APPENDIX C. DAIRY FARM CONSTRUCTION STANDARDS AND MILK PRODUCTION

I. TOILET AND SEWAGE DISPOSAL FACILITIES

FLUSH TOILETS

Flush toilets are preferable to pit privies, earth closets or chemical toilets at both dairy farms and milk plants. Their installation shall conform to the Local or State plumbing regulations. Toilets shall be located in a well-lighted and well-ventilated room. Fixtures shall be protected against freezing. The following shall be considered defects in flush-toilet installations:

1. Insufficient water pressure or volume;
2. Leaky plumbing;
3. Clogged sewers, as evidenced by overflowing toilet bowl;
4. Broken tile lines or clogged disposal field;
5. Access of dairy lactating animals to the effluent below the sewer or disposal-field discharge;
6. Effluent coming to the surface of the ground in the absorption field;
7. Toilet room floor soaked with urine or other discharges;
8. Offensive odors or other evidence of lack of cleanliness; or
9. Location of soil lines, septic tank, absorption field or leaching pit closer to the source of water supply than the limits indicated in Appendix D.

SEPTIC TANKS

Disposal of the wastes from toilets should preferably be into a sanitary-sewer system. Where such systems are not available to a dairy farm or milk plant, the minimum satisfactory method should include treatment in a septic tank, with the effluent discharged into the soil. Where soil of satisfactory permeability is not available, the effluent shall be disposed of in accordance with the rules of the Local or State Health Authority. It is preferable to treat floor drainage, wastes from washing of utensils, etc., in separate systems. When such wastes are combined with toilet wastes in the septic tank system, careful consideration must be given to the expected flow in the design of both the septic tank and the leaching system.

The septic tank shall be located a safe distance from water sources as determined by consideration of the criteria indicated in Appendix D. The Regulatory Agency shall review and approve proposed installations prior to the initiation of construction. The location should permit easy access for inspection and cleaning. The site should be chosen to make the largest possible area available for the disposal field.

The size of the septic tank should be based on the average daily flow of sewage, a retention period of approximately twenty-four (24) hours and adequate sludge storage. The minimum liquid capacity of a septic tank should be 3,000 liters (750 gallons). The outlet should be baffled to prevent scum from passing out with the overflow. The septic tank cover or slab should be watertight, designed to be insect and rodent proof and to withstand any load likely to be placed upon it. Each tank should have a manhole for each compartment, when it is provided with a solid-slab cover. The manhole covering should be made watertight. Septic tanks should be constructed of materials that are not subject to excessive corrosion or deterioration.

DISPOSAL FIELDS FOR SEPTIC TANKS

A distribution box is considered desirable in every field system. The design of the field should be based on the expected sewage flow, the actual absorptive quality of the soil and the total bottom area of the trenches. Tile or perforated pipe designed for this use, of not less than 10 millimeters (4 inches) diameter, is recommended for field laterals. Laterals should be separated by at least three (3) times the width of the trenches, with a minimum of 2 meters (6 feet).

Trenches should be filled with broken stone or screened gravel, from a depth of at least 15 centimeters (6 inches) below the distributing pipes, to a level at least 5 centimeters (2 inches) above the top of the lines. When drain tile is used, joints should be open about 5 millimeters (¼ inch), and the openings protected by tarpaper strips over the top and sides. The aggregate should be protected from loose backfill by means of a separating strip of untreated building paper or similar material. Under no condition should a field with less than 13.9 square meters (150 square feet) of effective absorption area (30 meters of 46 centimeters (100 linear feet of 18-inch) trench be provided for any individual unit. The maximum length of individual lines should not exceed 30 meters (100 feet). The slope of the field's lateral lines may vary from 5 centimeters (2 inches) to 10 centimeters (4 inches) per 30 meters (100 feet), but should never exceed 15 centimeters (6 inches) per 30 meters (100 feet). It is desirable to have the tile lines within 46 centimeters (18 inches) of the finished grade; however, the total depth of the lateral trenches should never average more than 91 centimeters (36 inches).

In some instances seepage pits may provide a more satisfactory means of disposal of effluent. Walls should be permeable and the liquid capacity should be not less than that of the septic tank. Total wall area should be proportionate to absorptive quality of the soil and to expected sewage flow.

Information as to methods of making percolation tests to determine absorptive quality of the soil may be obtained from Local and/or State Health Departments. From the same sources, advice may be obtained as to trench areas needed for various numbers of users, in relation to observed percolation rates. In view of their close knowledge of local conditions, it is recommended that such assistance be requested before an absorption system is constructed.

