort has been made to ensure that the translation is as accurate as possible, the accuracy and completeness of the content is not entirely guaranteed. For accurate and up-to-date information, please refer to the original Japanese version.

**Ministry of Agriculture, Forestry and Fisheries of Japan**
**Livestock Industry Bureau**

# Table of Contents

## Section 1. Scope of these guidelines

The "Standards relating to the Methods of Destruction of Animals (Notice of the Prime Minister's Office No. 40 of 1995)" (see Appendix I) state that the method of euthanasia of an animal should "be the method of causing the Animal to Be Destroyed to lose consciousness and stopping its cardiac function or lung function in an irreversible manner by a chemical or physical method, using a method that minimizes the Pain or Distress of the Animal to Be Destroyed as much as possible, or shall be any other normal method that is socially accepted."

Furthermore, the World Organisation for Animal Health (WOAH) recommends that the general principles in the Terrestrial Animal Health Code (WOAH Code) "Killing of Animals for Disease Control Purposes" should also apply when animals need to be killed for other purposes such as after natural disasters or for culling animal populations.

Based on the above, these guidelines have been developed to supplement the "Standards relating to the Methods of Destruction of Animals" with regard to on-farm euthanasia methods.

Euthanasia conducted to prevent the spread of livestock infectious diseases (e.g., the culling of farm animals that are infected with or suspected to be infected with foot-and-mouth disease or highly pathogenic avian influenza) must be carried out in accordance with the "Guidelines for the Prevention of Specific Livestock Infectious Diseases," based on the "Act on the Prevention of Infectious Diseases in Livestock (Act No. 166 of 1951)."

## Section 2. Responsibilities

When it becomes necessary to euthanize farm animals (including poultry, unless otherwise specified) on a farm, managers (e.g., owners) should ensure that all personnel involved in the euthanasia of animals such as operators, who carry out the euthanasia and handlers (persons who are responsible for the humane handling and care of farm animals) should have the relevant skills and competencies by providing opportunities to receive guidance from veterinarians or other qualified advisers in advance.

### [Actions recommended for implementation]

Operators and handlers should have the relevant skills and competencies through receiving guidance from veterinarians or other qualified persons and understand the purpose and necessity of euthanasia with consideration of animal welfare.

Managers and operators should acquire the necessary knowledge on the underpinning behavioral, anatomical and physiological processes of the animals, their habits, and the appropriate environment for them to reduce the anxiety, pain and distress of the animals and to avoid unnecessary stress during euthanasia.

Operators should routinely acquire knowledge and techniques on the methods and procedures of euthanasia, the use of relevant equipment, and methods for restraining farm animals, with guidance from veterinarians or other qualified persons as needed. Additionally, they should also maintain and inspect the equipment for effective stunning and euthanasia.

When performing euthanasia, operators and others should conduct the activities, including restraining and euthanizing farm animals, with consideration for their own safety.

When the operational procedures are concluded, there should be a written report describing the practices adopted and their effect on animal welfare, operator safety and biosecurity.

### [Actions recommended for future implementation]

None

## Section 3. Planning on-farm euthanasia of farm animals

The frequency and methods required for on-farm euthanasia of farm animals vary depending on the breed of the animals, the population of the animals being managed, and other factors. In addition, when farm animals are injured, it may be desirable from an animal welfare perspective to euthanize them promptly. Therefore, it is desirable to prepare a euthanasia plan in advance for farms where euthanasia of farm animals is frequently performed. The euthanasia plan should take into account the different phases of the procedures to be applied for euthanasia (e.g. choice of sites, methods, etc.) and the measures restricting the movements of the animals to ensure that all animals are humanely and quickly euthanized, and minimize negative welfare impacts of the euthanasia. The following should be included:

- minimizing movement and handling of animals;
- euthanizing the animals on the premises where they are being reared; however, there may be circumstances where the animals may need to be moved to another location for euthanasia for reasons such as ensuring animal hygiene, the safety of the animals or operators;
- the species, number, age, and size of animals to be euthanized, and the order of euthanizing them;
- methods of euthanasia of the animals and their costs;
- housing, husbandry, location of the animals;
- the availability and effectiveness of equipment needed for euthanasia of the animals, as well as the time necessary to euthanize all the animals subject to euthanasia;
- the facilities available on the premises for use during euthanasia;
- biosecurity and environmental issues;
- the competences, skills, health, and safety of the operators;
- relevant laws and regulations;
- the impact on other nearby premises holding animals;
- possibilities for removal, disposal, and destruction of carcasses.

**[Actions recommended for implementation]**

None

**[Actions recommended for future implementation]**

None

## Section 4. Handling of farm animals

When euthanizing farm animals, it should not cause avoidable anxiety, pain, distress or suffering in animals.

### [Actions recommended for implementation]

Following the decision to euthanize the animals, euthanasia should be carried out as quickly as possible so as not to cause avoidable anxiety, pain, distress or suffering in animals.

Until the animals are euthanized, normal husbandry should be maintained in a way that does not cause unnecessary stress, with consideration for animal welfare and based on acquired knowledge of their basic behaviors and habits.

The handling and movement of animals subject to euthanasia should be minimized and when done, it should be carried out carefully. Animal restraint should be sufficient to facilitate effective euthanasia, and when restraint is required, the euthanasia should follow with minimal delay.

### [Actions recommended for future implementation]

None

## Section 5. Considerations for biosecurity management

Operational procedures for euthanasia should be adapted to the specific circumstances operating on the premises and should address animal welfare, aesthetics of the method of euthanasia, cost of the method, operator safety, biosecurity and environment aspects.

### [Actions recommended for implementation]

Euthanasia should be conducted using methods that consider biosecurity procedures (hygiene management) to minimize the risk of disease spread and infected animals should be euthanized first, followed by in-contact animals, and then the remaining animals. For biosecurity considerations, the movement of animals suspected of being affected with disease should be minimized. If there is any leakage of bodily fluids from the animals, the area where euthanasia was performed, and any tools used should be thoroughly cleaned and disinfected.

