

STANDARD OPERATING PROCEDURES
DIVISION OF COMPARATIVE MEDICINE
UNIVERSITY OF SOUTH FLORIDA

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Page 1 of 2

TITLE:	Carbon Dioxide (CO₂) Euthanasia in Rodent Species
SCOPE:	Animal Care Personnel
RESPONSIBILITY:	Facility Manager, Animal Care, and Research Personnel
PURPOSE:	To Outline the Proper Procedures for Performing CO ₂ Euthanasia in Rodent Species

I. PURPOSE

1. This procedure outlines the proper methods of using carbon dioxide to euthanize rodent species while avoiding or minimizing discomfort, distress, and pain.

II. RESPONSIBILITY

1. The Veterinarians oversee all aspects of animal health, and are assisted by all program staff.
2. Facility Managers ensure implementation of all procedures.
3. Research staff is required to follow these guidelines.

III. PROCEDURES

1. The AVMA Panel on Euthanasia has stated that CO₂ is acceptable **with conditions** for euthanasia of small rodents.
 - a. Advantages:
 1. Provides rapid depression with analgesic and anesthetic effects (CO₂ narcosis).
 2. Readily available and can be purchased in compressed gas cylinders.
 3. Non-flammable, non-explosive, and poses minimal hazards to personnel.
 4. Does not introduce chemical residues in tissues.
 - b. Disadvantages:
 1. CO₂ is heavier than air. Incomplete filling of the chamber can induce some animals to try to avoid exposure by climbing or jumping which appears distressful.
 2. Neonatal rodents are resistant to CO₂ induced euthanasia.
 3. Induction of loss of consciousness at lower concentrations may produce pulmonary and upper respiratory tract lesions.
 4. High concentrations may be distressful to some animals.
2. **Compressed CO₂ in gas cylinders is the only acceptable source of CO₂** for euthanasia. CO₂ generated by other methods such as from dry ice, fire extinguishers, or chemical means (e.g., antacids) is unacceptable.
3. Only animals of the **same species** should be placed into a chamber at any time.
4. Animals are placed into chambers so that they have **sufficient floor space** and are not overcrowded. **Minimum space requirements as listed in the "Guide" must be met for all rodents at all times.** Cages of rodents are not to be combined for the purpose of euthanasia.

5. Euthanasia of more than one animal at a time should always be performed in cohorts of live animals (i.e., live animals must not be placed in the chamber with dead animals).
6. To reduce stress, rodents should be **euthanatized in their home cage whenever possible**. This can be accomplished by delivering CO₂:
 - a. Via a Euthanex® lid over the home cage after removing the filter and wire tops.
 - b. Via the air supply port of an IVC cage.
7. Alternatively, animal(s) are placed in a clean microisolator box with a Euthanex® lid.
NOTE: Sudden exposure to high concentrations of CO₂ may be distressful to some species. Pre-filling the CO₂ chamber is no longer recommended.
8. CO₂ delivery to the microisolator is accomplished by turning the CO₂ cylinder valve and flow meter on so that animal(s) are slowly exposed to increasing levels of CO₂ at the following flow rates which will displace 10-30% of the cage volume/minute:

Species	Cage Type	Flow Rate L/min
Mice	Static (small)	2
	Static (large)	6
	IVC (w/o lid)	3
	IVC (w/ lid)	4
Rat	Static	8
	IVC (w/o lid)	11
	IVC (w/ lid)	13

9. Gas flow may be increased as loss of consciousness is observed and flow should be maintained for at least one minute after apparent clinical death (e.g., cessation of cardiovascular and respiratory movements).
 - a. Immediate post-mortem blood collection can be facilitated by performing cervical dislocation immediately upon observation of cessation of respiratory movement and subsequently collecting blood via cardiac puncture.
10. Turn off CO₂ flow meter and cylinder valve.
11. **Death must be verified** by the assurance of the cessation of respiratory and cardiovascular movements by observation at room air for at least 10 minutes, or by employing a secondary method of euthanasia such as cervical dislocation, decapitation, or bilateral thoracotomy prior to carcass disposal.
12. **Chambers/lids must be cleaned/dried** between animals or groups of animals to minimize odors that might distress animals prior to euthanatization.
13. **Animals must not be euthanatized in animal housing rooms** except during special circumstances such as during quarantine and/or exposure to infectious agents.
14. Neonates (up until approximately 10 days) are resistant to euthanasia by CO₂ due to their inherent resistance to hypoxia, and may require prolonged exposure time to any type of inhalant. Consequently, **CO₂ alone should not be used alone as a sole means of euthanatizing neonates**. CO₂ may be used to induce narcosis but must be followed with another acceptable method of euthanasia (e.g., decapitation, cervical dislocation, or bilateral thoracotomy) to ensure death. Euthanasia of feti or prenatal mice should be accomplished immediately after removal from the dam. Incomplete neural development in mouse feti less than 14 days of gestation suggests that pain perception at this age is minimal.

Approved:

Date: