

Terrestrial Animal Health Standards Commission February 2016

CHAPTER 7.6.

**KILLING OF ANIMALS FOR
DISEASE CONTROL PURPOSES**

[Article 7.6.1.]

[Article 7.6.2.]

[Article 7.6.3.]

[Article 7.6.4.]

Article 7.6.5.

Table summarising killing methods described in Articles 7.6.6.-7.6.18.

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	Article reference
Cattle	all	free bullet	no	non-lethal wounding	Article 7.6.6.
Cattle	all except neonates	penetrating captive bolt - followed by pithing or bleeding	yes	ineffective stunning <u>non-lethal wounding, regaining of consciousness before death</u>	Article 7.6.7.
Cattle	adults only	non-penetrating captive bolt, followed by bleeding	yes	ineffective stunning, regaining of consciousness before <u>killing death</u>	Article 7.6.8.
Cattle	calves only	electrical, two-stage application	yes	pain associated with cardiac arrest after ineffective stunning	Article 7.6.10.
Cattle	calves only	electrical, single application (method 1)	yes	ineffective stunning	Article 7.6.11.
Cattle	all	injection with barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	Article 7.6.15.

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
Sheep and goats	all	free bullet	no	non-lethal wounding	Article 7.6.6.
	all except neonates	penetrating captive bolt, followed by pithing or bleeding	yes	ineffective stunning, non-lethal wounding , regaining of consciousness before death	Article 7.6.7.
	all except neonates	non-penetrating captive bolt, followed by bleeding	yes	ineffective stunning, regaining of consciousness before death	Article 7.6.8.
	neonates	non-penetrating captive bolt	yes	non-lethal wounding	Article 7.6.8.
	all	electrical, two-stage application	yes	pain associated with cardiac arrest after ineffective stunning	Article 7.6.10.
	all	electrical, single application (method 1)	yes	ineffective stunning	Article 7.6.11.
	neonates only	CO ₂ /air mixture	yes	slow induction of unconsciousness, aversiveness of induction	Article 7.6.12.
	neonates only	nitrogen and/or inert gas mixed with CO ₂	yes	slow induction of unconsciousness, aversiveness of induction	Article 7.6.13.
	neonates only	nitrogen and/or inert gases	yes	slow induction of unconsciousness	Article 7.6.14.
	all	injection of barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	Article 7.6.15.
Pigs	all, except neonates	free bullet	no	non-lethal wounding	Article 7.6.6.

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
	all except neonates	penetrating captive bolt, followed by pithing or bleeding	yes	ineffective stunning, <u>non-lethal wounding</u> regaining of consciousness before death	Article 7.6.7.
	neonates only	non-penetrating captive bolt	yes	non-lethal wounding	Article 7.6.8.
	all ¹	electrical, two-stage application	yes	pain associated with cardiac arrest after ineffective stunning. <u>design of the stunning tongs not appropriate for the small head or body of neonates</u>	Article 7.6.10.
Pigs (contd)	all	electrical, single application (method 1)	yes	ineffective stunning	Article 7.6.11.
Pigs (contd)	neonates only	CO ₂ / air mixture	yes	slow induction of unconsciousness, aversiveness of induction	Article 7.6.12.
Pigs (contd)	neonates only	nitrogen <u>and/or</u> inert gas mixed with CO ₂	yes	slow induction of unconsciousness, aversiveness of induction	Article 7.6.13.
Pigs (contd)	neonates only	nitrogen <u>and/or</u> inert gases	yes	slow induction of unconsciousness	Article 7.6.14.
Pigs (contd)	all	injection with barbiturates and other	yes	non-lethal dose, pain associated with injection site	Article 7.6.15.
Pigs (contd)	adults only	<u>penetrating and</u> Non-penetrating captive bolt	yes	ineffective stunning <u>non-lethal wounding, regaining of consciousness before death</u>	Article 7.6.8.
Poultry	day-olds and eggs only	maceration	no	non-lethal wounding, non-immediacy	Article 7.6.9.
Poultry	adults only	electrical, single application (method 2)	yes	ineffective stunning	Article 7.6.11.