If an outbreak of an infectious disease is suspected, appropriate measures, such as promptly notifying relevant agencies, should be taken in accordance with the “Act on Domestic Animal Infectious Diseases Control.”

The location and method of euthanasia should be chosen with attention to ensuring the operator safety, preventing effect on the surrounding environment and neighboring farms, and methods for the storage and disposal of carcasses following euthanasia should be decided in advance.

### [Actions recommended for future implementation]

None

## Section 6. Procedure for euthanasia

### 1. Implementing euthanasia methods in compliance with laws and regulations

The “Standards relating to the Methods of Destruction of Animals” state that methods of euthanasia should, "be the method of causing the Animal to Be Destroyed to lose consciousness and stopping its cardiac function or lung function in an irreversible manner by a chemical or physical method, using a method that minimizes the Pain or Distress of the Animal to Be Destroyed as much as possible, or shall be any other normal method that is socially accepted," and this should be adhered to from an animal welfare perspective as well.

**[Actions recommended for implementation]**

Methods for on-farm euthanasia of farm animals include: (1) stunning through a percussive blow to the head or electricity, gas, or similar means, followed by cervical dislocation, decapitation, or bleeding; and (2) lethal injection to cause unconsciousness and death. Since the appropriate method varies depending on the species, condition of the animal, and the equipment and facilities of farm, it is recommended to consult a veterinarian as needed to choose the suitable method for each farm (see Appendix II).

When performing euthanasia, animals should be checked continuously from the point of unconsciousness until confirmed death to ensure the absence of brainstem reflexes (e.g., dilated pupils and absence of breathing). In addition, since euthanasia methods vary according to species and age, operators should acquire knowledge on the selected method to ensure proper euthanasia.

For animal welfare considerations, young animals should be euthanized before older animals.

The operators should be competent to use and maintain available equipment and apply techniques for the species involved so as not to cause unnecessary stress to the animals.

The operational procedures of euthanasia should be adapted to the specific circumstances operating on the premises as necessary and should address, apart from animal welfare, aesthetics of the method of euthanasia, operator safety, biosecurity and environmental aspects.

**[Actions recommended for future implementation]**

None

## 2. Methods for stunning farm animals

Methods for stunning farm animals as a preliminary step to euthanasia include the use of electricity and gas. Depending on the animal species and the stunning method, the procedure for stunning may sometimes complete the euthanasia process.

**[Actions recommended for implementation]**

When stunning farm animals by electricity, the stunner control device should generate the appropriate voltage and current for the specific species and animals should be restrained to apply the electrodes in an appropriate position. Electrodes should be cleaned regularly to enable optimum electrical contact to be maintained. Operators should wear appropriate protective clothing during the procedure. For pigs and poultry, high voltage or current should be used to produce an effective stun and death.

Stunning farm animals by gas is performed by placing them in a gas-filled container or apparatus introducing a gas mixture (e.g., carbon dioxide, nitrogen, an inert gas, or a mixture of them). The container or apparatus should allow the required gas concentration to be maintained and accurately measured. Since the time required to induce unconsciousness and the pain experienced by the animal vary depending on the type and concentration of gas, it is important to understand the characteristics of the gas being used and to confirm both the required time with the proper gas concentration to induce unconsciousness and the number of animals that can be put into the container or apparatus. The equipment used should be inspected regularly. For neonatal animals and poultry, sufficient exposure time should be allowed to produce an effective stun and death.

**[Actions recommended for future implementation]**

None

## 3. Euthanasia methods for farm animals

When euthanizing farm animals, methods used should result in immediate death or immediate loss of consciousness lasting until death. When loss of consciousness is not immediate, induction of unconsciousness should be non-aversive or the least aversive possible and should not cause avoidable anxiety, pain, or distress.

Euthanasia methods for farm animals include cervical dislocation, decapitation, exsanguination, lethal injection, and maceration.

Cervical dislocation (see Appendix III) and decapitation result in death from cerebral anoxia due to cessation of breathing and/or blood supply to the brain. Cervical dislocation is not suitable for large poultry and other methods should be considered.

Decapitation results in death by cerebral ischaemia using a knife or similar tool. The required equipment should be kept in good working order for effective use.

Bleeding, which is performed after stunning, is a method of leading animals to death through the severance of the major blood vessels in the neck or chest that results in a rapid fall in blood pressure and cerebral ischaemia. Animals should be monitored continuously until death is confirmed. The required equipment such as a knife should be kept in good working order for effective use.

Lethal injection is a method that can be used for all farm animals and that cause rapid loss of consciousness followed by death. Animals should be monitored continuously until death is confirmed. The specific methods including the doses and routes of administration, and the need of sedation prior to injection vary depending on factors such as species and size of the animals; therefore, it is recommended to consult a veterinarian to select an appropriate method for each animal. A backup method should be available in case the farm animal does not die.

Maceration, utilizing a mechanical apparatus with rotating blades or projections, causes immediate fragmentation and death in day-old poultry and embryonated eggs. Maceration requires specialized equipment to cause immediate death, the rate of introducing the birds should not allow the equipment to jam, birds to rebound from the blades or the birds to suffocate before they are macerated.

Among these methods, including those using machinery, electricity, or gas, provisional translations of the recommendations for euthanasia methods that can be implemented at the farm level in accordance with Japanese laws and regulations are provided in Appendix II of these guidelines. Refer to them along with the original text as needed.

**[Actions recommended for implementation]**

When euthanizing farm animals, methods used should result in immediate death or immediate loss of consciousness lasting until death.

When loss of consciousness is not immediate, induction of unconsciousness should be non-aversive or the least aversive possible and should not cause avoidable anxiety, pain, or distress.

Operators should correctly understand the characteristics of each euthanasia

method, appropriately carry out the procedure and monitor the farm animal until death is confirmed, and properly maintain and adjust the required equipment.