EARTH-PIT PRIVY

The earth-pit privy offers the most suitable type of excreta disposal unit for the dairy farm where water carriage systems of disposal cannot be provided. While there are many different designs in use, the basic elements are the same in all cases.

1. **General:** The earth pit should be of such capacity that it may be used for several years without requiring the privy to be moved. Excreta and toilet paper are deposited directly into the pit. Aerobic bacteria break down the complex organic material into more or less inert material. Insects, animals and surface water must be prevented from entering the pit. It is essential that the privy be designed and constructed so that the pit can be kept fly tight.

2. **Location:** The location of the privy shall take into account the need to prevent the contamination of water supplies. The criteria of Appendix D. shall be applied. On sloping ground, it shall be located at a lower elevation than the water supply. On level ground, the area around both the privy and water supply should be mounded with earth. If the installation of an

earth-pit privy will endanger the safety of the water supply, other methods of disposal must be used.

The site should be accessible to all potential users. Consideration should be given to the direction of prevailing winds to reduce fly and odor nuisances. The privy pit should not encroach within 2 meters (6 feet) of any building line or fence, in order to allow proper construction and maintenance.

3. **Pit, Sill, and Mound:** A minimum pit capacity of 4.6 cubic meters (50 cubic feet) is recommended. The pit should be tightly sheathed for a meter or several feet below the earth surface, but openings in the sheathing are desirable below this depth. The sheathing should extend from 25-50 millimeters (1-2 inches) above the natural ground surface, to provide space between the sill and the upper portion of the sheathing, so that the floor and building will not rest on the sheathing. A reinforced concrete sill should be provided for support of the floor and superstructure. The sill should be placed on firm, undisturbed earth.

An earth mound, at least equal in thickness to the concrete sill, should be constructed with a level area 46 millimeters (18 inches) away from the sill in all directions.

4. **Floor and Riser:** Impervious materials, such as concrete, are believed to be most suitable for the floor and riser. Because privy units are commonly used as urinals, the use of impervious materials for risers is desirable in the interest of cleanliness. In cold climates, wood treated with a preservative, such as creosote, has been found to be durable and to reduce the problem of condensation. Therefore, in some sections of the country, wood may be used if approved by the Local or State Health Authority.

5. **Seat and Lid:** Both seat and lid should be hinged to permit raising. Material used in construction should be light in weight, but durable. Seats should be comfortable. Lids shall be self-closing. Two (2) objections to self-closing seat lids are: Discomfort from the lid resting on the upper portion of the user's back and contact of the oftentimes soiled or frost-covered bottom surface of the lid with the user's clothing. A seat lid has been devised which overcomes these objections. This lid is raised to a vertical position by lifting it from the rear, so that the top surface of the lid is against the user, rather than the bottom surface that is normally exposed to the pit.

6. **Vent:** Venting practices differ in many parts of the United States, because of differences in climatic conditions. In some States, particularly those in the South, vents have been omitted entirely and results from this practice appear to be satisfactory. Vents may pass vertically from either the pit or the riser, through the roof or directly through the wall near the floor. The vertical vent from pit or riser may lead to a horizontal vent passing through both walls or diagonally across a corner of the building.

In all cases, vents are screened. Galvanized, steel-wire screens dipped in paint, copper screens and bronze screens are used. Nearly all designs employ a screen with 6 (six) meshes to the centimeter (sixteen (16) meshes to the inch). Hardware cloth is used to cover the outside entrance to vents to prevent entrance of large objects that would clog the vent.

It is stated by some authorities that venting serves no useful purpose and that vents should be eliminated from earth-pit privies. Satisfactory recommendations with respect to vents can be made only after certain technical problems have been solved. The most important of these is the moisture condensation problem due to the temperature difference between the pit and the superstructure. The use of a cold wall, to condense moisture within the pit, has been suggested. In view of the uncertain value of venting, no recommendations are offered.

