GUIDE for the CARE and USE of LABORATORY ANIMALS
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USE of
LABORATORY ANIMALS

Prepared by the
COMMITTEE ON REVISION OF THE GUIDE FOR LABORATORY
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Notice

The study reported herein was undertaken under the aegis of the National Research Council with the express approval of the Governing Board of the NRC. Such approval indicated that the Board considered that the problem is of national significance; that elucidation or solution of the problem required scientific or technical competence, and that the resources of NRC were particularly suitable to the conduct of the project. The institutional responsibilities of the NRC were then discharged in the following manner:

The members of the study committee were selected for their individual scholarly competence and judgment with due consideration for the balance and breadth of disciplines. Responsibility for all aspects of this report rests with the study committee to whom we express our sincere appreciation.

Although the reports of our study committees are not submitted for approval to the Academy membership nor to the Council, each report is reviewed by a second group of appropriately qualified individuals according to procedures established and monitored by the Academy’s Report Review Committee. Such reviews are intended to determine, inter alia, whether the major questions and relevant points of view have been addressed and whether the reported findings, conclusions, and recommendations arose from the available data and information. Distribution of the report is approved by the President only after satisfactory completion of this review process.
Preface

The Guide for the Care and Use of Laboratory Animals was first published in 1963 under the title Guide for Laboratory Animal Facilities and Care. It was revised in 1965, and again in 1968. More than 150,000 copies of the Guide have been distributed since it was first published, and it has become a primary reference on standards of animal care in scientific institutions.

The principal purpose of the Guide continues to be to assist scientific institutions in providing professionally appropriate care for laboratory animals. The recommendations are based on scientific principles, expert opinion, and experience with methods and practices that have proved to be consistent with high quality animal care.

The fourth edition of the Guide has a new title that reflects the enlarged scope of the recommendations for the care and use of animals. The changes and the new material in this edition are in keeping with the statement in the Introduction to each of the previous editions that “the Guide . . . must be a living document, subject to change with changing conditions and new information.”

This edition of the Guide was prepared by the Institute of Laboratory Animal Resources of the National Research Council under contract PH43–64–44, administered by the Animal Resources Branch, Division of Research Resources, N.I.H. The Guide may contain errors of omission and commission. Corrections and suggestions may be forwarded to the Institute of Laboratory Animal Resources (NAS–NRC), 2101 Constitution Avenue, N.W., Washington, D.C., 20418.
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Introduction

The scientific community has long recognized a scientific and ethical responsibility to provide humane care for experimental animals. The standards incorporated in the Guide for the Care and Use of Laboratory Animals reflect this concern for the welfare of animals used for research and education in biology and medicine. These standards are a synthesis of knowledgeable experience and opinion based on scientific principles and concepts, and they constitute a definition of humane animal care in professional terms. The Committee believes that the operation of institutional animal facilities should be guided by these recommendations, just as the American Association for Accreditation of Laboratory Animal Care (AAALAC) uses them in its accreditation program. They are intended as a yardstick against which institutions can measure and evaluate their animal care programs.

This edition of the Guide has been organized to cover the major areas of concern in the laboratory animal field. Section I deals with the management, housing, and care of animals, including methods to provide for their proper maintenance under laboratory conditions. Section II is concerned with laboratory animal quality, health, and the provision of adequate veterinary care for animals. Section III contains recommendations on staffing and on the protection of animal colony personnel against occupational hazards. Section IV deals with the use of animals, including discussion of the role of an institutional committee on use and care of animals, and recommendations to guide animal anesthesia, surgery, postsurgical care, and euthanasia. Section V is intended to supplement Sections I-IV and to assist scientific institutions in planning the physical resources needed to assure the adequacy of their animal care programs. Finally, the Appendices contain information relevant to the care and use of animals.

The Committee recognizes that the nature of the animal facilities and the specific methods used in implementing the animal care program will vary with the type and size of the scientific institution. It also recognizes that the proper control of certain experiments may require modification of recommendations in the Guide in the interest of the research. It emphasizes that nothing in the Guide is intended to limit the investigator's freedom and obligation to
plan and conduct animal experiments in accord with accepted scientific practice. Finally, it hopes the permissive language and intent of the Guide will encourage investigators to seek new and better methods of laboratory animal care and to apply professional judgment in the interpretation of these recommendations.

I. Laboratory Animal Management

The proper management of laboratory animals depends on many subjective and objective factors that interact differently in different institutions. Experienced animal care workers know that well-trained and motivated personnel frequently can overcome deficiencies in the physical plant or housing equipment to assure high quality animal care. For the purposes of the Guide, proper management is defined as any system of housing and care that permits animals to grow, mature, reproduce, or behave normally, and to be maintained in physical comfort and good health. Some of the specific considerations that give meaning to this definition are outlined in this section.

A. Housing and care

1. Criteria for evaluating a caging or housing system

The caging or housing system is one of the most important single elements in the physical environment for laboratory animals. Inasmuch as the well-being of the animals and the control of experiments are influenced by the housing system, it should always be designed carefully. The following criteria may be used to evaluate the caging or housing system (hereinafter referred to as the "system"):

(a) The system should be designed with the animals' physical comfort as a primary consideration. Physical comfort, as applied specifically to housing, includes factors such as keeping the animal dry and clean or providing an appropriate aquatic or marine environment; maintaining the animal in a state of relative thermal neutrality; providing sufficient space to assure freedom of movement and allow for normal postural adjustments; avoiding unnecessary physical restraint; providing convenient access to clean food and water; and, if animals are housed in groups, maintaining them compatibly without overcrowding.

(b) The functional operation of the system should be compatible with the maintenance of the animals in good health as measured by such factors as the maintenance
of normal body weight and the prevention of diseases. Housing of different animal species in the same room may contribute to spread of infectious diseases. This can be circumvented by housing only the same species in a single room or area.

(c) The system should be designed to facilitate effective sanitary maintenance and technical servicing. For example, bends and crevices in animal cages that may be difficult to clean, should be avoided; feeding and watering devices should be easily accessible for filling or changing.

(d) Throughout the system, the maintenance of the cages, runs, and pens in good repair should be considered mandatory, to prevent injury to the animals and to promote physical comfort. Particular attention should be given to avoiding sharp corners and edges or broken wires and to maintaining cage floors in good condition to prevent injury.

(e) The system should meet the investigator's research requirements. Rarely are the animal housing requirements found to be incompatible with the requirements for research. Animals may need to be housed, singly or in groups, in cages, runs, or pens. When toxic, infectious, or radioactive substances are used, special housing facilities may be needed to satisfy the requirements for both research and safety.

2. Physical activity, confinement, and restraint.

(a) Physical activity

One of the most widely debated questions in the field of animal care concerns the need for "exercise" or physical activity in the housing of laboratory animals, most specifically in the housing of dogs. The concept of exercise frequently is confused with release of animals from confinement in cages. Confinement in a cage has been equated by some with lack of exercise and physical or psychological discomfort, while regular release from confinement has been equated with exercise and physical or psychological well-being. However, confinement in a cage per se does not necessarily influence the amount of exercise an animal engages in, and it does not necessarily affect an animal's well-being.

In this text, "exercise" is defined as any physical activity. On this basis, whether dogs and other animals are exercised and what form it should take, are matters for professional judgment. Factors such as the breed and temperament, the previous history, the animal's physical condition, the nature of the research, and the expected duration of confinement are among those that should be considered in determining the need for supplementary exercise. If exercise is needed it may be provided regularly in any of several ways, such as by using a treadmill or exercise wheel, by walking animals on a leash, by providing access to runs, or by releasing animals from their cages in animal rooms.

Cages are often necessary or useful for intensive postsurgical care, for isolation of sick animals, for metabolic studies, and for short-term holding of dogs (one to three months). There are, however, practical reasons for providing pens, runs, or other out-of-cage space in all dog housing areas. In addition to providing more opportunity for exercise, pens or runs also provide a convenient place to hold dogs while their cages are being cleaned.

Professional judgment should be applied when determining exercise needs of large domestic animals such as horses and cattle. If exercise is needed, loafing areas, exercise lots, pastures, or controlled exercise are suitable.