**[Actions recommended for future implementation]**

None

# Appendix I

**“Standards relating to the Methods of Destruction of Animals (Notice of the Prime Minister's Office No. 40 of July 4, 1995)”**

**(Last revision: Notice of the Ministry of the Environment No. 105 of November 12, 2007) [Excerpt]**

Part I. General Principles

When it is necessary to perform Destruction of an animal, the Manager and Destruction Performer shall understand the physiology, ecology, habits, etc. of the Animal to Be Destroyed, and, based on the principle of respecting the dignity of life, endeavor to use a method that does not cause Pain or Distress for the animal, and shall endeavor to prevent the Animal to Be Destroyed from causing an infringement on the life, body or property of humans or from fouling or damaging the living environment of humans.

Part II. Definitions

In these Guidelines, the meanings of the terms set forth in the following items shall be as prescribed respectively in those items:

(1) Target Animal - An animal targeted by these Standards, which is any of the animals set forth in Article 44, paragraph (4) of the Act on Welfare and Management of Animals (Act No. 105 of 1973)
(2) Animal to Be Destroyed - A Target Animal for which Destruction is to be performed
(3) Destruction - An act of causing death of an Animal to Be Destroyed
(4) Pain or Distress - The mode of suffering, fear, anxiety, depression, etc. caused by pain from nociceptive stipulation and central nervous excitation, etc.
(5) Manager - A person who manages the keeping Animal to Be Destroyed, the facility for performing Destruction and the Animal to Be Destroyed
(6) Destruction Performer - A person pertaining to the Destruction of an Animal to Be Destroyed

Part III. Method of Destruction of an Animal to Be Destroyed

The method of Destruction of an Animal to Be Destroyed shall be the method of causing the Animal to Be Destroyed to lose consciousness and stopping its cardiac function or lung function in an irreversible manner by a chemical or physical method, using a method that minimizes the Pain or Distress of the Animal to Be Destroyed as much as possible, or shall be any other normal method that is socially accepted.

Part IV. Auxiliary Provisions

1. When keeping an Animal to Be Destroyed, endeavors shall be made to take appropriate measures in compliance with the purport of the Standards relating to the Care and Keeping of Animals at home, etc. (Notice of the Ministry of the Environment No. 37 of 2002), the Standards relating to the Care and Keeping of Animals for exhibition (Notice of the Ministry of the Environment No. 33 of 2004), the Standards relating to the Care and Keeping of Laboratory Animals and Reducing pain of laboratory animals (Notice of the Ministry of the Environment No. 88 of 2006), and the Standards relating to the Care and Keeping of Industrial Animals (Notice of the Prime Minister's Office No. 22 of 1987).
2. The person performing the Destruction shall endeavor to give considerations in compliance with the purport of these Guidelines also when performing the Destruction of an animal other than a Target Animal.

# Appendix II

## WOAH Code “Chapter 7.6. Killing of Animals for Disease Control Purposes [Excerpt from the 2016 adopted version]

Note: In Japan, under Article 4 of the “Act for Controlling the Possession of Firearms or Swords and Other Such Weapons (Act No. 6 of 1958),” it is possible to possess a firearm for use in slaughter operations with permission from the Prefectural Public Safety Commission, however, it is not permitted to possess a firearm for the purpose of euthanizing farm animals on farms. Therefore, specific euthanasia methods involving firearms – such as "free bullet," "penetrating captive bolt," "non-penetrating captive bolt," and " pithing" – are not included in the below table.

### Table summarizing euthanasia methods at the farm level

The methods are described in the order of mechanical, electrical and gaseous, not in an order of desirability from an animal welfare viewpoint.

| Species | Age range | Procedure | Restraint necessary | Animal welfare concerns with inappropriate application |
|---|---|---|---|---|
| Cattle | calves only | electrical, two-stage application | yes | pain associated with cardiac arrest after ineffective stunning |
| | calves only | electrical, single application (method 1) | yes | ineffective stunning |
| | all | injection with barbiturates and other drugs | yes | non-lethal dose, pain associated with injection site |
| Pigs | all | electrical, two-stage application | yes | pain associated with cardiac arrest after ineffective stunning; design of the stunning tongs not appropriate for the small head or body of neonates |
| | all | electrical, single application (method 1) | yes | ineffective stunning |
| | neonates only | $CO_2$/ air mixture | yes | slow induction of unconsciousness, aversiveness of induction |
| | neonates only | nitrogen or inert gas mixed with $CO_2$ | yes | slow induction of unconsciousness, aversiveness of induction |
| | neonates only | nitrogen or inert gases | yes | slow induction of unconsciousness |
| | all | injection with barbiturates and other drugs | yes | non-lethal dose, pain associated with injection site |

| | | | | |
|---|---|---|---|---|
| Poultry | day-olds and eggs only | maceration | no | non-lethal wounding, non-immediacy |
| | adults only | electrical, single application (method 2) | yes | ineffective stunning |
| | adults only | electrical, single application, followed by killing (method 3) | yes | ineffective stunning; regaining of consciousness before death |
| | all | $CO_2$/ air mixture<br>Method 1<br>Method 2 | <br>yes<br>no | slow induction of unconsciousness, aversiveness of induction |
| | all | nitrogen or inert gas mixed with $CO_2$ | yes | slow induction of unconsciousness, aversiveness of induction |
| | all | nitrogen or inert gases | yes | slow induction of unconsciousness |
| | all | injection of barbiturates and other drugs | yes | non-lethal dose, pain associated with injection site |
| | all | cervical dislocation | no | |
| | all | decapitation | no | |
| | adults only | addition of anesthetics to feed or water, followed by an appropriate killing method | no | ineffective or slow induction of unconsciousness |
| Equids | all | injection of barbiturates and other drugs | yes | non-lethal dose, pain associated with injection site |

## ● Maceration

1. Introduction

Maceration, utilizing a mechanical apparatus with rotating blades or projections, causes immediate fragmentation and death in day-old poultry and embryonated eggs.

2. Requirements

a) Maceration requires specialized equipment which should be kept in excellent working order.

b) The rate of introducing the birds should not allow the equipment to jam, birds to rebound from the blades or the birds to suffocate before they are macerated.

3. Advantages

a) Procedure results in immediate death.

b) Large numbers can be killed quickly.

4. Disadvantages
   a) Specialized equipment is required.
   b) Macerated tissues may present biosecurity or human health risks.
   c) The cleaning of the equipment can be a source of contamination.

