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USAEHA

Guide to Commensal Rodent Control

U.S. Army Environmental Hygiene Agency
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This guide is an introduction to basic commensal rodent biology and control methods. It covers the three species of commensal rodents found worldwide plus limited information on the Polynesian rat and five genera of North American wild rodents which also interact with man's interests. It is intended for use by persons interested in commensal rodent control in the United States and its possessions. The information contained in this guide was compiled from many sources, not all of which were in agreement. Readers can obtain additional information by consulting the references in Appendix A.

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USAEHA TECHNICAL GUIDE NO. 138
GUIDE TO COMMENSAL RODENT CONTROL

CHAPTER 1
GENERAL

1-1. Purpose and Scope

a. This technical guide (TG) is an introduction to basic commensal rodent biology and control methods.

(1) It covers the three species of commensal rodents found worldwide plus limited information on the Polynesian rat and five genera of North American wild rodents that also interact with man's interests.

(2) It is intended for use by persons interested in commensal rodent control in the United States and its possessions.

b. The information in this TG was compiled from many sources, not all of which were in agreement. Obsolete materials, methods, and ideas were discarded; new techniques and toxicants were added.

c. The information in this TG was accurate at the time it was compiled. However, the information is subject to change as advances are made in commensal rodent management.

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* This TG supersedes TG No. 138, January 1985.

1-2. Introduction

a. Traditionally, destruction of pest species by mechanical or chemical means has been the primary method used in pest control. Unfortunately, this approach is not always ecologically sound and seldom achieves lasting results.

b. Integrated pest management (IPM) takes an ecosystem approach to pest problems. Every species has certain identifiable minimum requirements. By eliminating or restricting those things necessary for survival of the pest species, man can limit the capability of an environment to support the pest. Often, habitat management alone will keep pest numbers below the level that man finds economically or aesthetically objectionable.

c. IPM for commensal rodents includes habitat modification (sanitation), rodent proofing, and population reduction. Unlike most pests, commensal rodents occupy a man-made environment and are somewhat dependent on man for their survival. Generally, it is both practical and economical to alter man's environment to make it less attractive to rodents.

d. IPM is not a new concept in commensal rodent control. Sanitation and rodent proofing as control methods probably predate toxicants.

1-3. References

A list of references can be found in Appendix A. Readers desiring additional information on commensal rodents are encouraged to consult these sources.

1-4. Abbreviations and Terms

A list of abbreviations and definitions of IPM and other terms pertaining to rodent control can be found in the glossary.

CHAPTER 2
HEALTH, DAMAGE, AND ECONOMIC CONSIDERATIONS

2-1. Disease Transmission

Only the most important rodent-borne diseases and parasites that affect humans are listed here. Detailed information can be found in medical and rodent literature.

a. **Plague** - Plague is caused by the bacillus *Yersinia pestis*. It is primarily a rodent disease that is transmitted by fleas. Man acquires the disease through contact with infected fleas or animal tissue. The pneumonic form is directly transmissible between humans. Plague persists in wild rodent populations in many parts of the world making urban rat-borne plague a potential threat wherever commensal rat species can contact the wild species reservoir.

b. **Murine typhus** - Murine typhus is a rickettsial infection (*Rickettsia mooseri*) transmitted by infected flea feces. The itch from a flea bite causes scratching and the feces left by the feeding flea are rubbed into the bite.

c. **Leptospirosis** - Rat-borne leptospirosis is caused by a spirochete, *Leptospira icterohaemorrhagiae*, that lives in rat kidneys and is shed in the urine. Humans may contract the disease from soil or water containing infected urine, or by handling a sick animal or infected animal tissue. It has been recently found that more infections are transmitted from cattle, swine, and dogs than from rats.

d. **Salmonellosis** - Salmonellosis, commonly known as infectious food poisoning, is spread to man through the infected feces and urine of rats and mice. Infection most commonly occurs as the result of contaminated foods or food preparation on contaminated surfaces. *Salmonella typhimurium* and *S. enteritidis* are the most common organisms involved and mice are probably more important than rats in the transmission of food poisoning diseases.

e. **Lymphocytic choriomeningitis** - The house mouse is the primary reservoir of this viral disease. Mice that are not killed by the disease may carry and excrete the virus for life. The blood and organs of tolerant mice carry high concentrations of the virus as do the urine, feces, and nasal secretions. Transmission to man is probably through ingestion of contaminated food or dust. Foci of infection in mice can persist for years in limited areas.

f. **Rickettsial pox** - Rickettsial pox is a mild rickettsial infection caused by *Rickettsia akari* that is transmitted from mice to man by the bite of the house mouse mite, *Allodermonyssus sanguineus*.

g. **Rat bite fever** - Two disease organisms may be transmitted to humans as a result of rat bite: *Spirillum minor* and *Streptobacillus moniliformis.* Chills and fever usually do not develop until sometime after the bite wound has healed.

h. **Trichinosis** - The causative agent of this parasitic infection is the nematode *Trichinella spiralis* that occurs worldwide in rats and swine. Animals may develop infection from eating infected rats or pig carcass trimmings from slaughterhouses. Pigs have been shown to contract trichinosis from infected rat feces in their food.

i. **Tapeworms** - *Hymenolepis nana* and *H. dimanuta* are two of the intestinal parasites transmitted to man by food that has been contaminated with tapeworm-bearing rodent feces.

j. **Tetanus** - The wound resulting from a rat bite may provide an entry point for the tetanus bacillus, *Clostridium tetani.*

k. **Rabies** - Rats and mice are rarely infected with rabies, and their bites do not normally require treatment for rabies.

l. **Hemorrhagic fever with renal syndrome (Korean hemorrhagic fever)** - Hemorrhagic fever is caused by a *Hantavirus* that is found in rats worldwide and in various field rodents depending on location. The virus is present in urine, feces, and saliva of persistently infected asymptomatic rodents. Human infection is presumed to be by inhalation of airborne virus from rodent excreta. A mild form of this disease, known as Seoul virus, is carried by roof rats.

2-2. Damage to Structures and Contents

a. Rodent damage to structures is a result of their attempts to gain entry, reach stored foods, or create harborage and nesting sites. Rat burrows can undermine foundations, roads, and small levees. Norway rats are known for exploiting structural flaws in foundations and sewer systems in order to gain ingress and egress.

b. Rodents often enter buildings by enlarging openings where pipes or wires pass through exterior walls and where doors, windows, or vent covers fit poorly. These enlarged openings reduce energy efficiency while facilitating rodent movement.

c. Within buildings, rats and mice will enlarge existing openings or create new ones in walls, around doors, and into cabinets or furniture. They use insulation within the walls for nesting sites. Mice frequently nest within stationary electrical appliances, damaging wiring and affecting

ventilation around motors. Mice have also been known to nest in vehicles in garages. Rodent gnawing may damage electrical wiring and soft pipes (plastic, lead) within walls.

d. Odors and contamination from feces and urine are as offensive to many people as destruction of clothing and personal possessions.

2-3. Damage to Crops and Stored Food Products

a. It has been estimated that rodents destroy about 4-5 percent of all stored grains worldwide. Twenty percent of all crops planted are lost to rodent damage or contamination. Rodents, including noncommensal (wild) species, attack growing sugar cane, vegetables, coconuts, rice, corn, sorghum, citrus fruits, and nuts. In addition to direct consumption, food storage and processing losses also result from contamination by rodent hair, feces, and urine (refs. A-3 and A-9).

b. Beyond actual destruction and contamination losses, the physical presence of rodents has a negative aesthetic value for many people.

2-4. Economic Value of Rodent Damage and Control

a. Rodent damage to man's interests is so widespread that accurately estimating the total monetary value of these losses is probably impossible. One rat consumes 15 to 20 pounds of foodstuffs per year. Based on 1982 agricultural prices, each rat costs a minimum of one dollar per year to feed. Mice consume far less total food, but their habit of nibbling and then discarding partially eaten items results in destruction of as much food as a rat would consume (ref. A-7).

b. The cost of disease treatment and control measures can be approximated, but the amount saved by disease prevention can only be guessed. It is safe to assume, however, that the cost of properly conducted rodent control is far less than the losses sustained when rodent infestations are ignored or tolerated.

CHAPTER 3
RODENT BIOLOGY

3-1. General

A knowledge of the habitat requirements, sensory abilities, behavior, and reproductive capability of commensal rodents forms the basis for management of these pests.

3-2. Food, Water, and Habitat Requirements

a. Rats and mice prefer to live close to their source of food. If food and favorable habitat are in close proximity, rodents will thrive.

b. Norway and roof rats require 15 to 25 grams (g) (dry weight) of food and 15 to 30 milliliters (ml) of water daily. House mice consume only 3 g of food and less than 3 ml of water. Mice are usually able to get sufficient water from the food they eat and can survive without free water. While rats can get water from eating garbage, they normally use free water sources. All rodents eat grain and seeds. In addition, Norway rats consume meats, fish, and garbage; roof rats like fruit, nuts, snails, and insects. Principal food sources for rodents are stored food and garbage in urban areas; field crops and natural vegetation in rural areas. Stored feeds and foodstuffs in warehouses and food processing plants are highly attractive to rodents.

c. In addition to food and water, commensal rodents require harborage (shelter), nesting materials, and secure travel lanes (runs, runways). Rodents thrive in clutter. Refuse piles, open dumps, old buildings, junk vehicles, piles of building materials, and weedy, debris-filled vacant lots provide excellent harborage. Rats and mice readily enter deteriorated or structurally faulty buildings and basements. Norway rats burrow in gardens, yards, and stream banks, and along walls and fences; roof rats take up residence in dense vegetation. Clutter within buildings also enhances rodent populations by providing shelter and secure runs.

d. Although rodents will travel in exposed places for short distances, they must have secure places to retreat to when threatened. They also need adequate insulating materials for their nests if they are to survive and reproduce at low temperatures.

e. Food, water, and harborage are essential to rodent survival. Elimination or reduction of these elements puts stress on a population and threatens its existence.

3-3. Sensory Abilities

a. Laboratory studies indicate that rodent eyes have high light sensitivity but poor visual acuity. They are able to recognize simple patterns and shapes and detect movement in very dim light. They also have good depth perception at short distances (approximately 3 feet).

b. Their sense of touch aids in travel. The whiskers are kept in contact with floors and walls to aid in orientation and avoid obstacles or voids. Rats and mice prefer contact with vertical surfaces as they travel. This habit results in the establishment of well-defined and easily predictable travel routes or runs.

c. A well-developed sense of smell is used in recognizing individuals, following runs, and locating food. Odor is also important for detecting sexually active mates.

d. Rats and mice have acute hearing. They are sensitive to sudden noises, but adapt to repetitious sounds. In addition to audible sound, they also use ultrasounds in communication and echolocation.

e. Commensal rodents are able to detect foreign flavors in foods at very low levels. Researchers believe this is a defense against poisonous foods, as rats and mice are unable to vomit.

3-4. Activity Patterns

a. Commensal rodents are adapted for nighttime activity--a time when they are least likely to be disturbed by man. Usually, rats have two peaks of activity per night. The first peak occurs shortly after dark and the second just before daylight. Mice tend toward brief spurts of activity at 45-90 minute intervals. At high population density, rodent activity will persist throughout the night and extend into daylight because of increased competition for resources. In addition to feeding activities, both rats and mice continuously explore their territories, sampling (by smell and taste) familiar and new food or objects that they encounter. This continuous exploration leads to a familiarization with the features of their environment and expedites response to disturbance and predators.

b. An important component of rat behavior is known as neophobia or new object avoidance. The result of neophobia is that rats avoid new objects (bait, food, traps, etc.) that they encounter in their familiar environment for several days after the new object appears. If it is a food item, it will be tasted cautiously before it is accepted. This behavior also extends to familiar objects placed in new locations within their environment. Modification of their environment can cause rats to alter their behavior and travel routes. Immigrant rats do not exhibit neophobia as everything in the environment is strange when they enter it.

c. Mice do not avoid new objects or changes in their environment, but are attracted by them. However, because of their nibbling feeding habit, they do not readily consume large amounts of strange foods.

3-5. Movement, Territory, and Range

a. The extent of daily movement is determined by the distribution of food, water, and shelter. When these are in close proximity, house mice have a daily range 10-30 feet in diameter, Norway rats 100-150 feet, and roof rats 50-150 feet. However, recent radio telemetry studies have determined that movement can be much greater than these distances indicate.

b. Seasonal and other changes or alterations in their environment can cause rodents to travel greater distances or even to move to new locations. Populations in excess of habitat capacity also cause emigration to areas of low rodent density (even though these areas cannot support increased numbers). Daily range outdoors is usually greater than in buildings.

3-6. Social Structure/Relations

a. Both rats and mice exhibit territorial and hierarchical behavior. Males are territorial (at low to moderate densities), defending a system of burrows, runways, or nest sites, and the females living within that system. Dominant males tend to establish themselves near the most favorable feeding areas. When attacked, subordinates either flee or resort to appeasement behavior.

b. Norway rats are gregarious and will form colonies, while roof rats and house mice establish themselves as individual family groups. Territorial behavior results in the dispersion of the population throughout suitable habitats. It also limits population growth when critical habitat components are limited in distribution and can be defended by relatively few dominant individuals.

3-7. Reproduction

Reproduction in commensal rodents is characterized by early sexual maturity, a short gestation period, postpartum breeding, year-round breeding, and large litter size. These traits give rodents the potential for rapid population growth and quick recovery when their numbers are reduced by control programs. Reproductive parameters for individual commensal rodent species are summarized in Table 3-1.

Table 3-1
Reproduction in Commensal Rodents

	Norway Rat	Roof Rat	House Mouse
Become Independent (days)	60+	60+	40+
Sexual Maturity (days)	75-90	68-90	42-60
Gestation Period (days)	22-24	20-22	19-21
Young per Litter	8-9	6	5-6
Litters per Year	4-5	5-6	7-8
Breeding Season	All year under favorable conditions; warm weather or spring and fall peaks may occur in outdoor populations.		
Young per Female per Year	38	34	44
Life Expectancy (average, months)	7-12	7-12	<12
Average Young (weaned/female/year)	20	20	30-35

CHAPTER 4
RODENT IDENTIFICATION

4-1. General

There are about 15 species of the genus *Mus* and over 500 named forms of the genus *Rattus* worldwide. The descriptions in this TG cover only the three species of commensal rodents found worldwide, the Polynesian rat of the Pacific Islands, and five genera of North American wild rodents that may cause damage or otherwise interact with man's interests. Commensal rodents are characterized by scaly, very lightly haired tails, without sharp color contrast between top and bottom. Females have 10 or 12 mammae. The Polynesian rat looks like a small roof rat, but it has only eight mammae. The noncommensal rodents are highly variable, but all wild mice and wood rats have haired tails. The cotton rat and rice rat have annulate, lightly haired tails.

4-2. Characteristics of Selected Rodent Species Commonly Encountered by Man

The physical characteristics of commensal and wild rodents commonly encountered by man are listed in Table 4-1. Positive identification of these and related species may require reference to one or more of the field guides to mammals.

Table 4-1
Characteristics of Selected Rodent Species Commonly Encountered by Man

	Norway Rat Rattus norvegicus	Roof Rat Rattus rattus	Polynesian Rat Rattus exulans
General Appearance	Large, husky body; coarse, grizzled, reddish to grayish brown fur; white belly with gray underfur	Medium, slender body; black to gray to tawny color; long prominent guard hairs; uniform gray or white belly	Small to medium, slender body; brownish gray fur; white belly with gray underfur
Head	Blunt muzzle	Sharply pointed muzzle	Pointed muzzle
Eyes	Small	Large	Large
Ears	Short, thick, rounded; short fine hairs	Large, thin, hairless; stand out from fur	Large, hairless; stand out from fur
Tail	Shorter than head and body; paler below; coarse scales with short stiff hairs; carried stiffly behind the animal	Longer than head and body; uniform color; scaly; moves about with whiplike motion	May not be as long as head and body; uniformly dark; fine scales
Weight	150-600 g	110-300 g	100-125 g
Head and Body Length	190-255 mm	160-210 mm	150-200 mm
Tail Length	125-215 mm	150-250 mm	100-150 mm
Mammae	12	10	8
Droppings	Large; capsule shaped; up to 20 mm (3/4")	Medium; spindle shaped; up to 12 mm (1/2")	Medium; up to 8 mm (1/3")
Distribution/Habitat	Temperate climates in and around buildings, sewer systems, dumps, along waterways; colonial, burrow in ground	Mostly tropical, subtropical coastal regions; ships; semi-arboreal; agile climber; small family groups	Pacific islands; crops, field borders, fruit and nut trees

	House Mouse Mus musculus	Rice Rat Oryzomys palustris	Cotton Rat Sigmodon (3 species)
General Appearance	Small, slender body; light brown to dark gray; buff to dark gray belly	Medium body; grayish brown with gray or fulvous belly; soft, short fur	Medium body; grayish-brown to blackish-brown heavily mixed with pale buff; paler belly; gray feet; long coarse fur
Head	Pointed muzzle	Rounded muzzle	Rounded muzzle
Eyes	Small but prominent	Large	Large
Ears	Moderately large, prominent; some hairs	Small, haired	Rounded, nearly concealed by fur
Tail	About as long as head and body; uniformly dark; scaly	Long, scaly; slightly paler below	As long as head and body; scaly, finely haired; paler below
Weight	11-23 g	40-80 g	55-200 g
Head and Body Length	60-100 mm	120-132 mm	125-200 mm
Tail Length	75-100 mm	110-195 mm	75-150 mm
Mammae	10	8	8-10
Droppings	Rod shaped, up to 6 mm (1/4")	----	----
Distribution/Habitat	Worldwide in and around buildings, also rural; small family groups	SE U.S.; marsh areas, grasslands, sedges, ricefields; semi-aquatic	S and SW U.S.; tall vegetation, moist areas; alfalfa and other green crops

	Wood Rat Neotoma (8 species)	White Footed Mice Peromyscus (16 species)	Meadow Mice (Voles) Microtus (20 species)
General Appearance	Large, stocky; gray to brown; lighter to white feet and belly; soft, fine fur	Small, slender; gray to brown; white feet; usually white belly	Medium, stocky; brownish gray; long, soft fur
Head	Blunt muzzle	Pointed muzzle	Blunt muzzle
Eyes	Large	Large	Small, black bead-like
Ears	Large	Large, prominent	Small, nearly hidden by fur
Tail	Shorter than head and body; hairy; dark above, pale below	Long; usually bi-colored; haired	Shorter than head and body; haired
Weight	200-575 g	15-50 g	25-100 g
Head and Body Length	125-240 mm	50-105 mm	78-165 mm
Tail Length	100-215 mm	50-140 mm	28-90 mm
Mammae	4	6	8
Distribution/Habitat	W, S, and E North America; brushy or rocky areas; occasionally nest in buildings	Various species throughout North America; sometimes invades buildings	N U.S. and Canada; grassland; damages orchards, hay, shocked grain

CHAPTER 5
RODENT PROBLEM IDENTIFICATION

5-1. General

When planning a rodent control program, it is necessary to determine the approximate size of the rodent population present and its distribution within the available habitat.

