Guide for LABORATORY ANIMAL FACILITIES and CARE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Guide for
LABORATORY
ANIMAL
FACILITIES
and CARE

Prepared by the
COMMITTEE ON THE GUIDE FOR LABORATORY ANIMAL
FACILITIES AND CARE
of the
INSTITUTE OF LABORATORY ANIMAL RESOURCES
NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL

(Revised 1965)

U.S. DEPARTMENT OF
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Preface

More than 35,000 copies of the Guide for Laboratory Animal Facilities and Care have been distributed since the first edition was published in March 1963. The Guide’s reception in the scientific community has been uniformly favorable. It is serving as a useful common reference for institutions conducting animal care program.

Many suggestions for improvement have been received. These have been incorporated in the second edition in keeping with a statement in the Introduction to the first edition that “... the Guide... must be a living document, subject to change with changing conditions and new information.”

The primary 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 and on expert opinion and experience with methods and practices which have proved consistent with high quality care.

This edition has been prepared by the Institute of Laboratory Animal Resources (National Academy of Sciences-National Research Council) under contract PH 43-64-44, task order 12, supplement 1, administered by the Animal Resources Branch, Division of Research Facilities and Resources, National Institutes of Health. The staff of the ARB also received many of the suggestions for improving the Guide, and met with the Committee during the preparation of this edition.

The Institute’s Committee on the Guide acknowledges with appreciation the role of the Animal Care Panel in developing the concept of the Guide and in preparing the first edition. The Institute was requested to undertake this revision rather than the Animal Care Panel because of a recent agreement between the Executive Committees of the two organizations concerning their respective roles in the field of laboratory animal resources. It was decided that the preparation of guidelines and standards should be an Institute function.

The following individuals gave generously of their time in advising the Committee on many aspects of this project:

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Introduction

The need to prepare a second edition of the Guide just 2 years after its initial publication is one indication of the continuing rapid development of laboratory animal medicine and science. The various sections have been revised and reorganized in accordance with suggestions received since the first edition appeared. In addition, the scope has been broadened to include material on care and facilities for large domestic animals.

The scientific community has long recognized a scientific and ethical responsibility to provide humane care for experimental animals used in the service of man and animals. This commitment to high standards is expressed in the codes guiding animal experimentation and care adopted by numerous scientific societies and institutions. The Guide extends these codes by defining humane care in professional terms.

There is growing recognition that the care of laboratory animals is an institutional responsibility as well as the responsibility of individual investigators. The animal care programs of most large institutions are based increasingly on this partnership of responsibility; and the recommendations in the Guide assume it. Section I deals with methods of animal care. The recommendations are a synthesis of knowledgeable experience and opinion based on scientific principles and concepts. This section is intended to provide a yardstick against which institutions can measure and evaluate their animal care programs. The Committee believes that the routine operation of institutional animal facilities should be guided by these recommendations. Sections II and III dealing with personnel and physical plant are intended to supplement Section I and assist scientific institutions in planning the human and physical resources needed to assure the adequacy of their animal care programs.

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 scientific 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 accordance with accepted practice. Finally, it hopes the permissive language of the Guide will encourage investigators to seek new and better methods of laboratory animal care, and to maintain the Guide as "a living document, subject to change with changing conditions and new information."

The Guide may contain errors of omission and commission. Corrections and suggestions may be forwarded to the Animal Resources Branch, DRFR, at the National Institutes of Health.

1. Laboratory Animal Housing and Care

Comfortable housing is an essential element in good animal care. Comfort depends on a variety of subjective and objective factors which interact differently in different institutions. Accordingly, it is impossible to develop a single definition of comfortable housing which is applicable to all institutions. Experienced animal-care workers know that the well-being of animals is not entirely dependent on a modern physical plant and the newest housing equipment. Well-trained personnel frequently can overcome physical deficiencies to assure high-quality animal care. Therefore, for the purposes of the Guide, comfortable housing is defined as any system of management, care, and housing which permits animals to grow, mature, reproduce, or behave normally in the laboratory, and to be maintained in good health. Some of the specific considerations which give meaning to this definition are outlined in this section.

A. Housing

1. Criteria for evaluating a caging or housing system

The caging or housing system perhaps is the most important single element 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:

(a) It should meet the investigator's research requirements. Thus, animals may need to be housed singly or in groups; in cages, runs, or pens. Special requirements may prevail where toxic, infective, or radioactive substances are used.

(b) It should be designed with the animals' physical comfort as a primary consideration. Rarely are the requirements of research incompatible with physical comfort. Physical comfort, as applied specifically to the housing system, includes keeping the animal dry and clean; maintaining the animal in a state of relative thermal neutrality; providing sufficient space to assure freedom of movement; providing convenient access to clean food and water; and, if animals are group
housed, maintaining them in compatible groups without overcrowding.

(c) It should be compatible with the maintenance of the animals in good health as measured by factors such as maintenance of normal body weight and ability to prevent spread of communicable diseases.

(d) It should be designed to facilitate effective sanitary maintenance and technical servicing. For example, bends and crevices in animal cages, which may be difficult to clean, should be avoided; the system should permit easy and complete cleaning; feeders and watering devices should be easily accessible for filling or changing.

(e) Cages, runs, and pens should be kept in good repair to prevent injury to the animal and to promote physical comfort. Particular attention should be paid to avoiding sharp corners and edges or broken wires; and maintaining cage floors in good condition to prevent injury.

2. Exercise

One of the most widely debated questions in the field of animal care concerns the need for "exercise" in the housing of laboratory animals, most specifically in the housing of dogs. The concept of "exercise" frequently is confused with that of cage size. A "small" cage is equated with lack of "exercise" and physical discomfort, while a "large" cage, a pen, or a run is equated with "exercise" and physical well-being. The size of the cage does not necessarily influence the amount of "exercise" an animal engages in, or its well-being.

For the purpose of the Guide, "exercise" is defined as any physical activity which may restore, maintain, or improve health. On this basis, whether dogs and other animals are "exercised," and what form it should take, is a matter of professional judgment. If exercise is needed, it may be provided in any of several ways such as by use of a treadmill or exercise wheel, by walking animals on a leash, by providing access to runs, or by releasing animals from their cages in the animal room.

Cages are necessary and useful for intensive postsurgical care, for isolation of sick animals, for metabolic studies, and for short-term holdings of dogs (1 to 3 months). However, there are practical reasons for providing pens, runs, or other out-of-cage space in 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 cleaned. When dogs are allowed out of their cages regularly, sanitary maintenance of the cages is simplified. In addition, when dogs are held for longer than 3 months, their physical comfort can be maintained more easily if runs or pens are provided. Finally, the availability of runs or pens makes possible the housing of dogs in compatible groups.

The need for exercising large domestic animals, such as horses and cattle that are housed in tie stalls or stanchions, is well established. Exercise will prevent edema of the extremities, lessen foot problems, and reduce hoof care. In addition, physiological events such as estrus are more easily recognized in animals that are not confined. Loosening areas, exercise lots, pastures, or controlled exercise should be used depending upon the space available.

B. Sanitation practices

1. Cleanliness

(a) The animal facility should be kept clean. This means that a regular schedule of sanitary maintenance is necessary, including the elimination of radiological and toxicological products.

(b) Animal rooms, corridors, storage areas, and other parts of the animal facility should be washed, scrubbed, vacuumed, mopped, or swept, using appropriate detergents and disinfectants, as often as necessary to keep them free of dirt, debris, and harmful contamination. A continuing objective should be to keep these areas neat and uncluttered. Radiological and toxicological monitoring may also be necessary.

(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 nonhuman primates, daily changing of cage or pen litter may be necessary. Daily changing of bedding for the large domestic animals is 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, 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 of 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 good
practice to have extra cages available at all times to permit maintenance of a systematic cage-washing schedule. The washing or rinsing, or both, should be conducted at a temperature of 180°F. or higher to assure destruction of most pathogenic organisms. If this temperature cannot be attained, washing of equipment should be followed by appropriate disinfection. Where radioactive or toxic contamination is a problem, a system of monitoring of equipment should be instituted.

(f) Waste containers and implements should be maintained in a sanitary condition. It is good practice to wash each waste can every time it is emptied. As with animal cages, the minimum wash or rinse temperature, or both, should be 180°F. Similarly, cleaning implements such as scrapers, shovels, and mops should be sanitized regularly. (See sec. III. S and T.)

2. Sanitary waste disposal

(a) All waste should be collected and disposed of in a safe, sanitary manner. If waste cans are used, they should be made of metal or plastic, be leakproof, and equipped with tight-fitting lids. It is good practice to use leakproof disposable containers such as plastic sacks or lined paper bags as liners in waste cans, for disposal of animal tissues, carcasses, radiological or toxicological wastes. (See sec. III. S and T.)

(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 on a regular frequent schedule. If storage of waste prior to removal is necessary, the holding area should be physically separate from other storage facilities, and free from flies, cockroaches, rodents, and other pests. Cold storage is necessary for biological waste that may decompose at ambient temperatures.

3. Vermin control

(a) Cockroaches, flies, bedbugs, escaped or wild rodents, and similar pests, constitute a menace in any animal facility. Their elimination or effective control should be considered mandatory.

(b) Vermin control programs should be instituted in new buildings prior to occupancy. Effective control, and ultimate elimination, 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 pes-

ticides or trapping procedures in conjunction with a strict program of sanitary maintenance. Pesticide application must be under professional supervision in order to avoid toxic effects on animals and possible interference with experimental procedures.

4. Personal hygiene

(a) The maintenance of high standards of personal cleanliness among animal colony personnel is obligatory. Facilities necessary to meet 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 a neat and clean appearance. Suitable facilities should be available for storage of street clothing during the workday.

(c) Personnel working in animal facilities should receive regular physical examinations including appropriate diagnostic tests for diseases communicable between laboratory animals and man, and appropriate protective immunizing agents. For example, it is important to immunize animal care personnel against tetanus. Personnel handling primates should have periodic examinations for tuberculosis; and those handling newly arrived carnivora can be protected against rabies by preexposure immunization.

C. Feeding, watering, and identification of laboratory animals

1. Feeding

All laboratory animals should have access to feed daily 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

All laboratory animals should have access to water daily, according to their particular requirements. Ordinarily, drinking water should be available at all times. Watering devices such as drinking tubes and spouts, and automatic waterers should be examined routinely to assure their patency.

3. Identification

Laboratory animals should be identified by placing identification cards in the animal rooms, on cages, or on racks; by the use of com-
fortable collars or bands on the animals; by stains of various colors; by ear punching; by tattooing; or by other appropriate means. Identification cards should include information such as the name and location of the responsible investigator, pertinent dates, and any specific instructions for animal care personnel.

D. Diagnosis, control, and treatment of animal diseases

1. All laboratory animals should be observed frequently for clinical signs of illness, injury, or abnormal behavior by a person capable of recognizing such signs. (See sec. II.) It is good practice to observe animals daily, under ordinary circumstances. All deviations from normal, and deaths from unknown causes, should be reported promptly to the person responsible for animal disease control.

2. Persons qualified by experience or training should direct the control and treatment of nonexperimentally induced animal diseases and other abnormal conditions.

3. Animals which develop abnormalities rendering them unsuitable for laboratory purposes should be treated or painlessly killed. (See sec. I.F).

4. To facilitate proper diagnosis of abnormal conditions, laboratory-facilities or services should be available for diagnostic procedures. These should include facilities or services for the physical examination of animals and for necropsy; for histological and pathological examination of animal tissues; for handling, isolating, and identifying specific pathogens; for routine and specific laboratory procedures; and for inoculating test animals under suitable isolation conditions.

5. The general approach to the control and treatment of animal diseases and other abnormalities should include appropriate quarantine and isolation of animals (sec. I.E, below); control of animal quality by procurement from reliable sources (sec. I.E); proper sanitation practices (sec. I.B); and specific procedures to break the disease cycle as directed by the person responsible for disease control.

E. Quarantine and isolation of animals

For the purpose of the Guide, “quarantine” is defined as the segregation of newly received animals apart from animals already in use. “Isolation” is the segregation of animals suspected or known to be diseased, from animals which are in good health.

1. Newly received animals should be quarantined until their health status has been evaluated.

2. The duration of quarantine may vary according to the species used and the purpose for which they are used. For species such as rats, mice, rabbits, and hamsters, when obtained from reliable sources, the quarantine may be limited to the time necessary for competent inspection. For these and similar species, the control of quality at the source, and knowledge of the environmental history of the animals are effective adjuncts to quarantine within the institution. Where the environmental history of the animals is unknown, such as is commonly the case with dogs, cats, nonhuman primates, and large domestic animals, a more complete quarantine should be employed, including procedures such as are recommended below. These procedures may take as little as a few days or as long as several weeks to complete.

3. All animals should be inspected on arrival. If any animals are found to be in poor health, their management should be according to the recommendations in section I.D.

4. Animals intended for use in terminal studies, as in student demonstrations, should be clean and free of ectoparasites. It is good practice to prevent entry of such animals into the regular animal facilities prior to use.

5. It is good practice to institute a conditioning program which, at the discretion of the director of animal care, should include any or all of the following procedures:

   (a) Physical examination of the animals on arrival, including any necessary clinical and laboratory diagnostic tests for communicable diseases.

   (b) Veterinary care and treatment for ecto- and endoparasites, and other specific prophylactic or therapeutic procedures, such as immunizations, as necessary to protect against communicable diseases.

   (c) Adaptation to the laboratory diet, including supplemental feeding if necessary to meet nutritional requirements.

   (d) Observation of animals within the quarantine area until freedom from signs of communicable disease is assured.

   (e) Grooming procedures such as bathing, dipping, drying, and clipping.

6. Should a nonexperimentally induced communicable disease occur during the course of a study, the animals involved should be isolated from other animals, and their care should be managed so as to minimize or prevent direct or indirect contact with healthy animals. Management of such diseased animals should be according to the recommendations in section I.D.

F. Euthanasia

Euthanasia (the humane killing of animals) should be performed by the director of animal care, by the responsible investigator, or by trained persons under their immediate supervision.
1. Methods and materials

(a) The choice of method depends upon the species and the purpose for which the animal was used. The method of killing should not interfere with the types of post mortem tests to be performed.

(b) For laboratory animals such as the dog, cat, and the nonhuman primate, barbiturate solutions of high concentration should be administered intravenously or intraperitoneally. Guinea pigs and rabbits can also be swiftly and humanely killed by barbiturate solutions injected intraperitoneally.

(c) Mice, rats, and hamsters can be killed by the use of ether, chloroform, nitrogen, or CO₂ in a special chamber. Care should be taken to be sure that the chamber is not overcrowded.

(d) (Optional) Mice, rats, or hamsters can also be humanely killed by physical methods such as the separation of the spinal cord in the cervical area, or stunning by a sharp blow at the back of the head. These methods result in instantaneous unconsciousness and death without the excitant stage.

(e) In the large domestic animals, thiobarbiturates (1 gm/250 lbs. dissolved in 10 to 20 cc of water) administered rapidly (10 seconds) intravenously will produce anesthesia and restraint of short duration. The animal can then be killed humanely by any method desired.

G. Animal surgery and postsurgical care

1. Facilities, equipment, and supplies

If surgery is performed, appropriate facilities and equipment should be provided. The area should be operated in accordance with accepted surgical practice. Ordinary laboratory facilities can be utilized for nonsterile, terminal procedures, and for so-called “clean surgery” on small animals such as rats, mice, and hamsters. Aseptic surgery can be performed in a laboratory area if the laboratory is suitably designed and equipped. However, if aseptic surgery is performed routinely, especially on dogs, cats, or nonhuman primates, an area specifically designed for this purpose should be provided. A suitably equipped area for aseptic surgery on these species should contain or have access to facilities, equipment, and supplies such as—

(a) An autoclave or other equipment for effective sterilization of instruments, linens, gloves, gowns, and similar items.

(b) Scrub sink for surgical preparation.

(c) Operating tables, instrument stands, and tables.

(d) Operating light of sufficient power to assure clear illumination of the operative field.

(e) Instrument and linen packs appropriate for each surgical procedure.

(f) Instruments and equipment for tracheal intubation and artificial respiration.

(g) Caps, masks, and scrub suits for personnel in the surgical area.

(h) Kick buckets, laundry hampers, and other equipment as necessary for hygienic protection and maintenance.

(i) Whole blood, fluids, vasopressors, antibiotics, and other supportive drugs which may be needed during surgical procedures.

2. Operating rules

(a) A facility for aseptic surgery on dogs, cats, and nonhuman primates should be directed by a person qualified by experience or training.

(b) Operating procedures for the facility should include provision for the proper preparation and anesthetization of animals for surgery (in a separate area), the setting up and maintenance of the operating area, and for other assistance needed by the surgeon.

(c) Anesthetization should include all necessary procedures and drugs for eliminating sensibility to pain during surgical procedures, as determined by the responsible investigator or the director of animal care.

3. Postsurgical care

(a) Provisions should be made for intensive care of dogs, cats, nonhuman primates, and large domestic animals during the immediate postsurgical period, and for their subsequent aftercare. Intensive care includes procedures such as maintenance of adequate fluid balance; administration of whole blood, antibiotics, analgesics, or other drugs whenever indicated; recording rectal temperature; care of the surgical incision; emergency treatment; and similar clinical procedures. The duration of this period will vary with the type of surgery performed and the condition of the animal.

(b) The intensive postsurgical care area should be equipped for supportive treatment; or such equipment should be immediately available if needed. Heating pads or heated cages, steam vaporizers, compressed air, vacuum equipment, oxygen, examination table, and appropriate instruments are examples of the types of equipment which may be needed.
Laboratory facilities or services should be available as necessary to follow and support the animal's recovery.

H. Emergencies

Provision should be made for emergency care, day or night. Standard operating procedures for emergencies must be listed. These should include such items as—

(a) Name of responsible person or alternate.
(b) Means of contacting responsible person or alternate.

II. Personnel

The number of personnel and the qualifications required to support animal care programs depend on a variety of factors which may interact differently in different institutions. 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 animals maintained; and the nature of the teaching, testing, or research activities. It is evident that these interactions will result in a variety of staffing concepts and "chains of command," and no arbitrary statement of personnel requirements can be made. The intent of these recommendations is simply to provide guidelines which may be helpful in staffing to implement the criteria described in section I.

A. Professional personnel

Many research institutions have adopted the concept that their animal facilities and animal care programs require professional direction apart from and in addition to that provided by the research worker himself. They have employed specialists in laboratory animal medicine to assist in meeting an increased requirement for high-quality animals maintained under rigorously controlled environmental conditions. Scientists have welcomed this support; and the result has been the development of animal care units serving the scientific staff as an essential "central" resource. The units' functions vary from institution to institution, but may include the provision of a broad range of laboratory, clinical, research, and animal husbandry services. Some of the units have independent teaching and research functions as well.

Most units of the type described above are staffed by veterinarians having specialized training or experience in laboratory animal medicine. Many are diplomates of the American College of Laboratory Animal Medicine or have equivalent training or experience. (See app. I.) The subject areas in which they must be knowledgeable include:

1. Methods and techniques of laboratory animal care, handling, and experimentation.
2. Biology of the laboratory species, including comparative anatomy, physiology, pathology, and diseases.
3. Administration and management of laboratory animal facilities.

The development of a full-time professional staff specifically concerned with laboratory animal care is recommended. However, it may not be feasible in all institutions because the number of animals maintained may be small and because the scope and type of research or other use may not warrant it. In these institutions the use of part-time consultants may prove helpful.

Biomedical investigators traditionally have concerned themselves with animal care problems. They must continue to bear primary responsibility for the care of their animals. In many institutions biomedical investigators may not require additional assistance with animal care problems. However, the development of laboratory animal medicine as a specialized field has extended the resources and skills available to research scientists to assure high-quality care. The increased size and scope of biomedical research requires greater varieties and larger numbers of laboratory animals. Therefore, this field seems destined for further growth because investigators have recognized that it contributes to the well-being of their animals and the success of their research.

B. Animal care personnel

The care of laboratory animals, as outlined in section I, requires well-trained, experienced animal technicians properly supervised and directed. Scientific institutions should make provision for the training of newly employed animal technicians (see app. II), and for their direct supervision during the training period.

The size of the animal care staff should be adequate to assure daily attention to the needs of the laboratory species in accordance with recommendations in section I.

III. Physical Plant

The physical condition and design of animal facilities to a great extent determine the efficiency and the economy of their operation, and greatly influence standards for animal care. A well-designed facility, properly maintained, is an essential element in good animal care.

Many new animal facilities will be built in the next few years, and remodeling of existing quarters will occur. Thus, the question of what constitutes proper facilities for laboratory animals is important. In most institutions a research building is the product of many compromises, and it is not always possible to provide ideal solutions for difficult design problems. Nevertheless, careful planning can help to minimize these problems. This section of the Guide deals with design and construction features which 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 number of animals to be housed, the requirements for flexibility in the housing of different species, the physical relationship to the rest of the institution, and its geographical 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 where animals can be housed apart from areas of human occupancy. A sufficient number of animal rooms or areas are required to assure separation of species or isolation of individual projects; to provide for the receiving, quarantine, and isolation of animals; and to provide for their routine and specialized housing.

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

3. Receiving and storage areas for food, bedding, supplies, and equipment.
4. Office for administration, supervision, and direction of the facility.
5. Showers, sinks, lockers, and toilets for personnel.
6. Area for washing and sterilizing equipment and supplies. Dependent upon the volume of work, a well-equipped cleaning area includes facilities such as a cage-washing machine; bottle or glassware washing machine; rack-washing machine or area; waste can washing machine or area; utility sink; autoclave for equipment, food, and bedding; and separate areas for holding soiled and clean equipment. (See p. 6, par. 2 (b) and (c) and p. 28, par. S.4.)

7. Incinerator capable of burning all animal waste and refuse; or facilities for safe and sanitary storage of such waste prior to removal.

B. Service areas in relation to total size of the animal facilities

1. An area or areas equal in square feet to at least 25 percent of the animal housing space should be set aside for the service functions of the animal facility. The service functions include activities such as cage washing and sterilization; storage; diagnostic laboratory; office activities; receiving and quarantining of animals; and refuse disposal.
2. Where an animal facility is 1,000 square feet or less in size, it may be possible to carry out the service functions in an area which serves other activities as well. However, a separate facility for washing and sanitizing animal cages should be available.
3. In a facility up to 10,000 square feet in size, separate rooms or areas should be provided for the following service activities:
   (a) Receipt and quarantine of newly received animals.
   (b) Receipt and storage of animal food and supplies, including refrigeration.
   (c) Cleaning and sanitizing of cages and equipment.
   (d) Incinerator or protected area for refuse.
   (e) Lavatory facilities for personnel.
   (f) Office for supervisory and administrative personnel.
   (g) Laboratory facilities.
4. In institutions having several separate animal housing facilities, or one large area, which total more than 10,000 square feet, rooms or areas for all of the service functions listed in item 3 above should be provided. In addition, clinical laboratory areas should be provided (sec. I.D.). Some duplication of service areas may be required if the animal facilities are widely dispersed.

C. Physical relationship of animal facilities to research or teaching laboratories

Animal housing areas support research and teaching laboratories. Good animal husbandry and human comfort require physical separation of animal facilities and human occupancy areas such as offices and laboratories. This can be accomplished by locating the animal quarters in a separate wing or on separate floors of a multistory building, or by providing a separate building for animal housing. A one-story building for animal housing permits the most efficient and economical animal care operation, since vertical transport is avoided. However, it may be least desirable for research workers because of inaccessibility of their laboratories. Efficiency and economy in utilization of the research workers' time must be considered in planning animal facilities. Careful planning should make it possible to locate the animal areas adjacent to or near laboratory areas, but physically separated from them by barriers such as entry locks, separate corridors, or separate floors.

D. Materials

Maintenance costs as well as initial construction costs should be considered in selecting building materials; and materials should be selected which will facilitate efficient and hygienic operation of the animal quarters. Durable, waterproof, fire-resistant, seamless materials for interior surfaces are most desirable. Paints and glazes, in addition to being highly resistant to chemical solvents, cleaning agents, and scrubbing, shall be highly resistant to high-pressure sprays and impact.

E. Corridors

In most cases, corridors should be 7' wide to permit easy flow of personnel and equipment. The floor-wall junction should be coved to facilitate cleaning. Provisions should be made to protect walls from damage by equipment by providing curbs or guardrails, or bumpers on equipment. Exposed corners should be protected by reinforcing with steel or other durable material up to a height of 6'. 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 of the animal rooms.

F. Animal room doors

Animal room doors should swing toward the corridor only if there is a recessed vestibule. They should be at least 42'' wide and no less than 84'' high to permit easy passage of racks and equipment. The doors should fit tight to the frames and sills to provide a barrier against the entrance of vermin. Metal or metal-covered doors are preferred.
They should be equipped with kickplates and be self-closing. Recessed handles are recommended. Viewing windows are desirable. Door frames should be sealed completely to prevent their serving as vermin harborages.

G. Exterior windows

Exterior windows and skylights in animal rooms are not essential. If windows are provided, they should preferably 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 which will withstand repeated washing and disinfection. If windows are opened for ventilation purposes, effective screening is essential.

H. 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, materials specified should be of a monolithic nature or should have a minimum of joints. Some materials which have proven satisfactory are terrazzo, cupric oxychloride cement, smooth hard-surfaced concrete, neoprene terrazzo, and special hardened rubber base aggregates. A continuous waterproof membrane should be provided.

I. Walls

Walls should be monolithic, waterproof, painted, glazed or smooth, free of cracks or imperfect junctures at the floor, ceiling, corners, or utility penetrations. Materials should be acid or solvent resistant, capable of withstanding scrubbing with detergents and disinfectants. The walls must be capable of withstanding water streams of jets from high-pressure nozzles. Provisions should be made to protect walls from damage by movable equipment.

J. Ceilings

Ceilings formed by the concrete floor above are satisfactory if properly smoothed, sealed, and painted. Furred ceilings of plaster or fire code plasterboard should be sealed and painted with washable finish. Exposed pipes and fixtures at ceiling level are undesirable in nonhuman primate rooms because of the problems created by escaped animals.

K. Ventilation, temperature, and humidity control

1. Effective ventilation is necessary to maintain a low concentration of atmospheric contaminants such as odors or microorganisms, to regulate room temperature, and to promote comfort. Factors of importance in proper ventilation are temperature, humidity, and the movement of air.

2. If small animals (for example, dogs and rabbits) are housed outdoors with no access to indoor facilities, provisions to aid their natural temperature regulation are essential. When the ambient temperature falls below 50°F, some form of shelter and clean nesting materials should be provided. Materials such as shavings, straw, or paper can be used. When the ambient temperature exceeds 85°F, animals should be able to burrow, or lie on materials several degrees cooler than the surrounding air, or shade must be available.

3. A mechanical ventilation system is necessary in most indoor facilities. Air conditioning is highly recommended since it promotes environmental stability. Ideally, the ventilation system should permit individual adjustments within ±2°F for any temperature within a range of 65°F to 85°F. Relative humidity should be maintained year round within range of 40 to 70 percent, according to the needs of the species being maintained. Temperature and humidity should be controlled individually in each animal room. The animal facility and human occupancy areas should be ventilated separately. The system should provide frequent changes of room air without drafts. A minimum of 10 to 15 changes per hour is recommended. There should be no recirculation of room air unless it has been filtered to remove contaminants. An acceptable alternate is to provide zone control with limited recirculation of room air. Operation of the system at 74°F ±3°F and 50±10 percent relative humidity, using 100 percent fresh air during temperate weather and 50 percent fresh air during periods of temperature extremes is acceptable for situations where routine housing of animals is the primary requirement. (See sec. III. S and T for special situations.)

4. Maintenance of a given room temperature within even closer tolerances such as ±1°F, and of relative humidity within 5 percent, using 100 percent fresh air at all times, may be required for certain experiments. For example, where precise environmental studies are in progress, such controls may be essential. In such rooms recording devices for temperature and humidity should be installed, together with a failure alarm system which may control utilities and air supply. The sensing elements should be placed approximately at the average level of animal cage floors.

5. The concentration of odors or hazardous particles is not reduced efficiently simply by dilution due to an increase in air changes per
hour. A more effective procedure is to remove the source of contamination from the animal room.

Forced ventilation is recommended in all animal rooms. In a room having no forced ventilation, where circulation depends on the movement of air of different humidity and temperature, at least two ventilation openings are necessary. They should be situated in opposite sections of the room, one higher than the other. At least 1 square foot of air inlet and outlet should be provided for each 20 dogs, 80 cats, 400 rats, or 4,000 mice. No evaporation or heat reduction takes place in saturated air whose temperature is higher than an animal's body temperature, regardless of the velocity of air.

In air-conditioned facilities, 10 to 15 air changes per hour are considered adequate for comfort. The ability to maintain odor-free facilities depends upon the number and species of animals housed, on the sanitation practices, as well as on a properly designed ventilation system.

L. Power and lighting

The electrical system should provide ample lighting, sufficient power outlets, safety provisions such as explosion proof outlets in rooms where volatile, explosive anesthetics may be used, and waterproof outlets where water is used in cleaning.

Lighting should be uniformly diffused throughout the area to be served. Although 10 to 15 foot-candles of light are considered sufficient to maintain vital animal activity and rhythms, at least 50 foot-candles are necessary for ordinary servicing of animal rooms. For most animal housing areas, a minimum lighting intensity of 75 foot-candles at the level of the cage racks is recommended. Animal treatment and examination areas should have a minimum of 100 foot-candles at the work surface.

Surface-mounted fluorescent fixtures are efficient and are available in a variety of fixtures which can also be sealed to the ceiling. Incandescent or fluorescent lamps in tightly sealed fixtures hung from the ceiling are adequate. Recessed fluorescent lamps, sealed within the ceiling, are acceptable. Light fixtures should be properly sealed to prevent their serving as vermin harborage.

Adoption of a standard daylight equivalent is recommended in windowless animal facilities. This can be accomplished by providing a centrally controlled, timed, off-on lighting system; or by attaching a simple timer to the light switch in each animal room.

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

M. Drainage

All waste fixtures and equipment should be connected through traps to soil and waste pipes. If floor drains are used, the drainpipes should not be less than 4” in diameter. In heavy-use areas such as dog kennels, 6” diameter drains are recommended. A flushing drain, much like an ordinary toilet bowl, set in the floor, is an effective aid in the disposal of solid waste. A porous trap bucket to screen out solid waste provides an effective alternative to removal of solid materials through the drain. 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 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 sec. III. S and T.)

Floor drains are not essential in animal rooms for species such as rats, mice, or hamsters. Floors in such rooms can be maintained satisfactorily by wet vacuuming, or by sweeping and mopping with appropriate disinfectants or cleaning compounds. The recommended minimum pitch of floors where floor drains are used is 1/4” per foot. Proper pitching of the floor is an essential element in establishing good drainage in animal rooms; and particular attention should be paid to this detail in planning animal facilities.

N. 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 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 to have the storage areas verminproof.

Food storage areas should be physically separated from refuse areas. Temperatures in the storage rooms may be the ambient temperature. However, it is good practice to hold packaged animal feeds (pellet rations) at 50° F. or less. Refrigerated storage should be available for meats, fruits, vegetables, and other perishable items.

Refuse storage areas should preferably be kept below 45° F. to reduce putrefaction of waste or animal carcasses. Obnoxious materials should be covered or packaged. The area should be constructed so it can be kept clean and free of vermin.

Adequate space for storing equipment is essential. This is an effective way to prevent clutter in animal rooms. All storage areas should be cleaned periodically.
O. Noise control

Noise is inherent in the operation of animal facilities, both from the animals, and animal-care routines. Noise may be undesirable because of its effects on personnel, and on the animals themselves. Inasmuch as background and “operational” noise is an environmental factor in the control of animal experiments, it should be considered in the design of animal facilities.

Ordinarily, species such as rats, mice, guinea pigs, cats, and hampsters do not create disturbing noise in animal facilities. Noise from a monkey colony can be troublesome. However, dogs invariably 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 residences are 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 removing major cage-cleaning activities from animal 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 density is more important than acoustical materials in reducing the transmission of sound. Acoustical materials may be used in animal rooms by direct application to the ceiling, or as part of a suspended ceiling, providing the rooms are vermin-proof. 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.

P. Facilities for washing and sterilizing equipment and supplies

An area for washing and sterilization is essential to keep equipment physically clean, to reduce obnoxious odors, to minimize the spread of infectious diseases, and to provide for the comfort of experimental animals. The washing and sterilizing activity is best conducted outside of the animal rooms in an area specifically designed for the purpose, and centrally located, if possible. Consideration should be given to factors such as—
Q. Large animals

For purposes of the Guide, large animals are defined as domestic animals, such as horses, sheep, cows, goats, and pigs.

Conventionally, these animals are housed in pens and barns. Even when ambient temperatures fall below freezing, most large animals prefer to remain outdoors if adequate feed, water, bedding, and shelter are available.

The housing of large, domestic animals in an urban research facility will parallel in many respects the housing of other laboratory animals. Because of their size, however, special consideration must be made for their restraint and confinement. The following sections refer to housing of large animals in rural areas.

1. Service and feed alleys

Service and feed alleys should permit easy passage of equipment. In drive through units, if a tractor and trailer are used, the service alley should be 8' to 9' wide. Feed alleys, 4' to 5' in width, are preferred, although these, too, may vary with the equipment used.

2. Doors and pen gates

Animal exit or entry doors should be 4' to 6' in width. The doors should fit tightly to provide a barrier to vermin. Metal flashing (28 gage) on the bottom of wood doors will prevent rodent damage. Metal doors are preferable. Doors to large service alleys should be “overhead or sliding” type. Door sills should not be raised above 2' and a concrete apron should extend outside for at least 6'. Pen or stall gates should be 4' in width and 8' high for adult horses and cattle. The gate sizes can be smaller for sheep, hogs, and calves, but for accessibility and efficient operation a 4' width is applicable even to small pens. Doors to outside pens for hogs should be 2' to 2½' wide and 3' high.

3. Windows

Windows are unnecessary. If they are provided, they should be placed at a high level to prevent breakage by animals. The inside glass should be framed flush with the wall, eliminating sills where dirt and dust can collect. Insulating glass is preferred. Approximately 1 square foot of window space per 30 to 40 square feet 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 severe weather, weak acid or alkali solutions.

A good-quality concrete floor with a hard but moderately rough surface to prevent animal slipping is preferred. A floor thickness of 4” is recommended for light loads and up to 6” 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. Double-wall masonry (cavity insulation) or single masonry with inner insulation containing vapor barriers are recommended.

6. Ceilings

A ceiling height of 8½' 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

A minimum indoor temperature of 40° F. is acceptable. Large domestic animals are well adapted to this temperature and the most important governing factor is the comfort of the caretaker or investigator.

(a) When large animals are maintained outdoors and ambient temperatures fall below freezing, areas protected against prevailing winds must be provided. Adequate bedding should be provided, and shade must be provided when the ambient temperature exceeds 85° F.

(b) Indoor facilities require adequate ventilation to control moisture and odor. A ventilating system capable of exhausting 100 c.f.m./1,000 pounds animal weight is recommended. A temperature should be maintained of not lower than a minimum of 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 areas with extremely high ambient temperatures, the facility cannot be kept lower than the environmental temperature and air conditioning may be necessary.

8. Power and lighting

The electrical system should provide adequate power for operation of all electrical equipment. Outlets should be conveniently located and numbers will be dependent on existing codes and intended uses.
Switches for operational machinery should be readily accessible and located clear of machinery to prevent injury to the operator. Provisions should be made for emergency power in case of failure.

Lighting should be uniformly diffused throughout the facility. It is desirable to deliver 10 to 20 foot-candles of light at 1 foot above the floor for adequate servicing. Higher levels of lighting may be required for special areas such as treatment rooms. In windowless facilities a controlled timed off-on system may be used.

9. Storage areas

(a) Feed storages should be separated from manure disposal areas. Storage area should be minimal so that continual turnover is possible depending on the availability of supply. The feed storage area should be clean and verminproof. A regular vermin control program should be established. Sacked concentrates should be stored off the floor.

(b) 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. A regular program of vermin control should be in effect in the disposal or storage area.

10. 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 all-weather access should be provided.

(b) Feeding platforms and bunkers should be centrally located and all-weather access 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. It is recommended that there be paved or concrete platforms or aprons around buildings and feeders. The slope should be 1”/foot away from bunkers and waterers and 1/2” to 3/4”/foot away from buildings or resting areas.

R. Space recommendations for laboratory animals

The size of a cage, pen, or run, and the number of animals to be housed in each, are matters of professional judgment. The recommendations below are arbitrary, but they are based on the best available information as to a reasonable space allocation for the routine housing of animals of the weights or ages indicated in table I. They are included here simply as a guide, and their incompleteness is acknowl-
TABLE I.—Suggested space for the routine housing of laboratory animals—Con.

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight or age</th>
<th>Type of housing</th>
<th>Overall size (inches)</th>
<th>Number of animals</th>
<th>Housing area/animal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Width</td>
<td>Depth</td>
<td>Height</td>
</tr>
<tr>
<td>Hogs (adult sow)</td>
<td></td>
<td>Pen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sow with pigs</td>
<td></td>
<td>Do</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult boars</td>
<td>18-45 kg</td>
<td>Do</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 to 100 kg</td>
<td>20-60</td>
<td>Do</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 These recommendations may require modifications according to the body conformations of particular species.
2 As a further general guide, the cage dimensions should be: (a) the height of the dog at the withers, plus at least 6 inches (height); (b) the length of the dog from the tip of the nose to the base of the tail, plus at least 6 inches (width or depth).
3 Loose housing is outdoor housing which includes an open shed for shelter.

edged. As has been stressed in section I, the adequacy of any housing system must be evaluated in each institution by the professional director of animal care in terms of the previously mentioned criteria. (See sec. I.A.)

5. Special facilities needed for biological safety in infectious disease units

The materials used in the construction of infectious disease units and other animal facilities are similar. However, in the design of infectious areas, the need for effective isolation is obviously of greater importance, especially where diseases transmissible to man are under investigation. An infectious disease unit should be separate from holding areas for normal animals. The unit 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 infectious disease units to aid in the protection of personnel and to prevent cross-infection among animals in the colony; as for example:

1. Pass through locker rooms for the storage of clean street clothing and the changing into laboratory clothing.
2. Air lock entry to and from the infectious disease unit, preferably with ultraviolet light barriers within the lock.
3. An area for the removal of contaminated clothing should be located at the exit, between the ultraviolet lock and a shower. The exit from the shower should lead to the locker room.
4. Autoclave to sterilize cages, bedding, watering devices, feeders, and waste before cleaning or removal. Some institutions pass through autoclaves in a wall between the animal room and the cage-washing room or corridor. This makes it possible to sterilize equip-

ment and supplies entering or leaving the room, and establishes a flow system from "contaminated" to "clean." Automatic interlocks may be used to prevent the door on the clean side from being opened until a sterilization cycle is completed. If equipment is sterilized before it leaves the infectious disease unit, it may be washed in a machine serving other areas. However, in large units, a separate washing area should be provided.

3. Animal rooms in infectious disease units should be ventilated under negative pressure with respect to corridors or adjoining non-infectious areas. Ten to fifteen changes per hour of conditioned air generally are sufficient for all needs. There should be no recirculation of room air in infectious areas.

Exhaust air from the units should be filtered. Spun-glass filters having an efficiency of 99 percent or greater are recommended. It is important that the filter frame be sealed tightly in the plenum chamber to prevent leakage of unfiltered air. Electronic precipitation is effective, but the maintenance cost of this system is high. Frequent servicing is necessary to maintain rated filtration effectiveness. Incineration is another effective air treatment system. However, it is expensive, except when the volume to be incinerated is small (75 to 90 cubic feet per minute or less). Large oil or gas-fired incinerators are feasible to sterilize large volumes of air containing highly infectious organisms. Ordinarily, incineration of air is unnecessary, except in the highest risk areas, such as when dangerous aerosols are used.

6. Special rack and caging systems may be helpful, depending on the organism under study and the mode of exposure of the experimental animals. Ultraviolet lamps and reflectors have been found helpful in controlling airborne spread of infections between cages. They should be attached in a horizontal position at both ends of each cage rack shelf to provide a band of radiation across the top of the cages. The radiation is effective in reducing the escape of airborne vegetative organisms from animal cages. It is not as effective against bacterial spores. Ultraviolet lamps should be effectively shielded to protect animals and personnel from eye damage. Protective goggles for personnel are necessary.

Several types of ventilated cages are available. They are useful where airborne organisms are under investigation. Ventilated lids can be made to fit ordinary animal cages. This entails the use of airtight gaskets around the rim of the lid, an exhaust pipe which can be connected to a central exhaust system, and an air intake equipped with a glass fiber filter. More complex units such as Horsfall cubicles or flexible film isolators may also serve usefully for this type of work.

7. 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, and service piping for gas, air, water, and vacuum. A 250-cubic-feet-per-minute air filter to exhaust air from the cabinet will serve effectively except for the most hazardous types of infectious disease research. With this system a high-velocity airflow into the cabinet is essential for safety.

8. Disinfectant vaporizers are helpful in decontaminating an animal room following conclusion of experiments and removal of all animals. The room should be sealed; 1 milliliter of 37 percent formaldehyde should be vaporized for each cubic foot of airspace and allowed to act for 6 to 8 hours. Room temperature should be at least 70°F, and relative humidity 80 percent during the decontamination procedure. Beta propiolactone, used in the same way as formaldehyde, in a concentration of 300 milligrams per cubic foot, is also an effective air and surface decontaminant.

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

T. Special requirements for radiation safety

Radiation safety is a fundamental obligation in housing radioactive animals. Where radionuclides are used, provision must be made for the protection and monitoring of personnel and protection of animals not involved in the experimental program. (See applicable Federal, State, and local regulations.)

1. An area should be provided for housing radioactive animals in accordance with Federal, State, and local regulations. This may be done by holding such animals in well-ventilated, radio-chemical fume hoods or glove boxes designed for this purpose, or by treating the entire holding room as a hood. If biologically significant levels of gamma ray emitters are to be used, appropriate lead shielding should be provided. Appropriate ventilation should also be provided. Service controls should be located outside of the hood to reduce exposure and spread of contamination.

2. To protect against 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 blotting paper applied to walls, floors, and bench tops are recommended. Rubber or vinyl tiles, or linoleum, applied over a concrete floor will provide adequate protection, since these materials are nonporous and can be lifted if necessary. Epoxy resin paints or surfacing materials will seal plaster walls effectively if properly applied.

3. 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.

4. Work surfaces such as bench tops and the interior of animal-holding hoods should be covered with strippable coatings, or disposable waterproof backed blotting paper. These will protect the surfaces adequately when low levels of activity are used. Stainless-steel trays should be used to cover the bench top and floor of the hood.

5. Personnel must be protected during animal injection procedures. Syringes may be covered with a plastic shield when using up to several millicuries of beta ray emitters. For injection of low levels of gamma ray emitters, the syringe may be covered with a lead shield. However, for higher levels the entire operation should be performed by remote control.

6. Personal dosimeters and survey equipment must be used in accordance with Federal, State, and local regulations.

7. Facilities for disposal of radioactive animal waste:

(a) Gaseous radioactive wastes may be diluted with the air by release in hood effluents. Volatile wastes in combustible materials may be released by incineration, providing insoluble particulates of high specific activity are not permitted to escape in the effluent. Incineration also is a means of reducing the bulk of nonvolatile materials to about 20 percent of their original weight. Small numbers of animals containing small amounts of radionuclides are readily disposed of by incineration. Large numbers may require concentration by incineration or other means, followed by special disposition. The solid radioactive wastes should be divided into burnable and nonburnable portions at the point of origin.

(b) Water-soluble waste can usually be disposed of by dilution in the sewer system. When this method of disposal is used, the possibility of reconcentration within the diluting medium must be considered as well as the expected dilution within the sewer system. The quantities disposed of should be controlled so that hazards are not presented to sanitation and sewage plant personnel.

(c) Storage facilities for radioactive animal carcasses and excreta should be provided until the activity is reduced sufficiently for disposal by dilution, or until they can be disposed of as ordinary stable wastes. Such wastes should be monitored by the institutional radiation safety officer. Special shielding of the storage area may be required. To minimize waste control and disposal problems, the smallest animal capable of fulfilling the experimental requirements should be used.
(d) Mechanical washing equipment should be of a type which will facilitate decontamination of cage equipment and will not itself accumulate radioactive waste. For example, radioactive cages should not be washed in machines which recirculate the wash solution.

(e) One hundred percent fresh air should be circulated in animal rooms. There should be no dilution or recirculation of room air. Filtration of exhausted air is necessary where high levels of radionuclides are present.

(f) A radiation safety officer should be appointed to supervise activities involving the use of radionuclides.

Appendix I

PREREQUISITES FOR CERTIFICATION BY THE AMERICAN COLLEGE OF LABORATORY ANIMAL MEDICINE

The following prerequisites must be met to the satisfaction of the council of the American College of Laboratory Animal Medicine before a candidate will be certified as competent in laboratory animal medicine:

(a) Have satisfactory moral and ethical standing in the profession.

(b) Be a graduate of a school of veterinary medicine approved by the American Veterinary Medical Association.

(c) Have completed a comprehensive written examination.

(d) Have completed 2 years of postdoctoral training in laboratory animal medicine in a formal program approved by the college and have had 2 years of approved full-time experience in laboratory animal medicine; or have a master's degree in some area of biology or medicine and have had 4 years of approved full-time postdoctoral experience in laboratory animal medicine; or have had 6 years’ approved full-time postdoctoral experience in laboratory animal medicine.

(e) Have published, or presented in a form suitable for publication, a written dissertation on some phase of laboratory animal medicine.

(f) Have completed a comprehensive oral and practical examination.
B. Senior Animal Technician

1. Age: 21 years minimum.
3. Experience: 3 years' animal care in an approved laboratory animal facility.
5. Vocational education: Must furnish evidence of having acquired knowledge of principles of laboratory animal care. Successful completion of an Animal Technicians Certification Board recommended course for Senior Animal Technicians will satisfy this qualification.

In addition to the subjects listed under "Vocational Education" for Junior Animal Technicians, the applicant must have a comprehensive understanding of the following:

(a) Recognition of clinical signs of illness in laboratory animals.
(b) Animal nutrition, including preparation of special diets.
(c) Elementary genetics, including breeding of laboratory animals.
(d) Supervision of animal care personnel, including planning of work routines.
(e) Administrative procedures and recordkeeping.
(f) Laboratory and technical procedures such as preparation of surgical equipment, euthanasia, oral and parenteral administration of drugs under supervision, bleeding of animals, assistance with preoperative and postoperative care of animals.

6. Examinations: The applicant must satisfactorily complete the written, oral, and practical examinations prepared or approved by the Animal Technicians Certification Board. If the applicant has a Junior Animal Technician's certificate, the practical examination will be waived. The final written examination of a recognized and approved course may be accepted in lieu of a written examination given by the Board. The oral and the practical examination (if required) must be given by a Board member or by someone appointed by the Board.

7. Fee: The examination fee is $10, and it is not refundable in the event of failure to pass or complete the examination.

C. Animal Quarters Supervisor

1. Age: 26 years minimum.
2. Education: High school graduate (minimum).
3. Experience: 8 years full time in laboratory animal facility. A maximum of 2 years' experience credit may be granted by the Board for degrees in animal husbandry, biology, or other appropriate disciplines.
5. Vocational education: Applicant must possess a comprehensive and detailed knowledge of laboratory animal care, facilities, equipment design, administration, and an understanding and familiarity with research laboratory animals. Applicant must have a comprehensive understanding of the subjects listed under "Vocational Education" under the qualifications for Junior Animal Technician and Senior Animal Technician. (A Senior Animal Technician Certificate is desirable.) In addition, the applicant must have a comprehensive understanding of the following subjects:

(a) Administration of animal facilities, including purchasing, detailed recordkeeping, cost accounting, and management of animal care personnel.

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Appendix II

QUALIFICATIONS FOR CERTIFICATION BY THE ANIMAL TECHNICIANS CERTIFICATION BOARD OF THE ANIMAL CARE PANEL*

A. Junior Animal Technician

1. Age: 18 years minimum.
2. Education: Grammar school graduate.
3. Experience: 1 year of animal care in an approved laboratory animal facility.
5. Vocational education: Must furnish evidence of having acquired knowledge of basic principles of laboratory animal care. Successful completion of an Animal Technicians Certification Board-recommended course will satisfy this qualification. Otherwise, evidence of having completed appropriate college courses, or other evidence of having attained equivalent basic knowledge of the principles of laboratory animal care may be presented.

In any case the applicant must have a comprehensive understanding of the following:

(a) Routines of feeding and watering laboratory animals.
(b) Methods of cleaning animal cages and equipment.
(c) Basic principles of sanitation and disinfection.
(d) Recognition of vermin and their control.
(e) Personal hygiene.
(f) Restraint and handling of laboratory animals.
(g) General and personal safety in animal facilities.
(h) Recordkeeping and animal identification methods.
(i) Basic system of biology (i.e., structure and function of organ systems).
(j) Sexing of animals; gestation periods; weaning ages of common laboratory species.
(k) The signs of normal health and behavior in laboratory animals.
(l) Principles of experimental methods.
(m) The meaning of responsibility for the care and management of a group of experimental animals.

6. Examinations: The applicant must satisfactorily complete the written, oral, and practical examinations prepared or approved by the Animal Technicians Certification Board. The final written examination of a recognized and approved course may be accepted in lieu of a written examination given by the Board. The oral and practical examination must be given by a Board member or by someone appointed by the Board.

7. Fee: The examination fee is $5, and it is not refundable in the event of failure to pass or complete the examination.

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*Animal Care Panel, Post Office Box 1028, Joliet, Ill., 60434.
(b) Supervision of the operation of a surgical laboratory, including the preparation of complex equipment, service as a surgical assistant, implementation of a prescribed program of postoperative care.
(c) Operation of facilities, including performance of routine clinical laboratory procedures in bacteriology, hematology, and parasitology.

6. Examinations: The applicant must satisfactorily complete the written and oral examinations prepared or approved by the Animal Technicians Certification Board. Examination must be given by a member of the Board or someone appointed by the Board.

7. Fee: The examination fee is $25, and is not refundable in the event of failure to pass or complete the examination.

Appendix III

CERTIFICATION PROCEDURES OF THE ANIMAL TECHNICIANS CERTIFICATION BOARD OF THE ANIMAL CARE PANEL

A. Junior or Senior Animal Technicians

1. For groups. This includes local ACP Branches who wish to set up a local program for technicians, for a firm or an institution that wishes to set up a program within its own establishment, or local areas without an established ACP Branch where a group of firms and/or individuals wish to establish a local program for technicians.

(a) Obtain from the chairman of the Animal Technicians Certification Board a detailed outline of a Board-approved course. If you have a course already set up, submit a detailed outline of the course to the chairman for approval.

(b) The final written exams must be approved by the Board. The Board, upon request, will send, with the course outline, a sample final exam to indicate the level of instruction that is expected. If the person in charge of the local training course wishes to prepare the written examination, he should submit it to the chairman of the Board before the course is completed to save time.

(c) The final written examination is to be graded by the person in charge of the local course, who will then send the papers to the chairman of the Board for approval. All persons receiving a Board-approved passing grade can then apply for the remaining oral and practical (if required) parts of the examination which must be given by a member of the Board or an appointed examiner. All application forms are to be sent to the chairman of the Animal Technicians Certification Board who will arrange the scheduling of the oral and practical examination.

2. For individuals: This includes people who meet the required classifications and have successfully complete courses other than those arranged through the Animal Technicians Certification Board, such as the Raiston Purina Correspondence Course.

(a) As it is not practical or feasible to have a member of the Board give the examinations for a single person, arrangements must be made to have several applicants take the examinations in a location convenient to the several applicants involved. The office of the supervisor of any of the applicants in the local area can serve as the central collection station for application, but with the supervisor of the facility as the local liaison person.

(b) After the local liaison office has been set up, apply for an application from the Animal Care Panel Business Office, Post Office Box 1028, Joliet, Ill., 60434, and return the completed form to the local liaison
person, who will in turn submit the applications to the chairman of the Animal Technicians Certification Board.

(c) The local liaison person will then request a copy of the written examination form for each applicant, arrange for and supervise the examination at one time, and return the examination papers to the chairman of the Board or to the Board member designated to process the papers.

(d) The chairman (or the designated member of the Board) will then arrange for the details of giving the oral and practical parts of the examinations.

Appendix IV

SELECTED BIBLIOGRAPHY ON THE CARE AND MANAGEMENT OF LABORATORY ANIMALS

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