7. **Superstructure:** Privy structures are standardized to some extent. The majority are 1.2 meters by 1.2 meters (4 x 4 feet) in plan, with a height of 2 meters (6.5 feet) in front, and 1.8 meters (5.5 feet) at the rear. A roof with a 1-to-4 slope is commonly used. The building should be constructed of substantial material, painted for resistance to weather and fastened solidly to the floor slab. Proper roof overhang should be provided to dispatch rainwater from the roof away from the mound.
The roof should be constructed of watertight materials, such as wood, composition shingles or metal. Achieving ventilation of the building by omitting siding beneath the roof is common, except in cold climates, where the siding is usually perforated. Windows are sometimes used in the northern latitudes. Provision of coat hooks is desirable.
8. **Defects in Earth-Pit Privies:** The following shall be considered defects in pit-toilet installations:

a. Evidence of caving around the edges of the pit;
b. Signs of overflow, or other evidence that the pit is full;
c. Seat covers broken open or not self-closing;
d. Broken, perforated or unscreened vent pipe;
e. Uncleanliness of any kind in the toilet building;
f. Toilet room opening directly into milkhouse; and
g. Evidence of light entering the pit, except through the seat when the seat cover is raised.

MASONRY-VAULT PRIVY

A masonry-vault privy is essentially a pit privy in which the pit is lined with impervious materials and in which provision is made for the removal of excreta.

1. **Function:** Masonry vaults are used chiefly where the ground water table is close to the ground surface, or where it is necessary to prevent contamination of nearby water courses, wells and springs. They are also recommended for use in limestone formations to prevent contamination of water streams in the solution channels of the limestone. This type of disposal unit is satisfactory only where adequate maintenance and servicing are assured.
2. **Construction:** Masonry vaults may be constructed of brick, stone or concrete, with the latter preferred. The vault must be watertight to keep out ground water and to prevent leakage of the vault's contents. A readily accessible cleanout door is necessary. It shall be constructed to prevent access of insects, animals and surface water to the vault's contents. The floor of the superstructure, which forms a partial covering for the vault, must be impervious. Concrete is recommended.

CHEMICAL TOILET

In some areas where pit toilets might menace water supplies, where a sufficient volume of water for the operation of flush toilets is not available and where there is no prohibitive statute or ordinance, the chemical toilet may be accepted. Provided that it:

1. Has a receiving tank of acid resisting material with an opening easily accessible for cleaning;
2. Has a bowl, of nonabsorbent materials, sufficiently elevated above the receiving basin to prevent splashing the user;

3. Has the tank and bowl vented with at least a 7.6 centimeters (3 inches) screened pipe, preferably of cast iron, extending at least 60 centimeters (2 feet) above the roof line;
4. Has the tank charged, at proper intervals, with chemicals of a bactericidal nature and concentration;
5. Is placed in a well-lighted and well-ventilated room which does not open directly into the milkhouse; and
6. Has an effective method of final disposal, including burial, or a leaching vat or a cesspool where it will not endanger any water supply.

1. **Type:** Chemical toilets differ from privies, in that they are commonly placed inside the dwelling, whereas privies are generally located apart from the dwelling. There are, in general, two (2) types of chemical toilets:
   a. The commode type, in which a pail containing a chemical solution is placed immediately below the seat; and
   b. The tank type, in which a metal tank holding the chemical solution is placed in the ground directly beneath the seat. A pipe or conduit connects the riser with the tank. Tanks are usually cleaned by draining to a subsurface seepage pit.
2. **Function:** Toilets of this type are predominant in cold climates, where it is found desirable to have toilet facilities in or near the home, and where running water is not available for flush toilets.
3. **Chemicals:** Sodium hydroxide is commonly used to prepare the caustic solution for either commode or tank type chemical toilets. The chemical is dissolved in water and placed in the receptacle. The purpose of the chemical solution is to emulsify the fecal matter and paper and to liquefy the contents. In order to accomplish this action, the chemical solution must be maintained at proper strength and the mixture must be agitated each time the toilet is used. Odors are produced chiefly by the liberation of ammonia, when the caustic solution is weak, or when mixing by agitation is not carried out.

Difficulties are encountered when the caustic solution becomes diluted and fails to emulsify the fecal matter. When this occurs, the chemical solution breaks down, due to absorption of carbon dioxide from the air, and the solution ceases to be caustic. The decomposition of fecal matter produces foul odors.

4. **Sludge Disposal:** Disposal of the resultant mixture is a disagreeable task. In the case of small commode types, the usual method of disposal is burial in the earth. Tank units are usually so constructed that the tank is emptied into a seepage pit. When emulsification is not complete, particles of paper clog the seepage pit requiring corrective measures. Because of fundamental differences in design, chemical toilets resemble other types of privies only in the seat construction and manner of venting. Usually, risers or stools manufactured commercially are used.