Pigs (contd)

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
Poultry (contd)	adults only	electrical, single application, followed by killing (method 3)	yes	ineffective stunning; regaining of consciousness before death	Article 7.6.11.
Poultry (contd)	all	CO ₂ / air mixture Method 1 Method 2	yes no	slow induction of unconsciousness, aversiveness of induction	Article 7.6.12.
Poultry (contd)	all	nitrogen and/or inert gas mixed with CO ₂	yes	slow induction of unconsciousness, aversiveness of induction	Article 7.6.13.
Poultry (contd)	all	nitrogen and/or inert gases	yes	slow induction of unconsciousness	Article 7.6.14.
Poultry (contd)	all	injection of barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	Article 7.6.15.
Poultry (contd)	all	cervical dislocation	no		Point 1 of 7.6.17.
Poultry (contd)	all	decapitation	no		Point 2 of 7.6.17.
Poultry (contd)	adults only	addition of anaesthetics to feed or water, followed by an appropriate killing method	no	ineffective or slow induction of unconsciousness	Article 7.6.16.
<u>Equids</u>	<u>all</u>	<u>free bullet</u>	<u>no</u>	<u>non-lethal wounding</u>	<u>Article 7.6.6.</u>
	<u>all, except neonates</u>	<u>penetrating captive bolt followed by pithing or bleeding</u>	<u>yes</u>	<u>ineffective stunning, non-lethal wounding, regaining of consciousness before killing death</u>	<u>Article 7.6.7</u>
	<u>all</u>	<u>injection of barbiturates and other drugs</u>	<u>yes</u>	<u>non-lethal dose, pain associated with injection site</u>	<u>Article 7.6.15.</u>

Article 7.6.6.

Free bullet1. Introduction

- a) A free bullet is a projectile fired from a shotgun, rifle, handgun or purpose-made humane killer.
- b) The most commonly used firearms for close range use are:
 - i) humane killers (specially manufactured/adapted single-shot weapons);
 - ii) shotguns (12, 16, 20, 28 bore and .410);
 - iii) rifles (.22 rimfire);
 - iv) handguns (various calibres from .32 to .45).
- c) The most commonly used firearms for long range use are rifles (.22, .243, .270 and .308).
- d) A free bullet used from long range should be aimed to penetrate the skull or soft tissue at the top of the neck of the animals (high neck shot) and to cause irreversible concussion and *death* and should only be used by properly trained and competent marksmen.

2. Requirements for effective use

- a) The marksman should take account of human safety in the area in which he/she is operating. Appropriate vision and hearing protective devices should be worn by all personnel involved.
- b) The marksman should ensure that the animal is not moving and in the correct position to enable accurate targeting and the range should be as short as possible (5–50 cm for a shotgun) but the barrel should not be in contact with the head of the animals.
- c) The correct cartridge, calibre and type of bullet for the different species age and size should be used. Ideally, the ammunition should expand upon impact and dissipate its energy within the cranium.
- d) Shot animals should be checked to ensure the absence of brain stem reflexes.

3. Advantages

- a) Used properly, a free bullet provides a quick and effective method for *killing*.
- b) It requires minimal or no *restraint* and can be used to kill from a distance by properly trained and competent marksmen.
- c) It is suitable for *killing* agitated animals in open spaces.

4. Disadvantages

- a) The method is potentially dangerous to humans and other animals in the area.
- b) It has the potential for non-lethal wounding.
- c) Destruction of brain tissue may preclude diagnosis of some *diseases*.
- d) Leakage of bodily fluids may present a *biosecurity* risk.
- e) Legal requirements may preclude or restrict use.
- f) There is a limited availability of competent personnel.

5. Conclusion

The method is suitable for cattle, sheep, goats and, pigs, and equids including large animals in open spaces.

Figure 1. The optimum shooting position for cattle is at the intersection of two imaginary lines drawn from the rear of the eyes to the opposite horn buds.

