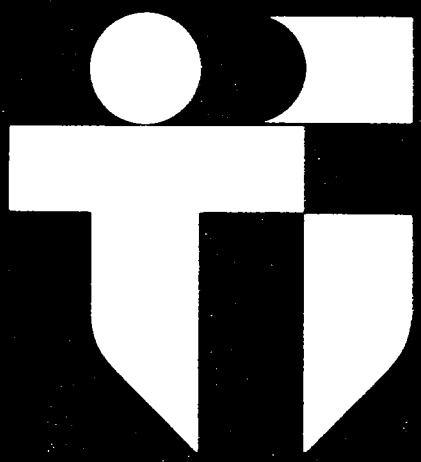
EUTHANASIA — CARBON MONOXIDE CHAMBER

OPERATIONAL GUIDE
For Animal Care And Control Agencies



AMERICAN HUMANE

Practical Application:

These carbon monoxide euthanasia chamber specifications are for the purpose of initiating procedures to standardize construction, performance, and operation according to acceptable humane criteria.

For ease of assimilation and presentation, the information has been divided into five parts:

I. Basic Objectives
II. Euthanasia Room
III. (A) Carbon Monoxide Source
(B) Gas Saturation Computation
(C) Improved Filtration
IV. Chamber
V. Operation

I. BASIC OBJECTIVES

The carbon monoxide euthanasia chamber specifications are directed at meeting the following basic objectives:

Humaneness
Safety
Consistent performance
Ease of operation
Reasonable cost

To satisfy the first requirement, humaneness, carbon monoxide euthanasia should render animals unconscious within two minutes or less. Death should occur immediately after unconsciousness. **Carbon monoxide is not recommended for euthanizing animals under 8 weeks old.**

The design of euthanasia equipment and layout of the lethal room should be planned for efficiency and safety. The employees, the public, and the other animals in the shelter must be taken into consideration.

The equipment must be maintained in maximum operating condition to insure humaneness. With this in mind, a regular schedule of maintenance must be followed. When equipment is not working properly, it may not be humane. The recommendations given here provide information for ease of operation as well as a minimum of cost.

II. EUTHANASIA ROOM

The room used to house the carbon monoxide chamber must be used only for that purpose. It must be a separate room, marked "private" and equipped with a self-latching (normally locked) door. Windows, if any, should be limited to skylights or to small units near the ceiling. The public should not have ready access to this area. Electrical installation, including lighting fixtures, switching, and wiring should be of an approved explosion-proof type.

Employee Safety

A room exhaust fan, venting to the outside and in addition to the fan in the chamber, should be installed. The fan should have sufficient capacity to completely change the air in the room in one minute. The fan should be wired so that it is on at all times when the room is occupied.

A carbon monoxide sensing device should be installed in the room near the chamber, and another near the CO source, to sound an alarm whenever an accumulation of 1/10 of 1% or more CO is present in the room. An alarm also should be connected to sound in the office for additional safety.

Direct, private access to a holding freezer, refrigerator, and/or to a crematory is recommended.

III. (A) CARBON MONOXIDE SOURCE

The production of source of CO gas should take the following into consideration:

Immediate availability
Freedom from impurities

Suitable concentration
Ease of handling

Carbon monoxide may be obtained in two ways.

1. CO is available in cylinders, which is the preferred source. Pure CO from cylinders does not have to be filtered or cooled, and comes properly concentrated.

2. A less desirable alternative is to utilize an internal combustion engine. **Internal combustion engines utilized as gas generators will require proper filtration and cooling of gases prior to introduction to the lethal chamber.** A four-cycle type engine is preferable because of reduced production of undesirable combustibles. A two-cycle engine should not be used. Engineering research indicates that the operation of an automotive type four-cycle engine in good condition at idle speed, utilizing regular gasoline or preferably an unleaded fuel, can produce suitable quantities of CO to saturate a relatively large chamber within a short period. The carburetor should be set at a slightly rich mixture.

Newer engines must be checked for smog-control devices. If the engine is equipped with such a device, it must be by-passed so that CO will be produced.

Another source of CO is a small, 5-7 h.p. aircooled engine.

Research indicates that maximum generation of CO occurs at idle speeds (approximately 500-600 rpm for water-cooled engines; 1200-1600 rpm for air-cooled engines). Racing the engine actually reduces the amount of CO produced. Verification of compliance with manufacturer's suggested idling speeds by using a tachometer is recommened.

Fuels with additives or premium fuels are not desirable for this prupose since they release undesirable combustibles which are difficult to filter.