5. Conclusion
   The method is suitable for killing day-old poultry and embryonated eggs.

**● Electrical – two-stage application**

1. Introduction
   A two-stage application of electric current comprises firstly an application of current to the head by scissor-type tongs, immediately followed by an application of the tongs across the chest in a position that spans the heart.
   The application of sufficient electric current to the head will induce "tonic/clonic" epilepsy and unconsciousness. Once the animal is unconscious, the second stage will induce ventricular fibrillation (cardiac arrest) resulting in death. The second stage (the application of low frequency current across the chest) should only be applied to unconscious animals to prevent unacceptable levels of pain.

2. Requirements for effective use
   a) The stunner control device should generate a low frequency (AC sine wave 50 Hz) current with a minimum voltage and current as set out in the following table:

| Animal | Minimum voltage (V) | Minimum current (A) |
|---|---|---|
| Cattle | 220 | 1.5 |
| Sheep | 220 | 1.0 |
| Pigs over 6 weeks of age | 220 | 1.3 |
| Pigs less than 6 weeks of age | 125 | 0.5 |

   b) Appropriate protective clothing (including rubber gloves and boots) should be worn.
   c) Animals should be restrained, at a minimum free-standing in a pen, close to an electrical supply.
   d) Two team members are required, the first to apply the electrodes and the second to manipulate the position of the animal to allow the second application to be made.
   e) A stunning current should be applied via scissor-type stunning tongs in a position that spans the brain for a minimum of 3 seconds; immediately following the

application to the head, the electrodes should be transferred to a position that spans the heart and the electrodes applied for a minimum of 3 seconds.

f) Electrodes should be cleaned regularly and after use, to enable optimum electrical contact to be maintained.

g) Animals should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

h) Electrodes should be applied firmly for the intended duration of time and pressure not released until the stun is complete.

3. Advantages

a) The application of the second stage minimizes post-stun convulsions and therefore the method is particularly effective with pigs.

b) Non-invasive technique minimizes biosecurity risk.

4. Disadvantages

a) The method requires a reliable supply of electricity.

b) The electrodes should be applied and maintained in the correct positions to produce an effective stun and kill.

c) Most stunner control devices utilize low voltage impedance sensing as an electronic switch prior to the application of high voltages; in unshorn sheep, contact impedance may be too high to switch on the required high voltage (especially during stage two).

d) The procedure may be physically demanding, leading to operator fatigue and poor electrode placement

5. Conclusion

The method is suitable for calves, sheep and goats, and especially for pigs (over one week of age)

**● Electrical – single application**

1. Method 1

Method 1 comprises the single application of sufficient electrical current to the head and back, to simultaneously stun the animal and fibrillate the heart. Provided sufficient current is applied in a position that spans both the brain and heart, the animal will not recover consciousness.

a) Requirements for effective use

i) The stunner control device should generate a low frequency (30–60 Hz) current with a minimum voltage of 250 volts true RMS under load.

ii) Appropriate protective clothing (including rubber gloves and boots) should be worn.

iii) Animals should be individually and mechanically restrained close to an electrical supply as the maintenance of physical contact between the stunning electrodes and the animal is necessary for effective use.

iv) The rear electrode should be applied to the back, above or behind the heart, and then the front electrode in a position that is forward of the eyes, with current applied for a minimum of 3 seconds.

v) Electrodes should be cleaned regularly between animals and after use, to enable optimum electrical contact to be maintained.

vi) Water or saline may be necessary to improve electrical contact with sheep.

vii) An effective stun and kill should be verified by the absence of brain stem reflexes.

b) Advantages

i) Method 1 stuns and kills simultaneously.

ii) It minimizes post-stun convulsions and therefore is particularly effective with pigs.

iii) A single team member only is required for the application.

iv) Non-invasive technique minimizes biosecurity risk.

c) Disadvantages

i) Method 1 requires individual mechanical animal restraint.

ii) The electrodes should be applied and maintained in the correct positions to produce an effective stun and kill.

iii) Method 1 requires a reliable supply of electricity.

d) Conclusion

Method 1 is suitable for calves, sheep, goats, and pigs (over one week of age).

2. Method 2

Method 2 stuns and kills by drawing inverted and shackled poultry through an electrified water bath stunner. Electrical contact is made between the "live" water and earthed shackle and, when sufficient current is applied, poultry will be simultaneously stunned and killed.

a) Requirements for effective use

i) A mobile water bath stunner and a short loop of processing line are required.

ii) A low frequency (50–60 Hz) current applied for a minimum of 3 seconds is necessary to stun and kill the birds.

iii) Poultry need to be manually removed from their cage, house or yard, inverted and shackled onto a line which conveys them through a water bath stunner with their heads fully immersed.

iv) The required minimum currents to stun and kill dry birds are:

- Quails: 100 mA/bird
- Chickens: 160 mA/bird
- Ducks & geese: 200 mA/bird

- Turkeys: 250 mA/bird.

A higher current is required for wet birds.

v) An effective stun and kill should be verified by the absence of brain stem reflexes.

b) Advantages

i) Method 2 stuns and kills simultaneously.

ii) It is capable of processing large numbers of birds reliably and effectively.

iii) This non-invasive technique minimizes biosecurity risk.

c) Disadvantages

i) Method 2 requires a reliable supply of electricity.

ii) Handling, inversion and shackling of birds are required.

d) Conclusion

Method 2 is suitable for large numbers of poultry.

3. Method 3

Method 3 comprises the single application of sufficient electrical current to the head of poultry in a position that spans the brain, causing unconsciousness; this is then followed by a killing method such as cervical dislocation and decapitation.

a) Requirements for effective use

i) The stunner control device should generate sufficient current (more than 600 mA/duck and more than 300 mA/bird) to stun.

ii) Appropriate protective clothing (including rubber gloves and boots) should be worn.

iii) Birds should be restrained, at a minimum manually, close to an electrical supply.

iv) Electrodes should be cleaned regularly and after use, to enable optimum electrical contact to be maintained.

v) Birds should be monitored continuously after stunning until death to ensure the absence of brain stem reflexes.

b) Advantages

Non-invasive technique (when combined with cervical dislocation) minimizes biosecurity risk.

c) Disadvantages

i) Method 3 requires a reliable supply of electricity and is not suitable for large-scale operations.

ii) The electrodes should be applied and maintained in the correct position to produce an effective stun.

iii) Birds should be individually restrained.

iv) It should be followed by a killing method.

d) Conclusion

Method 3 is suitable for small numbers of poultry.

## ● $CO_2$/ air mixture

1. Introduction

Controlled atmosphere killing is performed by exposing animals to a predetermined gas mixture, either by placing them in a gas-filled container or apparatus (Method 1) or by placing transport modules or crates containing birds in a gas tight container and introducing a gas mixture (Method 2) or by the gas being introduced into a poultry house (Method 3). Method 3 should be used whenever possible, as it eliminates welfare issues resulting from the need to manually remove live birds. Although Method 2 requires handling and crating of the birds, it benefits bird welfare overall in comparison with Method 1 as it reduces the risk of death by smothering or suffocation.

Inhalation of carbon dioxide ($CO_2$) induces respiratory and metabolic acidosis and hence reduces the pH of cerebrospinal fluid (CSF) and neurons thereby causing unconsciousness and, after prolonged exposure, death.

Exposure to carbon dioxide does not induce immediate loss of consciousness, therefore the aversive nature of gas mixtures containing high concentrations of $CO_2$ and the respiratory distress occurring during the induction phase are important considerations for animal welfare.

2. Method 1

The animals are placed in a gas-filled container or apparatus.

a) Requirements for effective use in a container or apparatus

i) Containers or apparatus should allow the required gas concentration to be maintained and accurately measured.

ii) When animals are exposed to the gas individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.

iii) Animals can also be introduced to low concentrations (as low concentrations are not aversive) and the concentration could be increased afterwards and the animals then held in the higher concentration until death is confirmed.

iv) Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.

v) Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

b) Advantages

i) $CO_2$ is readily available.

ii) Application methods are simple.

iii) The volume of gas required can be readily calculated.

iv) As the units are operated outdoors, the gas is dispersed quickly at the end of each cycle by opening the door, improving operator's health and safety.
v) The system uses skilled catching teams and equipment in daily use by the industry.
vi) Metal containers can be readily cleansed and disinfected.

c) Disadvantages

i) The need for properly designed container or apparatus.
ii) The aversive nature of high $CO_2$ concentrations.
iii) No immediate loss of consciousness.
iv) The risk of suffocation due to overcrowding.
v) Difficulty in verifying death while the animals are in the container or apparatus.

d) Conclusion

Method 1 is suitable for use in poultry, and neonatal sheep, goats and pigs.

3. Method 2

In this method, the crates or modules holding the birds are loaded into a chamber into which gas is introduced. A containerized gassing unit (CGU) typically comprises a gas-tight chamber designed to accommodate poultry transport crates or a single module. The chamber is fitted with gas lines and diffusers, with silencers that are connected via a system of manifolds and gas regulators to gas cylinders. There is a hole at the top to permit displaced air to escape when the container is filling with gas.

The procedures for the operation of CGU include:

(a) position the container on level, solid, open ground;
(b) connect the gas cylinder to the container;
(c) load birds into the container;
(d) shut and secure the door;
(e) deliver the gas until a concentration of 45% by volume of carbon dioxide has been achieved at the top of the container;
(f) allow time for the birds to become unconscious and die;
(g) open the door and allow gas to be dispersed in the air;
(h) remove the module;
(i) check each drawer for survivors;
(j) humanely kill any survivors; and
(k) dispose of carcasses appropriately.

a) Requirements for effective use of containerized gassing units (CGU)

i) The birds should be caught gently and placed in crates or modules of appropriate size and at appropriate stocking densities to allow all birds to sit down.
ii) The crates or module full of birds should be placed inside the container and the door shut only when the operator is ready to administer the gas.

iii) Ensure the container door is locked and administer the gas until a minimum concentration of 45% carbon dioxide is achieved at the top of the crates.

iv) An appropriate gas meter should be used to ensure the appropriate concentration of carbon dioxide is achieved and maintained until it can be confirmed that the birds have been killed.

v) Sufficient exposure time should be allowed for birds to die before the door is opened. In the absence of a viewing window that allows direct observation of birds during killing, cessation of vocalizations and convulsive wing flapping sounds, which can be listened to by standing near the container, can be used to determine that the birds are unconscious and that death is imminent. Remove the crates or modules from the container and leave them in the open air.

vi) Each crate or module should be examined and birds checked to ensure they are dead. Dilated pupils and absence of breathing indicate death.

vii) Any survivors should be humanely killed.

viii) Ducks and geese are resilient to the effects of carbon dioxide and therefore require a minimum of 80% $CO_2$ and a longer period of exposure to die.

b) Advantages

i) The gas is introduced quickly and quietly resulting in less turbulence and disturbance to the birds.

ii) Gradual increase in the concentration of $CO_2$ minimizes the aversive nature of this method for inducing unconsciousness.

iii) The use of transport crates or modules to move birds minimizes handling. Birds should be handled by trained, experienced catching teams at the time of depopulation of the poultry house.

iv) The modules are loaded mechanically into the CGU and a lethal mixture of gas is rapidly introduced into the chamber immediately after sealing.

v) $CO_2$ is readily available.

vi) Birds are exposed to gas more uniformly and they do not smother each other when compared with Method 1.

vii) The volume of gas required can be readily calculated.

viii) As the units are operated outdoors, the gas is dispersed quickly at the end of each cycle by opening the door, improving operator's health and safety.

ix) The system uses skilled catching teams and equipment in daily use by the industry.

x) Metal containers can be readily cleansed and disinfected.

c) Disadvantages

i) Requires trained operators, trained catchers, transport modules and fork lift. However, this equipment and suitable areas with hard surfaces are usually available.

ii) The main limiting factors are speed of catching birds.

iii) In the absence of a viewing window, visual confirmation of death while the birds are still in the container is difficult. However, cessation of vocalizations and convulsive wing flapping sounds can be used to determine onset of death.

d) Conclusion

i) Method 2 is suitable for use in a wide range of poultry systems, providing there is access to vehicles to carry the containers and equipment.

ii) Birds should be introduced into the container or apparatus, which is then sealed and filled as quickly as possible with the required gas concentrations, i.e. more than 40% $CO_2$. Birds are held in this atmosphere until death is confirmed.

iii) Method 2 is suitable for use in poultry, and neonatal sheep, goats and pigs. However, $CO_2$ is likely to cause a period of distress in the animals before they lose consciousness.