5-2. Rodent Indicators

Resident commensal rodents leave a variety of signs within the areas they frequent. Visual sightings of rats indicate a moderate to high degree of infestation. Rats are rarely seen when infestation is low. Mice are more commonly seen in daylight than rats, and sighting them does not necessarily mean a high population. Other signs that occur in direct proportion to rodent abundance are:

a. **Sounds** - Sounds of gnawing, scratching, squeaks, and running in walls and across ceilings can be heard in buildings infested by rodents.

b. **Droppings** - These are found in places rats and mice frequent. Mouse droppings are similar to those of bats and some insects; rat droppings are larger. Only fresh droppings are soft.

c. **Urine** - Rodent urine is not visible on all materials under natural light. Under ultraviolet light it fluoresces bluish white to yellowish white. Unfortunately, other materials such as lubricating oils and the optical bleaches found in many detergents also fluoresce. For positive identification, place the suspect material on Urease Brom Thymol Blue test paper, moisten with water, and add a cover glass. The appearance of a bluish spot within 3-5 minutes indicates rodent urine.

d. **Smudge Marks** - Dirt and oil on rodent fur leaves smudge marks where they rub against pipes, beams, and openings in their travels. Rat smudges are much more conspicuous than those left by mice.

e. **Runs/Trails** - Runs occur in sheltered areas where rodents feel secure as they move. They appear as dust-free pathways within buildings or beaten paths outdoors. Like smudge marks, rats trails are more conspicuous than those made by mice.

f. **Tracks** - Footprints and tail marks may be found in dust and mud. Tracking patches made with flour or talc can be used to determine rodent presence in buildings. Dry soil dust can be used outdoors if it is protected from weather and disturbance.

g. **Odor** - Mice produce a musky odor that an experienced observer can differentiate from rat odor. Odor is probably not detectable when the population is low and ventilation good.

h. **Gnawing** - Rodent gnawing results in small piles of wood chips around doors, baseboards, and windows; damage to stored goods and food product containers; and enlarged openings where pipes and wires penetrate walls.

i. **Burrows** - Holes and enlarged openings in walls are often burrow entrances. Norway rat burrows may be found around/under foundations and along stream banks.

j. **Nests, Food Caches** - Mouse and rat nests may be found when cleaning garages, attics, and other storage areas; in vehicles that have been parked for more than a few days; and around refrigerator/freezer motors. Rat food caches may also be found during clean-up operations.

k. **Pet Reactions** - Most cats and dogs show strong interest in wall or floor areas where rats or mice are present, especially if it is a recent invasion.

5-3. Population Trends

Measuring food consumption at nontoxic bait stations, or periodic sampling with tracking patches, snap traps, or glueboards can be used to monitor population trends.

NOTE: Sublethal dosages of acute toxicants cause bait shyness; therefore, census baiting following the use of acute toxicants may underestimate the actual population.

5-4. Rodent Survey Checklist

Use of a rodent survey checklist is recommended as an aid in recording the components of a rodent problem and planning management strategy. It also provides a record for review and evaluation. A sample checklist can be found in Appendix B.

CHAPTER 6
MANAGEMENT TECHNIQUES

6-1. General

a. Effective IPM involves reduction of the pest population to acceptable levels and elimination of the conditions that enabled the pest to become a problem. This requires development of a program to fit specific local environmental conditions and pests.

b. The most enduring and cost-effective commensal rodent control is achieved by making the environment as unattractive to rodents as possible without making it unfit for its intended use. Habitat modification should be accompanied by a direct population reduction program using appropriate lethal techniques. After the rodent infestation has been controlled, habitat management and preventive control should prevent a recurrence. However, when rodents are abundant, the population should be reduced before starting habitat modification. This prevents control area rodents from dispersing to cause problems in untreated areas.

c. Before initiating a rodent management plan, the pest manager should assess the situation to determine whether or not active management is necessary. When the problem rodents are not causing significant or unacceptable damage or health hazards and the problem is unlikely to become worse, no direct control may be an appropriate action. There may also be situations where the cost and effort required for effective control is unaffordable or exceeds the possible benefits. The advantages to this approach are that it is easy, cheap, and poses low toxicant hazards. The disadvantages are that public reaction may be negative and changes in the environment might permit an irruption of the pest population (to the embarrassment of the pest manager).

6-2. Habitat Management

Habitat management, environmental cleanup, or sanitation for commensal rodents involves reduction or elimination of sources of food, water, and harborage.

a. Eliminating Food.

(1) Deny access to garbage by using cans with tight fitting lids; secure lids to prevent dislodging by dogs, raccoons, and other animals.

(2) Protect bagged trash and garbage from dogs, cats, and rodents by keeping it in metal containers until collection; clean up spills immediately.

(3) Avoid leaving pet food available overnight and clean up spilled food.

(4) Dispose of animal wastes.

(5) Clean up fallen fruit, nuts, and excess garden produce.

(6) Control garden snails and slugs, especially where roof rats are present.

(7) Do not add garbage to compost piles unless the compost is in a rodent-proof container.

(8) Store foodstuffs and crops in rodent-proof containers.

(9) Clean up spilled grain.

(10) Rodent proof bird feeders and clean up spilled feed daily.

b. **Eliminating Water.**

(1) Repair leaking plumbing.

(2) Drain low spots where runoff forms puddles.

(3) Eliminate water holding items such as old tires, cans, and other refuse.

(4) Limit availability of, or access to, pet water, bird baths, and fish ponds.

(5) Repair breaks or leaks in sewer systems.

c. **Eliminating Harborage.** Rodents rely on concealment for protection while traveling, feeding, and resting. They avoid well-lighted and open spaces as much as possible.

(1) Clean up debris, rubble, building materials, and trash.

(2) Stack lumber and firewood off the ground and away from buildings.

(3) Thin or remove dense vegetation; keep fence lines clear of thick growing vines and shrubs.

(4) Minimize weeds, grass, and shrubs adjacent to buildings.

(5) Trim tree limbs that overhang roof lines.

(6) Keep basements and attics free of clutter.

(7) Stack warehoused materials away from walls.

(8) Get rid of unused vehicles, appliances, and machinery.

(9) Destroy or remove potential nest materials such as upholstery, feathers, paper, cloth, or straw.

6-3. Rodent Proofing

a. An extension of habitat management is rodent exclusion from buildings and food sources (rodent proofing). This involves the use of barriers to keep rodents from entering an area or moving to adjacent areas. For buildings, this means eliminating openings larger than 1/4 inch. Recent research indicates that mice are capable of enlarging gaps as small as 1/8 inch in gnawable materials that have exposed edges their upper incisors can grip.

b. Rodent-proof structures require solid foundations without large cracks or other openings and concrete basement floors with no gaps around utility entries. All vent openings must be covered with 1/4-inch mesh hardware cloth or expanded metal grillwork of similar size. All doors, windows, and screens must fit snugly. It may be necessary to protect wooden doors and windows with sheet metal where rodent gnawing is a problem.

c. Metal collars can be used to prevent rodent entry where pipes and wires enter a building; metal barriers can also be used to prevent rats from using pipes and wires as travel lanes.

d. Since Norway rats are capable of entering buildings from sewer systems via toilet traps, consideration should be given to installation of rodent-proof waste pipes where these rats are a problem. Broken floor drains and unscreened vent pipes also allow rats access to building interiors.

e. For detailed information on rodent proofing in existing buildings and new construction, see Appendix C.

6-4. Repellents

a. Chemical repellents can be used to exclude rodents from small areas for short periods of time. However, their effectiveness is limited in duration and the odor is offensive to man as well as to the rodents. Substantial effort has been expended in the development of rodent repellents for packaging

materials and buried cables, but none are currently available. Rabbit repellents are moderately effective for protecting small trees and shrubs from meadow mice for 2 to 3 months.

b. Electric fences have been used successfully to exclude rats from farm crops. They are expensive to install and maintain relative to other control measures, and they have seen limited use.

c. Although there have been studies that appear to show that ultrasonic sound in the 20 to 30 thousand cycles per second or kilohertz (kHz) range repels rodents, other scientific test data indicate that the repellent effect, if any, is very limited.

d. In order to effectively repel rodents, a minimum sound intensity of 85 decibels (as measured with a properly calibrated sound meter) is required throughout the treated area. Rodents will not be displaced from "sound shadow" areas or from locations with sound levels below 85 decibels. Potential applications for ultrasonic sound are food preparation areas and building entrances. Both of these locations are difficult to protect with toxicants. Since ultrasound does not kill rodents, it is still necessary to use appropriate lethal controls to eliminate rodents displaced from treated areas.

NOTE: Some advertising for ultrasonic devices misrepresents their capabilities. The U.S. Environmental Protection Agency (EPA), noting claims such as "delivers a tremendous blast of ultrasound---to pests and varmints---totally disrupts their eating, sleeping, and reproductive pattern," said producers should ensure that such statements or claims are accurate, or delete them from promotional literature. Also, the Armed Forces Pest Management Board has reviewed available information on numerous models of ultrasound devices and has never recommended their use or purchase.

e. Not to be confused with ultrasound are electromagnetic devices. These are claimed to create an electromagnetic field that disrupts the nervous system of pest species. The pest's normal activity supposedly declines and they starve to death. Remarkably, domestic animals and desirable wildlife are unaffected. While there is some scientific basis for the effects of electromagnetism, none of the devices marketed have proven effective in field tests.

6-5. Population Reduction

a. **Methods.** Reduction (or elimination) of rodent populations can be accomplished by chemical (rodenticides) or mechanical means (traps, glueboards). These tools are used to suppress high populations prior to environmental cleanup and to eliminate rodents remaining after the cleanup is completed.

(1) **Rodenticides.** The general categories of rodenticides are listed in this section. Information on individual compounds is listed in Appendix D; current brand names and manufacturers are listed in Appendix E. Rodenticides should not be used in food preparation/processing areas or where odors from rodents dying in inaccessible locations could cause a problem. See Appendix F for detailed information on controlling rodents with toxic baits.

(a) **Fumigants.** Fumigants are used to kill rodents in confined areas such as burrow systems, railroad cars, truck trailers, aircraft, and ships. They are also used to treat bulk grain and other stored commodities under covers and in warehouses. Fumigants are extremely hazardous and should be used only by trained personnel. They should not be used in or near occupied buildings. While fumigants kill insects as well as rodents, insects require 6 to 12 times higher dosages for effective control. Application rates should follow label instructions for the most resistant species when both rodent and insect (including rodent ectoparasites) control is desired.

(b) **Anticoagulants.** There are two types of anticoagulants: multiple dose and single dose or single feeding.

(1) **Multiple Dose Anticoagulants.** These compounds are considered the safest rodenticides for general use. They cause death through internal bleeding. Because the action is cumulative, rodents must feed on the anticoagulant treated bait for several days with not more than 48 hours between feedings. Adequate supplies of toxic bait must be kept available until control is achieved. The delayed onset of intoxication symptoms and lack of aversive taste assure good bait acceptance without a need for prebaiting. Vitamin K can be used as an antidote for accidental poisoning of domestic animals and humans.

(2) **Single Dose Anticoagulants.** These anticoagulants are similar to the multiple dose except that up to 90 percent of the rodents consuming them receive a lethal dose from a single feeding. Delayed death and lack of bait aversion make these compounds highly effective. Because of their higher potency they are more effective than multiple dose anticoagulants when competition with alternate food sources is a problem. However, they are more hazardous to nontarget species than the multiple dose compounds.

(c) **Acute Toxicants.** These compounds generally cause death within a few hours after ingestion. Due to the rapid onset of lethal effects and the often distinctive taste of these toxicants, prebaiting is necessary to familiarize rodents with the bait material and assure consumption of lethal amounts of the treated bait. These compounds are hazardous to humans and wildlife. Use is restricted to certified applicators.

(d) **Toxicant/Sterilant.** This type of rodenticide is toxic to all ages of rats and causes sterility in most adult males that consume a sublethal dose. It is also toxic to mice, but does not cause male sterility. Sterility does not occur in female rodents, juvenile males, or nonrodent species. Sterility in surviving males prevents the population rebound often observed when rats are controlled with other toxicants.

(e) **Slow-acting Toxicants.** These compounds combine the delayed effect features of the anticoagulants and the single dose qualities of acute toxicants. Their mode of action is different, however, and they are generally accepted by rodents without the need for prebaiting.

(f) **Special Toxicant Formulations.**

(1) **Tracking Powders.** Formulations of some of the anticoagulant and acute toxicants at 10-40 times higher concentration than is required for baits are used as tracking powders. Tracking powders are used only in locations inaccessible to humans and nontarget animals because of their high toxicity. The powder is placed in areas where rodents travel; the rodents pick up the toxicant on their feet and body fur and ingest it while grooming. Tracking powders are very effective against mice. However, rats groom less frequently than mice and the powder often falls off before they stop to groom. Tracking powders can be effective in situations where bait acceptance is poor and trap placement is difficult or impractical. They cannot be used where there is danger of contaminating food or animal feed. They do not work where moisture can cause caking of the powder, and they must be protected from displacement by air currents.

(2) **Liquid Baits.** Water soluble forms of anticoagulant or acute toxicants can be used in drinking water bait stations providing they do not have an aversive taste. Liquid baits are most effective against rats in dry situations where water availability can be controlled. They must be used with care as they are extremely hazardous to children and pets.

(2) **Mechanical Control Devices.**

(a) **Snap Traps.** Traps can be very effective in situations where toxicants cannot be used and where rodent infestations are not excessive. Hazards to people and domestic animals are minimal, there is little risk of contaminating foodstuffs, and odors from rodents dying in inaccessible locations are not a problem. However, trapping requires more equipment, labor, and skill than baiting. Effective trapping depends on putting the traps where rodents will contact them. The best locations are against walls, behind or under objects, and other places where rodents seeking concealment might go.

(1) Unbaited snap traps with expanded triggers (treadles) work well in narrow runways where rats cannot easily avoid passing over the trigger. Traps fastened in runways on overhead beams and pipes with the trigger in the rat's path can be highly effective. Unbaited trapping is most effective if sufficient traps can be set to block all the runways in the area at once; then rodents traveling formerly safe routes will blunder into the traps and be caught before they can learn to avoid them.

(2) Because they are strange objects, traps set in runways may upset some rats sufficiently that they will establish new travel routes. Baited traps set near runways should be used for these rodents. Traps left baited but unset next to runways for 3 to 4 days allow familiarization, and are more successful when they are later rebaited and set than traps that are set when they are first baited. As with unbaited traps, a large number of traps for a short period is more effective than a few traps over a longer time. Unbaited traps are not as effective against mice as they are against rats. Prebaiting mousetraps before setting them is not necessary as mice readily investigate strange objects. However, mice appear to become trap shy when traps are used for a long period of time.

(3) Meat baits, such as hot dogs or bacon, are effective for Norway rats, while nut meats and dried fruits may be best for roof rats. Peanut butter, plain or mixed with grain (rolled oats), works well for house mice. Different baits may be more effective in some areas due to local food preferences. Testing a variety of baits before starting a trapping program can aid in determining bait preference and increase trap success. A cotton ball wired to the trap trigger can be effective in capturing mice that are looking for nest materials.

(4) Bait must be securely fastened to the trap trigger, and the trigger mechanism must be sensitive enough that rodents cannot remove the bait without springing the trap. Used traps will lose sensitivity if they are carelessly stored and transported or poorly maintained. Baited and unbaited traps must be checked and reset daily.

(5) Avoid cleaning traps with water and soap or detergent. Use a stiff bristle brush to remove old bait and rodent remains. The presence of body odors and urine from previously captured rodents helps attract rats and mice to a trap.

(b) **Multiple Catch Traps.** Multiple catch traps are available for use against house mice. These traps are placed in mouse runways where activity is high. Mice seeking shelter enter the unbaited trap and are unable to escape from the holding compartment. There are no multiple catch traps available for rats.

(c) **Glueboards.** Glueboard placement and use is similar to regular snap trapping. The glueboards are placed in runways without bait and rodents attempting to cross them are caught on the sticky surface. They are more effective against mice than rats and can result in multiple catches, especially where populations are high. Glueboards must be inspected frequently and replaced when a rodent is captured as rodents cannot be easily removed from the glue. Glueboards (and snap traps) should not be used where they could be dragged or fall into situations that create a fire hazard or foul machinery. Trapped rodents are not immediately killed and may attract other rodents to be caught. However, they will be offensive to humans, especially children, who may attempt to release them and be bitten or become entangled in the glue. Some glues lose effectiveness at extreme high or low temperatures, when wet, or when covered by dust. Placing glueboards under the shelter of objects, boards, or boxes will help protect them from dust and weather.

(3) **Other Methods.**

(a) **Predators.** Although predators seldom control their prey, cats can effectively eliminate mouse infestations in buildings. However, not all cats are effective mousers and, in some situations, cats cause as many problems as the mice they are supposed to control. In rural locations, cats can suppress mouse populations even though they will not eliminate them, and their impact on birds is usually minimal. Effective control will require more cats than a mouse population can support and regular supplemental feeding of the cat(s) will be necessary. Rats are not effectively controlled by cats, but trained dogs (terriers) have been used on farms to suppress populations.

(b) **Diseases and Parasites.** Diseases and parasites are normal regulating mechanisms in wild rodent populations, and sometimes population irruptions are abruptly terminated by these agents. Artificial introduction of disease organisms has yet to be successful in controlling rodent problems, and the risk of adversely affecting the environment is high. Organisms virulent enough to overcome natural resistance might also attack beneficial animals and humans and are much harder to control in the environment than pesticides.

(c) **Reproductive Inhibitors and Chemosterilants.** Reproductive inhibitors and chemosterilants have shown promise for suppressing reproduction and population growth in several species. A major difficulty has been getting the target animals to ingest sufficient chemosterilant. To be effective, the reproductive inhibitor must reach approximately 85 percent or more of the females in a population, and its effect must be maintained throughout the breeding season; promiscuity requires that almost 100 percent of the males be rendered infertile before reproduction is markedly reduced. Chemosterilants may impart a flavor to baits that has a negative effect on acceptance. Field trials of Epibloc, which causes permanent male rat sterility, have shown favorable results, but prebaiting is required.

b. **Population Reduction Situations.** There are four general control situations where rodent population reduction by lethal methods is appropriate.

(1) **Knockdown.**

(a) Knockdown is a short, intense control effort aimed at rapid reduction of a rodent population. It is conducted where there is a high rodent population, extensive property damage, or human health hazard that demands immediate action. Knockdown is accomplished by using a large number of bait placements and fast-acting toxicants such as acute poisons and single dose anticoagulants. Fumigation may be practical in special situations, and ectoparasite control with a suitable insecticide is recommended when there are health hazards.

(b) Knockdown should precede environmental cleanup to avoid dispersing rodents to adjacent areas. Habitat modification after the rodents are removed is necessary to eliminate the conditions that led to the original infestations, since populations will rebound rapidly if favorable conditions persist. Knockdown/cleanout is often a starting point for an IPM program, but never the final solution.

(2) **Spot Treatment.** Spot treatment is used on limited areas where complete environmental cleanup is impossible, where the problem is seasonal or infrequent, or time and access are too short for an extended control treatment. Multiple dose anticoagulants, single dose anticoagulants, glueboards, and traps are all appropriate for these situations. Like knockdown, spot treatment offers only temporary control unless habitat conditions favorable to rodents can be eliminated.

(3) **Maintenance Control.**

(a) Maintenance control is long-term, low intensity control designed to keep a previously suppressed population at a minimal or acceptable level and to prevent reinfestation by immigrant rodents. Control may be conducted throughout the area being protected or set up as a perimeter barrier or interception zone for immigrant rodents. Traps, glueboards, and anticoagulant bait stations may be used, depending on the site being protected. The requirement for prebaiting makes acute toxicants unsuitable for maintenance control. However, single dose anticoagulants are very effective against transient rodents that might visit a bait station only once and would therefore be unaffected by a multiple-feed toxicant. The security of a covered bait station is especially attractive to immigrant and transient rodents where harborage has been limited through habitat management.

(b) To ensure that it is always attractive to rodents, the bait should be replaced with fresh bait at least once a month. Regular servicing is required to ensure that bait is available and in good condition or to remove dead rodents and reset traps or glueboards when these devices are used. Regular service also provides an opportunity to survey rodent populations and habitat for changes that may indicate developing problems.

(4) **Preventive Control.** Preventive control, the most important aspect of rodent management, is intended to solve a problem before it occurs. Generally, this involves habitat management (environmental sanitation) and periodic maintenance of rodent proofing to discourage invasion by rodents immigrating from infested areas. Preventive control with traps and covered bait stations is also appropriate in areas with a history of seasonal or periodic (cyclic) population buildups, or invasions from other habitats.

c. **Management Option Guide.** When planning a control program, the pest manager should draw on his past experience and knowledge of local conditions, taking into consideration such things as human involvement, pets and nontarget animals, ectoparasite hazards, cost of control versus benefits, kinds and value of damaged goods, structural problems, anticoagulant resistance, and public relations. The control methods listed in Table 6-1 are suggestions only; other methods may be more appropriate in certain situations. Use the method(s) that best fits the local need, including any local legal restrictions. Appendix G contains a list of rodent control products and suppliers of these products.

Table 6-1
Rodent Management Options

Site	Problem Species*	Suggested Control Methods
1. Land Areas		
Bare ground	None	None
Grass/Weeds Pasture Right-of-way Shrub/Grass/Weeds	Rn Mn Noncommensal	Burrow fumigation, sanitation, vegetation control Sanitation, vegetation control Vegetation management, burrow fumigation, trapping
Cropland	Usually noncommensal	Control only when potential loss exceeds control cost, use population surveys to plan preventive control, acute rodenticides or single dose anticoagulants, usually one treatment per season
Woodland Orchard Nurseries Shelterbelts	Mostly noncommensal	Remove undergrowth, mow or cultivate, repellents to protect trees, acute rodenticides and single dose anticoagulants
Residential yards and grounds	Rn, Rr, Mm Noncommensal	Sanitation, remove excess and dense vegetation, trapping, rodenticides in protected bait stations, weather resistant bait blocks, burrow fumigation
Salvage yards	Rn, Rr, Mm	Remove food sources and vegetation, acute rodenticides for population reduction followed by maintenance baiting with anticoagulants in protected bait stations, toxicant/sterilant could be used against rats
Landfills Garbage dumps	Rn, Rr, Mm	Bury waste daily, eliminate perimeter vegetation, acute rodenticides, toxicant/sterilant for rats
Sewer systems	Rn	Anticoagulants in paraffin baits
Sewage disposal areas	Rn	Vegetation management, burrow treatment, rodenticides in protected stations, paraffin baits

* Rn = Rattus norvegicus
Rr = Rattus rattus
Mm = Mus musculus

Site	Problem Species*	Suggested Control Methods
2. Transportation Facilities		
Aircraft	Mm	Trapping
Ships	Rn, Rr, Mm	Exclusion, trapping, fumigants, rodenticides, predator
Railroad cars	Rn, Rr, Mm	Fumigants, trapping
Shipping containers	Mm	Rodent proofing, fumigants
Terminals and warehouses	Rn, Rr, Mm	Exclusion by rodent proofing, indoor and outdoor sanitation, rodenticides, trapping, maintenance baiting with anticoagulants
3. Structures		
a. Agricultural		
Seed/Grain/Feed storage	Rn, Rr, Mm	Rodent proofing, sanitation, trapping, tracking powders, burrow treatment, predators
Livestock buildings	Rn, Rr, Mm	Sanitation, rodent proofing where practical, anticoagulant rodenticides in protected bait stations, tracking powders, trapping, predators
Other agricultural buildings	Rn, Rr, Mm	Rodent proofing, sanitation, trapping, maintenance baiting with anticoagulants
b. Residential		
Homes Apartments Townhouses	Rn, Rr, Mm	Rodent proofing, sanitation, trapping, glueboards, anticoagulant rodenticides, predators NOTE: Toxicants, glueboards, and traps must be placed where children and pets cannot reach them.
Vacant housing	Rn, Rr, Mm	Sanitation, rodent proofing, acute rodenticides for cleanout if access can be controlled, anticoagulant maintenance baiting for long-term reduction
Garages Storage buildings	Rn, Rr, Mm Noncommensal (rural areas)	Rodent proofing, sanitation, trapping, glueboards, anticoagulant rodenticides, tracking powders only in inaccessible areas
Yard and garden	Rn, Rr, Mm	Sanitation, vegetation control, trapping, weather resistant anticoagulant baits, burrow fumigation

Site	Problem Species*	Suggested Control Methods
c. Commercial Buildings		
Food processing	Rn, Rr, Mm	Rodent proofing, interior and exterior sanitation, exterior vegetation control, trapping. glueboards, anticoagulant rodenticides used only in nonfood and exterior areas
Food handling Restaurant Cafeteria/ Mess hall Drive-in	Rn, Rr, Mm	Rodent proofing, interior and exterior sanitation, traps, glueboards, exterior vegetation control
Food storage Warehouse	Rn, Rr, Mm	Rodent prcofing, sanitation (control of access to food supplies is extremely important), tracking powder, trapping, glueboards, water baits, fumigation, rodenticides (acceptance of baits often poor if there is easy access to other food sources)
Manufacturing/repairing	Rn, Rr, Mm	Rodent proofing, sanitation, rodenticides, water baits, trapping, glueboards, tracking powder, maintenance baiting with anticoagulants
Warehouse - nonfood	Rn, Rr, Mm	Rodent proofing, sanitation, trapping, glueboards (rodents in these situations are best controlled by rodent proofing and good housekeeping)
d. Commercial - Special Purpose		
Hospital - general	Rn, Rr, Mm	Rodent proofing, interior and exterior sanitation
Hospital - food and critical areas	Rn, Rr, Mm	Trapping, glueboards, sanitation
Hospital - noncritical (exterior)	Rn, Rr, Mm	Trapping, glueboards, sanitation, anticoagulant maintenance baiting
School	Rn, Rr, Mm	Rodent proofing, sanitation, trapping, glueboards
Greenhouse	Rn, Rr, Mm	Rodent proofing, sanitation, anticoagulant baits, trapping

CHAPTER 7
LAWS AFFECTING RODENT CONTROL ACTIVITIES

7-1. General

Although commensal rodents themselves are not protected by law, laws intended to protect the environment, human life, and nontarget organisms can have a significant impact on the control methods and materials used in rodent control. This section summarizes regulations affecting rodenticide usage. Appendix H lists Department of the Army regulations pertaining to pesticide use. Appendix I lists state and Federal agencies that can provide information on regulations, pesticide registration, endangered species, and Environmental Assessment (EA) or Environmental Impact Statement (EIS) requirements.

7-2. Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates compounds used as fumigants, repellents, or rodenticides. Under this Act, compounds used in rodent management must be registered with the EPA. The registration (label) specifies the pests, sites (locations), and rates of application that have been approved for that compound. The label also lists safety precautions to be observed, medical treatment in case of accidental poisoning, use restrictions, and disposal instructions. Use of a compound in a manner inconsistent with its label or use of an unregistered compound is a violation of this law. Chemical registrations under FIFRA can also include Experimental Use, Emergency Exemptions, and Special Local Needs (state registrations).

7-3. National Environmental Policy Act

The National Environmental Policy Act (NEPA) establishes National policies and goals for the protection of the environment. It requires Government agencies to give adequate consideration to environmental effects of proposed actions during the decision-making process. It also requires the preparation of an EA or EIS if a proposed action could result in a significant effect on the environment. Most commensal rodent control programs do not require an EA or EIS. If there is any question, however, appropriate regulations should be consulted.

7-4. Endangered Species Act

This Act prohibits any Federal action that could jeopardize the continued existence of any threatened or endangered species or destroy or modify habitat considered to be critical to the continued existence of such a species. The U.S. Fish and Wildlife Service maintains a list of endangered species and

critical habitats that is updated and revised frequently as the status of various species changes. Many states also have endangered species listings that may contain species not included on the National listing. Any actions that could involve endangered species and/or critical habitats may require an EA or an EIS.

7-5. State Registrations

In addition to EPA registration under FIFRA, some states, notably California, have their own registrations. Rodenticides should not be used in violation of state registration requirements.

7-6. Applicator Certification

Persons who apply or supervise the application of "restricted use" pesticides must be certified through training and examination. Certification is available through state and Federal agencies, and must be renewed periodically. The Army, Navy, and Air Force operate certification programs for Department of Defense (DOD) pesticide applicators.

7-7. Liability

Pest managers have a legal and moral obligation to conduct their activities in a manner that does not unnecessarily endanger humans, nontarget animals, or the environment. Careless or reckless actions, especially when pesticides are involved, invite lawsuits, jeopardize employment, and create negative publicity for the individuals and agencies involved.

CHAPTER 8
PUBLIC RELATIONS

8-1. General

Since commensal rodents are closely associated with human activity and habitation, rodent control should not be undertaken without informing and securing the cooperation of all persons who may be affected. Effective pre-control communications will help to avoid unanticipated problems and possible adverse publicity.

8-2. Objectives

a. The information to be communicated should be adapted to fit the local conditions and the number of people involved. The objectives of pre-control public relations include, but are not limited to:

(1) Inform the public and justify control (e.g., property damage, disease hazards, food contamination, control versus noncontrol cost comparison).

(2) Obtain cooperation instead of interference - gain access to residences and other structures; enlist assistance and support in environmental sanitation.

(3) Shape attitudes favorable to control - use socially acceptable control techniques; explain control methods to be used and reasons for using them instead of other methods.

(4) Explain safety considerations - hazards and precautions to be taken; ensure precautions will be taken to safeguard children and pets.

b. For small operations involving few people, communication can be direct and personal, but the basic information should always be in written form for easy reference should questions arise. Large operations will also require announcements through appropriate media.

8-3. Homeowners Checklist

A sample checklist for homeowners, renters, and building managers is provided in Appendix J. This checklist is designed both as an aid to these persons in carrying out their own rodent control and as a public relations tool.

CHAPTER 9
AREAS NEEDING FURTHER RESEARCH

9-1. Repellents

At this time there are no effective rodent repellents available for protecting packaged foods or telephone and electrical cables. Past research in this area has been only moderately successful. Further progress will probably only occur as a result of the search for additional applications for products originally developed for other uses.

9-2. Toxicants

a. There is a continuing need for the development of new toxicants as genetic resistance to existing anticoagulants develops. Special attention should be directed toward the development of single dose toxicants, with delayed onset of poisoning symptoms, that are selective for rodents and present low primary and secondary hazards to nontarget animals.

b. These toxicants may be discovered through active research with existing or new materials. However, products will be marketed only when it is profitable to do so. A good example of this is the adaption of commensal rodenticides for the control of agricultural and range rodents rather than developing specific toxicants for this rather limited market. Primary and secondary hazards to nontarget animals and birds, especially endangered species, is a major concern in field rodent control. More research on environmentally safe control methods and materials is needed. Discoveries in field rodent control should also benefit commensal rodent management.

9-3. Ectoparasite Control

a. Rodent fleas and other ectoparasites are important vectors of disease that afflict humans. Control of high rodent populations in urban areas requires concurrent or prior ectoparasite control to prevent these vectors from moving to human hosts when the rodents are killed. The ideal solution would be an insecticide that also killed the rodents. Unfortunately, the only compound that possessed these unique properties had adverse effects on the rest of the environment and is no longer available.

b. Research has shown that ectoparasites of ground squirrels can be killed by adding certain insecticides to squirrel baits. The systemic action of the insecticide was effective for over 90 days, and the squirrels appeared to be unharmed. Development of systemic insecticides and possibly insecticide-rodenticide combinations could aid in controlling ectoparasite transmitted disease.

9-4. Air Curtains

Several studies of rodent behavior have shown that rats and mice avoid drafts and blasts of air. Air curtains may be effective as rodent barriers in building entrances. Research in this area could lead to development of a barrier that would exclude rodents while permitting humans and vehicles to pass.

9-5. Ultrasonic Sound

Ultrasound is believed to be effective in repelling rodents at levels above 85 decibels in the 20-30 kHz frequency range. However, since ultrasound is only effective for short distances, does not travel around corners or pass through objects, and does not kill rodents, it is difficult to evaluate its effectiveness. Until numerous, carefully controlled field tests show its effectiveness, ultrasound cannot be recommended for rodent management.

APPENDIX A
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APPENDIX B
SAMPLE CHECKLIST FOR RODENT SURVEYS

1. Area/Location* _____ Date _____

   Investigator _____

   Address _____

   Occupant _____ Owner _____

   Phone _____

2. Land Use

   Vacant _____ Business _____ Food Processing _____

   Residential _____ Agricultural _____ Food Sales _____

3. Building Condition (Resistance to Rodent/Entry/Movement)

	Interior			Exterior		
Foundation:	Good ___	Fair ___	Poor ___	Good ___	Fair ___	Poor ___
Structure:	Good ___	Fair ___	Poor ___	Good ___	Fair ___	Poor ___

Rodent Access Routes:

Structural Openings	___	Windows	___
Conduits/Pipes	___	Doors	___
Floor Drains	___	Vents	___
Interior Doors	___	Pipes/Wires	___
Suspended Ceilings	___	Vegetation	___
Foundation	___	Burrows	___
Other	___		

* Use a separate checklist for each building at this location.

4. Rodent Habitat Availability (Mark yes (Y) or no (N) for each category)

	Interior	Exterior
a. Food		
Stored Food	_____	_____
Waste/Spillage	_____	_____
Pet Food	_____	_____
Garden	NA	_____
Fruit/Nut Trees	NA	_____
b. Water		
Plumbing Leaks	_____	_____
Natural Sources	_____	_____
c. Harborage		
Tall Grass/Weeds	NA	_____
Shrubs/Trees	NA	_____
Vines	_____	_____
Junk Vehicles, Appliances, Furniture	_____	_____
Stored Materials	_____	_____
Rubbish	_____	_____
Board Fences and Walls	_____	_____
Sewers (accessible to rodents)	_____	_____
Double Walls/Floors/Ceilings	_____	_____
Other Enclosed Spaces	_____	_____
Sheds, Other Outbuildings	NA	_____

5. Rodent Sign (Y/N)

	Basement/ Foundation	Main/ Upper Levels	Exterior
Live Rodents	____	____	____
Dead Rodents	____	____	____
Droppings	____	____	____
Urine	____	____	____
Smudge Marks	____	____	____
Tracks	____	____	____
Runs	____	____	____
Gnawing	____	____	____
Burrows/Holes	____	____	____
Nests	____	____	____
Sounds	____	____	____
Odors	____	____	____
Pet Behavior	____	____	____

6. Potential Toxicant Use Hazards

Children	____	Wildlife/Fish	____
Pets	____	Food/Water Contamination	____
Other Domestic Animals/Birds	____		

7. Control Options

Sanitation	_____	Acute Toxicants	_____
Rodent Proofing	_____	Multi-dose Toxicants	_____
Trapping	_____	Tracking Powder	_____
Glueboards	_____	Other	_____

8. Notes

a. Control history.

b. Rodent entry routes, sources of infestation, population reservoirs.

c. Habitat management recommendations.

d. Population reduction recommendations.

9. Sketch of Premises (Optional)

APPENDIX C
RODENT PROOFING

C-1. General

Rodent proofing is the use of appropriate materials, construction methods, and building design to prevent movement of rodents into and within a structure. The techniques used must be impervious to gnawing, prevent passage through openings, and discourage climbing. It is also necessary to eliminate harborage within walls and floors. Frequent inspection and maintenance is necessary to maintain the integrity of rodent proofing. In addition to rats and mice, rodent proofing also excludes birds, bats, squirrels, and other animals.

C-2. Knowledge of Physical Capabilities

Planning for rodent proofing requires knowledge of the physical capabilities of commensal rats and mice.

a. Rats are able to gain entrance through openings larger than 1/2 inch; mice can penetrate 1/4-inch gaps and will enlarge gaps as small as 1/8 inch if the material is gnawable. Mice are more often a problem than rats because they need only a very small hole for entry. Their limited movement, once established, enables them to exist in many situations without detection. Rats and mice will burrow under 4-feet deep foundation walls to gain access to cellars or crawl spaces under buildings containing food. They can crawl along most horizontal pipes, conduits, or wires, although Norway rats are less agile than roof rats and house mice.

b. Rats can climb the inside of pipes 1-1/2 to 4 inches in diameter; mice can negotiate smaller diameter pipes. Rats can also climb the outside of vertical pipes and conduits up to 3 inches in diameter and the outside of any pipe if it is within 3 inches of a wall or other continuous support. Mice and rats readily climb bricks, rough lumber, and other surfaces that offer footholds. They will use trees, shrubs, vines, and telephone or power lines to gain access to the upper stories of buildings.

c. Both rats and mice are good swimmers. Norway rats are known to travel in sewer lines, even against strong currents, and to dive through traps in plumbing fixtures. They are also capable of swimming over 48 hours in warm water before becoming exhausted.

d. Rats can jump up to 36 inches vertically and 48 inches horizontally from a flat surface. They can achieve greater distances with a running start or by jumping horizontally from an elevation. Rats can reach upward and sideways almost 18 inches on a smooth vertical surface in search of a toehold for climbing. Mice are capable of similar feats although the distances are shorter in keeping with their smaller size. All rodents can drop from over 15 feet and land on their feet without injury.

e. Rodent incisors grow continuously and frequent gnawing on hard materials is necessary to wear them down. Mice and rats will gnaw through lead sheathing and pipes, plastic, glass, cinder block, improperly cured concrete, and aluminum sheathing. All that is required for gnawing is a curved or angled surface that they can grip with their incisors.

C-3. Rodent Proofing Treatments

In view of the physical capabilities above, the following treatments are suggested:

a. **Foundations** - Basements with intact, properly cured, concrete floors and walls are impervious to rodent entry. Basements with cracked or broken floors and walls, breaks around floor drains, openings where utility lines enter, and earth or rubble floors may be invaded by rodents that burrow downward alongside the foundation wall until they encounter an opening in it or pass under it to emerge through the basement floor. Rodent proofing of foundation walls is accomplished by sealing all openings with concrete, reinforced with wire mesh where necessary. Where burrowing under the walls is a problem, a 4-inch thick L-shaped concrete curtain wall, extending a minimum of 28 inches below ground level and 15 inches outward at the bottom, can be installed against the outer side of the existing foundation. Installation of curtain walls is expensive and should be done only when necessary. If possible, the intact foundation wall should extend 12-18 inches above ground. Where surface drainage conditions permit, this may be accomplished by soil removal.

b. **Utility Entrances** - Any openings in exterior walls where wires or pipes enter a structure must be tightly sealed. Concrete (mortar) is used for openings in masonry walls (rock, brick, concrete, stucco) and 24-gauge or heavier sheet metal for wood, metal, or plastic siding.

c. **Gutters, Pipes, and Wires on Exterior Walls** - These appendages often provide convenient travel lanes on exterior walls. Rodents can also use wires to reach buildings from utility poles, and they will travel between structures on interconnecting wires or pipes. Blocking rodent access to upper levels of buildings reduces the need for rodent proofing eaves and other hard to reach areas. Sheet metal barriers that extend at least 18 inches horizontally and vertically are used as rat guards on wires and pipes to block rodent travel.

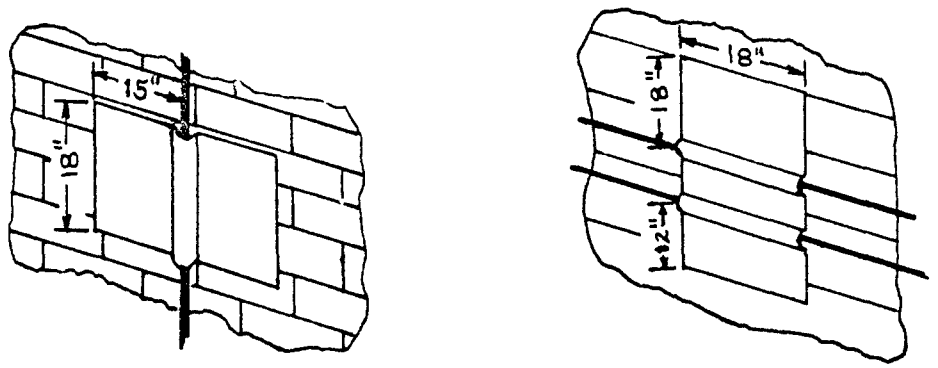
See Figures C-1a and C-1b for application details. If rats have access to a surface from which they can jump, the guard should be increased to 36 inches in height. Wires passing through guards must be insulated and protected from abrasion. Rat guards should be installed above the height of passing individuals and equipment. Where building design permits rodents to climb at wall junctions, sheet metal guards at least 12 inches wide and 18 inches or more aboveground (or floor) level should be installed. To prevent rats from climbing the inside of rainwater downspouts, a one-way metal flap valve may be installed at the bottom of the spout or a coarse mesh wire cone at the top. Both of these devices may require frequent servicing if blockage by leaves or debris is a potential problem.

d. **Interior Walls** - Openings cut in interior walls for routing utilities also facilitate rodent movement as well as providing harborage for cockroaches and other pests. Gaps around pipes, wires, duct work, etc., should be sealed as tightly as practicable using materials compatible with the building design and interior finish. Raceways and other utility routes within walls or between floors also provide rodent travel lanes and should be blocked as much as possible.

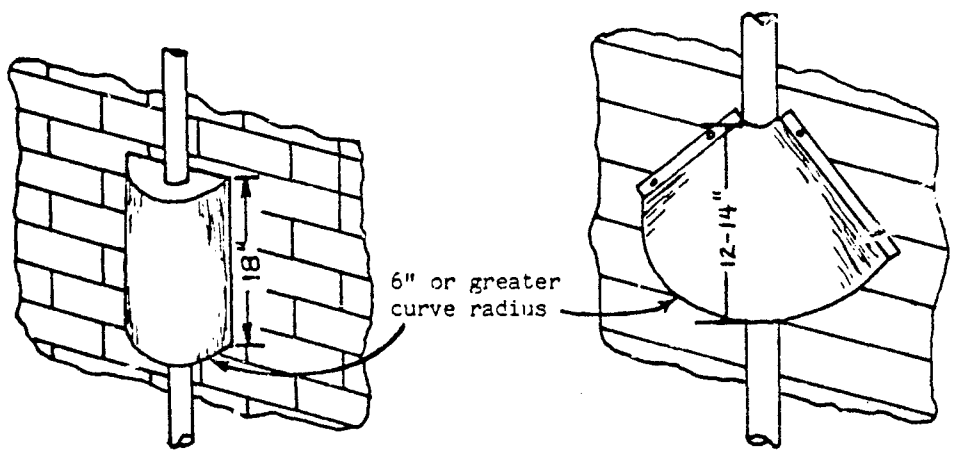
e. **Windows** - There should be no gaps between windows and building walls, and windows should fit snugly (no gaps) when closed. All windows that can be opened must be fitted with screens. In areas where the rodent population is high or windows are left open for long periods, 1/4-inch mesh hardware cloth should be used in addition to insect screening for basement and ground floor windows. This is especially important in warehouses and other buildings where damaged screens might not be noticed immediately. Aluminum and nylon insect screening is easily penetrated by rodents and should be supplemented with hardware cloth wherever rodent entry is a potential problem.

f. **Doors** - Open doors are an invitation to rodent entry. Wherever possible, exterior doors should be fitted with springs or automatic closing devices. There must be no more than a 3/16-inch gap between the door and its jamb when the door is closed. Loose fitting or damaged doors may be fitted with a sheet metal channel that encloses the bottom and lower corners of the door to keep rodents from enlarging the gap by gnawing. Sheet metal covering should also be used to protect door jambs subject to gnawing. Thresholds are subject to considerable wear and require frequent inspection and periodic replacement. Steel doors and jambs are recommended whenever doors need replacement. Attention should also be given to possible gaps between the jambs, thresholds, and building walls. Although rare nowadays, mail slots in doors allow pest entry unless they have self-closing covers.

g. **Vents, Exhaust Fans, and Chimneys** - These openings are sometimes overlooked, especially when they are on a roof. However, all openings that are accessible to rodents must be rodent proofed regardless of location. Foundation (crawlspace) and attic vents should have 1/4-inch mesh hardware cloth screening in addition to any insect screens that may be present.

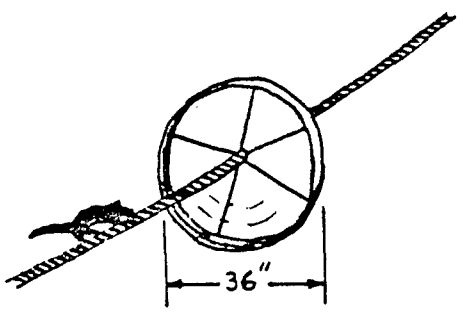


FLAT GUARDS FOR WIRES AND SMALL PIPES

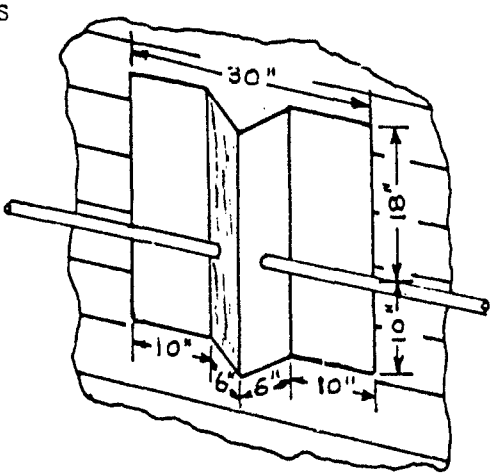


BARREL GUARD CONE GUARD

CURVED GUARDS FOR PIPES



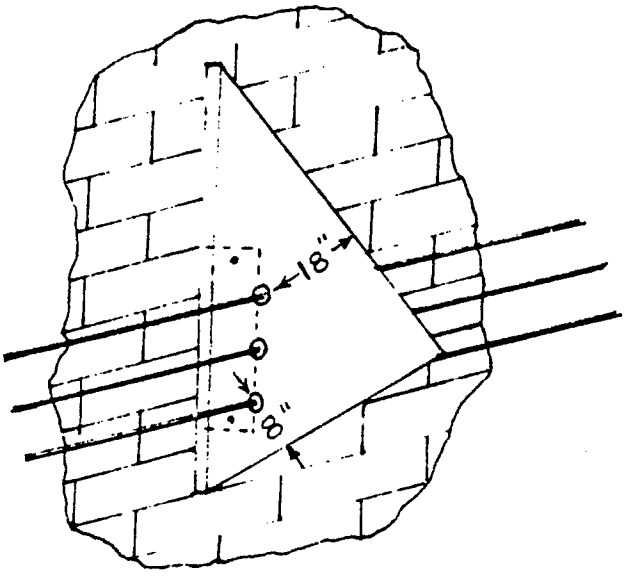
GUARD FOR SHIP MOORING LINE



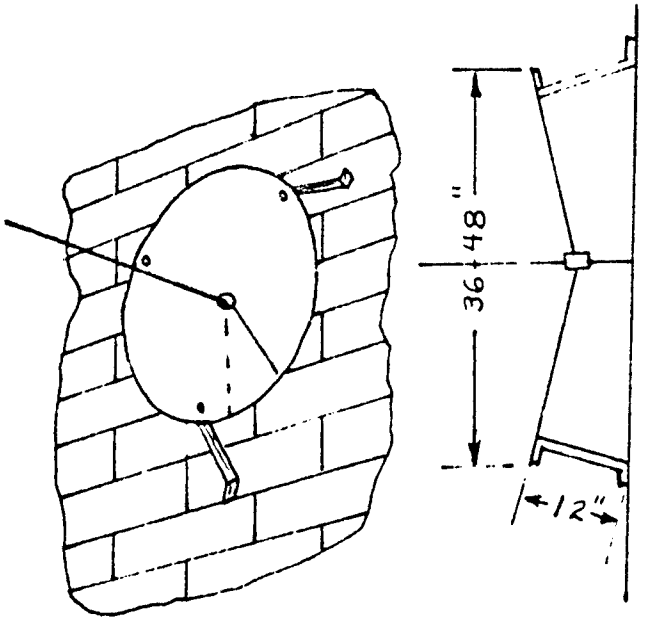
FOLDED RAT GUARD

Figure C-1a. Rat Guards

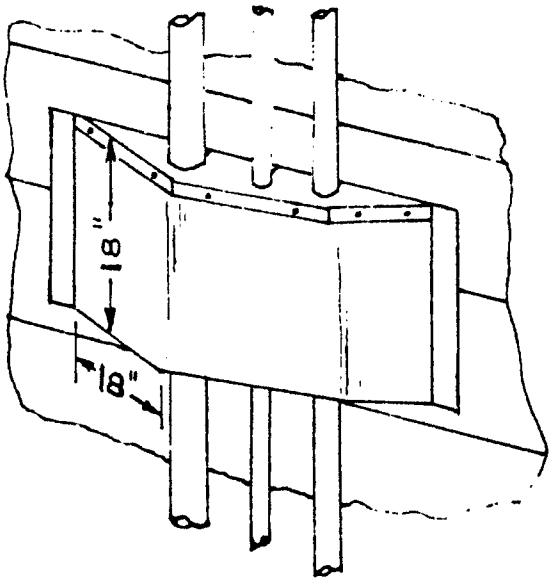
NOTE: Use 24-gauge or heavier galvanized sheet metal. Fasten to wall with anchor bolts, galvanized roofing nails, or lead-headed roofing nails. Space fasteners far enough apart that they cannot act as a ladder for rats. Use insulators where wires pass through guards. If necessary, point up mortar joints flush with brick for 12 inches on each side of guard. Flat guards are closed on top and open on the bottom. Triangular rat guard may be made in two pieces to facilitate installation around existing pipes or wires.



TRIANGULAR RAT GUARD



CONE GUARD FOR WIRES OR PIPES APPROACHING BUILDINGS



FLAT GUARD FOR LARGE PIPES OR GROUPS OF PIPES

Figure C-1b. Rat Guards

The additional screening must not interfere with the opening and closing of automatic vents or restrict air flow. This is especially important when screening is installed around exhaust fans. Ventilation openings in eaves must also be screened against rodents. Plumbing vents that extend less than 3 feet above the roof surface must be covered with 1/4-inch mesh hardware cloth. Mortar may be required to secure screening to masonry chimneys and vents. Fourteen gauge or heavier expanded metal can be substituted for hardware cloth where appearance is important. The metal should be galvanized or painted to prevent rusting.

h. **Business Entrances, Warehouse Doors, Loading Docks, and Railroad Entrances** - These openings are difficult to seal tightly and are frequently kept open for long periods of time. A good defense for this situation is the removal of all natural and man-made cover that could allow rodents to approach undetected. Perimeter baiting and trapping programs also help to reduce the number of rodents approaching. The volume and type of traffic through these doorways dictates the use of durable materials such as steel doors and jambs and concrete or steel sills. Steel exposed to moisture must be galvanized or painted for rust resistance.

(1) Loose fitting doors should be modified. Where floors are uneven or slope, it is often more practical to create a sill to fit the door when it is closed than to try and adapt the door bottom to an uneven floor. A design for a "floating" door bottom that follows floor contours is shown in Figure C-2.

(2) Rodent proofing of ill-fitting existing doors can sometimes be accomplished by the addition of 6-inch wide steel kick plates in combination with a 1/8-inch thick strip of rubber conveyor belting. The belting is flexible enough to conform to moderate floor irregularities but tough enough to resist wear and rodent gnawing. The gap between the closed door and sill should not exceed 1/8 inch.

(3) Sliding and overhead doors should fit as tightly on the sides as they do at the bottom. In addition to stopping rodents, the snug fit reduces heat loss. Consideration should be given to the potential freezing of doors to the floor or sill during cold weather. This is especially critical with sliding doors where the seal may travel in a narrow groove.

(4) Railroad entrances create special problems. Coarse steel wool packed between the rails and the door sill will discourage most rodents while permitting wheel passage, but it must be renewed every time a railroad car passes over it. Something better is a heavy rubber block called a Pest-A-Rester®. This device fills the gap between the rail and the sill on both

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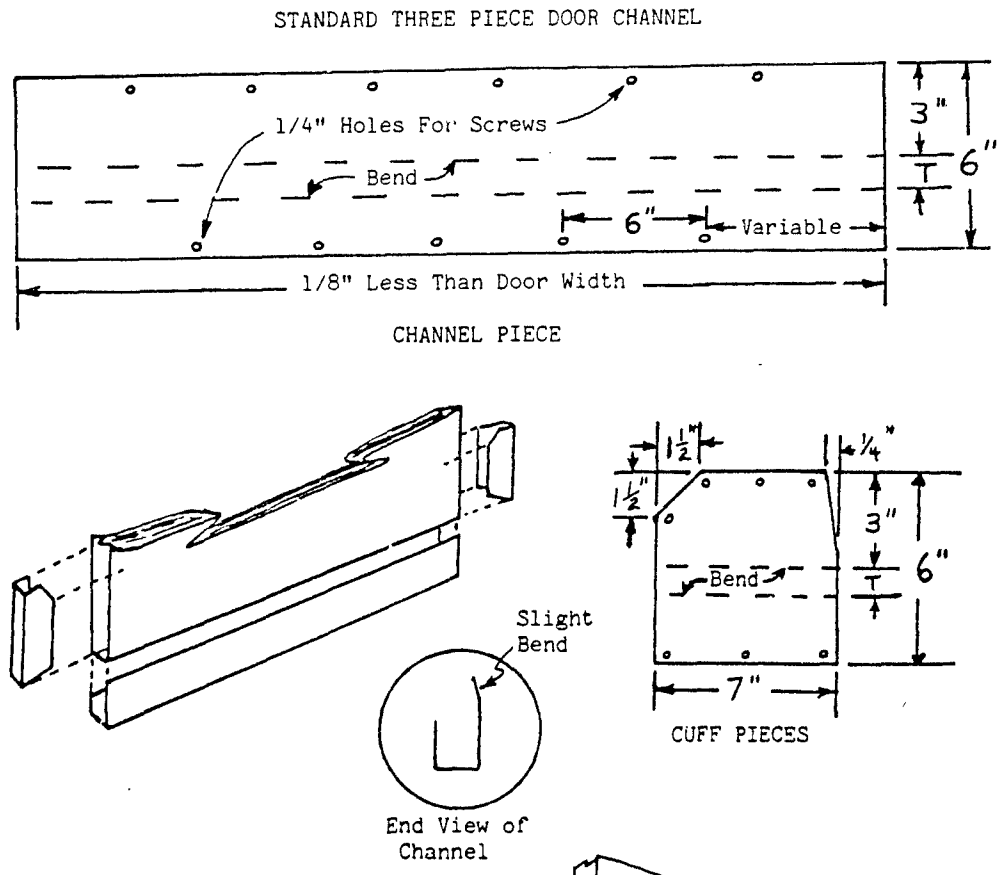
® Pest-A-Rester is a registered trademark of National Institute of Pest Management, Cape Girardeau, MO.



NOTE: T = door thickness. Install cuff pieces over channel. Use 24-gauge or heavier galvanized sheet steel. Fasten to door with 3/4-inch round-head nickel plated or brass screws.

Figure C-2. Rodent Protection for Door Bottoms

sides of the rail to provide a tight seal when the door is resting on the rails and sill, but is flexible enough to permit the flanged railroad wheels to depress it without damage when they pass over it. A similar device is made by Vot-Rat-Gard.

i. **Mobile Homes** - In contrast to modern site-built homes that are relatively rodent proof, most mobile homes abound in potential mouse entrances. Although they fit well initially, mouse-size gaps tend to develop around the doors and windows of lower priced models after a few years of use unless the home is carefully maintained. These gaps should be eliminated in order to keep pests out and maintain heating and cooling efficiency.

(1) Other entry points are openings under the floor for connection of water, fuel, electricity, and sewer; and the combustion air intakes for oil or gas fueled heating systems. The problem is exacerbated by the use of relatively soft fibrous materials to enclose the insulated underfloor space and by enclosing the area under the mobile home with "skirting." These favorable conditions allow mice to capitalize on structural defects in relative security.

(2) The resolution of rodent entry through the underfloor area lies in careful examination of the entire surface for entry points. This is especially important where skirting materials and underframe blocking provide direct travel routes between ground and underfloor.

(3) Metal guards should be fitted snugly around all utility and drain openings. Attention should also be given to eliminating gaps around the air intakes of heating and cooling systems. Air intakes must not be covered with screening if there is any possibility that airflow to the furnace will be reduced to less than that required for safe operation.

(4) Water heaters are often installed in compartments accessible from outside the mobile home. These compartments must be checked for access door fit, unscreened ventilation openings, and gaps around plumbing. (These compartments are also a good location for traps and bait stations.)

j. **Ships, Railroad Cars, Trucks, and Aircraft** - Rodents enter and leave these conveyances when they are parked (or moored) for loading or off-loading cargo and by stowing away within the cargo. Environmental sanitation in terminal areas reduces the problem by limiting rodent populations. Human activity and strong lighting at night repel rodents from boarding areas. Leaving loading ramps in place and doors open when loading is not actually taking place invites rodent entry. Rat guards on ship mooring lines prevent rodents from using them as travel lanes.

(1) Rodent control in cargo is primarily the responsibility of the shipper. However, everyone involved with cargo should work to keep it rodent free. This means protecting the integrity of shipping containers and storing them in rodent-free warehouses.

(2) All materials packed for transport should be carefully examined for the presence of mice and rats. Shipping containers should be inspected for rodent penetration before loading and upon arrival at their destination. Any rodents found should be eliminated.

(3) Since rodents require an edge or gap in order to gnaw an entry hole, smooth sided containers with reinforced edges and corners will discourage most rodents and make inspection for rodent entry easier. Broadly rounded surfaces are extremely rodent resistant, while containers with structural gaps or damaged edges and corners invite rodent penetration. Packing of rodent-free cargo in intact containers that are stored above floor level in rodent-free warehouses will prevent unnecessary shipment of rats and mice.

k. **Sewer Systems and Drain and Waste Lines** - Sewer systems and storm drains have provided food, harborage, and travel lanes for rats since their inception. Although it is not practical to keep rats out of sewers, measures can be taken to make movement into and out of sewer systems as difficult as possible. Smooth, vertical walls at junction boxes, storm drains, and manholes keep rats in sewers from exiting at these points.

(1) Breaks in lateral pipes or main tunnel walls that allow rats access to burrowing areas should be repaired, as few rats live within the sewer line itself. When adequate harborage is available in a sewer system, increasing rat populations will spread into adjacent areas. Unless controlled, rats may travel up building drains and emerge via toilet traps or roof vents. Special rat-proof waste pipes and roof vents can be installed to block rat movement where necessary. Floor drains require tight fitting covers with 3/8 inch or smaller openings and must be securely cemented into the floor.

(2) Private sewage systems in rural areas should have high quality pipes with securely fastened joints between buildings and septic tank. Drain fields should be buried 2 feet deep to discourage rodent entry via burrowing. Sumps and seepage pits should also be designed to prevent entry into building drains.

l. **Vegetation** - Vegetation in contact with or within jumping distance of a building allows rodents (including squirrels and other wild animals) easy access to upper levels, windows, and the roof. Such vegetation should be eliminated where practical. Vines growing on the side of buildings provide roosting and nesting cover for nuisance birds as well as protected travel lanes for rodents. When such growth is maintained for aesthetic reasons, extra precautions against rodent entry must be taken at all windows and vents and at the roof-wall junction since the vegetation provides security for intensive, long-lasting attempts to gain entry.

APPENDIX D
COMMENSAL RODENT CONTROL COMPOUNDS

D-1. Fumigants

Fumigant use is restricted to trained, certified applicators.

Aluminum phosphide/Magnesium phosphide

The metal phosphides release phosphine gas in the presence of moisture. They are used for treatment of rodent burrows outdoors only. Flammable.

Calcium cyanide

Calcium cyanide reacts with moisture to release hydrogen cyanide gas. It is used for outdoor treatment of rodent burrows. Flammable.

Chloropicrin

Vapors of this liquid are used for insect and rodent control in grain storage facilities. Chloropicrin is often used as a tracer with methyl bromide because its odor and tear-gas effect make it easy to detect at very low concentrations. Chloropicrin also functions as a repellent when rodents are able to escape from the treated area.

Dichlorobenzenes - ortho-dichlorobenzene, para-dichlorobenzene

These fumigants will kill rodents, but their principal use is against insects.

Methyl bromide

This gas is handled as a liquid under moderate pressure. It is used for agricultural commodity and soil fumigation and control of rodents in burrows (and buildings).

D-2. Repellents

Naphthalene

Also known as moth balls, naphthalene is used primarily as an insecticidal fumigant. It will function as a rat and mouse repellent, but it is effective only in confined spaces for short periods of time.

D-3. Anticoagulant Baits, Multiple Dose

These compounds cause death through internal and subcutaneous bleeding. Because of their slow action and multiple dose requirement, symptoms of intoxication appear only after several days, and bait shyness does not develop as a result of single sublethal dosages. Vitamin K is used as an antidote for this type of toxicant.

Warfarin

Warfarin is the first anticoagulant developed for rodent control. Warfarin resistant rodent populations have developed in some areas where it has been used for many years. Other toxicants are recommended where resistance is a problem. Warfarin is available as a concentrate and in prepared baits. The sodium salt is used to prepare water baits.

Prolin

Prolin is a combination of warfarin and the anti-bacterial agent sulfaquinoxaline that is added to retard production of Vitamin K in the digestive system thereby increasing the effectiveness of the anticoagulant. It is available in prepared baits or concentrate form. Warfarin resistant rodents are not affected by this compound.

Coumafuryl

Coumafuryl or Fumarin is available as a 0.5 percent powder for bait formulation or in water soluble form for water baits. It is not effective against anticoagulant resistant populations.

Valone

This toxicant is used primarily as a tracking powder. Although it can be used in baits, this use is not recommended due to poor acceptance by rodents.

Pival

Pival imparts insect and mold resistance to cereal baits. It is available as a 0.2 percent or 0.5 percent powder for bait formulation. Up to 5 percent edible oil may be added to the baits to prevent dusting and increase acceptance. It is also available in water soluble formulations. Pival is not effective against anticoagulant resistant rodents and is not as acceptable to mice as warfarin, diphacinone, or chlorophacinone.

Coumatetralyl

Coumatetralyl or Racumin is available in powder and liquid forms as well as ready-made baits. It is only partially effective against anticoagulant resistant rodents.

D-4. Anticoagulant Baits, Multiple or Single Feeding

Many rodents receive a lethal dose from a single feeding. Death, however, will not occur until several days after the initial feeding. Bait shyness does not occur, and multiple feedings ensure that rodents receive a lethal dosage.

a. **Anticoagulant Bait - Multiple Feed, High Potency.**

Chlorophacinone

Available as oil or dust concentrate, prepared bait and as a tracking powder, chlorophacinone is also used in water baits and paraffin bait blocks. It is not effective against anticoagulant resistant rodents.

Diphacinone

Diphacinone is available as a concentrate and as grain, peanut, apple, chocolate, fish, or meat flavored weather resistant bait. It is also available as a water soluble concentrate. It is more toxic to dogs than other anticoagulants, but it is not effective against anticoagulant resistant rodents.

Difenacoum

This compound is effective against many rat and mouse populations that show resistance to other anticoagulants. It is available as a ready-to-use grain bait.

b. **Anticoagulant Bait - Single Feeding.** A single feeding on these anticoagulants is sufficient to cause death in commensal rodents. Death occurs approximately 6 to 8 days after ingestion.

Brodifacoum

Brodifacoum is available as a grain based bait. It is highly effective against most anticoagulant resistant rodents. Secondary hazards to wildlife are possible, but current research indicates they are low when brodifacoum is used for commensal rodent control in and around buildings. Weather resistant wax bait blocks are also available.

Bromadiolone

Bromadiolone is available as a concentrate or in prepared baits. It is also used as a tracking powder. Death usually occurs after 6 to 8 days even though the initial dose is lethal. Bromadiolone may fail to kill some anticoagulant resistant rodents. Single feed paraffinized pellets and blocks are available for use in locations where moisture and mold are problems.

Flocoumafen

Flocoumafen is effective against anticoagulant resistant rodents and noncommensal rodents. It is used in urban and agricultural environments. It may present a secondary hazard to wildlife and pets.

D-5. Acute Rodenticide Bait - Delayed Action

Bromethalin

Death generally occurs 18 to 72 hours after ingestion of a single lethal dose of this rodenticide. Bait shyness is not a problem, and prebaiting is not necessary as rodents do not discriminate against Bromethalin treated baits. It is effective against anticoagulant resistant populations. It is directly toxic to wildlife and domestic animals, but there are no secondary hazards to dogs. Less bait is required than with conventional anticoagulants as animals do not feed again after ingesting a lethal dose. It has low secondary hazards compared to Brodifacoum and a low primary hazard to birds via bait, but it is highly toxic via gavage.

Cholecalciferol

Cholecalciferol, also known as Vitamin D, promotes the absorption of calcium from the gut and bone tissue into the blood from which it is deposited in the lungs, kidneys, and cardiovascular system. Cholecalciferol bait is generally well accepted for 2 to 3 days, but feeding ceases as poisoning symptoms develop. Death, believed to be due to kidney failure, occurs 4 to 8 days after ingestion of a lethal dose. Since bait shyness may result from sublethal dosage, prebaiting is recommended if alternate foods are abundant. Cholecalciferol is effective against anticoagulant resistant rats and mice. It is intended for general use in and around buildings. Cholecalciferol is toxic to many mammals and birds, but its slow action allows time for antidotal treatment. It degrades into less toxic products in the presence of air, moisture, and sunlight.

D-6. Acute Rodenticide Bait - Single Feeding, Prebait

Unlike anticoagulants, acute rodenticides normally cause death within 24 hours after ingestion of a single lethal dose. Because of the relatively rapid onset of lethal symptoms, rodents receiving sublethal doses may become bait shy. Some of the acute toxicants also have an aversive taste. Prebaiting for 3 to 6 days is recommended for these acute rodenticides. Population reduction may be unsatisfactory (60 percent or less) if prebaiting is omitted.

Alpha-chlorohydrin (Epibloc)

This slow-acting single dose rodenticide causes temporary to permanent sterility in male rats that consume sublethal doses. Lethal dosages cause death in 1 to 5 days. Because it metabolizes rapidly, rodents must consume a lethal dose in a very short time. For this reason Epibloc is available only as a 1 percent meal type bait packaged in 5 g sachets. This toxicant is noncumulative, biodegrades rapidly, and presents no secondary hazards. It is effective against mice as a toxicant but not as a sterilant. Prebaiting with the manufacturer's 25 g prebait sachets is recommended.

Fluoroacetamide and Sodium Fluoroacetate

These fast acting, tasteless compounds are used in baits or drinking water for rodent control. They are hazardous to all mammals and pose secondary hazards to nontarget animals that consume (the stomachs of) poisoned rodents. Fluoroacetamide is the slower acting of the two compounds, and it is less likely to cause bait shyness as a result of sublethal dosage.

Red Squill

Red squill is the powdered bulb of *Uraginea maritima*, a perennial that grows in the Mediterranean area. It is not uniform in potency. It is effective primarily against Norway rats and is ineffective against mice. It possesses a natural emetic action that protects nonrodents from poisoning. It is not recommended for use due to aversive taste and limited efficacy.

Scilliroside

Scilliroside is the most toxic glycoside found in red squill, a plant compound. It is available in premixed baits, and as a concentrate. Unlike red squill, it is effective against both rats and mice.

Strychnine

Strychnine is a white crystalline powder extracted from the seeds of *Strychnos nux vomica*. It has a bitter taste that causes aversion unless adequate prebaiting is done. It is toxic to birds and mammals both directly and secondarily. The concentrate is used for making grain baits. Prebaiting is required. Strychnine is not suitable for rats due to poor acceptance.

Zinc Phosphide

This gray powder releases phosphine gas in the presence of moisture. It has a disagreeable odor (to humans) that apparently is not offensive to rodents. It is available as a powder concentrate for bait formulation and as ready mixed baits. Grain baits are hazardous to birds. Prebaiting is required.

D-7. Tracking Powders - Restricted Use

Tracking powders are applied in a thin layer in protected rat and mouse runways, baitboxes, or tubes along walls. The powder is picked up by the rodents on their feet and fur and ingested during grooming. Tracking powders are more effective against mice than rats, but are not effective in moist situations. Tracking powders contain 10 to 40 times more toxicant than baits and should be used only where they will not be contacted by humans, pets, or other nontarget animals. They cannot be used where there is a possibility of contaminating food or surfaces that come in direct contact with food.

Bromadiolone, **Valone**, **Zinc Phosphide**, **Diphacinone**, **Chlorophacinone**, and **Warfarin** are available as tracking powders.

D-8. Water Baits - Restricted Use

Where water sources are limited and controllable, water soluble forms of anticoagulants may be used to poison the water for rats. Water baits are more hazardous to other animals than grain baits, and are not very effective against mice that require little or no drinking water, except in hot dry environments. Water baits must be protected against spillage and debris and serviced frequently.

D-9. Not Recommended

These compounds have been used against commensal rodents in the past, but they are no longer recommended for the reasons listed.

Alpha-chloralose - not available in the U.S.

ANTU (alphanaphtylthiourea) - aversive taste, bait shyness problems, effective against Norway rats only.

Arsenious oxide - arsenic trioxide - more effective toxicants available, not registered in the U.S.

Barium carbonate - more effective toxicants available.

Calcium cyanide - not registered in the U.S.

Coumachlor (tomorin) - not available in the U.S.

Crimidine - discontinued by manufacturer.

Flocoumafen - not registered in the U.S.

Gophacide - discontinued by manufacturer.

Naphthalene - limited effectiveness, repellent only.

Norbormide - not available, limited effectiveness.

Red Squill - may be difficult to obtain, quality varies, effective on rats only, bait shyness problems.

Pyriminil - discontinued by manufacturer.

Silatrane - not available.

Sodium chlorate - more effective toxicants available.

Strychnine - high toxicity, secondary hazards, aboveground uses cancelled, 1987.

Thallium sulfate - high toxicity, most uses banned.

1080 (sodium fluoroacetate) - nonselective, secondary hazards, no antidote available, registrations cancelled, 1990.

1081 (fluoroacetamide) - nonselective, secondary hazards, no antidote available, U.S. registrations cancelled.

APPENDIX E
CHEMICAL MANUFACTURERS AND TRADE NAMES OF RODENTICIDES IN CURRENT USE

The following table lists rodenticides by their common name, manufacturers,* and trade names. Not all manufacturers and trade names are listed.

Table E-1
Chemical Manufacturers and Trade Names of Rodenticides

Rodenticide (Common Name)	Manufacturers	Trade Names
Alpha chlorohydrin	Gametrics Ltd.	Epibloc[1]
Aluminum phosphide	Research Products Co.; Pestcon Systems, Inc.; Midland Fumigant, Inc.; Phos-Fume Chemical Co.	Quick-Phos; Gastoxin; L-Fume; Detia Rotox; Fumitoxin
Brodifacoum	ICI Americas, Inc.; Farnam Companies, inc.; D-Con Co., Inc.; Sherman Technology Corp.	Talon; Talon-G; Talon Weather Blok; Havoc; D-Con II; Lim N 8
Bromadiolone	LiphaTech, Inc.; Bell Laboratories, Inc.; J.T. Eaton & Co., Inc.; Purina Mills, Inc.	Eaton's A-C Formula 70; Contrac; Maki; Purina Rat-A-Rest/Mouse-A-Rest
Bromethalin	DowElanco; Purina Mills, Inc.; Roussel Bio Corp.	Vengance; Assault; Purina Last Stop; Bromethalin Bait
Cholecalciferol	Bell Laboratories, Inc.; Motomco Ltd.	Quintox; Rampage
Chlorophacinone	J.T. Eaton & Co., Inc.; LiphaTech, Inc.	Eaton's Blue A-C Tracking Powder; Eaton's A-C Formula 90; Rozol; Rozol Laq Berry; Mouse-Out
Chloropicrin	Great Lakes Chemical Corp.; Southern Mill Creek Products; Reddick Fumigants, Inc.	Clor-O-Pic; SMCP Cloropicrin Fumigant; Reddick Pic-C100
Coumachlor[2]		
Coumafuryl (Fumarin)	Hub States Corp.[3]	Blue Ribbon Rat & Mouse Bait; Hub States Rodent Blocks; Hub States Rodarin
Coumatetralyl[2]		

* Chemical manufacturers may not distribute their products directly, but they can supply distributor information upon request. For manufacturers' addresses, see Tables G-1 and G-2.

NOTE: See page E-4 for an explanation of footnote numbers.

Rodenticide (Common Name)	Manufacturers	Trade Names
(Para)Dichlorobenzene	Security Products Co. of Delaware, Inc.; Daniel R. Freeman	Repel #2 Wild Animal Repellent[1]; Repel
Difenacoum[2]		
Diphacinone	Bacon Products Co., Inc.; Bell Laboratories, Inc.; B & G Co.; Central Soya Co., Inc.; J.T. Eaton & Co., Inc.; Hopkins Agricultural Chemical Co.; Mackwin Co.; Motomco Ltd.; Redwood Chemical, Inc.; Roussel Bio Corp.; Sweet Corn Products Co.; Southern Mill Creek Products; The Archem Corp.; U.S. Marketing Distributors; Wilbur-Ellis Co.	AFC Diphacinone; Anticoagulant Rat & Mouse Bait Blocks; Di-Mix 110; Ditrac Tracking Powder; Diphacin Meal Bait; Crown Rat/Mouse Killer; Eagles-14 Diphacinone Rat Bait; Eaton's All-Weather Bait Bitz; Eaton's All-Weather Bait Blocks; Eaton's Semi-Permanent Bait Blocks; Finis (The End) Rat & Mouse Killer with Diphacinone; Gold Crest Promar (tracking powder & baits); Guardian Rat Bait; Kill Ko Rat Killer; Master Mix Blue Death-D Rat & Mouse Bait; Motomco Water Soluble Rodcide Concentrate; Para Blox; Promar; P.C.Q. Rat & Mouse Bait; Ramik Red/Brown/ Green; Rigo Professional Rat Killer-D; Rigo Rat Blues-D; Robert's Rodex; Ro-Dent; Rodent Cake; Rodere Paraffinized Rat Bait; Sewer Rat Bait Blocks; SMCP Diphacin (R) 110; SMCP Rat-Pel D; Trap-N-A-Sack; Tarla Diphas Blue/Green; Vantage
Flocoumafen[2]		
Fluoracetamide[2]		
Magnesium Phosphide	Degesch America, Inc.	Degesch Magtoxin Tablets-R
Methyl Bromide/ Bromomethane	Ameribrom, Inc.; Great Lakes Chemical Corp.; Reddick Fumigants, Inc.; Shadow Mountain Products Corp.; Van Waters & Rogers, Inc.	Methyl Bromide; Meth-O-Gas; Brom-O-Gas; Namco Pintofume; Namco Methyl Bromide; Namfume; Ameribrom Methyl Bromide; Metabrom; Reddick Bro-Mean C-O; Trical Methyl Bromide
Pindone/Pival	Abbeville Mixing Plant; Black Magic, Inc.; Cessco, Inc.; Ecolab, Inc.; J.T. Eaton & Co., Inc.; Motomco Ltd.; Purina Mills, Inc.; Southern Mill Creek Products	Bait-Tox Ready-Mixed Rat Bait; Black Magic Rat Killer with Pivalyl; Eaton's A-C Formula 50; Compound 333 Rat & Mice Bait; Lystads Rat & Mouse Killer; Motomco Contrax-P; Purina Rat-Kill; Pival Parakakes; Pival Rat-Kakes; SMCP/AFC Pivalyl Concentrate; Rodenticide Bait Anticoagulant Pival; Rodenticide Anticoagulant 0.5 percent Pival; Water Soluble Pivalyn; Water Soluble Rat & Mouse Killer; X-Cel Rat-Pel

NOTE: See page E-4 for an explanation of footnote numbers.

Rodenticide (Common Name)	Manufacturers	Trade Names
Prolin (Warfarin & Sulfaquinoxaline)[4]	Bacon Products Co., Inc.; Bell Laboratories, Inc.; Dean Jerry Exterminating Co.; Ford's Chemical & Service, Inc.; Fowler Pest Control; Good-Way Insecticide, Inc.; International Multifoods; Hopkins Agricultural Chemical Co.; Mackwin Co.; RMC Products Co.; Southern Mill Creek Products; Wilbur-Ellis Co.	A.F.C. Prolin Bait Ready-To-Use; D-Con Pellets; D-Con Ready Mixed; D-Con Mouse Prufe; Dean's Rat & Mouse Bait; Eagles-7 Rat Bait; Final Rat & Mouse Bait Pelleted; Good-Way Prolin Anticoagulant Rodenticide; Good-Way Prolin Rat & Mouse Killer; Hopkins Prolin Pellets; Hopkins Warfarin Plus Sulfa Q Pellets; Hopkins Prolin Pelleted Rat Bait; Pelletized Warf with Prolin; Superior W.W. 42 Rat & Mouse Poison; Ratorex with Prolin; RMC Meat Bait; Supersweet Rodent Rid Contains Prolin; Staffel's Rats-N-Mice Bait
Red Squill/Scilliroside	Pest Control Products Division of Hilo Products; Southern Mill Creek Products	AFC Red Squill Powder; Rat-Nip
Sodium Fluoroacetate[5]		
Strychnine[5]		
Valone	Motomco Ltd.; Southern Mill Creek Products	Motomco Tracking Powder; Trac Anticoagulant Tracking Powder
Warfarin[6]	Athena Corp; Bell Laboratories, Inc.; Blue Ribbon Feed Mill; Ford's Chemical & Service, Inc.; Furst McNess Co.; Hilliard Products, Inc.; Hobby's Rat & Mouse Bait, Inc.; Hopkins Agricultural Chemical Co.; Imperial Inc.; J.R. Coder Co.; Kelly's Professional Rodent Control; Mackwin Co.; MFA Oil Co.; Pipestone Products Co., Inc.; Purina Mills, Inc.; Safeguard Chemical Corp.; Spectrum Group Division of United Industries Corp.; Wilbur-Ellis Co.; Zoecon Corp.	Black Leaf Warf Pellets Mouse Killer; Chief Logan Rat & Mouse Killer; Crown "Pest Rid Brand" 0.5 percent Coated Warfarin Anti-Coagulant; D-Con Ready Mixed Kills Rats & Mice; D-Con Mouse Prufe; D-Con Pellets; Echols Mouse Pellets; Endo Rat Improved Killer Kakes; Ferret Rodenticide; Final Rat & Mouse Bait Pelleted; L.T.C. Kills Rats & Mice; H.K. Rat Bait; Hobby's Ready to Use Rat & Mouse Bait; Hopkins Warfcoat 1/1 Coated Warfarin; Hopkins Rodex Blox-1 with Cov-R-Tox; Kelly's Anticoagulant Rat & Mouse Bait; Liqua-Tox; McNess Ready-to-Use Rat & Mouse Killer; Purina Rat Control Pellets; Purina Place Pack Rat Control; Rat & Mouse Killer; Rat Bane Warfarin Concentrate Formula "42"; Ratorex with Prolin; Rat Toxin; R.B. #2 Kills Rats & Mice; Roberts Rodex Pelleted Bait; Safeguard Brand Rat & Mouse Killer; Warf Pellets Kills Rats & Mice Contains Warfarin; Warfarin Concentrate; Windler Rat & Mouse Killer

NOTE: See page E-4 for an explanation of footnote numbers.

Rodenticide (Common Name)	Manufacturers	Trade Names
Zinc Phosphide	Bonide Products, Inc.; Carajon Chemical Co., Inc.; HACCO, Inc.; Hopkins Agricultural Chemical Co.; LiphaTech, Inc.; Platte Chemical Co.; Southern Mill Creek Products	Force's Mous-Con; Force's Mous-Con #2; Hopkins Zinc Phosphide Pellets; Nott Zinc Phosphide 93; Rodenticide Zinc Phosphide; Ridall-Zinc; Ridal-Z Tracking Powder; Zinc Phosphide Bait; Zinc Phosphide Mouse Bait 201; Zinc Phosphide Rodent Pellets; Zinc Phosphide (Rumetan) 90 percent

[1] Registration may be cancelled in 1992
[2] Not registered in the U.S.
[3] Registration Active/Suspended
[4] Most of these registrations may be cancelled in 1992
[5] Not registered for commensal rodents
[6] Some of these registrations may be cancelled in 1992

APPENDIX F
CONTROLLING RODENTS WITH TOXIC BAITS

F-1. Toxic baits are highly effective in eliminating the rodents that consume them; however, rodents have developed feeding behaviors that tend to minimize their consumption of poisoned food. Knowledge of these behaviors is necessary for conducting an effective control program.

F-2. Although they will feed in open, lighted areas if they are undisturbed, rats and mice prefer to feed in dark, sheltered places away from drafts, predators, and human activity.

F-3. When food, water, and shelter are readily available, rats tend to remain within a 100-150 foot diameter area. Mice generally occupy an area 10-30 feet in diameter. Both species explore their entire range every day. Mice immediately examine new objects including traps and baits that appear in their environment. Rats behave in the opposite manner. Introduction of new objects or rearrangement of those already present upsets both exploratory and feeding behavior. Three or more days may elapse before resident rats adjust to changes in their environment. This neophobia or avoidance response is not found in immigrant rats since the entire environment is new to them.

F-4. The two species also differ in their feeding behavior. Mice tend to nibble on everything in their environment and readily sample strange foods. However, their nibbling behavior makes it unlikely that they will consume a lethal dose of toxic bait during the initial feeding at any single location. Rats sample new foods very lightly at first and only after filling their stomachs with familiar food items. After the initial sampling, rats and mice may temporarily avoid the new food. Several days can pass before it is consumed in any quantity even though they may eventually develop a preference for it. In general, rats tend to eat steadily on familiar foods at familiar locations; mice feed lightly and intermittently throughout their environment.

F-5. Because initial acceptance of unfamiliar food items is low, prebaiting is necessary to prevent sublethal dosing and subsequent bait aversion when an acute (fast-acting) toxicant is used.

F-6. Rats often carry large food items back to their nest to eat or to cache, but eat small particles where they find them. Laboratory studies indicate that they prefer smaller food particles such as coarsely ground rather than whole grain. While mice do not require much free water in their diet, rats do and they will consume more food if water is readily available than when it is limited.

F-7. Dominant individuals within a rodent social group may deny their subordinates access to some food sources, especially when high population density increases competition for limited resources. This means subordinate rats and mice may not have access to foods that are limited in distribution, such as bait stations, until the dominant rodents are eliminated. When cumulative or slow-acting toxicants are used, subordinates may not be able to obtain a lethal dose before the bait is consumed by the dominant rodents. Under these conditions, the distribution of numerous small bait quantities containing high potency (single dose) anticoagulants at approximately 7-day intervals has proved effective. This technique, known as pulsed baiting, eliminates the dominate rodents in the first round of baiting. Subordinates and rodents recovering from sublethal doses will have renewed feeding opportunities during the second and third bait applications. The bait may be distributed in prepared bait packets ("place packs") or in bait stations.

F-8. Numerous small bait stations, rather than a few large ones, afford better feeding opportunities to more rodents. Baiting should be continued long enough for all rodents in the area to consume a lethal dose. This may require 3-4 weeks of continuous baiting when multiple-feed anticoagulants are used. Single dose anticoagulants can be applied in numerous small baits on 3-5 occasions. These procedures will give subordinate rodents multiple opportunities to feed on the baits.

F-9. Controlling rodents with toxic baits tends to produce a bait shy (or bait-avoiding) population because the survivors of a control operation are those rodents that have consumed little or none of the bait. Since juvenile rodents tend to adopt the food habits of their parents, the offspring of these survivors will be less likely to accept bait than the original population. As a result, later control efforts may be less successful than the initial one.

F-10. The reasons for limited or nonconsumption of bait include: aversion formed as the result of sublethal dosage, aversion to the taste of the toxicant in the bait, preference for more attractive food items in the environment, lack of access to the bait, and avoidance of a strange food.

F-11. Control can be enhanced by using different bait and toxicants in subsequent control efforts and by prebaiting when acute toxicants are to be used. Prebaiting allows the bait to become part of the regular rodent diet, eliminates neophobia, and ensures consumption of lethal amounts when the toxicant is added. A variety of bait materials should be tested to identify the preferences of the local population if acceptance of standard baits is a problem. The prebait should be available at numerous points for at least 7 to 8 days to allow the entire population to become familiar with it. Competing food items should be eliminated to the greatest extent possible.

F-12. Due to the delayed onset of intoxication symptoms and death, anticoagulants do not cause bait aversion and, unlike acute toxicants, they do not require prebaiting. It is necessary, however, to ensure adequate bait distribution to the entire population as some rodents will consume much more than the amount necessary to kill them before they die.

F-13. There may be anticoagulant resistant individuals in any population. Continuous use of the same anticoagulant favors the development of a resistant population. Mice are more resistant to anticoagulants than rats; therefore, a higher concentration of toxicant in the bait than is normally used for rats may be necessary for good mouse control.

F-14. Use high quality bait materials. Poor results have been attributed to insect infested, moldy, or otherwise unattractive grain baits. If baits become spoiled or contaminated, they should be replaced with fresh bait. Baits formulated with an oil binder may be more attractive than plain grains. Other additives may cause flavor aversion. Test baits for acceptance if there is any doubt as to their palatability.

F-15. Many pet foods contain cereal grains; thus grain-based rodent baits, especially those containing oil as a binder, may also be attractive to dogs and cats. The newer, single dose anticoagulants are more toxic to dogs and cats than Warfarin. However, toxicity varies widely between toxicants.

F-16. Liquid (water) baits can be effective for rats where competition with other food sources reduces acceptance of grain-based baits. Water baits are extremely hazardous. They must be placed in spill-proof containers inaccessible to humans and nontarget animals. Unpoisoned water sources should be eliminated.

F-17. Proper placement of bait is important. Loose grain baits or pellets can be placed in burrow entrances or broadcast in some outdoor situations. Open bait trays are used indoors, when they can be placed behind, under, or inside objects where rodents can feel secure while feeding. Covered bait stations, either commercial or homemade, provide a secure place for feeding rodents and protect the bait from children and pets. These bait stations should have two entrances, approximately 2-1/2 inches in diameter, and be large enough for two rodents to feed simultaneously. They are placed along interior and exterior walls and in outdoor runways. When used outdoors, they must be weatherproof. Baits must not be used where they could contaminate foodstuffs or food preparation surfaces.

F-18. Many small bait stations are preferable to a few large ones for controlling an established population. One recommendation is for 200 g stations, 15 feet apart for rats; smaller stations with closer spacing are used for mice. Baiting outside buildings and along the property perimeter to intercept immigrant rodents requires fewer stations.

F-19. Paraffin baits are used in moist situations such as sewers or fastened to fences and trees for roof rats. Packaged baits in weather resistant wrappings are useful in burrows and hard to reach locations where it would be difficult to place bait stations. Table F-1 lists the various baits used in commensal rodent control.

F-20. Any bait application must be in accordance with label instructions and present minimal hazards to humans and nontarget animals. It is a good practice to conspicuously label the bait stations themselves and the adjacent wall or other structure. The station locations should be plotted on a map or otherwise recorded. This will make it easier to relocate them for removal or bait replenishment, warn people of their presence, and reduce the likelihood of accidents. Remember, casual or careless toxic baiting merely reduces a population to its optimum reproductive level; it does not solve the problem.

Table F-1
Rodent Baits

Type	Variations	Placement	Remarks
Loose grain	Finely ground Coarsely ground Rolled Whole Mixture	Open bait trays Covered bait stations Broadcast (whole grain) Burrows	Anticoagulants, general rat and mouse control Broadcast - some outdoor stations
Pelleted bait	1/8" to over 3/8" diameter	Open bait trays Covered bait stations Broadcast Burrows	General rat and mouse control Broadcast - outdoors Less waste than loose bait
Paraffin bait	Blocks Large pellets	Sewers, wet situations Burrows Fasten in trees, on fences	Where bait stations are impractical For roof rats in outdoor vegetation Where moisture is a problem
Weather resistant bait packets	Loose grain Pellets Combinations	Burrows Hard to reach locations	Where bait stations are impractical and bait needs weather protection Where many small baits are needed
Liquid (water) bait	Plain With sweetener	In spill-proof cups or special dispensers	Where food is plentiful and water is scarce Hot dry climates Primarily for rats
Moist bait	Fresh ground meat or fish Cooked grain Soaked grain	Open bait trays Covered bait stations Torpedo baits	Garbage dumps Burrows Sewers
Novelty bait	Extruded Paste Foam	Covered bait stations Burrows	Use in unconventional situations

APPENDIX G
RODENT MANAGEMENT PRODUCTS AND SUPPLIERS

G-1. This Appendix lists some of the principal U.S. suppliers of rodent control equipment and toxicants. It is not a complete list and is subject to change as new products are created and existing ones discontinued. Local and foreign suppliers offer many of these items under their own labels and brand names.

G-2. Table G-1 lists mechanical devices, suppliers, and suppliers' addresses. Table G-2 lists toxicants, suppliers, and suppliers' addresses.

Table G-1
Mechanical Devices

Mechanical Device	Supplier	Supplier's Address
Bait Stations	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	Brody Enterprises, Inc.	9 Arlington Place, Fair Lawn, NJ 07410
	J.T. Eaton & Co., Inc.	1393 E. Highland Rd, Twinsburg, OH 44087
	National Institute of Pest Management	2323 Brookwood Dr, Cape Girardeau, MO 63701
	Sherman Technology Corp.	76 Ninth Ave, New York, NY 10011
	Solvit, Inc.	7001 Raywood Road, Madison, WI 53713
	Wilco Distributors, Inc.	1215 W. Laurel Ave, P.O. Box 291, Lompoc, CA 93436
	Woodstream Corp.	P.O. Box 327, Lititz, PA 17543-0327
Tracking Stations	Terminate-Control Corp.	76 Ninth Ave, New York, NY 10011
Glueboards	Atlantic Paste & Glue Co., Inc.	4-53rd St, Brooklyn, NY 11232
	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	Brody Enterprises, Inc.	9 Arlington Place, Fair Lawn, NJ 07410
	J.T. Eaton & Co., Inc.	1393 E. Highland Rd, Twinsburg, OH 44087
	LiphaTech, Inc.	3600 W. Elm St, Milwaukee, WI 53209
	Necessary Trading Co.	8311 Salem Ave, New Castle, VA 24127
	Sherman Technology Corp.	76 Ninth Ave, New York, NY 10011
	Stone Chemical Laboratories, Inc.	487 N. Aberdeen St, Chicago, IL 60622
	Woodstream Corp.	P.O. Box 327, Lititz, PA 17543-0327

Mechanical Device	Supplier	Supplier's Address
Rail Guards	National Institute of Pest Management*	2323 Brookwood Drive, Cape Girardeau, MO 63701
	Vot-Rat-Gard	R. Rt 2, Cedar Rapids, IA 52401
Automatic Traps (multiple catch)	Dura-Built Products, Inc.	2135 Oak Ranch, San Antonio, TX 78259
	Hudson Devices, Inc.	376 E. Gundersen Dr, Carol Stream, IL 60188-2422
	Kness Manufacturing Co.	P.O. Box 70, Albia, IA 52531-0070
	Micro-Gen Equipment Corp.	10700 Sentinel Dr, San Antonio, TX 78217
	Morford Co.	P.O. Box 65003, West Des Moines, IA 50265
	Woodstream Corp.	P.O. Box 327, Lititz, PA 17543-0327
Live Traps (small animals)	Kness Manufacturing Co.	P.O. Box 70, Albia, IA 52531-0070
	National Live Trap Corp.	Route 1, Box 302, Tomahawk, WI 54487
	H.B. Sherman Traps, Inc.	P.O. Box 20267, Tallahassee, FL 32316
	Tomahawk Live Trap Co.	P.O. Box 323, Tomahawk, WI 54487
	Woodstream Corp.	P.O. Box 327, Lititz, PA 17543-0327
Snap Traps	Kness Manufacturing Co.	P.O. Box 70, Albia, IA 52531-0070
	McGill Metal Products Co.	142 E. Prairie Street, Marengo, IL 60152
	Woodstream Corp.	P.O. Box 327, Lititz, PA 17543-0327
Rodent Toilet Guards	Levenson's, Inc.	1407 Harney St, Omaha, NE 68102
Rodent Exclusion Material	Allen Special Products, Inc.	P.O. Box 605, Montgomeryville, PA 18936

* Manufacturer of Pest-A-Rester®

Table G-2
Toxicants

Toxicant	Supplier	Supplier's Address
Aluminum Phosphide	Midland Fumigant, Inc.	1805 S. 2nd St, Leavenworth, KS 66048
	Pestcon Systems, Inc.	5511 Capital Center Dr, Suite 302, Raleigh, NC 27606
	Phos-Fume Chemical Co.	12703 W. 117 St, Overland Park, KS 66210
	Research Products Co.	Division of McShares, Inc., P.O. Box 1450, Salina, KS 67402
	SCC Products & Soil Chemicals Co.	Box 782, Hollister, CA 95024
Brodifacoum	D-Con Co., Inc.	225 Summit Ave, Montvale, NJ 07645
	Farnam Companies, Inc.	301 W. Osborn Rd, Phoenix, AZ 85067
	ICI Americas, Inc.	Agricultural Products, New Murphy Rd & Concord Pike, Wilmington, DE 19897
	Sherman Technology Corp.	76 Ninth Ave, New York, NY 10011
Bromodialone	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	J.T. Eaton & Co., Inc.	1393 E. Highland Rd, Twinsburg, OH 44087
	LiphaTech, Inc.	3600 W. Elm St, Milwaukee, WI 53209
	Purina Mills, Inc.	Box 66812, St Louis, MO 63166
Bromethalin	DowElanco	Quad IV 9002 Purdue Rd, Indianapolis, IN 46268-1189
	Purina Mills, Inc.	Box 66812, St Louis, MO 63166
	Roussel Bio Corp.	170 Beaver Brook Rd, Lincoln Park, NJ 07035
Cholecalciferol	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	Motomco, Ltd.	P.O. Box 8422, Madison, WI 53708

Toxicant	Supplier	Supplier's Address
Chlorophacinone	J.T. Eaton & Co., Inc.	1393 E. Highland Rd, Twinsburg, OH 44087
	LiphaTech, Inc.	3600 W. Elm St, Milwaukee, WI 53209
Chloropicrin	Great Lakes Chemical Corp.	Director Governmental Affairs (Handy), Box 2200, West Lafayette, IN 47906
	Southern Mill Creek Products	5414 North 56th St, Tampa FL 33610
	Reddick Fumigants, Inc.	Highway 64 W, Box 391, Williamston, NC 27892
Coumafuryl (Fumarin)	Hub States Corp.	419 E. Washington St, Indianapolis, IN 46204
(Para)Dichlorobenzene	Daniel K. Freeman	25 Kevin Lee Lane, Rancho Mirage, CA 92270
	Security Products Co. of Delaware, Inc.	485 Oak Place, Suite 370, Atlanta, GA 30349
Difenacoum	ICI Americas, Inc.	Agricultural Products, New Murphy Rd & Concord Pike, Wilmington, DE 19897
Diphacinone	The Archem Corp.	1514 Eleventh St, Portsmouth, OH 45662
	Bacon Products Co., Inc.	Box 22187, Chattanooga, TN 37422
	B & G Co.	10539 Maybank Dr, Box 540428, Dallas, TX 75354
	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	Central Soya Co., Inc.	Regulatory Compliance Dept, Box 1400, Fort Wayne, IN 46801-1400
	J.T. Eaton & Co., Inc.	1393 E. Highland Rd, Twinsburg, OH 44087
	Hopkins Agricultural Chemical Co.	Box 7190, Madison, WI 53707
	Mackwin Co.	25 McConnon Dr, Winona, MN 55987
	Motomco, Ltd.	P.O. Box 8422, Madison, WI 53708
	Redwood Chemical, Inc.	1215 Jackson St, Houston, TX 77003
	Roussel Bio Corp.	170 Beaver Brook Rd, Lincoln Park, NJ 07035
	Southern Mill Creek Products	5414 North 56th St, Tampa, FL 33610

Toxicant	Supplier	Supplier's Address
Diphacinone (Con't)	Sweet Corn Products Co.	Box 487, Bloomfield, NE 68718
	U.S. Marketing Distributors	408 W. El Segundo Blvd, Los Angeles, CA 90061
	Wilbur-Ellis Co.	Box 9518, Fresno, CA 93792
Epibloc	Gametrics Ltd.	Colony (Wyoming) Route, Alzada, MT 59311
Isoval - Valone	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
Magnesium Phosphide	Degesch America, Inc.	P.O. Box 116, Weyers Cave, VA 24486
Methyl bromide/ Bromomethane	Ameribrom, Inc.	52 Vanderbilt Ave, New York, NY 10017-8622
	Great Lakes Chemical Corp.	Director Governmental Affairs (Handy), Box 2200, West Lafayette, IN 47906
	Reddick Fumigants, Inc.	Highway 64 W, Box 391, Williamston, NC 27892
	SCC Products & Soil Chemicals Co.	Box 782, Hollister, CA 95024
	Shadow Mountain Products Corp.	Box 1327, Hollister, CA 95024
	Van Waters & Rogers, Inc.	Subsidiary of Univar, 801 Second Ave, Suite 1600, Seattle, WA 98104
Pival - Pindone - Pivalyn	Abbeville Mixing Plant	516 Meyers St, Abbeville, LA 70510
	Black Magic, Inc.	217 Space Park So. Dr, Nashville, TN 37211
	Cessco, Inc.	1109 Central Ave, Box 18452, Charlotte, NC 28218-0452
	J.T. Eaton & Co., Inc.	1393 E. Highland Rd, Twinsburg, OH 44087
	Ecolab, Inc.	370 Wabasha St, Ecolab Center, St Paul, MN 55102
	Motomco, Ltd.	P.O. Box 8422, Madison, WI 53708
	Purina Mills, Inc.	Box 66812, St Louis, MO 63166
	Southern Mill Creek Products	5414 North 56th St, Tampa, FL 33610

Toxicant	Supplier	Supplier's Address
Prolin	Bacon Products Co., Inc.	Box 22187, Chattanooga, TN 37422
	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	Dean Jerry Exterminating Co.	307 E. 8th St, Spencer, IA 51301
	Ford's Chemical & Service, Inc.	3741 Red Bluff Rd #200, Pasadena, TX 77503-3316
	Fowler Pest Control	116 E. 5th St, Fowler, IN 47944
	Good-Way Insecticide, Inc.	Box 2768, Wheeling, IL 60090
	Hopkins Agricultural Chemical Co.	Box 7190, Madison, WI 53707
	International Multifoods	Agricultural Products Div, Multifoods Tower, Box 2942, Minneapolis, MN 55402
	Mackwin Co.	25 McConnon Dr, Winona, MN 55987
	PMC Products Co.	Box 848, Ft Dodge, IA 50501
	Southern Mill Creek Products	5414 North 56th St, Tampa, FL 33610
	Wilbur-Ellis Co.	Box 9518, Fresno, CA 93792
Red Squill/Scilliroside	Pest Control Products Div of Hilo Products	Box 69, Big Indian, NY 12410
	Southern Mill Creek Products	5414 North 56th St, Tampa, FL 33610
Valone	Motomco, Ltd.	P.O. Box 8422, Madison, WI 53708
	Southern Mill Creek Products	5414 North 56th St, Tampa, FL 33610
Warfarin	Athena Corp.	1919 Lone Star Dr, Dallas, TX 75212
	Bell Laboratories, Inc.	3699 Kinsman Blvd, Madison, WI 53704
	Blue Ribbon Feed Mill	Rt 2, Celina, OH 45822
	J.R. Coder Co.	10290 S. E. Cindy Lane, Boring, OR 97009
	Ferret Laboratories	120 Storck St, Box 437, Slinger, WI 53086

Toxicant	Supplier	Supplier's Address
Warfarin (Con't)	Ford's Chemical & Service, Inc.	3741 Red Bluff Rd #200, Pasadena, TX 77503-3316
	Furst McNess Co.	120 E. Clark St, Freeport, IL 61032
	Hilliard Products, Inc.	1453 Division Highway, New Holland, PA 17557
	Hobby's Rat & Mouse Bait, Inc.	685 Forest Park Dr, Berne, IN 46711
	Hopkins Agricultural Chemical Co.	Box 7190, Madison, WI 53707
	Imperial, Inc.	Box 98, Shenandoah, IA 51601
	Kelly's Professional Rodent Control	Rt 3, Box 86F, Edinburg, TX 78539
	Muckwin Co.	25 McConnon Dr, Winona, MN 55987
	MFA Oil Co.	200 South 7th, Box 519, Columbia, MO 65201
	Pipestone Products Co., Inc.	P.O. Box 36, Trosky, MN 56177
	Purina Mills, Inc.	Box 66812, St Louis, MO 63166
	Safeguard Chemical Corp.	806 E. 144 St, Bronx, NY 10454
	United Industries Corp.	Spectrum Group Division, Box 15842, St Louis, MO 63114
	Wilbur-Ellis Co.	Box 9518, Fresno, CA 93792
	Zoecon Corp.	A Sandoz Co., 1200 Denton Dr, Dallas, TX 75234
Zinc Phosphide	Bonide Products, Inc.	2 Wurz Ave, Yorkville, NY 13495
	Carajon Chemical Co., Inc.	P.O. Box 167, Fremont, MI 49412
	HACCO, Inc.	537 Atlas Ave, Madison, WI 53716
	Hopkins Agricultural Chemical Co.	Box 7190, Madison, WI 53707
	LiphaTech, Inc.	3600 W. Elm St, Milwaukee, WI 53209
	Platte Chemical Co.	419 18th St, Box 667, Greeley, CO 80632
	Southern Mill Creek Products	5414 North 56th St, Tampa, FL 33610
		537 Atlas Ave, Madison, WI 53716

APPENDIX H
DEPARTMENT OF ARMY REGULATIONS PERTAINING TO PESTICIDE USE

The following regulations govern use of pesticides by U.S. Army military and civilian personnel.*

AR 40-5	Preventive Medicine
AR 40-574	Aerial Dispersal of Pesticides
AR 200-1	Environmental Protection and Enhancement
AR 200-2	Environmental Effects of Army Actions (environmental impact assessments and statements)
AR 210-17	Inactivation of Installation
AR 385-32	Protective Clothing and Equipment (see also TB Med 223)
AR 420-74	Natural Resources: Land, Forest, and Wildlife Management
AR 420-76†	Pest Management (see also TMs 5-629, 5-630, 5-632)
AR 700-93	Processing and Shipping DOD Sponsored Retrograde Materiel Destined for Shipment to the United States, Its Territories, Trusts, and Possessions

* List may not be complete.
† Primary reference.

APPENDIX I
STATE AND FEDERAL GOVERNMENT AGENCIES

These agencies should be able to provide answers to questions on animal damage control methods, endangered species, and pesticide registrations for the localities under their jurisdiction.

SECTION I. ENVIRONMENTAL PROTECTION AGENCY REGIONAL OFFICES

STATE	REGIONAL OFFICE ADDRESS
CONNECTICUT MAINE MASSACHUSETTS NEW HAMPSHIRE RHODE ISLAND VERMONT	Region 1 Room 2203 John F. Kennedy Federal Building Boston, Massachusetts 02203 617-223-7210
NEW JERSEY NEW YORK PUERTO RICO VIRGIN ISLANDS	Region 2 Room 900 26 Federal Plaza New York, New York 10007 212-264-2525
DELAWARE MARYLAND PENNSYLVANIA VIRGINIA WASHINGTON, DC WEST VIRGINIA	Region 3 841 Chestnut St Philadelphia, Pennsylvania 19107 215-597-9814
ALABAMA FLORIDA GEORGIA KENTUCKY MISSISSIPPI NORTH CAROLINA SOUTH CAROLINA TENNESSEE	Region 4 345 Courtland St, NE Atlanta, Georgia 30308 404-881-4727
ILLINOIS INDIANA MICHIGAN MINNESOTA OHIO WISCONSIN	Region 5 Federal Building 230 South Dearborn St Chicago, Illinois 60604 312-353-2000

STATE	REGIONAL OFFICE ADDRESS
ARKANSAS LOUISIANA NEW MEXICO OKLAHOMA TEXAS	Region 6 Interfirst 2 1201 Elm St Dallas, Texas 75270 214-767-2600
IOWA KANSAS MISSOURI NEBRASKA	Region 7 324 East 11th St Kansas City, Missouri 64106 816-374-5493
COLORADO MONTANA NORTH DAKOTA SOUTH DAKOTA UTAH WYOMING	Region 8 Suite 900 1860 Lincoln St Denver, Colorado 80295 303-844-3895
ARIZONA CALIFORNIA HAWAII NEVADA PACIFIC TRUST TERRITORIES	Region 9 215 Fremont St San Francisco, California 94105 415-974-8135
ALASKA IDAHO OREGON WASHINGTON	Region 10 1200 Sixth Ave Seattle, Washington 98101 206-442-5810