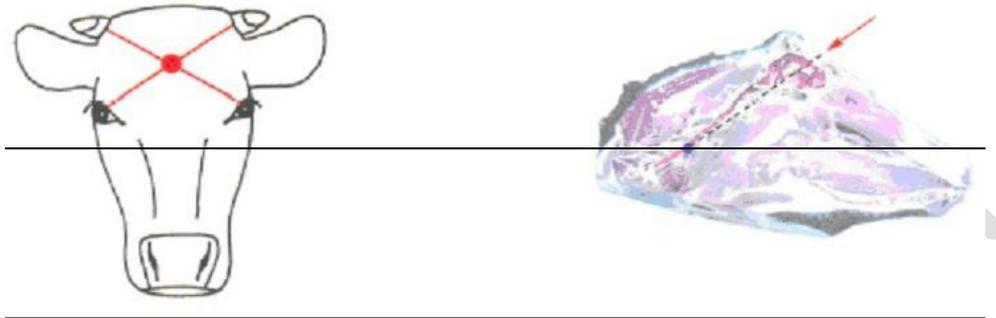


Figure source: Humane Slaughter Association (2005) Guidance Notes No. 3: Humane Killing of Livestock Using Firearms. Published by the Humane Slaughter Association, The Old School, Brewhouse Hill, Wheathampstead, Hertfordshire AL4 8AN, United Kingdom (www.hsa.org.uk).

Figure 2. The optimum position for hornless sheep and goats is on the midline.

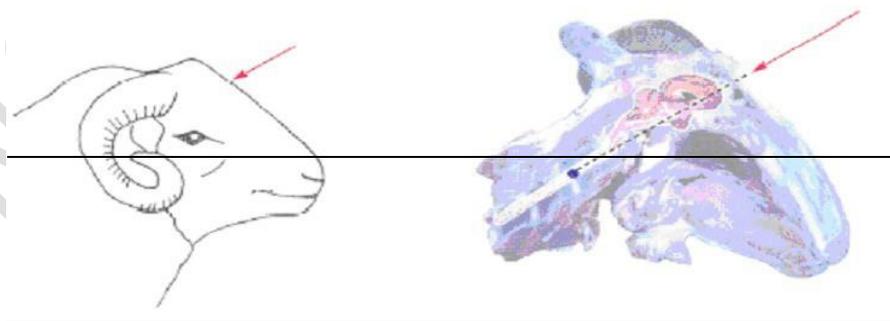


Figure source: Humane Slaughter Association (2005) Guidance Notes No. 3: Humane Killing of Livestock Using Firearms. Published by the Humane Slaughter Association, The Old School, Brewhouse Hill, Wheathampstead, Hertfordshire AL4 8AN, United Kingdom (www.hsa.org.uk).

Figure 3. The optimum shooting position for heavily horned sheep and horned goats is behind the poll aiming towards the angle of the jaw.

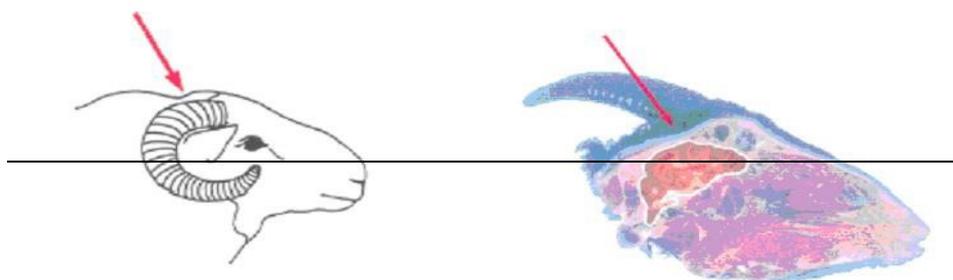


Figure Source: Humane Slaughter Association (2005) Guidance Notes No. 3: Humane Killing of Livestock Using Firearms. Published by the Humane Slaughter Association, The Old School, Brewhouse Hill, Wheathampstead, Hertfordshire AL4 8AN, United Kingdom (www.hsa.org.uk).