4. Method 3

The gas is introduced into a poultry house.

a) Requirements for effective use in a poultry house

i) Prior to introduction of the $CO_2$, the poultry house should be appropriately sealed to allow control over the gas concentration. The interval between sealing and gas administration should be kept to the minimum so as to avoid overheating.

Forced ventilation systems, where fitted, should only be switched off immediately prior to gas administration.

The main water supply to the poultry house may have to be turned off and water drained to avoid freezing and bursting of water pipes.

Feeders and water troughs should be lifted to avoid obstruction of the gas entry and prevent injury to birds.

ii) Gas delivery pipes or lancets should be positioned appropriately such that birds are not hit directly by very cold gas delivered at high pressures. It may be necessary to exclude birds from the area in front of the delivery pipes, for a distance of about 20 meters, by partitioning the house with nets, wire mesh or similarly perforated materials.

iii) The house should be gradually filled with $CO_2$ so that all birds are exposed to a concentration of >40% until they are dead; a vaporizer may be required to prevent freezing.

iv) Devices should be used to accurately measure the gas concentration at the maximum height accommodation of birds.

b) Advantages

i) Applying gas to birds *in situ* eliminates the need to manually remove live birds.

ii) $CO_2$ is readily available.

iii) Gradual raising of $CO_2$ concentration minimizes the aversiveness of the induction

of unconsciousness.

c) Disadvantages

i) It is difficult to determine volume of gas required to achieve adequate concentrations of $CO_2$ in some poultry houses.

ii) It is difficult to verify death while the birds are in the poultry house.

The extremely low temperature of liquid $CO_2$ entering the house and formation of solid $CO_2$ (dry ice) may cause concern for bird welfare.

d) Conclusion

Method 3 is suitable for use in poultry in closed-environment sheds. This method could be developed for killing pigs. However, $CO_2$ is likely to cause a period of distress in the birds before they lose consciousness.

**● Nitrogen or inert gas mixed with $CO_2$**

1. Introduction

$CO_2$ may be mixed in various proportions with nitrogen or an inert gas (e.g. argon), and the inhalation of such mixtures leads to hypercapnic-hypoxia and death when the oxygen concentration by volume is $\leq$2%, or $\leq$5% for chickens. Various mixtures of $CO_2$ and nitrogen or an inert gas can be administered to kill birds using Methods 1 and 2 described above (CO2/ air mixture). Whole house gassing with mixtures of $CO_2$ and nitrogen, or an inert gas, has not been tested owing to the complex issues presented by mixing gases in large quantities. Such mixtures however do not induce immediate loss of consciousness, therefore the aversiveness of various gas mixtures containing high concentrations of $CO_2$ and the respiratory distress occurring during the induction phase, are important animal welfare considerations.

Pigs and poultry appear not to find low concentrations of $CO_2$ strongly aversive, and a mixture of nitrogen or argon with $\leq$30% $CO_2$ by volume and $\leq$2% $O_2$ by volume can be used for killing poultry, neonatal sheep, goats and pigs.

2. Method 1

The animals are placed in a gas-filled container or apparatus.

a) Requirements for effective use

i) Containers or apparatus should allow the required gas concentrations to be maintained, and the $O_2$ and $CO_2$ concentrations accurately measured during the killing procedure.

ii) When animals are exposed to the gases individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.

iii) Animals should be introduced into the container or apparatus after it has been filled with the required gas concentrations (with $\leq$2% $O_2$), and held in this atmosphere until death is confirmed.

iv) Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.

v) Containers or apparatus should not be overcrowded and measures are needed to avoid animals suffocating by climbing on top of each other.

b) Advantages

Low concentrations of $CO_2$ cause little aversiveness and, in combination with nitrogen or an inert gas, produces a fast induction of unconsciousness.

c) Disadvantages

i) A properly designed container or apparatus is needed.

ii) It is difficult to verify death while the animals are in the container or apparatus.

iii) There is no immediate loss of consciousness.

iv) Exposure times required to kill are considerable.

d) Conclusion

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

3. Method 2

In this method, the crates or modules holding the birds are loaded into a container and gas is introduced into the container. As shown in the example below, each containerized gassing unit (CGU) typically comprises a gas-tight chamber designed to accommodate poultry transport crates or a module. The container or chamber is fitted with gas lines and diffusers, with silencers, which in turn are connected via a system of manifolds and gas regulators to gas cylinders. There is a hole at the top of the unit to permit displaced air to escape when filling the container with gas.

Procedures involved in the operation of CGU include:

(a) position the container on a level, solid, open ground;

(b) connect gas cylinder to the container;

(c) load a module of birds into the container;

(d) shut and secure the door;

(e) deliver the gas to the point where less than 2% by volume of oxygen is found at the top of the container;

(f) allow time for the birds to become unconscious and die;

(g) open the door and allow the gas to be dispersed in air;

(h) remove the module;

(i) check each drawer for survivors;

(j) humanely kill survivors, if any; and

(k) dispose carcasses appropriately.

a) Requirements for effective use of containerized gassing units (CGU)

i) The birds should be caught gently and placed in crates or modules of appropriate size and at appropriate stocking densities to allow all birds to sit down.

ii) The crates or module of birds should be placed inside the container and the door shut only when the operator is ready to administer the gas mixture.

iii) Ensure the container door is locked and administer the gas mixture until <2% residual oxygen is achieved at the top of the crates.

iv) An appropriate gas meter should be used to ensure a concentration of oxygen <2% is achieved and maintained until it can be confirmed that the birds have been killed.

v) Sufficient exposure time should be allowed for birds to die before the door is opened. In the absence of a viewing window, which allows direct observation of birds during killing, cessation of vocalizations and wing flapping sounds can be observed by standing close to the container and used to determine the onset of death in birds. Remove the crates or modules from the container and leave them in the open air.

vi) Each crate or module should be examined and birds checked to ensure they are dead. Dilated pupils and absence of breathing movements indicate death.

vii) Any survivors should be humanely killed.

viii) Ducks and geese do not appear to be resilient to the effects of a mixture of 20% carbon dioxide and 80% nitrogen or argon.

b) Advantages

i) The gas mixture is introduced quickly and quietly resulting in less turbulence and disturbance to the birds.

ii) The use of transport crates or modules to move birds minimizes handling. Birds should be handled by trained, experienced catching teams at the time of depopulation of the poultry house.

iii) The modules are loaded mechanically into the CGU and a lethal mixture of gas is rapidly introduced into the chamber immediately after sealing.

iv) Mixtures containing up to 20% carbon dioxide in argon are readily available as welding gas cylinders.

v) Birds are exposed to gas in a more uniform manner, and they do not smother each other when compared with Method 1.

vi) Two CGU can be operated in tandem and throughputs of up to 4,000 chickens per hour are possible.

vii) The volume of gas required can be readily calculated.

viii) As the units are operated outdoors the gas is dispersed quickly at the end of each cycle by opening the door, improving operators' health and safety.

ix) The system uses skilled catching teams and equipment in daily use by the industry.
x) Metal containers can be readily cleansed and disinfected.

c) Disadvantages

i) Requires trained operators, trained catchers, transport modules and a fork lift. However, such equipment and suitable outdoor areas with a hard surface are usually available.
ii) The main limiting factors are speed of catching birds and availability of gas mixtures.
iii) In the absence of a viewing window, visual confirmation of death while the birds are still in the container is difficult. However, cessation of vocalizations and convulsive wing flapping can be used to determine the onset of death.
iv) CGU could be used to kill poultry on small to medium farms, e.g. up to 25 thousand birds on a single farm.

d) Conclusion

i) Method 2 is suitable for use in poultry and in neonatal sheep, goats and pigs.
ii) Method 2 is suitable for use in poultry in a wide range of poultry systems providing that these have access to vehicles to carry containers and equipment.
iii) Animals should be introduced into the container or apparatus, which is then sealed and filled as quickly as possible with the gas mixture. A residual oxygen concentration of less than 2% should be achieved and maintained and birds should be held in this atmosphere until death is confirmed.

**● Nitrogen or inert gases**

1. Introduction

This method involves the introduction of animals into a container or apparatus containing nitrogen or an inert gas such as argon. The controlled atmosphere produced leads to unconsciousness and death from hypoxia. Research has shown that hypoxia is not aversive to pigs and poultry, and it does not induce any signs of respiratory distress prior to loss of consciousness.

2. Requirements for effective use

a) Containers or apparatus should allow the required gas concentrations to be maintained, and the $O_2$ concentration accurately measured.
b) When animals are exposed to the gases individually or in small groups in a container or apparatus, the equipment used should be designed, constructed, and maintained in such a way as to avoid injury to the animals and allow them to be observed.
c) Animals should be introduced into the container or apparatus after it has been filled with the required gas concentrations (with $\leq$2% $O_2$), and held in this atmosphere until death is confirmed.

d) Team members should ensure that there is sufficient time allowed for each batch of animals to die before subsequent ones are introduced into the container or apparatus.
e) Containers or apparatus should not be overcrowded, and measures are needed to avoid animals suffocating by climbing on top of each other.

3. Advantages

Animals are unable to detect nitrogen or inert gases, and the induction of hypoxia by this method is not aversive to animals.

4. Disadvantages

a) A properly designed container or apparatus is needed.
b) It is difficult to verify death while the animals are in the container or apparatus.
c) There is no immediate loss of consciousness.
d) Exposure times required to kill are considerable.

5. Conclusion

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

**● Lethal injection**

1. Introduction

A lethal injection using high doses of anesthetic and sedative drugs causes CNS depression, unconsciousness and death. In practice, barbiturates in combination with other drugs are commonly used.

2. Requirements for effective use

a) Doses and routes of administration that cause rapid loss of consciousness followed by death should be used.
b) Prior sedation may be necessary for some animals.
c) Intravenous administration is preferred, but intraperitoneal or intramuscular administration may be appropriate, especially if the agent is non-irritating.
d) Animals should be restrained to allow effective administration.
e) Animals should be monitored to ensure the absence of brain stem reflexes.
f) Personnel performing this method should be trained and knowledgeable in anesthetic techniques.

3. Advantages

a) The method can be used in all species.

b) Death can be induced smoothly.

4. Disadvantages
a) Restraint or sedation may be necessary prior to injection.
b) Some combinations of drug type and route of administration may be painful, and should only be used in unconscious animals.
c) Legal requirements and skill and training required may restrict use to veterinarians.
d) Contaminated carcasses may present a risk to other animals or domestic animals.

5. Conclusion
The method is suitable for killing small numbers of cattle, sheep, goats, pigs, equids and poultry.

**●Addition of anesthetics to feed or water**

1. Introduction
An anesthetic agent which can be mixed with poultry feed or water may be used to kill poultry in houses. Poultry which are only anesthetized need to be killed by another method such as cervical dislocation.

2. Requirements for effective use
a) Sufficient quantities of anesthetic need to be ingested rapidly for effective response.
b) Intake of sufficient quantities of anesthetic is facilitated if the birds are fasted or water is withheld.
c) If birds are anesthetized only, it should subsequently be followed by a killing method such as cervical dislocation and decapitation.

3. Advantages
a) Handling is not required until birds are anesthetized.
b)There may be biosecurity advantages in the case of large numbers of diseased birds.

4. Disadvantages
a) Non-target animals may accidentally access the medicated feed or water when provided in an open environment.
b) Dose taken is unable to be regulated and variable results may be obtained.
c) Animals may reject adulterated feed or water due to illness or adverse flavor.
d) The method may need to be followed by killing.
e) Care is essential in the preparation and provision of treated feed or water, and in the disposal of uneaten treated feed/water and contaminated carcasses.