(b) Confinement and restraint

The use of restraint chairs or other confinement devices is sometimes necessary for research. The following considerations should guide investigators in the use of restraint equipment:

(1) The period of confinement or restraint should be the minimum required to accomplish the research objectives.

(2) Confinement of primates in chairs or other restraint devices is not to be considered a "normal" method of laboratory housing, although it may be required to attain specific research objectives.

(3) Restraint chairs should not be used simply as a convenience to the investigator in the handling or management of primates.

(4) When primates are restrained in chairs or other confinement devices, particular attention must be paid to the possible development of lesions or illness that may be associated with continuous
3. Sanitation practices

1. Cleanliness

(a) The animal facility should be kept clean. A regular schedule of sanitary maintenance is necessary, including the elimination of radioactive, toxic, and infectious wastes.

(b) Animal rooms, corridors, storage spaces, and other areas of the animal facility should be cleaned as often as necessary using appropriate detergents and disinfectants to keep them free of dirt, debris, and harmful contamination. A continuing objective should be to keep these areas neat and uncluttered. Monitoring may also be required for radiologic, toxicologic, and infectious agents.

(c) If litter or bedding is used in animal cages or pens, it should be changed as often as necessary to keep the animals dry and clean, and to minimize offensive odors. For routine maintenance of small rodents, such as rats, mice, or hamsters, one to three such changes per week ordinarily should suffice. For larger species such as dogs, cats, and primates, daily changing of cage or pen litter may be necessary.

Daily removal of soiled bedding for the large domestic animals may be necessary to maintain cleanliness and sanitation. It may be necessary to clean stanchions or tie stalls twice daily.

(d) Cages or pens from which animal waste is removed by hosing or flushing should be cleaned one or more times daily. This system may require removal of the animals during servicing in order to keep them dry.

(e) Animal cages, racks, aquaria, and accessory equipment, such as feeders and water bottles, should be washed and sanitized as often as necessary to keep them physically clean and free from contamination. Ordinarily, this can be achieved by washing the cages and accessories once or twice weekly, and the racks every other week. In addition, cages should always be sanitized before new animals are placed in them. It is a good practice to have extra cages available at all times to allow for a systematic cage-washing schedule. The washing or rinsing, or both, should be conducted at a temperature of 83° C. (180° F.) or higher for a sufficient period of time to assure destruction of most pathogenic organisms. Sanitizing may also be accomplished with appropriate disinfectants. Where radioactive, infectious, or toxic materials are used, a system of equipment monitoring should be instituted.

(f) Waste containers and implements should be maintained in sanitary condition. It is a good practice to line the waste cans with disposable liners and to wash each waste can every time it is emptied, using the same methods as suggested above for animal cages. As with animal cages, the minimum wash or rinse temperature, or both, should be 83° C. (180° F.) or higher for a sufficient period of time to assure destruction of most pathogenic organisms, or appropriate disinfectants should be used.

2. Sanitary waste disposal

(a) All waste should be collected and removed in a safe, sanitary manner. If waste cans are used, they should be made of metal or plastic, be leakproof, and be equipped with tight-fitting lids. It is advisable to use leakproof disposable liners in waste cans, for disposal of animal tissues, carcasses, and radioactive or toxic wastes. (See sections V. G., V. II.)

(b) Highly infectious wastes should be rendered noninfectious, by autoclaving or other effective means, before removing them from the animal facility.

(c) Waste materials should be removed regularly and frequently. If storage of waste prior to removal is necessary, the storage area should be physically separated from other storage facilities, and be free from flies, cockroaches, rodents, and other pests. Cold storage to prevent decomposition of biological waste may be required prior to disposal.

(d) Most states and municipalities have statutes or ordinances controlling disposal of wastes. Compliance with these requirements is an institutional responsibility.
3. Vermin control

(a) Cockroaches, flies, escaped or wild rodents, and similar pests which constitute a menace in animal facilities should be effectively controlled or eliminated.

(b) Vermin control programs should be instituted in new buildings prior to occupancy. Effective control can be attained in older buildings, even where heavy infestation has occurred. This can be accomplished by sealing or eliminating all breeding sites, and by using pesticides or trapping procedures in conjunction with a strict program of sanitary maintenance. Pesticide application must be carried out under professional supervision to avoid toxic effects to the animals and possible interference with experimental procedures. The harmful build-up of these materials or their disposal in undesirable quantities into public waste systems or the environment must be avoided.

C. Feeding, watering, and identification of laboratory animals

1. Feeding

All laboratory animals should have daily access to feed according to their particular requirements. The food should be clean, free of contaminants, palatable, and nutritionally adequate. It should be fed in amounts sufficient to assure normal growth in immature animals and maintenance of normal body weight in adults.

2. Watering

Laboratory animals should have daily access to water, according to their particular requirements. Ordinarily, drinking water should be available at all times unless adequate water is supplied in the diet. Watering devices such as drinking tubes and spouts, and automatic waterers should be examined routinely to assure their patency and use by the animals. It may be necessary to train animals to use automatic watering devices.

3. Identification and records

Laboratory animals should be identified by placing identification cards in the animal rooms, on cages, or on racks; by the use of comfortable collars, bands, or identifying plates or tags on the animals; by stains of various colors; by ear punching or ear tagging; by tattooing; by freeze branding; or by other appropriate means. Identification cards should include such information as the source of the animal, name and location of the responsible investigator, and pertinent dates.

Records on experimental animals are essential to good animal care and for some species are required by federal law. These records should include notations on the source of origin and eventual disposition of each animal in addition to other relevant information.

D. Provisions for emergency care

Provision must be made for the emergency care of animals. Institutional security personnel and fire or police officials should know how to reach the responsible individual. This can be accomplished by prominently posting his name in the animal facilities, or listing him with the institution’s central telephone center or security department. The objective must be to assure that animals will be cared for should an emergency arise.
II. Laboratory Animal Quality and Health

Concern for the quality and health of laboratory animals is both a humane and a scientific requirement. The procedures recommended here are based upon current knowledge. Some are based on experimentally-deduced information; the remainder are based on expert opinion.

A. Adequate veterinary care

Adequate veterinary care consists of a program of disease prevention and control, appropriate for each species, administered by a veterinarian qualified by training or experience to administer such a program. The program must include the provision of husbandry appropriate for each species, the frequent observation of all animals by a person qualified to verify the health of each animal, the availability of veterinary medical service for animals found to be ill or injured, and the application of currently accepted measures of prophylaxis and therapy. Adequate veterinary care also includes consideration for humane aspects of animal experimentation such as the proper use of anesthetics, analgesics, and tranquilizers.

B. Quarantine and isolation of animals

1. Quarantine

Quarantine is the separation of newly received animals from animals already in the facility until the health status of the newly received animals has been evaluated. This evaluation should be made in accordance with acceptable veterinary medical practice. Applicable local, State, or Federal regulations pertaining to the health of the animals must be followed. For species such as rats, mice and hamsters, when obtained from reliable sources, the quarantine may be limited to the time necessary for inspection upon arrival. For these and similar species, control of quality at the source and knowledge of the environmental history of the animals are effective as a part of the quarantine protocol within the institution. Where the environmental history of the animal is unknown, such as is commonly the case with dogs, cats, primates,
and large domestic animals, more complete quarantine procedures should be employed.

The quarantine period is often used to condition animals. During this period some or all of the following may be performed:
(a) Determination as to whether the animals are appropriate for the intended use.
(b) Physical examination of the animals, including performance of appropriate clinical and laboratory diagnostic tests and appropriate treatment.
(c) Diagnosis and control of diseases transmissible between animals and man.
(d) Stabilization of the nutritional state of the animals.
(e) Grooming, including bathing, dipping, drying and clipping as may be required.

2. Isolation

Isolation is the complete separation of animals either known or suspected of being diseased, or of being carriers of disease, from animals that are in good health. When a non-experimentally induced infectious disease is recognized, the animals involved should be completely separated from all other animals. This may be accomplished by placing the animals in isolation units or separate rooms. Management of such diseased animals should be carried out according to the recommendation in Section II D.