Engines should be new or rebuilt engines. A compression test should indicate that the individual cylinders are approximately equal within plus or minus 10%. The variation between dry and wet compression tests should be approximately 15 pounds or less. These tests will indicate any serious engine leakage to oil burning and production of undesirable combustibles.

III. (B) GAS SATURATION COMPUTATION

Experts indicate that a 1% concentration of CO is lethal. Studies indicate that animals introduced into a 6-8% of CO lose consciousness within 25 to 30 seconds.

For standardized computation purposes the following conservative formula may be used, keeping in mind that in a four-cycle engine, each fourth stroke is an exhaust stroke, and that analysis of the exhaust should indicate a 5% CO content.

To determine the CO (5% of exhaust) output of a water-cooled gasoline engine, find the engine displacement in cubic inches and the revolutions per minute (RPM) at idle speed. Multiply the engine displacement by the RPM. Divide by 4 (each 4th stroke of a four-cylinder engine is an exhaust stroke).

Example:
Assume an engine has a displacement of 250 cubic inches and an idle speed of 600 RPM.

$$\frac{250 \text{ cu. in.} \times 600 \text{ RPM}}{4 \text{ (exhaust strokes)}} =$$

$$\frac{150{,}000}{4} = 37{,}500 \text{ cu. in. of exhaust per minute}$$

To convert to cubic feet, divide 37,500 cubic inches of exhaust by 1,728 (constant number to convert cubic inches to cubic feet).

$$\frac{37{,}500}{1{,}728} = 21.7 \text{ cu. ft. of exhaust per minute}$$

Find the capacity of the CO chamber in cubic feet—width x height x length.

Assume a chamber 3 x 4 x 3 = 36 cubic feet.

Divide the capacity of the CO chamber in cubic feet (36) by the cubic feet of exhaust produced per minute:

36 ÷ 21.7 = 1.66 minutes for the chamber to fill with exhaust containing approximately 5% CO.

III. (C) IMPROVED FILTRATION

The filter should serve to remove any impurities from the gas and to cool the gas. When possible the filter should be self-cleaning and relatively maintenance free.

Engineering studies indicate that a "scrubber" type of filter is a vast improvement over simply bubbling the gas through water.

A filter "scrubber" can be constructed as follows: (see illustration) A 40-gallon capacity "water heater type" tank is obtained and fitted out according to the drawing. It is filled approximately 2/3 full with a coarse gravel. (The size of this gravel is such that when screened it will pass through a 2" mesh and be retained by a ¾" mesh). The gravel must NOT be limestone.

The tank is constructed with a drain at the bottom and a water shower head at the top. The tank is not filled with water at any time. The shower head continuously wets the gravel with a light spray of water which drains out of the tank when it reaches the bottom. The gas is introduced into the tank and collected as indicated. This system is superior to merely bubbling the gas through water, since the gravel presents a greater wetted surface and diffuses the gas to a greater extent. In addition, the constant flow and draining of water cleans the gravel and cools the gas.

It is suggested that connections between the tank and the engine as well as between the tank and the chamber have a section of flexible coupling hose to reduce the transmission of mechanical vibration. In addition, the input should be connected to a by-pass valve, so that the engine exhaust may be diverted during engine warm-up. This is to allow a warm-up period for the engine without building up a back pressure.

IV. CHAMBER

The lethal chamber can be a cubic box, relatively airtight, of approximately 36 cubic feet capacity. It is customarily constructed of masonry, steel plate, or some similar impervious material. It should be equipped with an air-tight door to expedite animal handling and chamber sanitation. Safety requires the provision of an exhaust fan, venting to the outside of the lethal room and capable of clearing the chamber in one minute. The fan is normally wired to be automatically switched on and operating whenever the chamber door is opened. An air-intake vent will be required if the fan is operated in order to clear the chamber before the door is opened. To reduce hazard potential from explosion or pressure build-up inside the chamber, the exhaust fan duct should include a gravity-weighted cap or closure.

A small vent is sometimes installed at the bottom of the lethal chamber to permit oxygen to escape more rapidly as the engine exhaust is introduced. However, this should also be vented to the outside.

The chamber must be equipped with accurate temperature gauges to insure that the internal temperature of the chamber does not exceed 110°F (41.3°C).

A window and interior light may be provided to facilitate observation.

The electrical installation should be of an approved explosion-proof type.