Chemical toilets shall be used only where there is assurance of constant maintenance and where safe disposal of the contents is assured. Neither sludge nor liquid effluent from chemical toilet tanks shall be discharged to a sewage system in which treatment processes are involved. Otherwise, the chemical constituents of the sludge or liquid effluent may seriously interfere with the biological action upon which such treatment processes depend.

5. **Defects:** The following shall be considered defects in a chemical toilet installation:
   a. Violation of any of the above requirements;

b. Disagreeable odors indicating to-infrequent charging with chemicals or inadequate concentration of chemicals in the charge;
c. Evidence of improper disposal of the tank contents; and
d. Lack of cleanliness in the toilet compartment and room.

CONSTRUCTION PLANS

Detailed construction drawings for septic tanks, pit privies, masonry-vault privies and chemical toilets complying with State regulations may be secured from the Local and State Health Authority.

II. GUIDELINE #45 - GRAVITY FLOW GUTTERS FOR MANURE REMOVAL IN MILKING BARNS

Published by the Dairy Practices Council

The gravity flow gutter concept for manure removal comes from Europe. Manure falls into a deep gutter in the barn floor and then flows by gravity to a cross channel or outlet pipe to storage. A low (8-20 centimeters) (3"-8") dam retains a lubricating liquid layer over which the manure flows (Fig. 1). After one (1) to three (3) weeks in a newly started gutter, the manure surface forms an incline of 1-3% above the dam. Then the manure moves continuously over the lip. The gutter must be deep enough to contain manure sloped at this shallow angle.

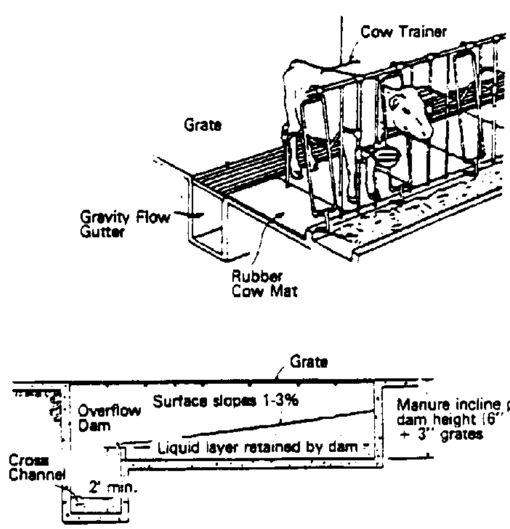

Figure 1. Side Cross Section of a Gravity Flow Gutter

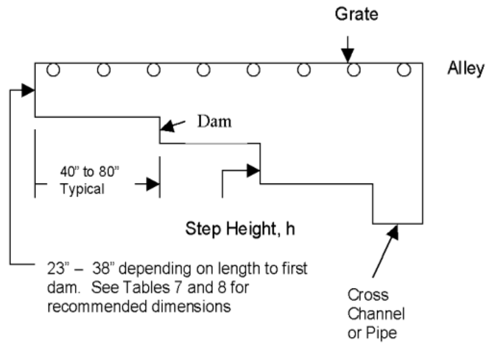

Figure 2. Stepped Gravity Flow Gutter

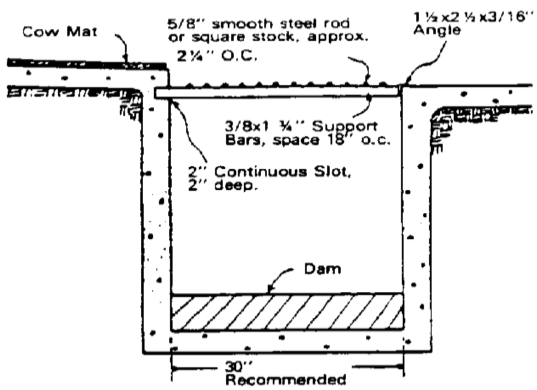

Figure 3. Cross Section of a Typical Gutter and Grate

Because manure moves by its own weight, no mechanical equipment is required to remove it from the barn. Generally the cost of the gutter and cover grates is less than the cost of installing, operating and maintaining a mechanical cleaner.

This system is neither a flush gutter, where 115-225 liters (30-60 gallons) of water per cow is needed to remove manure from the gutter, nor is it an under-barn storage that is open to the barn. Rather, it is a conveying channel that carries the manure from behind the cow to the outside storage. The top surface of the slurry has been recorded to move 3 meters (10 feet) per hour.