5. Conclusion

The method is suitable for killing large numbers of poultry in houses. However, a back-up method should be available to kill birds that are anaesthetized but not killed.

## ● Cervical dislocation and decapitation

1. Cervical dislocation (manual and mechanical)

a) Introduction

Unconscious poultry may be killed by either manual or mechanical cervical dislocation (stretching the neck). This method results in death from cerebral anoxia due to cessation of breathing and/or blood supply to the brain.

When the number of birds to be killed is small, and other methods of killing are not available, conscious birds of less than 3 kilograms may be killed using cervical dislocation in such a way that the blood vessels of the neck are severed and death is instantaneous.

b) Requirements for effective use

i) Killing should be performed either by manually or mechanically stretching the neck to sever the spinal cord with consequent major damage to the spinal cord.

ii) Consistent results require strength and skill so team members should be rested regularly to ensure consistently reliable results.

iii) Birds should be monitored continuously until death to ensure the absence of brain stem reflexes.

c) Advantages

i) It is a non-invasive killing method.

ii) It can be performed manually on small birds.

d) Disadvantages

i) Operator fatigue.

ii) The method is more difficult in larger birds.

iii) Requires trained personnel to perform humanely.

iv) Human health and safety concerns due to handling of the birds.

v) Additional stress to the animals from handling.

2. Decapitation

a) Introduction

Decapitation results in death by cerebral ischaemia using a guillotine or knife.

b) Requirements for effective use

The required equipment should be kept in good working order.

c) Advantages

The technique is effective and does not require monitoring.

d) Disadvantages

i) The working area is contaminated with body fluids, which increases biosecurity risks.

ii) Pain if consciousness is not lost immediately.

**● Bleeding**

a) Introduction

Bleeding is a method of killing animals through the severance of the major blood vessels in the neck or chest that results in a rapid fall in blood pressure, leading to cerebral ischaemia and death.

b) Requirements for effective use

i) A sharp knife is required.

ii) An access to the neck or chest of the animal is required.

iii) Animals should be monitored continuously until death to ensure the absence of brain stem reflexes.

c) Advantages

The technique is effective in producing death after an effective stunning method which does not permit pithing.

d) Disadvantages

i) A delayed or ineffective bleeding due to convulsions may occur.

ii) The working area is contaminated with body fluids, which increases biosecurity risks.

# Appendix III

**Example method of cervical dislocation for poultry**

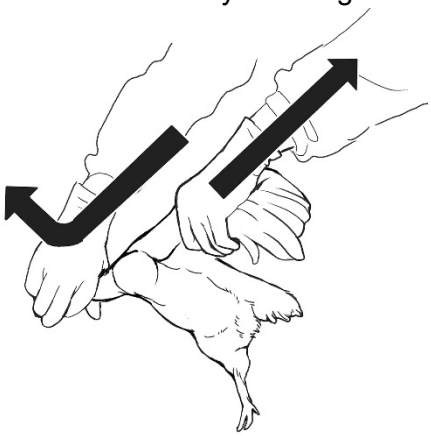
Small poultry can be euthanized via manual cervical dislocation; however, as the poultry grows and becomes larger, this method requires increased skill, experience, and strength.

For mature poultry, grasp the base of the wings or both legs with the non-dominant hand (Figure 1), using the thumb and index finger of the dominant hand, place the thumb under the beak, and hold just behind the skull (Figure 2-(1)). While holding down the cervical vertebrae with fingers, extend the neck downward and simultaneously pull the neck backward (Figure 2-(2)). Pulling firmly and swiftly allows for reliable cervical dislocation in one motion.

Indicators of death include: (1) feeling a gap between the vertebrae in the neck, (2) cessation of breathing, and (3) no blinking when the eyeball is touched, with dilated pupils.

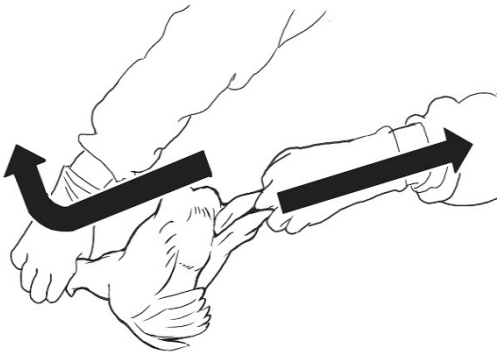
**Figure 1**

・When restrained by the wings



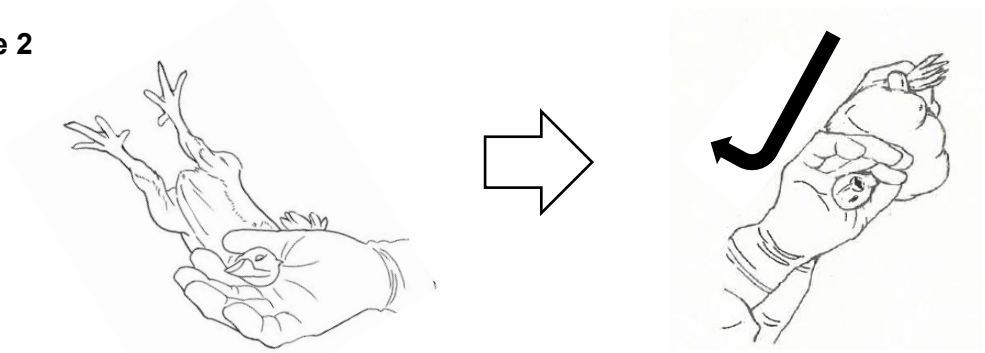
Restrain the poultry so that the base of the wings and the head are aligned in a straight line.

・When restrained by both legs



Restrain the poultry so that the legs and the head are aligned in a straight line.

**Figure 2**



(1) Using the thumb and index finger of the dominant hand, place the thumb under the beak and hold just behind the skull

(2) While pressing the cervical vertebrae with the fingers, extend the neck downward and simultaneously pull the poultry's neck backward.