It is suggested that consideration be given to a cylindrical chamber such as is used in high altitude (low pressure) euthanasia. This would

provide for efficient utilization of CO. There are indications that the curved shape of the cylinder will also distribute the gas more evenly through the chamber.

The design of the chamber should allow for separation of animals by species and size. Costs would be reduced by utilizing a chamber already available. The 36-38' diameter and 42-48' length would provide reasonable standardization and assure planning for a uniform level of performance. A wheeled dolly is also available as part of the cylindrical chamber system. There are several advantages to the use of this type of equipment.

V. OPERATION

The operation of a CO euthanasia chamber should meet the following provisions to comply with the *Basic Objectives* discussed previously.

A. Gas generator, gas scrubber, and chamber should be in good operating condition.

B. The gas scrubber's water supply should be on. (Euthanasia room fan should be on.)

C. Engine should be warmed up, utilizing a gas by-pass valve to pipe exhaust to the outside, prior to directing CO into the chamber.

D. More than one animal (where possible) may be placed in dolly or in chamber in individual cages. Do not overcrowd or introduce incompatible animals, or live animals with dead animals. If young animals are placed in the chamber, they should be at least 3 inches off the floor for fast exposure to the carbon monoxide.

E. Animals should be left in the chamber with continuing gas supply for a minimum of 15 minutes.

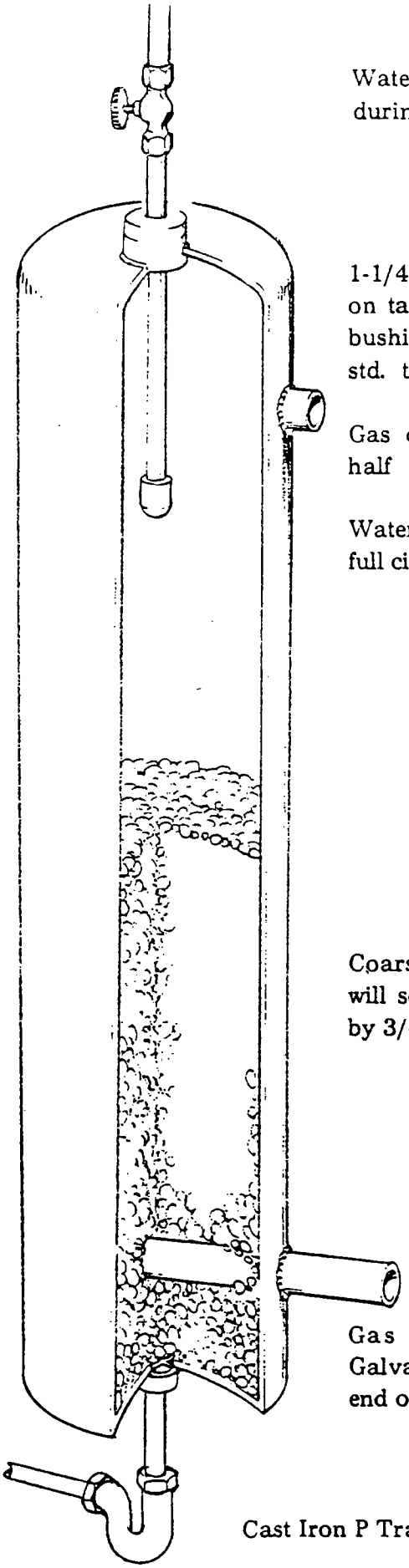
F. Following the 15-minute lethal cycle, the outside by-pass should be opened, and the engine shut off, to prevent moist air from the filter being drawn back by vacuum into the engine.

G. The chamber exhaust fan should be operated for approximately five minutes, to clear the chamber of CO before the door is opened and bodies removed.

H. Animals should be individually checked to insure death has taken place.

I. Chamber should be thoroughly cleaned.

J. Maximum safety precuations should be observed at all times.



Water spray to be on continously during operation of chamber.

1-1/4" galvanized half coupling welded on tank end with 1-1/4" x 3/8" brass bushing and 3/8" x 12" brass nipple, std. thd. one end, other thd. 4" long.

Gas outlet to CO chamber 2" galv. half nipple welded on, thd. outside.

Water spray 3/8" brass spray nozzle, full circle type.

Coarse gravel - (not limestone) Size: will screen past 2" mesh and retained by 3/4" mesh.

Gas intake from engine, 2" x 20" Galvanized nipple inlet welded in, Thd. end outside tank.

To Drain

Cast Iron P Trap

Carbon Monoxide Gas "Scrubber" and Filter