



Designation: E 590 – 95

Standard Guide for the Use and Development of Sodium Monofluoroacetate (Compound 1080) as a Predacide¹

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INTRODUCTION

Vertebrate animal control is a relatively primitive science lacking many of the research tools and procedures which are well established in other biological areas. This field is still more of an art or skill highly dependent on field experience. This is particularly true in dealing with higher forms that are neither domestic nor commensal. All are capable of elementary reasoning in addition to learned behavioral patterns; thus, pesticidal work has been difficult and in some areas impossible to standardize. We recognize, however, that the effort to do so must be continued in order to provide reasonable safeguards in application and to improve the science.

1. Scope

1.1 Sodium monofluoroacetate (Compound 1080) has been used for 30 years in animal control. However, since effective application as a predacide is directly related to the use of specific delivery systems, a standard guide is deemed both desirable and necessary.

1.2 The target species are primarily wild canids that may cause economic damage to domestic animals and crops. Additional purposes may include local population suppression to control rabies or other epizootics in wild canids such as foxes and coyotes.

1.3 The major use of Compound 1080 is in coyote (*Canis latrans*) control programs by application of bait stations during winter months. It is also used in red fox (*Vulpes fulva*) control programs in some sparsely settled areas.

1.4 Several nations in the world use or have developed use of this material and since this is the most complete document developed, the committee feels the guide should remain, recognizing the major emphasis deals with North American fauna.

1.5 Field experience is absolutely essential in the use of this product and any dispersal technique. Other experience is inadequate for safe and effective use.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific hazard statements are given in Sections 5 and 12.

2. Physical and Chemical Properties

2.1 Sodium monofluoroacetate (FCH_2COONa), also known as Compound 1080, is a white, crystalline, essentially odorless powder. The pure compound has been described as having a mildly salty, sour, or vinegar taste. It is hygroscopic and highly soluble in water but relatively insoluble in organic solvents such as kerosene, alcohol, and acetone, and in animal and vegetable oils and fats. It is unstable above 110°C and decomposes at 200°C. It also decomposes slowly in aqueous solution.

2.2 Compound 1080 is absorbed through the gastrointestinal tract, open wounds, mucous membranes, and pulmonary epithelium. It is not readily absorbed through intact skin. Toxicity is approximately equivalent whether the chemical is administered orally, subcutaneously, intramuscularly, intraperitoneally, or intravenously.

3. Mode of Action

3.1 Compound 1080 toxicity is primarily caused by inhibition of the citric acid (Krebs) cycle, which is essential for conversion of food into energy. The inhibition is caused by fluorocitrate, a metabolite of Compound 1080, which blocks citrate and succinate metabolism. Increased citrate secondarily inhibits energy production by blocking glucose metabolism.

4. Toxicology

4.1 Toxic symptoms follow a variable latent period as short as 1/2 h to as long as several hours. Singly or combined, causes of death are cardiac failure, depression of the central nervous system, or respiratory failure. In general, death in herbivores is caused by cardiac failure and in carnivores by central nervous system disorders. There is no established antidote, although four drug treatments have shown therapeutic effects. Medical treatment is primarily symptomatic.

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4.2 Compound 1080 is highly toxic to the family Canidae. The recorded LD50 (Note 1) for coyotes (*Canis latrans*) is 0.1 mg/kg (Note 2) and for gray foxes (*Urocyon cinereoargenteus*) is less than 0.3 mg/kg. Other recorded mammalian LD50 values range from 0.1 mg/kg in black rats (*Rattus rattus*) to 60.0 mg/kg for opossums (*Didelphus marsupialis*). Recorded LD50 values in birds lie between 0.6 and 1.3 mg/kg for magpies (*Pica pica*) and 20.0 mg/kg for Gambel's quail (*Lophortyx gambeli*). The estimated human LD50 is in the range from 0.7 to 2.1 mg/kg. (Other LD50 values are listed in Table 1.)

NOTE 1—LD50, the median lethal dosage, is a statistical estimate of the dosage that would be lethal to 50 % of a very large population of the test species.

NOTE 2—mg/kg refers to milligrams of toxicant per kilogram of body weight.

4.3 When used as a predicide, secondary toxicity to some species has occurred, but tertiary effects have not been shown. Most secondary hazards demonstrated have been unidirectional, from small to larger species. Partial metabolism, excretion, and distribution of Compound 1080 through body organs prior to death are factors that act to reduce secondary hazards. Additional factors are species sensitivity and body size, feeding behavior of the scavenger, and the parts of prey animals or carrion ingested.