Figure 4. The optimum shooting position for pigs is just above eye level, with the shot directed down the line of the spinal cord.



Figure source: Humane Slaughter Association (2005) Guidance Notes No. 3: Humane Killing of Livestock Using Firearms. Published by the Humane Slaughter Association, The Old School, Brewhouse Hill, Wheathampstead, Hertfordshire AL4 8AN, United Kingdom (www.hsa.org.uk).

Article 7.6.7.

Penetrating captive bolt

1. Introduction

A penetrating captive bolt is fired from a gun powered by either compressed air or a blank cartridge. There is no free projectile.

The captive bolt should be aimed on the skull in a position to penetrate the cortex and mid-brain of the animal. The impact of the bolt on the skull produces unconsciousness. Physical damage to the brain caused by penetration of the bolt may result in *death*; however, pithing or bleeding should be performed as soon as possible after the shot to ensure the *death* of the animal. Shooting *poultry* species with the captive bolts results in immediate destruction of the skull and brain, causing *death*. For a detailed description on the use of this method, see Chapter 7.5.

2. Requirements for effective use

- a) For cartridge powered and compressed air guns, the bolt velocity and the length of the bolt should be appropriate to the species and type of animal, in accordance with the recommendations of the manufacturer.
- b) Captive bolt guns should be frequently cleaned and maintained in good working condition.
- c) More than one gun may be necessary to avoid overheating, and a back-up gun should be available in the event of an ineffective shot.
- d) Animals should be restrained; at a minimum, they should be penned for cartridge powered guns and in a race for compressed air guns.
- e) The operator should ensure that the head of the animal is accessible.
- f) The operator should fire the captive bolt at right angles to the skull in the optimal position (see figures 1, 3 & 4. ~~The optimum shooting position for hornless sheep is on the highest point of the head, on the midline and aim towards the angle of the jaw).~~
- g) To ensure the *death* of the animal, pithing or bleeding should be performed as soon as possible after *stunning*.
- h) Animals should be monitored continuously after *stunning* until *death* to ensure the absence of brain stem reflexes.

3. Advantages

- a) Mobility of cartridge powered equipment reduces the need to move animals.
- b) The method induces an immediate onset of a sustained period of unconsciousness.

4. Disadvantages

- a) Poor gun maintenance and misfiring, and inaccurate gun positioning and orientation may result in poor *animal welfare*.
- b) Post stun convulsions may make pithing difficult and hazardous.
- c) The method is difficult to apply in agitated animals.
- d) Repeated use of a cartridge powered gun may result in over-heating.
- e) Leakage of bodily fluids may present a *biosecurity* risk.
- f) Destruction of brain tissue may preclude diagnosis of some *diseases*.

5. Conclusions

The method is suitable for *poultry*, cattle, sheep, goats, ~~and~~ pigs and equids (except neonates), when followed by pithing or bleeding.

Article 7.6.8.

Non-penetrating captive bolt1. Introduction

A non-penetrating captive bolt is fired from a gun powered by either compressed air or a blank cartridge. There is no free projectile.

The gun should be placed on the front of the skull to deliver a percussive blow which produces unconsciousness in cattle (adults only), sheep, goats and pigs, and *death* in *poultry* and neonate sheep, goats and pigs. Bleeding should be performed as soon as possible after the blow to ensure the *death* of the animal.

2. Requirements for effective use

- a) For cartridge powered and compressed air guns, the bolt velocity should be appropriate to the species and type of animal, in accordance with the recommendations of the manufacturer.
- b) Captive bolt guns should be frequently cleaned and maintained in good working condition.
- c) More than one gun may be necessary to avoid overheating, and a back-up gun should be available in the event of an ineffective shot.
- d) Animals should be restrained; at a minimum mammals should be penned for cartridge powered guns and in a race for compressed air guns; birds should be restrained in cones, shackles, crushes or by hand.
- e) The operator should ensure that the head of the animal is accessible.
- f) The operator should fire the captive bolt at a right angles to the skull in the optimal position (~~figures 1–4~~).
- g) To ensure *death* in non-neonate mammals, bleeding should be performed as soon as possible after *stunning*.
- h) Animals should be monitored continuously after *stunning* until *death* to ensure the absence of brain stem reflexes.