SECTION II. STATE PESTICIDE REGULATION INFORMATION AND EXTENSION SERVICES

STATE	PESTICIDE REGULATION INFORMATION	EXTENSION SERVICES
ALABAMA	Alabama Dept. of Agriculture and Industry P.O. Box 3336 Montgomery, Alabama 36193 205-242-2650	State Extension Services Auburn University Auburn, Alabama 36849 205-844-4000
ALASKA	Alaska Dept. of Environmental Cons. P.O. Box 0 Juneau, Alaska 99811-1800 907-465-2600	Cooperative Extension Service University of Alaska Fairbanks Fairbanks, Alaska 99775-5200 907-474-7246
ARIZONA	Arizona Dept. of Agriculture and Environmental Services 1684 West Adams St Phoenix, Arizona 85201 602-833-5422	Cooperative Extension Services Forbes Building, Room 301 University of Arizona Tucson, Arizona 85721 602-621-7209
ARKANSAS	Arkansas State Plant Board P.O. Box 1069 Little Rock, Arkansas 72203 501-225-1598	University of Arkansas Cooperative Extension State Office P.O. Box 391, 72202 Brookwood Rd Little Rock, Arkansas 72203 501-671-2000
CALIFORNIA	California Dept. of Food and Agriculture Pesticide Registration 1220 N. St, Room A-400 Sacramento, California 95814 916-322-5130	University of California Berkeley Extension 2223 Fulton St Berkeley, California 94720 415-642-4111
COLORADO	Colorado Dept. of Agriculture and Plant Industry 700 Kipling St, Suite 4000 ATTN: Steve Blunt/Mrs. M. Klann Lakewood, Colorado 80215 303-239-4100	State Cooperative Extension 1 Administration Building Colorado State University Fort Collins Fort Collins, Colorado 80523 303-491-6281
CONNECTICUT	Environmental Protection Agency ATTN: Hazardous Material 1222 Washington St Hartford, Connecticut 06106 203-566-1932	Cooperative Extension Systems 1376 Storrs Rd University of Connecticut Storrs, Connecticut 06269-4036 203-486-4125
DELAWARE	Delaware Dept. of Agriculture 2320 South DuPont Hwy Dover, Delaware 19901 302-739-4811	Cooperative Extension Service 131 Townson Hall University of Delaware Newark, Delaware 19717-1303 302-451-2504
DISTRICT OF COLUMBIA		Cooperative Extension Service University of the District of Columbia 901 Newton St, NE Washington, DC 20017 202-576-6993

STATE	PESTICIDE REGULATION INFORMATION	EXTENSION SERVICES
FLORIDA	Florida Dept. of Agriculture Bureau of Pesticides Registration MD 2 3125 Conner Blvd Tallahassee, Florida 32399-1650 904-488-6678 / 904-487-2130	Florida Cooperative Extension Service 1038 McCarty Hall University of Florida Gainesville, Florida 32611 904-392-1761
GEORGIA	Georgia Dept. of Agriculture Agriculture Building 19 Martin Luther King Blvd Atlanta, Georgia 30334 404-656-3718	State Extension Services Room 111 Connor Hall (Dr. Wayne Jordan) University of Georgia Athens, Georgia 30602 404-542-3824
GUAM		Extension Services College of Agriculture and Life Sciences University of Guam UOG Station Mangilao 96923
HAWAII	Hawaii Dept. of Agriculture P.O. Box 22159 Honolulu, Hawaii 96823-2159 808-548-7125	Cooperative Extension Service 3050 Maile Way University of Hawaii at Manoa Honolulu, Hawaii 96822 808-956-6007
IDAHO	Idaho Dept. of Agriculture P.O. Box 790 Boise, Idaho 83701 208-334-3243	Agricultural Extension Education Morrill Hall 224 University of Idaho Moscow, Idaho 83843 208-885-6358
ILLINOIS	Illinois Dept. of Agriculture Division of Plant Industry and Consumer Affairs P.O. Box 19281 - Fairgrounds Springfield, Illinois 62794-9281 217-785-2427	State Extension Services 122 Mumford Hall 1301 West Gregory Drive University of Illinois Urbana, Illinois 61801 217-333-2660
INDIANA	Office of Indiana State Chemist 1154 Biochemistry Building West Lafayette, Indiana 47907-1154 317-494-1492	Cooperative Extension Services 1140 Agriculture Administration Building Purdue University West Lafayette, Indiana 47907-1140 317-494-8489
IOWA	Iowa Dept. of Agriculture and Land Stewardship Pesticide Registration Division Wallace Building 900 East Grand Des Moines, Iowa 50319 515-281-4339	State Extension Services 110 Curtiss Hall Iowa State University Ames, Iowa 50011 515-294-4576
KANSAS	Kansas State Board of Agriculture Division Registration Plant Health 901 South Kansas Ave, 7th Floor Topeka, Kansas 66612-1281 913-296-2263	State Extension and Forestry Service Kansas State University 2610 Claflin Rd Manhattan, Kansas 66502-2798 913-532-5752

STATE	PESTICIDE REGULATION INFORMATION	EXTENSION SERVICES
KENTUCKY	Kentucky Dept. of Agriculture Division of Pesticides 500 Merow Capital Plaza Tower Frankfort, Kentucky 40601 502-564-7274	State Extension Services University of Kentucky (C. Oran Little) S123 Agriculture Science Building North Lexington, Kentucky 40546 606-257-4302
LOUISIANA	Louisiana Dept. of Agriculture and Forestry P.O. Box 3596 (Dr. Fred Whitford) Baton Rouge, Louisiana 70821-3596 504-925-3789	Dr. Denver T. Loupe, Vice Chancellor and Director Cooperative Extension Service Knapp Hall Louisiana State University Baton Rouge, Louisiana 70803-1900 504-388-6083
MAINE	Maine Dept. of Agriculture, Food and Rural Resources State House Station #28 Augusta, Maine 04333 207-289-3871	University of Maine Cooperative Extension 102 Libby Hall (Judi Bailey) Orono, Maine 04469 207-581-3194
MARYLAND	Maryland Dept. of Agriculture 50 Harry S. Truman Pkwy Rm 500 Annapolis, Maryland 21401 410-841-5700	Cooperative Extension University of Maryland College Park, Maryland 20742 301-405-2903
MASSACHUSETTS	Executive Office of Environmental Affairs Food and Agriculture Division ATTN: Pesticide Reg. (Mrs. Rivera) 100 Cambridge St Boston, Massachusetts 02202 617-727-3020 ext. 130	Cooperative Extension Stockbridge Hall University of Massachusetts Amherst, Massachusetts 01003 413-545-4800
MICHIGAN	Michigan Dept. of Agriculture 1615 South Harrison East Lansing, Michigan 48823 517-373-5040	State Extension Services 106 Agriculture Hall (Dr. W. J. Moline) Michigan State University East Lansing, Michigan 48824 517-355-2803
MINNESOTA	Minnesota Dept. of Agriculture Agronomy Service Division 90 West Plato Blvd St. Paul, Minnesota 55107 612-296-8312	State Extension Services 240 Coffey Hall University of Minnesota 1420 Eckles Ave St. Paul, Minnesota 55108 612-624-2703
MISSISSIPPI	Mississippi Dept. of Agriculture and Commerce Division of Plant Industry ATTN: Mr. Fulton P.O. Box 5207 Mississippi State, Mississippi 39762 601-325-3390	Cooperative Extension Service Mississippi State University P.O. Box 5446 Mississippi State, Mississippi 39762 601-325-3036
MISSOURI	Missouri Dept. of Agriculture Division of Plant Industry P.O. Box 630 Jefferson City, Missouri 65101 314-751-2462	State Extension Service 309 University Hall University of Missouri Columbia, Missouri 65211 314-882-7754

STATE	PESTICIDE REGULATION INFORMATION	EXTENSION SERVICES
MONTANA	Montana Dept. of Agriculture Agriculture/Livestock Bldg Capitol Station 6th & Roberts Sts Helena, Montana 59620 406-444-3144	State Extension Services Montana State University Bozeman, Montana 59717 406-994-3681
NEBRASKA	Nebraska Dept. of Agriculture Bureau of Plant Industry 301 Centennial Mall South P.O. Box 94947 Lincoln, Nebraska 68509 402-471-2394	Cooperative Extension Service University of Nebraska 211 Agriculture Hall Lincoln, Nebraska 68583-0703 402-472-2966
NEVADA	Nevada Dept. of Agriculture 350 Capitol Hill Ave P.O. Box 11100 Reno, Nevada 89510 702-688-1180	State Extension Services Department of Range, Wildlife, and Forestry University of Nevada 1000 Valley Rd Reno, Nevada 89512 702-784-4055
NEW HAMPSHIRE	New Hampshire Dept. of Agriculture 10 Ferry St, Caller Box 2042 Concord, New Hampshire 03302-2042 603-271-3550/3551	State Extension Services Taylor Hall University of New Hampshire Durham, New Hampshire 03824 603-862-1520
NEW JERSEY	New Jersey Dept. of Environmental Protection CN 411 380 Scotch Rd West Trenton, New Jersey 08625 609-530-4123	State Extension Services Rutgers, The State University P.O. Box 231 New Brunswick, New Jersey 08903 201-932-9306
NEW MEXICO	New Mexico Department of Agriculture Bureau of Pesticide Management P.O. Box 30005, Dept 3AQ Las Cruces, New Mexico 88003 505-646-2133	Cooperative Extension Box 3AE University of New Mexico (Robert L. Gilliland) Las Cruces, New Mexico, 88003 505-646-3748
NEW YORK	New York Dept. of Environmental Conservation Pesticides Management Bureau 50 Wolf Rd Albany, New York 12233-7254 518-457-7482	Cornell Cooperative Extension 276 Roberts Hall P.O. Box 8 Kennedy Ithaca, New York 14853-5901 607-255-2117
NORTH CAROLINA	North Carolina Dept. of Agriculture P.O. Box 27647 Raleigh, North Carolina 27611 919-733-3556	Cooperative Extension Services Box 7602 North Carolina State University Raleigh, North Carolina 27650 919-737-2811
NORTH DAKOTA	North Dakota State Dept. of Health and Consolidated Laboratory Consumer Protection Division 2635 East Main St Bismarck, North Dakota 58501 701-221-6149	Cooperative Extension Service Greg Dahl Extension Pesticide Box 5638 North Dakota State University Fargo, North Dakota 58105 701-237-7173

STATE	PESTICIDE REGULATION INFORMATION	EXTENSION SERVICES
OHIO	Ohio Dept. of Agriculture and Plant Industry 8995 East Main St, ATTN: Bob Wolfhurst Reynoldsburg, Ohio 43068 614-466-2732	Cooperative Extension Services 2120 Fyffe Rd Ohio State University (Dr. Bobby D. Moser) Columbus, Ohio 43210 614-292-6181
OKLAHOMA	Oklahoma State Board of Agriculture 2800 Lincoln Blvd Oklahoma City, Oklahoma 73105-4298 405-521-3864	State Extension Services Oklahoma State University (C. B. Browning) Stillwater, Oklahoma 74078 405-744-5398
OREGON	Oregon Dept. of Agriculture 635 Capitol St, N.E. Salem, Oregon 97310-0110 503-378-3776	Oregon State University Extension Service Ballard Hall Oregon State University (Dr. O. E. Smith) Corvallis, Oregon 97331-3606 503-737-2713
PENNSYLVANIA	Pennsylvania Dept. of Agriculture Bureau of Plant Industry 2301 North Cameron St Harrisburg, Pennsylvania 17110-9408 717-787-4843	State Extension Service 323 Agriculture Administration Building Pennsylvania State University University Park, Pennsylvania 16802 814-863-3438
PUERTO RICO	Puerto Rico Dept. of Agriculture P.O. Box 10163, ATTN: Hector Nunez San Juan, Puerto Rico 00908 809-722-2638	Extension Services University of Puerto Rico (Dr. Jesse Roman) Mayaguez, Puerto Rico 00708 809-833-7000
RHODE ISLAND	Rhode Island Dept. of Environmental Management Division of Agriculture 22 Hayes St Providence, Rhode Island 02908 401-277-2781	State Extension Services University of Rhode Island Kingston, Rhode Island 02881 401-792-2474
SOUTH CAROLINA	Department of Fertilizer and Pest Control 256 Poole Agriculture Center Clemson University Clemson, South Carolina 29634-0394 803-656-3171	State Extension Services 103 Barre Hall Clemson University Clemson, South Carolina 29634 803-656-3382
SOUTH DAKOTA	South Dakota Dept. of Agriculture Sigurd Anderson Building Pierre, South Dakota 57501 605-773-3724	State Extension Services P.O. Box 2207D Agricultural Hall (Dr. Mylo Hellickson) South Dakota State University Brookings, South Dakota 5700/ 605-688-4792
TENNESSEE	Tennessee Dept. of Agriculture P.O. Box 40627 Melrose Branch 7 Ellington Agricultural Center Nashville, Tennessee 37204 615-360-1030	Agricultural Extension Service P.O. Box 1071 University of Tennessee Knoxville, Tennessee 37901-1071 615-974-7114

STATE	PESTICIDE REGULATION INFORMATION	EXTENSION SERVICES
TEXAS	Texas Dept. of Agriculture P.O. Box 12847 Capital Station Austin, Texas 78711 512-463-7476	Agriculture Extension Service Texas A&M University College Station, Texas 77843 409-845-7967
UTAH	Utah Dept. of Agriculture 350 North Redwood Rd Salt Lake City, Utah 84116 801-538-7100	State Extension Services Utah State University (Dr. R. Paul Larsen) Logan, Utah 84322-4900 801-750-2200
VERMONT	Vermont Dept. of Agriculture, Food and Market 120 State St Montpelier, Vermont 05620-2901 802-828-2431/2430	State Extension System Room 103 Morrill Hall University of Vermont (Robert E. Honnold) Burlington, Vermont 05405 802-656-2990
VIRGIN ISLANDS		Cooperative Extension Service R.R. #2, Box 10,000 (Darshan S. Padda) Kingshill, St Croix, VI 00850 809-778-0246
VIRGINIA	Virginia Dept. of Agriculture and Consumer Services Office of Pesticide Management ATTN: Vicki Groome P.O. Box 1163, Rm 403 Richmond, Virginia 23209 804-786-3798	State Extension Services 336 Burruss Hall Virginia Tech (James F. Johnson) Blacksburg, Virginia 24061-0220 703-231-6707
WASHINGTON	Washington Dept. of Agriculture Division of Grain and Chemicals 406 General Administration Building Olympia, Washington 98504 206-753-5064	Dr. F. L. Poston Cooperative Extension 411 Hulbert Hall Washington State University Pullman, Washington 99164-6230 509-335-2933
WEST VIRGINIA	West Virginia Dept. of Agriculture Pesticide Division State Capitol Building Charleston, West Virginia 25305 304-348-2209	Cooperative Extension Services Room 817 Knapp Hall, P.O. Box 0631 West Virginia University (Dr. Rachael Tompkins) Morgantown, West Virginia 26506-0631 304-293-5691
WISCONSIN	Wisconsin Dept. of Agriculture Trade and Consumer Protection 801 West Badger Rd P.O. Box 8911 Madison, Wisconsin 53708 608-266-7756	Cooperative Extension Services 432 North Lake St University of Wisconsin (Dr. Patrick Boyle) Madison, Wisconsin 53706 608-263-2775
WYOMING	Wyoming Dept. of Agriculture 2219 Carey Ave Cheyenne, Wyoming 82002 307-777-7321	Cooperative Extension Box 3354 University Station (Dr. James O. DeBree) Laramie, Wyoming 82071 307-766-4133

APPENDIX J
SAMPLE CHECKLIST FOR HOMEOWNERS, RENTERS, AND BUILDING MANAGERS

This checklist is intended as an aid for residents and building managers in identifying steps they can take to reduce rodent infestations on their property.

1. Owner/Occupant _____ Date of Survey _____

   Address _____

2. Rodent Evidence (Rats = R, Mice = M)

Droppings/Urine	_____	Nests	_____
Gnawing/Sounds	_____	Odors	_____
Tracks/Trails/Rub Marks	_____	Pet Behavior	_____

3. Yard and Neighborhood Conditions (check conditions that need improvement)

Thin dense vines, shrubbery	_____
Mow tall vegetation	_____
Clean up trash, clutter	_____
Remove junk vehicles, appliances, furniture	_____
Clean up garbage spills	_____
Replace worn or damaged garbage/trash containers and lids	_____
Clean up spilled bird food	_____
Bring in pet food at night, clean up spills	_____
Clean up pet excrement	_____
Remove ripe/excess vegetables from garden	_____
Clean up fallen fruit, nuts	_____
Store animal feed in rodent-proof buildings or containers	_____
Eliminate or repair dilapidated outbuildings	_____

4. Building Conditions (check items needing repairs)

Install screens on windows, vents	_____
Repair loose-fitting doors, windows	_____
Eliminate gaps around pipes and other utilities entering through walls	_____
Repair broken floor drains	_____
Patch breaks in foundation walls and floors	_____
Repair leaking plumbing	_____
Eliminate overhanging tree limbs	_____
Remove vines from walls, especially around windows	_____
Repair holes in interior walls	_____
Clean up cluttered basement	_____
Clean up cluttered attic	_____
Clean up cluttered garage	_____
Eliminate unnecessary stored materials	_____
Store food in rodent-proof containers	_____

5. Control Methods - Use traps and toxicants only where children and pets cannot reach them.

Clean up clutter	_____
Eliminate food sources	_____
Traps	_____
Anticoagulant rodenticides	_____

GLOSSARY

SECTION I. ABBREVIATIONS

DOD
Department of Defense

EA
Environmental Assessment

EIS
Environmental Impact Statement

EPA
U.S. Environmental Protection Agency

FIFRA
Federal Insecticide, Fungicide, and Rodenticide Act

g
gram

IPM
integrated pest management

kHz
kilohertz

ml
milliliter

mm
millimeter

NEPA
National Environmental Policy Act

TG
technical guide

SECTION II. TERMS

Commensal Rodent
A rodent that shares man's habitat and food.

Ecosystem
A habitat and all the organisms dependent on that habitat.

Environment
An organism's physical surroundings; the soil, water, vegetation, and man-made structures in an area.

Habitat
The environment in which an organism normally occurs.

Harborage
Vegetation, man-made structures, objects, or trash that provide shelter and nesting materials for rodents.

Integrated Pest Management (IPM)
The use of all feasible biological, chemical, and cultural techniques available in an economically and ecologically sound manner to keep pest damage below an economic injury level while minimizing hazards to the environment.

Prebait
Bait, without toxicant, that is used to familiarize a rodent population with a bait material and reduce aversion to the toxic bait formulation.

Rodent Proofing
Modifying a structure to prevent entry by rodents.

Sanitation - environmental cleanup
The removal of garbage and trash that could provide food and shelter to rodents.

Wild Rodent
A rodent that does not normally share man's habitat.

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