4.4 Physical and chemical properties of Compound 1080 and relative sensitivity of canid species are such that it is one of the most effective known chemicals for canid control. Although Compound 1080 is highly toxic to many homeothermic species, there is a sufficient range of sensitivity between species and differences in species behavior to provide a degree of selectivity by appropriate bait formulation. Additional selectivity is provided by suitable station placement and exposure periods.

5. Storage and Handling

5.1 The use of toxic chemicals requires certain precautions; and the following safety rules should be observed at all times in handling Compound 1080 concentrate, solutions, and treated baits:

5.1.1 All applicators and supervisory personnel shall be adequately trained and qualified. They should be fully aware of exposure hazards and proper storing and handling procedures to prevent human or nontarget animal exposure. First aid instructions and necessary material must be available at all times during handling procedures.

5.1.2 Compound 1080 concentrate shall be stored and transported only in properly labeled containers. It should be held under lock at all times except during necessary procedures for packaging, issuing to applicators, and treating baits. Extraordinary care shall be taken to prevent contact with food and access by children, irresponsible individuals, livestock, and pets.

5.1.3 **Precaution**—Respirators, protective clothing, and gloves should be worn at all times when handling the concentrate. However, waterproof gloves are adequate for handling liquid solutions and treated baits. Smoking and eating should be avoided when preparing baits, and precautions should be taken to prevent contact of the chemical with skin or clothing.

Respirators, clothing, and gloves should be thoroughly cleaned or destroyed after each exposure to the chemical. The applicator should wash his hands after handling the chemical or treated bait. Supervisory personnel should be responsible for providing proper equipment and ensuring that it is used only by experienced applicators authorized to prepare Compound 1080 baits.

5.1.4 Inventories of Compound 1080 concentrate and treated baits must be maintained. These shall include amounts purchased, storage locations, amounts distributed to applicators, and amounts used. Applicators shall keep records of quantities of Compound 1080 issued to them by the agency, quantities used and returned to the agency, and numbers of baits treated and placed by them. Applicators shall return all unused Compound 1080 concentrate and empty containers to agency or administrative headquarters at the end of each baiting season.

5.1.5 Under no circumstances shall applicators transfer possession of Compound 1080 concentrate, solutions, or treated baits to unauthorized individuals. However, applicators may require assistance in handling of bait animals, mapping of station sites, transportation, and placement and exposure of baits at approved, authorized station sites. Such assistance is not considered transfer of possession.

6. Formulation

6.1 Since Compound 1080 is highly soluble in water, an aqueous solution injected into meat is an effective delivery method. The standard use formula in this method for control of wild canids is 1.6 g of Compound 1080/45.4 kg (100 lb) of bait material. This formulation has been used successfully on coyotes and wolves in Canada and the United States, dingos in Australia, and black-backed jackals in South Africa. The impregnated meat bait is especially suited for use in remote locations during winter months to control coyote populations, especially in northern or sub-alpine climates.

6.2 When treated according to standardized directions, 1.4 oz of impregnated meat bait is equivalent to 1 LD50 for coyotes. (Other LD50 values are listed in Table 1.)

6.3 An alternative method for Compound 1080 application to control wild canids is the use of small perishable baits, generally smaller than 20 g, each containing a single lethal dose. Bait materials normally used are ground or rendered lard, tallow, or other fats which are relatively solid and physically stable at cool temperatures, but which melt at temperatures of approximately 26 to 32°C. Baits of this type are destroyed by warm weather in the event that they cannot be recovered for burning or burial. Since Compound 1080 exhibits a high degree of adsorption to plant root tissues and other cellulosic materials and is degraded by soil bacteria, the amounts of Compound 1080 released present little or no hazard in the environment.

6.4 Based on available toxicity data and probable maximum body weights for wild canids, suggested minimum single dosages for perishable Compound 1080 baits are:

5.0 mg 1080/bait for coyotes; maximum body weight 25 kg
3.0 mg 1080/bait for red foxes; maximum body weight 9 kg
2.0 mg 1080/bait for gray foxes; maximum body weight 7 kg

Dose levels may be readily adjusted, where necessary.

commensurate with body weights of local canid populations.

7. Preparation

7.1 The procedure for impregnated Compound 1080 bait preparation for coyote control is standard. Horses, mules, sheep, or other similar bait animals are killed and butchered into pieces weighing approximately 22.8 kg (50 lb) for treatment. The viscera are removed and are not treated. A scale of sufficient capacity to weigh the baits should be used to ensure proper treatment levels of Compound 1080 for each section of bait.

7.2 Compound 1080 at the rate of 1.6 g/45.4 kg (100 lb) of meat to be treated is dissolved in an appropriate volume of warm water. The water should not be heated to boiling (100°C (212°F)) when preparing the solution. Normally, 1.0 litre (1.06 qt) is adequate to treat 45.4 kg (100 lb) of meat. The amount of Compound 1080 concentrate and the volume of water used are adjusted appropriately for greater or lesser amounts of meat.