3. Advantages

- a) The method induces an immediate onset of unconsciousness, and *death* in birds and neonates.
- b) Mobility of equipment reduces the need to move animals.

4. Disadvantages

- a) As consciousness can be regained quickly in non-neonate mammals, they should be bled as soon as possible after *stunning*.
- b) Laying hens in cages have to be removed from their cages and most birds have to be restrained.
- c) Poor gun maintenance and misfiring, and inaccurate gun positioning and orientation may result in poor *animal welfare*.
- d) Post stun convulsions may make bleeding difficult and hazardous.
- e) Difficult to apply in agitated animals; such animals may be sedated in advance of the *killing* procedure.
- f) Repeated use of a cartridge powered gun may result in over-heating.
- g) Bleeding may present a *biosecurity* risk.

5. Conclusions

The method is suitable for *killing poultry*, and neonate sheep, goats and pigs up to a maximum weight of 10 kg.

[Article 7.6.9.]

Article 7.6.10.

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 minimises post-stun convulsions and therefore the method is particularly effective with pigs.
- b) Non-invasive technique minimises *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 utilise 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).

Figure 5. Scissor-type tongs.



[Article 7.6.11.]

[Article 7.6.12.]

Nitrogen and/or inert gas mixed with CO₂

1. Introduction

CO₂ 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 <2%, or <5% for chickens. Various mixtures of CO₂ and nitrogen or an inert gas can be administered to kill birds using Methods 1 and 2 described under Article 7.6.12. Whole house gassing with mixtures of CO₂ 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 CO₂ and the respiratory distress occurring during the induction phase, are important *animal welfare* considerations.

Pigs and *poultry* appear not to find low concentrations of CO₂ strongly aversive, and a mixture of nitrogen or argon with ≤30% CO₂ by volume and ≤2% O₂ 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 O₂ and CO₂ 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 ≤2% O₂), 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 CO₂ 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* (~~refer to Figures under Article 7.6.12.~~). As shown in the example below, each containerised 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 includes (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 containerised 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 vocalisation 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 minimises 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 outdoor 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 vocalisation 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.





Figure source: Department of Clinical Veterinary Science, University of Bristol, United Kingdom.

Article 7.6.14.

Nitrogen and/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 O₂ 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 $\leq 2\%$ O₂), 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.

Article 7.6.15.

Lethal injection

1. Introduction

A lethal injection using high doses of anaesthetic 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 anaesthetic techniques

3. Advantages

- a) The method can be used in all species.
- b) *Death* can be induced smoothly.

4. Disadvantages

- a) *Restraint and/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 *wild animals* or domestic animals.

5. Conclusion

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

[Article 7.6.16.]

[Article 7.6.17.]

Article 7.6.18.

Pithing and bleeding

1. Pithing

a) Introduction

Pithing is a method of *killing* animals which have been stunned by a penetrating captive bolt, without immediate *death*. Pithing results in the physical destruction of the brain and upper regions of the spinal cord, through the insertion of a rod or cane through the bolt hole.

b) Requirements for effective use

- i) Pithing cane or rod is required.
- ii) An access to the head of the *animal* and to the brain through the skull 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 immediate *death*.

d) Disadvantages

- i) A delayed ~~and/or~~ ineffective pithing due to convulsions may occur.
- ii) The working area is contaminated with body fluids, which increases *biosecurity* risks.

2. 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 ~~and~~ or ineffective bleeding due to convulsions may occur.

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

— Text deleted.

1 The only preclusion against the use of this method for neonates is the design of the stunning tongs that may not facilitate their application across such a small-sized head or body.