USA COMMENTS

TERRESTRIAL ANIMAL HEALTH STANDARDS COMMISSION REPORT

SEPTEMBER 2009

CHAPTER 7.6.

KILLING OF ANIMALS FOR DISEASE CONTROL PURPOSES

Article 7.6.1.

General principles

…

Article 7.6.5.

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

This comment refers to text listed in Article 7.6.5., table summarizing killing methods described in Articles 7.6.6.-7.6.18.

Poultry	adults only	~~non-~~ non penetrating captive bolt	yes	ineffective stunning	7.6.8.

Rationale: In the proposed text for adult poultry, 'non-' as used in 'non-penetrating' has been recommended for deletion. We suggest the proposed changes should not be made because deletion of 'non' in this context is not consistent with information provided in Article 7.6.8., which discusses the use of a non-penetrating captive bolt for killing poultry; see specifically Article 7.6.8., point 4.b), which provides guidance for the use of the non-penetrating captive bolt for killing laying hens, and Article 7.6.8., point 5, which indicates the non-penetrating captive bolt is suitable for killing poultry.

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	7.6.6.
	all except neonates	penetrating captive bolt - followed by pithing or bleeding	yes	ineffective stunning	7.6.7.
	adults only	non-penetrating captive bolt, followed by bleeding	yes	ineffective stunning, regaining of consciousness before killing	7.6.8.
	calves only	electrical, two-stage application	yes	pain associated with cardiac arrest after ineffective stunning	7.6.10.
	calves only	electrical, single application (method 1)	yes	ineffective stunning	7.6.11.

	all	injection with barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	7.6.15.
Sheep and goats	all	free bullet	no	non-lethal wounding	7.6.6.
	all except neonates	penetrating captive bolt, followed by pithing or bleeding	yes	ineffective stunning, regaining of consciousness before death	7.6.7.
	all ~~except neonates~~ * (see rationale below)	non-penetrating captive bolt, followed by bleeding	yes	ineffective stunning, regaining of consciousness before death	7.6.8.
	neonates	non-penetrating captive bolt	yes	non-lethal wounding	7.6.8.
	all	electrical, two-stage application	yes	pain associated with cardiac arrest after ineffective stunning	7.6.10.
	all	electrical, single application (method 1)	yes	ineffective stunning	7.6.11.
	neonates only	CO_2 / air mixture	yes	slow induction of unconsciousness, aversiveness of induction	7.6.12.
	neonates only	nitrogen and/or inert gas mixed with CO_2	yes	slow induction of unconsciousness, aversiveness of induction	7.6.13.
	neonates only	nitrogen and/or inert gases	yes	slow induction of unconsciousness	7.6.14.
	all	injection of barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	7.6.15.
Pigs	all, except neonates	free bullet	no	non-lethal wounding	7.6.6.
	all except neonates	penetrating captive bolt, followed by pithing or bleeding	yes	ineffective stunning, regaining of consciousness before death	7.6.7.
	neonates only	non-penetrating captive bolt, followed by bleeding* (see rationale below)	yes	non-lethal wounding	7.6.8.
	all[1]	electrical, two-stage application	yes	pain associated with cardiac arrest after ineffective stunning	7.6.10.
	all	electrical, single application (method 1)	yes	ineffective stunning	7.6.11.
	neonates only	CO_2 / air mixture	yes	slow induction of unconsciousness, aversiveness of induction	7.6.12.
	neonates only	nitrogen and/or inert gas mixed with CO_2	yes	slow induction of unconsciousness, aversiveness of induction	7.6.13.
	neonates only	nitrogen and/or inert gases	yes	slow induction of unconsciousness	7.6.14.
	all	injection with barbiturates and other	yes	non-lethal dose, pain associated with injection site	7.6.15.
Poultry	adults only	~~non-~~ non penetrating captive bolt, followed by bleeding* (see rationale below)	yes	ineffective stunning	7.6.8.
	day-olds and eggs only	maceration	no	non-lethal wounding, non-immediacy	7.6.9.
	adults only	electrical, single application (method 2)	yes	ineffective stunning	7.6.11.
	adults only	electrical, single application, followed by killing (method 3)	yes	ineffective stunning; regaining of consciousness before death	7.6.11.

***Rationale:** Article 7.6.8 notes that the non-penetrating captive bolt is an appropriate method for stunning/killing poultry and that "bleeding should be performed as soon as possible after the blow to ensure the death of the animal." The Humane Slaughter Association of the United Kingdom (http://www.hsa.org.uk) recognizes the captive bolt as a humane method of stunning birds and neonatal sheep, goats, and pigs but notes that death may not always result from its use. It recommends bleeding following the use of the captive bolt for all animals regardless of age.

Species	Age range	Procedure	Restraint necessary	Animal welfare concerns with inappropriate application	Article reference
Poultry (contd)	all	CO_2 / air mixture Method 1 Method 2	 yes no	slow induction of unconsciousness, aversiveness of induction	7.6.12.
	all	nitrogen and/or inert gas mixed with CO_2	yes	slow induction of unconsciousness, aversiveness of induction	7.6.13.
	all	nitrogen and/or inert gases	yes	slow induction of unconsciousness	7.6.14.
	all	injection of barbiturates and other drugs	yes	non-lethal dose, pain associated with injection site	7.6.15.
	adults only	addition of anaesthetics to feed or water, followed by an appropriate killing method	no	ineffective or slow induction of unconsciousness	7.6.16.