7.3 The warm aqueous Compound 1080 solution is injected at 50 to 75-mm (2 to 3-in.) intervals into the sections of meat by means of a meat pickling syringe. The quantity of solution injected is adjusted to the weight of each section of meat to ensure correct Compound 1080 treatment levels. Following injection, the sections are allowed to cool until post mortem rigor develops to allow adequate time for diffusion of Compound 1080 to occur and reduce loss of the solution by leakage.

7.4 Minimizing danger to nontarget carrion-eating species is partially dependent on reasonably even Compound 1080 distribution in the meat. Tests have shown that the Compound 1080 solution may diffuse as far as 75 mm (3 in.) from injection sites but is more concentrated around the injection site. Greatest diffusion occurs when meat is treated while warm, immediately after butchering the animal, although the solution does not penetrate the connective tissue between muscle layers. Therefore, by treating meat before rigor develops and by injecting the solution at frequent intervals both horizontally and vertically, overlapping diffusion will tend to distribute Compound 1080 evenly throughout the meat.

7.5 After rigor develops in the treated bait sections, they may be divided into sections of appropriate size for placement at the selected station sites.

7.6 Time required for treated meat to cool and reach normal post mortem rigidity may be several hours. In addition, temporary bait storage at the treatment site may be necessary or desirable. Warning signs must, therefore, be prominently displayed on access roads, other logical entrance points, and at the treatment site so long as baits remain exposed.

7.7 Small perishable baits may be prepared by thoroughly mixing Compound 1080 concentrate directly with melted bait material, followed by forming individual baits of suitable size to contain a single lethal dose. Normally, Compound 1080 concentration in the bait material should be adjusted to provide single-dose baits weighing 10 to 15 g. A suitable inactive dye that does not cause aversion in the target species, such as nigrosene black, may be added to the Compound 1080 concentrate as a means to ensure thorough mixing in preparation of bait material and to identify toxic bait material.

7.8 Perishable baits may also be prepared by insertion of suitable capsules or pellets containing a single lethal dose into

preformed small baits. Capsules or pellets should be fully enclosed and covered by bait material to avoid detection and possible bait shyness. Capsules and pellets should dissolve rapidly upon contact with canid gastrointestinal fluids. Where necessary to facilitate dosage preparation in capsules or pellets, an inactive nonrepellent substance such as powdered confectioners sugar is useful as a volume expander for Compound 1080 concentrate.

7.9 Perishable baits should be maintained at cool temperatures to aid in handling and to prevent them from sticking together. An additional aid in handling is provided by coating them with sugar, fish meal, or other similar nonrepellent materials. Food scents attractive to canids may be added to such coatings to improve bait acceptance.

8. Placement

8.1 Written authorization to establish each Compound 1080 station and a description of the precise location by section, township, and range or other suitable location criteria, must be obtained from the landowner, lessee, or administrator for each baiting season. Copies of these documents shall be maintained by the control agency and the applicator for attachment to station records.

8.2 Supervisory personnel shall review each authorization for Compound 1080 station placement to ensure that stations are properly authorized and that location descriptions are accurate. Each proposed station shall be plotted on a map of sufficient scale to ensure accuracy in determining its location relative to other stations.

8.3 Permanent records shall be maintained by supervisory personnel at agency headquarters for all Compound 1080 stations placed during each baiting season. These records must show the dates of placement and destruction or termination of each station, the number of original and replacement perishable baits, the weights of original and replacement impregnated meat baits, approximate amounts consumed at each station, and approximate weight of remaining bait when the station is terminated or destroyed at the end of each baiting season. Each station shall be plotted on a map of sufficient scale to show its location accurately by section, township, and range or other suitable location criteria. Each applicator shall maintain similar records with maps of stations established and baits placed by him during each baiting season.

8.4 In addition to the applicator, at least one other authorized applicator or supervisor who is familiar with the area must be fully aware of the precise location of each Compound 1080 station and capable of conducting necessary station maintenance and destruction in the event that unavoidable circumstances prevent the original applicator from doing so at the end of the baiting season. It is highly desirable that the landowner, lessee, administrator, or his authorized agent also be fully aware of the precise bait location, but he shall not be permitted to place or move a bait independently of an authorized applicator or supervisor.