C. Separation by species

The physical separation of animals by species may sometimes be necessary to protect against interspecies transmission of infectious diseases and to meet environmental requirements. This is best accomplished by housing the animals in separate rooms. The following are examples of the considerations which should guide those who must determine the need for separate housing by species:

1. Primates

Certain species of primates may carry subclinical or latent viral infections that may be fatal when transmitted to another species. For example, Herpesvirus tamarinus may cause mild stomatitis in squirrel monkeys (Saimiri sciureus); but fatal epizootics have followed natural transmission of the virus from squirrel monkeys to owl monkeys (Aotus trivirgatus) and some marmosets (Saguinus sp.). Squirrel monkeys should not be housed in the same room with these latter species. Herpesvirus simiae (B virus) is seen in Asian monkeys, especially in the rhesus and cynomolgus monkeys. It is best to house them apart from other primate species. Primates of African origin should probably be housed apart from other primate species to protect against the spread of viruses, such as Yaba or Yaba-like and Marburg. The great apes should be separated from other primates and should have strictly limited contact with man because they may be carriers as well as victims of diseases carried by man such as tuberculosis, infectious hepatitis, variola, rubeola, and poliomyelitis.

2. Rabbits

Rabbits should be housed in separate rooms because they frequently harbor organisms such as Pasteurella sp. and Bordetella sp. which are infectious to cats, primates, guinea pigs, and other species. Furthermore, rabbits are more comfortably maintained at lower temperatures than are suitable for most other common laboratory species.

3. Cats and dogs

The housing of cats and dogs in the same room is acceptable. It is best to separate the cages or pens so as to minimize visual contact; but experience has shown that these species usually accommodate to each other when confined in the same room.

D. Diagnosis, treatment and control of animal diseases

All laboratory animals should be observed frequently for clinical signs of illness, injury, or abnormal behavior by a person trained to recognize such signs. (See section III.) It is good practice to observe the animals daily. All deviations from normal, and deaths from unknown causes, should be reported promptly to the person responsible for animal disease control.

Animals that develop spontaneous disease or other abnormalities rendering them unsuitable for laboratory purposes should be treated or painlessly killed. (See section IV D.)

Diagnostic laboratory services may be required to supplement the physical examination of animals and facilitate the proper diagnosis of abnormal conditions. These services should include necropsy, histological examination of animal tissues, isolation and identification of specific pathogens, and routine or specialized laboratory procedures.

The control and treatment of animal diseases and other abnormalities may require the appropriate quarantine and isola-
to support animal care programs depend on several factors. Among these are the type of institution; its size; the nature of the administrative structure for animal care; the nature of the physical plant; the number and species of the animals maintained; and the nature of the teaching, testing, or research activities. Therefore, no arbitrary statement can be made concerning personnel requirements. The intent here is simply to provide guidelines which may be helpful in acquiring staff capable of implementing these standards.

A. Professional personnel

Animal care programs require professional direction in addition to that provided by the user of the animal. The functions of such programs may include the provision of a broad range of laboratory, clinical, research, and animal husbandry services. These programs should be directed by veterinarians having specialized training or experience in laboratory animal medicine. (See Appendix III.)

The employment of a full-time staff specifically concerned with the animal care program is recommended. This includes the professional and supporting personnel necessary to implement the veterinary, animal husbandry, and administrative aspects of the program. It may not be feasible in all institutions to employ a large staff for this program because the number of animals maintained may be small. In these institutions consultants experienced in laboratory animal medicine may provide adequate veterinary care.

B. Animal care personnel

Animal care programs require administrative, technical, and husbandry support. Courses of education and training in animal technology are offered in numerous institutions. (See Appendix IV.) A national certification program for animal technicians exists. (See Appendix II.) Scientific institutions should make provisions for the employment of such specialists or for on-the-job training.
and supervision of personnel to assure effective implementation of their animal care programs.

C. Personal hygiene and personnel health program

1. Personal hygiene

(a) The maintenance of high standards of personal cleanliness among animal colony personnel is obligatory. The facilities necessary for meeting this obligation should be provided.

(b) To aid in maintaining a high standard of personal hygiene, laboratory clothing suitable for use in the animal facility should be provided. This clothing should be changed as often as necessary to enable personnel to maintain personal cleanliness. Suitable facilities should be available for storage of street clothing during the workday.

(c) Eating, drinking, and smoking by personnel should not be permitted within animal rooms. A separate area or room is recommended for these purposes.

2. Personnel health program

(a) An occupational health program is mandatory for personnel working in laboratory animal facilities and for other personnel with significant animal contact. It should include preplacement and periodic physical examinations. The specific occupational hazards that may exist should be recognized, such as diseases transmissible between animals and man. An immunization schedule appropriate to the animal care program should be developed. For example, it is important to immunize animal care personnel against tetanus. Those handling carnivores, bats, or other species that can transmit rabies may have to be protected by preexposure immunization.

(b) Zoonoses surveillance should be an essential part of the occupational health program. An adequate surveillance program should include a permanent case record of individual work assignments. Records concerning bite wounds and occurrence of any unusual illnesses should be retained by the institution. Personnel should be instructed to notify their supervisor of suspected health hazards. Consideration should be given to obtaining and storing individual preplacement and postemployment sera for future diagnostic purposes.

(c) Diseases of primates transmissible to man can be a serious hazard to personnel. The disease prevention program should include regularly scheduled examinations for tuberculosis for individuals having contact with primate colonies such as animal technicians, investigators, research technicians, maintenance workers, and guards. Protective clothing such as full-length gowns, gloves, masks, and face shields should be available for use when handling primates.
IV. Use of Laboratory Animals

Proper care and humane treatment of animals during their use in research and education require scientific and professional judgment. This implies specific knowledge of the needs of the animals, the requirements of the research, and the setting in which the research is to be conducted. Scientific and professional judgments about the use of animals are best made in accordance with the requirements of the institution. The guidelines in this section are intended to aid in developing institutional policies governing animal research.

A. Monitoring the use and care of animals

The appointment of a Committee on Use and Care of Animals is one effective way to develop and monitor policies to guide animal care in keeping with institutional requirements. The membership of the committee should be representative of the various users, and at least one of the members should be a Doctor of Veterinary Medicine. The committee should be responsible for evaluating the animal care program in regard to the maintenance of acceptable standards for the care, use, and treatment of animals in research and education.

B. Anesthesia and analgesia

The proper use of anesthetics, analgesics, and tranquilizers in laboratory animals is necessary for humane and scientific reasons. The use and choice of the most appropriate drug(s) are matters of professional judgment to be determined by the responsible investigator or the attending veterinarian in accordance with the institutional policies.

If a procedure must be conducted without the use of an anesthetic, analgesic or tranquilizer because such use would defeat the purpose of an experiment, the procedure must be directly supervised by the responsible investigator in agreement with institutional policies and local, State, or Federal regulations. (See Appendix V.)

Muscle relaxants or paralytics are not anesthetics and they should not be used alone for surgical restraint. They may be used
for surgery in conjunction with drugs known to produce adequate analgesia.

C. Surgery and postsurgical care

1. Appropriate facilities and equipment should be available for surgical procedures. (See section V.E.) Laboratory facilities may be utilized for nonsterile terminal procedures and for clean surgery on small animals such as rats, mice, guinea pigs, and hamsters if accepted surgical techniques and procedures are followed.

2. A facility intended for aseptic surgery should be used only for that purpose and should be maintained and operated to assure cleanliness of the area. All nonterminal surgery on dogs, cats, primates, and large domestic animals should be done aseptically.

3. A facility for aseptic surgery should be directed and staffed by qualified personnel.

4. Aseptic surgery should be performed only by individuals qualified by training or experience. Provisions should be made for instruction in aseptic surgery for individuals requiring training.

5. Appropriate facilities and equipment should be available for the postsurgical care of animals. (See section V.E.) Postsurgical care should include observation of the animal until recovered from anesthesia, administration of supportive fluids and drugs, care of the surgical incisions, and observation to assure the animal’s physical comfort and optimal recovery. Appropriate records should be maintained. Trained personnel should be available to deal with emergencies at any time.