Article 7.6.6.

Article 7.6.12.

CO_2 / air mixture ~~(under study)~~

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 2 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 prevents *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 neurones 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.

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.

~~2.~~3 Method 2

Comment: This item should be listed as point 3, not point 2.
Rationale: Typographical error.

In this method, the crates or modules holding the birds are loaded into a chamber into which gas is introduced. As illustrated in the example below, a containerised 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 surviving birds (j) humanely kill any survivors and (k) dispose of carcasses appropriately.

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

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

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

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 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 40% carbon dioxide is achieved at the top of the crates.

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

Rationale: The proposed text suggests that a constant concentration of carbon dioxide be maintained during the killing process. This seems like a contradiction to the accompanying text that suggests the carbon dioxide concentration is increased until a minimum of 40% is achieved at the top of the crates, and then the concentration is maintained until all birds have expired. Our recommended change in the text is for consistency within the guidelines.

v)

vi) 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, c~~C~~essation of vocalisation 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.

Rationale: We recommend that the new text be added if a viewing window is present allowing visual inspection of death or imminent death of the birds.

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~~ resistant to the effects of carbon dioxide and therefore require a minimum of 80% CO_2 and a longer period of exposure to die.

Rationale: The substitution of the word 'resistant' for the proposed word 'resilient' may provide clarification for the reader on the intent of the guideline.

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 minimises the aversive nature of this method for inducing unconsciousness.

iii) 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.

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.

Rationale: Syntax change.

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 and availability of gas.

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

Rationale: The inclusion of a viewing window can help rectify this concern (see previous comments). Additionally, unlike in the previous section (Article 7.6.12., point 2., [Method 2],

subsection a.v, second sentence), the text as proposed makes no reference to listening for wing flapping.

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 ~~handling~~ other needed equipment.

Rationale: It is not clear what is meant by handling equipment. We recommend the addition of 'other needed' as alternative and more encompassing text.

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.

ii) 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.

~~23~~4. Method ~~2~~ 3

Comment: This item should be listed as point 4, not point 3.
Rationale: Typographical error.

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, will have to be switched off prior to gas administration.

The mains 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 the 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 vaporiser 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 minimises 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 2 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 *animals* before they lose consciousness.

Article 7.6.13.

Nitrogen and/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 <2%. Various mixtures of CO_2 and nitrogen or an inert gas can be administered to kill birds using Methods 1 and 3 described under Article 7.6.12. 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 <30% CO_2 by volume and <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.

ii) *Animals* should be introduced into the *container* or apparatus after it has been filled with the required gas concentrations (with <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.

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

~~5.~~ 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.

~~4.~~ c) 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~~. 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 ~~monitor and maintain the level of oxygen continuously during the operation.~~ ensure a concentration of oxygen < 2% is achieved and maintained until it can be confirmed that the birds have been killed.

Rationale: As recommended for identical text appearing in Article 7.6.12., point 2., subsection a.iv, the proposed text seems to suggest that a constant concentration of oxygen be maintained during the killing process. This is in contrast to the accompanying text that suggests oxygen concentration be decreased until a maximum of 2% is achieved at the top of the container.

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, ~~The c~~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.

Rationale: Similar text appears in Article 7.6.12., point 2., subsection a., v. Again, we recommend the option of a viewing window be considered.

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

vi) Any survivors should be humanely killed.

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

Rationale: The substitution of the word 'resistant' for the proposed word 'resilient' may provide clarification for the reader on the intent of the guideline.

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 outdoors~~?~~ the gas is dispersed quickly at the end of each cycle by opening the door, improving operators' health and safety.

Rationale: Typographical error.

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, ~~It is difficult to~~ visual~~ly~~ 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.*

Rationale: The inclusion of a viewing window can help rectify the difficulty in confirming death. Additionally, no reference is made in the proposed text to listening for wing flapping as an additional method to determine onset of death.

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 ~~handling~~ other necessary equipment.

Rationale: It is not clear what is meant by handling equipment. We recommend the addition of 'other necessary' as alternative and more encompassing text.

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.

Article 7.6.14.

Nitrogen and/or inert gases

1. …

Article 7.6.17.

Cervical dislocation and decapitation

1. Cervical dislocation (manual ~~and mechanical)~~

a) Introduction

Unconscious poultry may be killed by either manual cervical dislocation (stretching of the neck) ~~or mechanical neck crushing with a pair of pliers. Both methods~~ 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, ~~or are impracticable,~~ 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~~.~~

Rationale: Cervical dislocation of a small number of birds may be acceptable when other methods of killing are unavailable. However, research shows that this method can have drawbacks with brain activity continuing for up to 30 seconds after dislocation is carried out – even when the correct technique is used. Therefore, this method should not be used when time is available to obtain a more humane method of killing.

We note that cervical dislocation (Article 7.6.17) is not included in the table summarizing killing methods (Article 7.6.5). We support excluding cervical dislocation from the table as we do not believe this method should be used on a routine basis, as noted above.

Methods that crush the neck (e.g. pliers) do not cause concussion and are therefore unlikely to cause painless or immediate loss of consciousness.

b) Requirements for effective use

i) *Killing* should be performed either by manually or mechanically stretching the neck to sever the spinal cord or by using mechanical pliers to crush the cervical vertebrae with consequent major damage to the spinal cord.

ii) …