8.5 The applicator shall establish the fewest possible number of Compound 1080 bait stations to provide effective control while reducing the potential hazard to nontarget species that travel less extensively than wild canids. Normally, coyote numbers can be effectively reduced by placement of stations in

the average of one per township 93 km² (36 square miles). In some areas, more frequent placement may be required; and in others, wider dispersal is possible. This does not mean that stations must be placed precisely 9.65 km (6 miles) apart, or exactly in the center of each township, since selective, effective, and adequate placement cannot in all cases be achieved by station placement dictated by township survey boundaries or other arbitrary spacing criteria; but with adequate knowledge of an area and its primary coyote travel routes, stations can be placed so that each will be effective over a relatively large area. The applicator should study the area, examine the potential sites, and select those which exhibit the desired characteristics for selective and effective bait exposure. Following the initial baiting season, the applicator should examine the results of each station, select those which are most effective as continuing sites, and move or delete those which are not effective or necessary.

8.6 In selecting Compound 1080 station sites, the applicator shall take every possible precaution to protect nontarget species through avoidance of intensive farming and agricultural areas and timbered or stream areas where furbearers concentrate. Stations shall be confined to areas that are sparsely inhabited and not ordinarily used by the public during bait exposure. They shall normally be placed a minimum of 1.6 km (1 mile) from occupied residences and 0.4 km (1/4 mile) from public roads regularly traveled by the general public during the exposure period.

8.7 To facilitate recovery and destruction of uneaten bait, all Compound 1080 impregnated meat baits placed, must be securely fastened to a stationary solid object such as a bush, tree, post, or stake at the station sites to prevent their being carried away by animals. Warning signs must be visible from each Compound 1080 station and be displayed on all access roads and at other logical entrance points throughout the exposure period. All such signs shall be removed when the stations are removed or destroyed.

8.8 Baits should be transported in covered, locked, leak-proof containers to prevent accidental exposure to pets and nontarget species.

8.9 Field conditions will dictate specific station placement. Relatively snow-free locations in rough terrain and areas of known predation near travel routes used by target species during the baiting season are preferred. Effective locations include wind-swept hillsides and passes through hilly areas, intersections of animal trails and rims of arroyos, gullies, or canyons. In general, particularly in level terrain, it is advantageous to place stations within the area traveled by target animals so that prevailing winds carry the odor toward their travel routes.

8.10 Wild canids are attracted by fresh and weathered animal carcasses, including skeletal remains, but they are wary and suspicious of new or strange objects in their environment. Therefore, establishment of "draw stations" composed of such remains encourages regular visitation of such sites, particularly when placed near their preferred travel routes. When established several weeks or months prior to the baiting season, such draw stations will encourage early acceptance of Compound 1080 baits placed nearby.

8.11 Perishable single-dose Compound 1080 baits may be placed near established draw stations or preferred travel routes in suitable locations for the target animals to find them. Protective natural coverings such as small flat stones, cow-chips, or other objects may be used to prevent baits from being seen and taken by scavenging birds. The number of baits placed at each station site, normally from 10 to 30, is determined by field inspection and by the history of target and nontarget species activity in each station area.

8.12 Compound 1080 perishable bait stations should be examined periodically to determine bait acceptance and to replace baits as necessary.

8.13 Compound 1080 impregnated meat bait stations will remain functional without frequent attention from the applicator. In fact, continued absence of humans leads to increased station effectiveness for wild canids. If baits are not accepted within 30 days, a series of knife cuts in the flesh will often encourage feeding.

9. Exposure Period

9.1 Compound 1080 bait stations shall be established as late in the fall season, or in early winter, as is practicable, dependent upon weather and travel conditions, to accomplish desired control and to prevent unnecessary hazard to nontarget species. Consideration must also be given to special-use periods, such as hunting and fishing seasons, in the placement areas. Baits shall be removed and destroyed in early spring, following a suitable exposure period, as weather and travel conditions permit. Normally, this exposure period will begin in December and continue into March or April of the following year, dependent upon exposure required, weather, and travel conditions.

10. Disposal

10.1 Compound 1080 baits must be completely destroyed at the end of each baiting season. The preferred method to destroy Compound 1080 baits is to burn all uneaten bait material and bury the ashes. Deep burial is an acceptable alternative method. Buried bait material, including the ashes from burning, should be contaminated with lime, creosote, or other repellent material so that it will not be eaten by digging animals. Burial sites should be well removed from human habitations and water courses.

11. General Labeling Requirements

11.1 Compound 1080 stations should be labeled for use only by experienced, qualified, and certified applicators.

11.2 First aid and medical instructions must be provided to applicators and supervisory personnel. Proper containers and equipment for safe storage, transportation, and handling of Compound 1080 concentrate, solutions, and treated baits must be available at all times during use.

11.3 Written authorization for station placement must be obtained from the landowner, lessee, or administrator for each baiting season.

11.4 Warning signs must be displayed at bait treatment areas, near station sites, and on access roads and trails leading to such sites throughout the periods that baits are exposed. These signs must all be removed when the stations are