D. Euthanasia

Euthanasia should be performed by trained persons in accordance with institutional policies and applicable laws. The choice of method should depend on the species of animal and the project for which the animal was used. The method of euthanasia should not interfere with any postmortem examinations or determinations to be performed.

Dogs, cats, guinea pigs, rabbits, and primates can be killed quickly and humanely by injecting high concentrations of barbiturate solutions intravenously or intraperitoneally. Mice, rats and hamsters can be killed by cervical dislocation, or by the use of ether, nitrogen, or carbon dioxide in an uncrowded chamber.

In large domestic animals rapid intravenous administration of high concentrations of thiobarbiturate will produce anesthesia for a short period of time. The animal can then be killed humanely.

V. Physical Plant

The physical condition and design of animal facilities, to a great extent, determine the efficiency and economy of their operation and greatly influence standards for animal care. A well-designed, properly maintained facility is an essential element in good animal care. This section of the Guide deals with the design and construction features that must be considered in the planning and operation of animal facilities.

A. Functional areas

The design, scope, and size of an animal facility depend on the nature of the research activities, the animals to be housed, the physical relationship to the rest of the institution, and the geographic location. The following functional areas are considered essential in a modern animal facility:

1. A separate building, a separate wing, one or more floors, or separate rooms are needed. A sufficient number of animal rooms or areas are required to assure separation of species when necessary, or isolation of individual projects; to receive, quarantine and isolate the animals; and to provide for their routine and specialized housing.

2. Specialized laboratories or areas contiguous with or near the animal housing areas are needed for activities such as surgery; intensive care; necropsy; radiography; preparation of special diets; and the diagnosis, treatment, and control of laboratory animal diseases. If radioisotopes, toxic substances, or infectious agents are to be used, special facilities or areas may be required.

3. Receiving and storage areas should be provided for food, bedding, supplies, and equipment.

4. Space should be provided for the administration, supervision, and direction of the facility.

5. Showers, sinks, lockers, and toilets are required for personnel.

6. An area must be designated for washing and sterilizing the equipment and supplies. Depending upon the volume of work, a well-equipped cleaning area includes facilities such as a cage-washing machine; a bottle- or glassware-washing machine; a rack-wash-
animal housing usually permits the most efficient and economical animal care operation, since vertical transport is avoided. However, this may not be the most desirable choice for research workers because of the distance from their laboratories. In planning animal facilities, efficiency and economy in utilizing the research worker's time must be considered. Careful planning should make it possible to locate the animal housing areas adjacent to or near investigator's laboratories; but they should be physically separated from the laboratories by barriers such as entry locks, separate corridors, or separate floors. A recent development in animal housing is the use of modular units, such as specially designed trailers or prefabricated structures. Such units should meet construction guidelines as stated in section V.D.

Many institutions have developed farm-type facilities for conditioning, isolating and quarantining large animals and for maintaining them over long periods of time.

D. Construction guidelines

Building materials should be selected to facilitate efficient and hygienic operation of animal quarters. Durable, waterproof, fire-resistant, seamless materials are most desirable for interior surfaces. Paints and glazes, in addition to being highly resistant to chemical solvents, cleaning agents, and scrubbing, also should be highly resistant to high-pressure sprays and impact. Construction should conform to local institutional rules and regulations (building codes).

1. Corridors

Corridors should be at least seven feet wide to facilitate easy flow of personnel and equipment. The floor-wall junction should be coved to facilitate cleaning. Provisions should be made for curbs, guardrails, and bumpers on equipment to protect the walls from damage. Exposed corners should be protected by reinforcing them with steel, or another durable material. Corridors leading to dog kennels should be provided with a noise trap such as a double-door entry lock. Wherever possible, access to utilities such as waterlines, drainpipes, and electrical connections should be through service panels or shafts located in the corridors outside the animal rooms.

2. Animal room doors

Doors should open into the animal room. If they open to the corridor, there should be a recessed vestibule. Doors should be at least 107 centimeters [cm.] (42 inches) [in.] wide and not less than
213 cm. (84 in.) high to permit easy passage of racks and equipment. The doors should fit tightly within the frames and both should be completely sealed to provide a barrier against the entrance or harboring of vermin. Metal or metal-covered doors are preferable. They should be equipped with locks, kickplates and be self-closing. Recessed handles are recommended. Viewing windows are desirable.

3. Exterior windows

Exterior windows and skylights are not needed in the animal rooms if adequate ventilation and lights are provided. (See sections V.D.8., V.D.9.) If windows are provided, it is preferable that they be nonopening, without sills or horizontal surfaces where dust can collect, of an insulating construction (in areas of temperature extremes), and sealed with a material that will withstand repeated washing and disinfecting. If windows are opened for ventilation purposes, effective screening is essential.

4. Floors

Floors should be smooth, waterproof, nonabsorbent, nonslip, wear resistant, acid and solvent resistant, capable of being scrubbed with detergents and disinfectants, and capable of supporting racks, equipment, and storage areas without gouging, cracking, or pitting. Depending upon the functions carried on in specific areas, the materials specified should be of a monolithic nature or should have a minimum of joints. Some materials that have proven satisfactory are terrazzo, cupric oxychloride cement, smooth hard surfaced concrete, neoprene terrazzo, special hardened rubber-base aggregates and other synthetic products. A continuous waterproof membrane may be needed. Where sills are installed at the entrance to the room, they should be designed so as to allow for the passage of equipment.

5. Drainage

If floor drains are used, they should be of the rim flush type. The drainpipes should not be less than 10.2 cm (4 in.) in diameter. The recommended minimum pitch of floors is .64 cm. per meter (.25 in. per ft.). Proper pitching of the floor is an essential element in establishing good drainage in animal rooms; particular attention should be paid to this detail in planning animal facilities. In heavy-use areas such as dog kennels, drains at least 21.2 cm. (6 in.) in diameter are recommended. A flushing drain or heavy duty disposal unit set in the floor is an effective aid for the disposal of solid waste. A porous trap bucket in the drain can also be used to screen out solid waste. All drainpipes should have short runs to the main, or they should be steeply pitched from the opening. When drains are not in use they should be capped and sealed to prevent any backflow of sewer gases. Lockable drain covers are useful in preventing use of the drains for disposal of materials which should be swept up and removed by other means. (See section V.G., V.H.)

Floor drains may not be essential in animal rooms for species such as rats, mice, guinea pigs, or hamsters. Floors in such rooms can be maintained satisfactorily by wet vacuuming, or by sweeping and mopping with appropriate disinfectants or cleaning compounds.

6. Walls

The walls should be free of cracks, utility penetrations or imperfect junctures at the doors, ceilings, or corners. Surface materials should be acid or solvent resistant, capable of withstanding scrubbing with detergents and disinfectants, and capable of withstanding water under high pressure. Provision should be made to protect walls from damage by movable equipment.

7. Ceilings

Ceilings formed by the concrete floor above are satisfactory if properly smoothed, sealed, or painted. Furred ceilings of plaster or fireproof plasterboard should be sealed and painted with a washable finish. Exposed pipes and fixtures at ceiling level are undesirable.

8. Ventilation, temperature, and humidity control

(a) Effective ventilation is necessary to regulate room temperature and to promote comfort. Important factors for proper ventilation are temperature, humidity, air movement, and air pressure. The ability to maintain odorless facilities depends upon the number and species of animals housed, and the sanitation practices, as well as upon a properly designed ventilation system.

(b) Ideally, a system should permit individual adjustments within ±1° C. (±2° F.) for any temperature within a range of 18° to 29° C. (65° to 85° F.). The relative humidity should be maintained throughout the year within a range of 30 to 70 percent according to the needs of the species being maintained and local climatic conditions. Air conditioning is highly recommended since it promotes environmental stability. Each animal
room or groups of rooms serving a common purpose should have individual controls for the regulation of temperature and humidity. The animal facility and human occupancy areas should be ventilated separately. The system should provide frequent changes of room air without drafts. Ten to fifteen changes per hour are recommended. There should be no recirculation of room air unless it has been filtered to remove contaminants. Under certain circumstances ultraviolet irradiation of the room air may be helpful in reducing the concentration of airborne pathogenic organisms.

(c) Laminar flow systems are available as modular units or as entire laminar flow rooms. Air is blown through a bank of filters and louvers which are designed to provide unidirectional flow without eddy currents. This isolates animals from each other and from particulate matter in the animal room.

9. Power and lighting

The electrical system should provide ample lighting, sufficient power outlets and safety provisions (such as explosion proof outlets, located 1.53 m. (5 ft.) off the floor, in rooms where explosive anesthetics may be used, and waterproof outlets where water is used in cleaning).

Lighting should be uniformly diffused throughout the area. For most animal housing areas, a minimum lighting intensity of 100 foot-candles at the level of the cage racks is recommended. Animal treatment and examination areas should have a minimum of 125 foot-candles at the work surface.

Fluorescent lights are efficient and are available in a variety of fixtures that can be sealed and surface-mounted to the ceiling. Incandescent or fluorescent lights in tightly sealed fixtures hung from the ceiling are acceptable. Light fixtures should be properly sealed to prevent the harboring of vermin.

In windowless animal facilities a time-controlled lighting system is recommended to provide a regular diurnal lighting cycle.

Provision should be made for emergency power for ventilation and light in the event of a power failure.

10. Storage areas: food and bedding, refuse, equipment

In areas where delivery schedules are reliable, the amount of space required for food and bedding storage can be held to a minimum. The best utilization is achieved by maintaining constant turnover.

Bulk supplies of food and bedding should not be stored in animal rooms. A separate vermin-proof area or room should be available in which food and bedding can be stored off the floor on pallets, racks, or carts. A continuing pest control program is essential. It is most desirable for the storage areas to be vermin-proof.

Food storage areas should be physically separated from refuse areas. It is good practice to hold packaged animal feeds (pellet rations) at 10° C. (50° F.) or less. Refrigerated storage should be available for meats, fruits, vegetables, and other perishable items.

Refrigerated storage for animal waste and dead animals is essential. This storage area should be separated from any other cold storage, be used exclusively for refuse storage, and preferably be kept below 7° C. (45° F.) to reduce putrefaction of waste or animal carcasses. Obnoxious materials should be covered or packaged. The area should be constructed so that it can be kept clean and free of vermin.

Adequate space for storage of unused equipment is essential. This area should be constructed so that it can be kept clean and free of vermin.

11. Noise control

Noise from the animals and animal-care routine is inherent in the operation of animal facilities. Noise may be undesirable because of its effect on personnel and on the animals themselves. Inasmuch as background and "operational" noises are an environmental factor in the control of animal experiments, they should be considered in the design of animal facilities.

Ordinarily, species such as rats, mice, guinea pigs, cats, and hamsters do not create a disturbing amount of noise in animal facilities. Noise from a monkey colony can be troublesome, and invariably dogs are the cause of unwelcome noise. Barking is disturbing to personnel working inside and outside of the animal facilities. It may also pose important public relations problems if there are residences near the laboratory.

The physical separation of human and animal occupancy areas is the best way to minimize disturbances to laboratory personnel from the sounds of animals and animal-care routines. Within animal facilities, noisy activities such as cage washing and refuse disposal should be carried out in rooms or areas separate from the animal housing areas. Unwelcome noise from animal-care routines can be minimized by appropriate indoctrination and training of personnel, by using rubber-tired casters and rubber bumpers on carts, trucks, and racks; and by locating major cage cleaning activities away from rooms to areas specifically designed for this purpose.
The use of sound-reducing materials in animal rooms can be helpful. Concrete walls are more effective than metal or plaster walls in containing sound because their density reduces sound transmission. Acoustical materials may be used in animal rooms by direct application to the ceiling, or as part of a suspended ceiling, provided the rooms are vermin-proof. The elimination of windows also helps to contain sound.

Where dogs are housed outdoors, such as on the roof of a building, barking sounds can be directed upward by appropriate baffling of the surrounding parapet area. This procedure is helpful only when there are no taller buildings nearby.

12. Facilities for sanitizing equipment and supplies

An area for sanitizing equipment and supplies is essential to keep equipment physically clean, reduce obnoxious odors, and minimize the spread of infectious diseases. Sanitizing is best done in a centrally located area specifically designed for the purpose. Consideration should be given to such factors as:

(a) Location with respect to animal rooms, traffic flow that separates "clean" and "dirty" area, elevators, ease of access, and disposal of waste
(b) Soundproofing
(c) Utilities such as hot and cold water, steam, floor drains, and electric power
(d) Proximity to cage and equipment storage areas (It is essential to provide separate holding areas for soiled and clean equipment)
(e) Insulation of walls and ceilings where necessary
(f) Ventilation with installation of proper vents and provisions for dissipation of steam
(g) Access doors of sufficient width to assure free movement of equipment

The use of a mechanical equipment-washing machine is highly recommended. The machine should provide both wash and rinse cycles, preferably with flexible time settings for each. If sanitization depends on heat for effectiveness, the wash or rinse cycle or both, should be conducted at not less than 83 °C. (180 °F.) for sufficient time to assure destruction of most pathogenic organisms. Specimens from "cleaned" equipment should be taken periodically and cultured to determine the adequacy of the washing routine.

Large pieces of equipment may have to be washed by hand. However, portable cleaners that dispense detergent and hot water or steam under pressure are more efficient than hand cleaning. Some institutions use a booth in the cage-washing area for rack washing. Such an area serves well when equipped with hot and cold water, steam and a detergent dispenser. It should be vented to exhaust the steam. Where the size of the animal facility warrants the investment, a large washing machine for racks, dog cages, and other large pieces of equipment is useful. If no machine is available, hand washing of small cages can be accomplished in a large sink or tub, using appropriate detergents, disinfectants, and vigorous scrubbing.

A machine for washing bottles and sipper tubes is recommended if large numbers of water bottles are used. Some cage-washing machines may also be used for this purpose. If bottles are washed by hand, powered rotating brushes located at the washing sink are useful, and provision should be made for dipping or soaking the water bottles in detergent and disinfectant solutions. A two-compartment sink or tub is adequate for this purpose.

Some means of sterilization such as an autoclave or a gas chamber is essential for sterilizing equipment and supplies where pathogenic organisms are involved. An autoclave for sterilization of animal cages is essential where pathogenic agents are under investigation. (See section V.G.) In certain specialized facilities such as in production colonies of cesarean derived, defined environment animals, autoclaving or other methods of sterilization of food and bedding may be necessary. However, routine sterilization of cages, food, and bedding is not considered essential if care is taken to use clean materials from reliable sources.

Provisions should be made to prevent the harmful build up of cleansing and sanitizing materials or their disposal in undesirable quantities into public waste systems or the environment.

E. Special facilities for aseptic surgery

A facility for aseptic surgery should be designed in accord with all applicable local and state building codes.

Operating room(s) should be equipped with appropriate surgical equipment and accessories. It may be necessary to provide explosion proof outlets and locate them 1.58 m. (5 ft.) off the floor if explosive agents are used. It may also be necessary to provide a conductive floor similar to that required in surgical areas in human hospitals.

A separate surgical preparation area should be provided.

An area equipped with surgical sinks should be provided, preferably apart from the operating area.

A surgical support area should be provided for storing instruments and supplies and for washing and sterilizing instruments.

An area for intensive care and supportive treatment of animals during the recovery period should be provided. Equipment and supply items that may be helpful in the intensive care area are
heating pads, vaporizers, vacuum equipment, respirator, cardiac monitor, and oxygen.

Lockers, showers and toilets should be provided for personnel and an area for dressing in surgical attire. It is preferable to locate this area adjacent to the surgical facility.

F. Facilities for large domestic animals

Horses, sheep, cows, goats, and pigs usually are housed in pens and barns. It is advisable for the planning architect to consult with agricultural engineers or animal housing experts to obtain specific information. The following sections refer to housing of large domestic animals in rural areas:

1. Service and feed alleys

Service and feed alleys should permit easy passage of equipment. If a tractor or trailer is used in drive-through units, the service alley should be 3.1 m. (10 ft.) wide and sloped .64 cm. per m. (.25 in. per ft.) towards direction of manure movement. A concrete curb, 10.16 to 15.24 cm. (4 to 6 in.) high, along both sides of the alley should be installed if a water flush system is used. Feed alleys, 1.22 to 1.55 m. (4 to 5 ft.) in width, are preferred although these, too, may vary with the equipment used.

2. Doors and pen gates

Animal exit or entry doors may be 1.22-3.66 m. (4-12 ft.) wide and 2.44-3.66 m. (8-12 ft.) high depending on the species being housed and type of traffic. Doors 2.44 m. (8 ft.) or wider should be the “overhead or sliding” type. Metal doors are preferable. The doors should fit tightly to provide a barrier to vermin. Metal flashing (28 gauge) on the bottom of wooden doors will prevent entry of rodents. Door sills should not be raised above 5.08 cm. (2 in.) and a concrete apron should extend outside for at least 1.83 m. (6 ft.). Pen or stall gates should be at least 1.22 m. (4 ft.) in width and 2.44 m. (8 ft.) high for adult horses and cattle. The gate sizes can be smaller for sheep, hogs, and calves, but for accessibility and efficient operation a 1.22 m. width is applicable even to small pens. Doors to outside pens for hogs should be .61 m. to .76 m. (2 to 2½ ft.) wide and .915 m. (3 ft.) high.

3. Windows

Windows are unnecessary. If they are to be used, they should be installed at least 1.83 m. (6 ft.) from the stall floors. The inside glass should be framed flush with the wall, eliminating sills where dirt and dust can collect. Insulating glass is preferred. Approximately .093 sq. m. (1 sq. ft.) of window space per 9.15 to 12.20 sq. m. (30 to 40 sq. ft.) of floor space is recommended. The windows are generally fixed, but in some cases can be opened to provide ventilation. If the windows are opened, screening should be provided.

4. Floors

Floors should be waterproof, nonslip and wear resistant. They should be resistant to weak acid or alkali solutions and to the adverse effects of severe weather. A good quality concrete floor with a hard but moderately rough surface to provide good footing for the animals is preferred because of its durability and ease of cleaning. Sufficient bedding, soft plastic or rubber surfaces should be provided over concrete pen or stall floors to prevent foot and other musculoskeletal problems. The floor should slope .64 cm. per m. (.25 in. per ft.) to provide good drainage. A floor thickness of 10.16 cm. (4 in.) is recommended for light loads and up to 15.24 cm. (6 in.) if tractors or trucks are used. A waterproof membrane should be laid prior to pouring the floor.

5. Walls

Walls should be waterproof, painted, smooth, or glazed and free from cracks or imperfect junctures. Vapor barriers of materials with a permeability rating of one or less are necessary to prevent passage of water, or single masonry with inner insulation containing vapor barriers is recommended.

6. Ceilings

A ceiling height of at least 2.59 m. (8.50 ft.) is recommended for most large animal facilities. Concrete ceilings are satisfactory if sealed. A waterproof membrane is frequently used. Plywood or asbestos board is suitable, but all joints should be sealed.

7. Ventilation, temperature, and humidity control

Large animal facilities require adequate ventilation to control moisture and odor. A ventilating system capable of exhausting 100 cubic feet per minute [cfm] per 1,000 pounds of animal weight is recommended. The minimum temperature should not be lower than 4° C. (40° F.). A minimum of 4 air changes per hour in the winter and 15 air changes per hour in the summer should be provided. Drafts on the animals should be avoided. In geographical areas with extremely high ambient temperatures, air conditioning may be necessary if the temperature in the facility cannot be maintained lower than the ambient temperature.
8. **Power and lighting**

An adequate electrical system should be provided. Outlets should not be placed in stall walls. Retractable reel extension cords are recommended for use within stalls. Electrically-operated machinery should have accessible safety switches.

Lighting intensity should be uniform throughout the facility. A minimum of 25 foot candles at floor level should be adequate for servicing. Higher levels of lighting may be required for special areas such as treatment rooms. In windowless facilities an automatic time-controlled lighting system may be used.

9. **Feed storage**

Feed storage areas should be separated from other service areas and from the animal housing area. Shelf life of manufactured feeds should be considered so that the amounts stored are sufficient to meet the availability of supply and usage with optimal rate of turnover. A convenient means of storing feed concentrate is in an outdoor, closed metal bin which is emptied by a mechanical auger. The feed storage area should be clean and vermin-proof. A regular vermin control program should be established. If concentrates in sacks are used, they should be double bagged preferably with a plastic liner.

10. **Waste disposal**

Daily removal of manure from indoor facilities is recommended. If manure is held before disposal, it is recommended that storage of manure spreaders or wagons should be indoors or in screened areas. Waste disposal or storage should conform to all local, State, and Federal ordinances.

11. **Outdoor facilities**

(a) Waterers should be located on concrete or paved platforms. In cold climates, heating devices are necessary to prevent freezing. The waterers should be conveniently located and readily available in all weather conditions.

(b) Feeding platforms and bunks should be centrally located and all-weather access should be provided. Concrete or paved platforms are recommended to facilitate cleaning.

(c) Outdoor lots should be sloped away from buildings, feeders, and waterers. Low areas should be filled with gravel or crushed rock and sand. Paved or concrete platforms or aprons around buildings and feeders are recommended. The slope should be 2.54 cm. per .305 m. (1 in. per ft.) away from bunks and waterers and 1.27 cm. per .305 m. (.50 in. per ft.) away from buildings or resting areas.

G. **Special facilities for biological safety in infectious disease units**

The recommendations in section V.D. regarding the materials used in the construction of animal holding facilities can generally be applied to similar facilities in infectious disease units. However, floor, ceiling, and wall surfaces must be capable of withstanding frequent applications of corrosive chemical agents or disinfecting agents.

Effective isolation is necessary when the disease under investigation is transmissible to man or when it may spread to animals. A unit for infectious diseases should be separated from areas holding normal animals and should be close to or part of the laboratory where the work is being done, either in a separate building or in an isolated part of a larger building.

Several special facilities should be incorporated into units where investigation is being done with agents known to be infectious to both man and animals. These facilities are necessary to protect personnel and to prevent cross-infection:

- Pass-through locker rooms should be provided for storing street clothing and for changing into clean laboratory clothing.
- An air lock entry to and from the infectious disease unit should be provided, preferably with ultraviolet light barriers within the air lock.
- An area for the removal of contaminated clothing should be located at the exit, between the ultraviolet light barrier and shower. The exit from the shower should lead to the locker rooms.
- An autoclave is necessary to sterilize cages, bedding, watering devices, feeders, and waste before cleaning or removal. Pass-through autoclaves are best located in a wall between the animal room and the cage-washing room or corridor. This makes it possible to sterilize equipment and supplies entering or leaving the room, and establishes a flow system from “contaminated” to “clean areas.” If equipment is sterilized before it leaves the infectious disease unit, it may be washed in a machine serving other areas. In large infectious disease units, a separate washing area should be provided.
- Animal rooms in infectious disease units should be venti-
lated under negative pressure with respect to corridors or adjoining noninfectious areas. Ten to fifteen changes of air per hour generally are sufficient. There should be no recirculation of room air in infectious areas.

Room exhaust air should be filtered. Spun glass filters with a one to five micron particle retention of 95 to 99 percent are adequate. Ease of installation may cause a preference for the ultra-high-efficiency 99.99 percent retention filter. Either should be preceded by a prefiler dust stop or other means of removing hair, feathers, or other coarse particles. The filter frame must be sealed tightly in the plenum chamber to prevent leakage of unfiltered air. Electronic precipitation is effective, but maintenance cost is high. Incineration also is effective, but it is expensive, except when the volume to be incinerated is small. Large oil- or gas-fired incinerators are feasible for sterilizing large volumes of air containing highly infectious organisms. Ordinarily, incineration of air is unnecessary, except in the high risk areas.

- Special rack and caging systems may be helpful, depending on the organism under study and the mode of exposure of the experimental animals. If properly maintained, ultraviolet lamps and reflectors can prevent the airborne spread of infections between cages. Depending upon the location of the ultraviolet lamps it may be necessary to shield the lamp to protect animals and personnel from eye damage. Protective goggles may be necessary. High-efficiency-spun-glass-filter materials used on the sides or top of a small animal cage also will prevent cross-infection.

Several types of ventilated cages are available and useful where airborne organisms are under investigation. Ventilated lids can be made to fit ordinary animal cages by use of airtight gaskets around the rim of the lid, which are connected to a central exhaust system, through a filter. Horsfall type cubicles or flexible film isolators may also be used for this type of work.

- Ventilated cabinets or hoods are recommended for the inoculation of animals with infectious organisms and for necropsy of infected animals. These should be equipped with viewing windows, glove ports, lights, ultraviolet lamps, an air exhaust filter, and outlets for gas, air, water, and vacuum. Effective air exhaust blowers provide at least 60 linear feet per minute air flow through the frontal opening. For example, a cabinet with an opening of 25.4 x 152.4 cm. (10 x 60 in.) would need a 300 cfm blower operating against an air flow resistance of about 5.08 cm. (2 in.) as measured on a water gauge (one for the filter and one for the air ducts), when allowance is made for a 50 cfm variable loss.

- Disinfectant vaporizers are helpful in decontaminating an animal room following the conclusion of experiments and removal of all animals. The room should be sealed; one milliliter of 37 percent formaldehyde should be vaporized per cubic foot of air space and allowed to act for six to eight hours. The room temperature should be at least 21°C. (70°F.) and the relative humidity 80 percent during the decontamination.

Ancillary facilities such as sinks and hose bibs are recommended to facilitate cleaning and disinfection in the rooms housing infected animals.

H. Special requirements for radiation safety

Radiation safety is a fundamental obligation of all users of sources of ionizing radiation. This obligation is a joint responsibility of the investigator, radiation safety officer, and the director of the laboratory animal facility.

Any person utilizing radioactive materials not exempted by law must be licensed by proper authority. The license application ordinarily requires a statement concerning the training and experience of the applicant, location within the institution where the radioisotope will be used including animal rooms, special radiation safety devices available, methods of waste disposal, and a full description of the records to be maintained. Periodic inspections are performed by the licensing authority to determine that experiments are conducted in strict accordance with the safety requirements.

The physical properties and biological fates of nuclides are so diverse that it is impossible to provide specific guidance for each radioactive isotope. The general statements below are applicable to most situations. When specific radioactive isotopes are to be used expert advice should be sought.

1. Prior to the performance of an experiment requiring the use of radioactive materials, a conference involving the investigator, radiation safety officer, and director of the animal facility is recommended. At that time individual responsibility, as well as any specialized care and waste disposal requirements, can be discussed.

2. An area should be designated for the housing of animals
receiving radioactive material. This may be an entire room or a well-marked portion of a room. It is imperative that adequate ventilation be provided.

3. To protect against undue radioactive contamination of animal rooms, all surfaces should be nonporous and easily washable. Cracks and crevices should be sealed. Strippable materials or disposable waterproof-backed paper is recommended for application to walls, floors, and bench tops. Rubber or vinyl tiles, or linoleum, applied over a concrete floor will provide adequate protection since these materials are nonporous and can be removed if necessary. Epoxy resin paints will seal plaster walls effectively if properly applied.

4. To facilitate decontamination, stainless steel is recommended for animal cages and sinks in preference to galvanized steel, porcelain, or soapstone. Rough surfaces such as nonsmooth welds, which are difficult to decontaminate, should be avoided.

5. Personal dosimeters and survey equipment must be used in accordance with applicable regulations.

6. Radioactive waste must be disposed of in accordance with applicable regulations and license. Facilities must be provided for holding radioactive waste and animal carcasses. In some instances the ordinary storage facilities may be used for holding the waste, if properly monitored, until all radioactivity has decayed. Special shielding of the storage area may be required.

7. Mechanical washing equipment should be of a type that will facilitate decontamination of cage equipment but will not itself accumulate radioactive waste. For example, radioactive cages should not be washed in machines which recirculate the wash solution.

I. SPACE RECOMMENDATIONS FOR LABORATORY ANIMALS

The size of a cage, pen, run, or other enclosure and the number of animals to be housed in each, are matters of professional judgment. The recommendations in this section are based on the best available information concerning reasonable space allocations for the housing of animals in experimental use. Cage and pen areas other than those suggested here should be considered equally acceptable if they provide equivalent comfort for the animals. The adequacy of the housing system must be under continuous review. (See section I.A.) Detailed housing standards for various laboratory animal species have been published by the Institute of Laboratory Animal Resources, National Academy of Sciences-National Research Council. (See Appendix I.) The specifications applying to the housing of certain species of animals are stated in the regulations, promulgated under Animal Welfare Act 1970. (See Appendix V.)
SPACE RECOMMENDATIONS FOR LABORATORY ANIMALS

(continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight</th>
<th>Type of Housing</th>
<th>Floor Area/Animal (Square)</th>
<th>Height 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horse</td>
<td>Over 700 kg</td>
<td></td>
<td>14.0 m (150 ft)</td>
<td>—</td>
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<tr>
<td></td>
<td>—</td>
<td>Tire Stall</td>
<td>4.1 m (44 ft)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>Pen</td>
<td>13.4 m (144 ft)</td>
<td>—</td>
</tr>
</tbody>
</table>

1 Height means from the resting floor to the cage top.
2 These recommendations may require modifications according to the body conformations of particular breeds. As a further general guide, the height of a dog cage should be equal to the height of the dog over the shoulders (at the withers), plus at least six inches, and the width and depth of the cage should be equal to the length of the dog from the tip of the nose to the base of the tail, plus at least six inches.
3 The primates are grouped according to approximate size with examples of species that may be included in each group:
   Group 1—Marmosets, tupaías, and infants of various species.
   Group 2—Cebus and similar species.
   Group 3—Macques and large African species.
   Group 4—Baboons, monkeys larger than 15 kg, and adult members of brachiating species such as gibbons, spider monkeys and woolly monkeys.
   Group 5—Great Apes.
4 Where primates are housed in groups in pens, only compatible animals should be kept. Minimum height of pens should be six feet. Resting perches, nesting boxes and escape barriers necessary for the well being of the particular animals should also be provided.
5 Sufficient headroom must be provided so birds can stand erect without crouching.

Appendix I

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Laboratory Animal Diseases and Therapy


Laboratory Animal Anesthesia and Surgery


Laboratory Animal Husbandry, Restraint, and Related Problems


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Design and Construction of Animal Quarters and Cages


Technical and Professional Education


Appendix II

PROFESSIONAL AND CERTIFYING LABORATORY ANIMAL SCIENCE ORGANIZATIONS

American Association for Accreditation of Laboratory Animal Care (AAALAC), 4 East Clinton Street, P. O. Box 13, Joliet, Illinois 60434.

This non-profit corporation formed by leading scientific and educational organizations promotes high quality standards of animal care through a voluntary accreditation program. Animal care facilities which apply for accreditation are site visited by a team of two site visitors who submit a detailed report to a twelve member Council on Accreditation. Following the standards listed in the Guide for the Care and Use of Laboratory Animals, the Council on Accreditation reviews applications for accreditation and visitors' reports to determine whether AAALAC should grant full accreditation, provisional accreditation or withhold accreditation.

Fully accredited animal care facilities receive a certificate of accreditation and are included on a published list of accredited facilities. Full accreditation by AAALAC is accepted by the National Institutes of Health as assurance that the animal facilities are evaluated in accordance with the NIH policy on laboratory animals. (This policy was first announced in the NIH Guide for Grants and Contracts, No. 7, June 14, 1971.)

Any institution maintaining, using, importing, or breeding laboratory animals for purposes of scientific research or investigation is eligible to apply for AAALAC accreditation.

American Association for Laboratory Animal Science (AALAS), 4 East Clinton Street, Box 10, Joliet, Illinois 60434.

The American Association for Laboratory Animal Science is an organization made up of individuals and institutions professionally concerned with the production, care, and use of laboratory animals. It provides a means for collection and exchange of information on all phases of laboratory animal care and management.

The Association meets annually, publishes a bimonthly journal entitled Laboratory Animal Science, the AALAS Bulletin, and other publications.

The Association's Animal Technician Certification Board provides a means of developing uniform standards for technician training by defining the qualifications, preparation and approval of examinations for training programs and certifies successful candidates.

American College of Laboratory Animal Medicine (ACLAM), c/o Dr. Albert E. New, Secretary-Treasurer, Veterinary Medicine Division, 6570 AMRL/VM, Wright-Patterson AFB, Ohio 45433.

ACLAM, a specialty board of the American Veterinary Medical Association, was founded in 1957 to encourage education, training and research in laboratory animal medicine, to establish standards of training and experience for qualification of specialists in this field and to recognize such qualified specialists by suitable certification or other means. An individual who meets the prerequisites for examination, satisfactorily completes an examination composed of written, practical and oral sections, and who is approved by the Board of Directors, is certified as a Diplomate of the College.

American Society of Laboratory Animal Practitioners (ASLAP), c/o Dr. Stanley Wampler, Secretary-Treasurer, Federated Medical Resources, 230 N. Broad Street, Philadelphia, Pa. 19102.

This Society holds regular meetings for the exchange of information on laboratory animal practice. It encourages training and education in laboratory animal science.
Appendix III

TRAINING PROGRAMS IN LABORATORY ANIMAL MEDICINE

The purpose of these programs is to provide broad basic training for veterinarians desirous of teaching or studying laboratory animal medicine or acting as professional directors of laboratory animal facilities.

Institutions currently offering training programs in laboratory animal medicine for graduate veterinarians are:

Director, Department of Comparative Medicine, University of Alabama Medical Center, 1919 7th Avenue South, Birmingham, Alabama 35233.

Director, Division of Laboratory Animal Medicine, Stanford University, Stanford, California 94305.

Director of the Animal Department, J. Hillis Miller Health Center, University of Florida, Gainesville, Florida 32601.

Assistant Director for Animal Facilities, Division of Biological and Medical Research, Argonne National Laboratory, Argonne, Illinois 60439.

Program Chairman, Veterans Administration Resident Investigator Training Program, Veterans Administration, Edward Hines, Jr. Hospital, Hines, Illinois 60411.

Chairman, Department of Vivarium Science and Research, Tulane University School of Medicine, 1430 Tulane Ave., New Orleans, Louisiana 70112.

Chief, Animal Resources, Medical Research Laboratory, Edgewood Arsenal, Maryland 21010.

Program Director, Postdoctoral Training Program in Laboratory Animal Medicine, Division of Laboratory Animal Medicine, School of Medicine, Johns Hopkins University, Baltimore, Maryland 21205.

Program Director, Postdoctoral Training in Laboratory Animal (Comparative) Pathology, Division of Laboratory Animal Medicine, School of Medicine, Johns Hopkins University, Baltimore, Maryland 21205.

Director, Unit for Laboratory Animal Medicine, the University of Michigan, Ann Arbor, Michigan 48104.

Director, Department of Laboratory Animal Medicine, School of Medicine, University of Missouri, Columbia, Missouri 65201.

Head, Department of Laboratory Animal Medicine, The Bowman Gray School of Medicine, Winston-Salem, North Carolina 27103.

Chief, Laboratory Animal Medicine, College of Veterinary Medicine, The Ohio State University, 2578 Kenny Road, Columbus, Ohio, 43210.

Chairman, Department of Comparative Medicine, Milton S. Hershey Medical Center, Pennsylvania State University, Hershey, Pa. 17033.

Head, Department of Veterinary Public Health, College of Veterinary Medicine, Texas A&M University, College Station, Texas 77843.

Chief, Veterinary Sciences Division, USAF School of Aerospace Medicine, Brooks Air Force Base, Texas 78235.
## Appendix IV

### ANIMAL TECHNOLOGY PROGRAMS

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<th>Location</th>
<th>Length of Program (years)</th>
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<td></td>
<td></td>
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<td></td>
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<td>Sacramento, California 95823</td>
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| Michigan State University | 1 and 2 | Medical Institute of Minnesota  
2309 Nicolet Avenue  
Minneapolis, Minnesota 55404  
University of Minnesota  
Waseca Technical College  
Waseca, Minnesota 56093 |
| Nebraska | 2 | Veterinary Technology Department  
School of Technical Agriculture  
University of Nebraska  
Curtis, Nebraska 69025 |
| New Jersey | 2 | Camden County College  
P. O. Box 200  
Blackwood, New Jersey 08012 |
| New York | 2 | Animal Science Technology Department  
Agricultural and Technical College  
State University of New York  
Delhi, New York 13753  
Biological Technology Department  
Laboratory Animal Technology  
Agricultural and Technical College  
State University of New York  
Farmingdale, New York 11735  
Board of Cooperative Education Services  
Division of Occupational Education  
Nassau County  
125 Jericho Turnpike  
Jericho, New York 11753  
Laboratory Animal Science Program  
College of Health Related Professions  
State University of New York  
Downstate Medical Center  
450 Clarkson Avenue  
Brooklyn, New York 11203 |
| North Carolina | 2 | Veterinary Medical Technology Department  
Central Carolina Technical Institute  
Sanford, North Carolina 27330 |
| Ohio | 2 | Animal Care Technology Program  
University of Cincinnati  
Raymond Walters Branch  
9555 Plainfield Road  
Cincinnati, Ohio 45296  
Department of Laboratory Animal Medicine  
College of Medicine  
University of Cincinnati  
Cincinnati, Ohio 45221 |
| Pennsylvania | 2 | College of Agriculture  
Pennsylvania State University  
University Park, Pennsylvania 16802  
Laboratory Animal Technology Option  
Department of Animal Pathology  
University of Vermont  
Burlington, Vermont 05401 |
| Texas | 4 | Biomedical Science Program  
Department of Veterinary Public Health  
College of Veterinary Medicine  
Texas A & M University  
College Station, Texas 77843  
Texas State Technical Institute  
James Connally Campus  
Waco, Texas 76705 |
| Vermont | 4 | Laboratory Animal Technology Option  
Department of Animal Pathology  
University of Vermont  
Burlington, Vermont 05401 |
| Virginia | 2 | Blue Ridge Community College  
Box 80  
Weyers Cave, Virginia 24486 |
<p>| Washington | 4 | Laboratory Animal Science Major |</p>
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<td>Department of Animal Sciences Washington State University Pullman, Washington 99163</td>
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<td>Wyoming</td>
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<td>Northwest College for Medical and Dental Assistants 1305 Seneca St. Seattle, Washington 98122</td>
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<td>2</td>
<td>Fort Steilacoom Community College 6010 Mount Tacoma Drive, S.W. Tacoma, Washington 98499</td>
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<td></td>
<td>2</td>
<td>Madison Area Technical College 211 N. Carroll Street Madison, Wisconsin 53703</td>
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<tr>
<td></td>
<td>2</td>
<td>Technical College of Rockies 700 Broadway Thermopolis, Wyoming 82443</td>
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### Appendix V

**RELEVANT FEDERAL LAWS AND IMPLEMENTING RULES AND REGULATIONS**

#### Animal Welfare

Animal Welfare Act of 1970—Pursuant to the Act of August 24, 1966, Public Law 89–544, as amended by the Public Law 91–579, provisions are made to protect the owners of animals, from the theft of their animals, to prevent the sale or use of animals which have been stolen, and to insure that certain animals intended for use in research facilities or for exhibition purposes or for use as pets, are provided humane care and treatment. The law provides for regulating the transportation, purchase, sale, housing, care, handling, and treatment of animals used in research, for exhibition, and other purposes.


#### Endangered Species

Endangered Species Conservation Act of 1969. This Act was established under Public Law 91–135, December 5, 1969. The purpose is: to prevent the importation of endangered species of fish or wildlife into the United States; to prevent the interstate shipment of reptiles, amphibians, and other wildlife taken contrary to State law; and for other purposes.

The implementing rules and regulations for this Act are published in the *Code of Federal Regulations (CFR)*, Title 50—Wildlife and Fisheries, Chapter 1—Bureau of Sport Fisheries and
Wildlife, Fish and Wildlife Service, Department of Interior. Amendments are published in the Federal Register under the Title.

A list of the animal species currently considered endangered can be obtained by writing to the Office of Endangered Species, U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C. 20240.