CONSTRUCTION

1. **Gutter Depth:** Gutter depth depends on the length of the gutter and the angle of incline of the manure surface. Design in this guideline assumes the manure surface forms a 3% slope. Most diets form wetter manure, and with no bedding the slope may be 1% less. The bottom should be level so the dam will hold a uniform liquid layer. The maximum depth of the gutter at

the end opposite the discharge shall not exceed 138 centimeters (54 inches). In addition, the outlet shall be clear of obstructions.
The depth includes an allowance for a 15 centimeters (6 inches) dam and 8 centimeters (3 inches) deep grates.
Adding steps may decrease the maximum manure depth. The depth from the bottom of each dam to the bottom of the next level varies depending on the distance between steps. (Refer to Figure 2)

Table 6. Slot Size vs. Cattle Age

Age (Months)	1-6	6-12	12-24	Over 24
Slot Size (in.)	1 – 1 ⅛	1⅛ – 1⅜	1⅜ – 1⅝	1 ½ - 1⅝

2. **Width of Gutters:** The bottom of the gutter shall not exceed 91 centimeters (36 inches) in width. A 76 centimeters (30 inches) wide gutter is recommended. The gutter opening may be narrowed to 50-60 centimeters (20-24 inches) in order to reduce the size and costs of grates.
3. **Overflow Dam:** The dam retains a lubricating liquid layer over the channel, which is essential to maintain flow. Typical heights range between 8 and 20 centimeters (3 and 8 inches). Dams, if removable, would facilitate total cleanout, when and if necessary. Concrete, a steel plate, or a plank may be used to construct the dam. Caulking may be needed to seal the dam.

Table 7. Gravity Flow Gutter Depth vs. Length for Manure from Lactating Animals

Length		**Depth**	
Meters	Feet	Cm.	Inches
12	40	58	12
18	60	78	18
24	80	96	24
30	100	114	30
36	120	132	36

4. **Length**: A 70 meters (226 feet) long gutter has worked, but typical distances between dams range from 12 to 24 meters (40 to 80 feet). Longer channels must be deeper; hence, they may cost more because they require more concrete and stronger forms.

Table 8. Step Height vs. Length for Stepped Gravity Flow Gutters		
Step Height		
Length Between Dams	For 1.5% Manure Incline	For 3% Manure Incline
40’	7”	14”
50’	9”	18”
60’	11”	22”
70’	13”	25”
80’	15”	29”

5. **Grates:** Commercial steel grates for stall barns and concrete slats for freestall barns are generally available. Table 7 suggests slot widths. Grates for stall barns are made from round or flat steel stock.
6. **Cross Channel:** The cross channel may be constructed like the gutter. At least a 60 centimeters (2 feet) drop from the top of the dam to the bottom of the cross channel is suggested to prevent backup of manure into it. The channel may be extended directly to storage. The slurry should enter the bottom; to prevent storage gases and cold air from returning up the channel. Channel depth, below grade, should be sufficient to prevent freezing.
Gravity flow via a concrete, steel or plastic pipe may also be used to transfer manure to the bottom of the outside storage. Pipe as small as 38 centimeters (15 inches) diameter has been used successfully. However, 60 centimeters (24 inches) diameter pipe is recommended.
Do not empty channels into large sumps or pits within, or having direct openings into the barn. These storages will produce gas and odors that will be drawn into the barn through the ventilation systems.

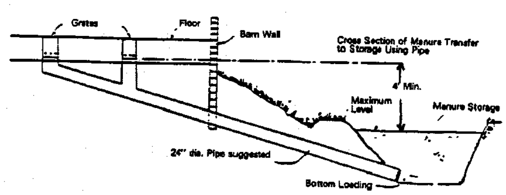

Figure 4. Manure Transfer to Storage

MANAGEMENT

1. **Flooding of Gutters:** Prior to stocking the building, fill the gutters with 8-15 centimeters (3-6 inches) of water to start the lubrication layer.
2. **Bedding Usage**: The type and amount of bedding used is important to successful operation. Up to .5 kilograms (1 pound) per lactating animal per day of sawdust, fine cut shavings or peanut hulls still allows the system to work. Some have worked with long straw bedding, but it is not recommended. More bedding or long straw increases manure stiffness and may clog the gutter.

Lactating animal mats allow minimum bedding use. Sometimes water may need to be added, depending upon the feed ration and amount of bedding used.
3. **Wastage and Deposits:** Keep feed and hay out of the gutter. Barn lime and soil brought in from outside may settle to the bottom. For this reason, the overflow dam, on some gutters, is removable for clean out. Buildup of solids has not been a problem under normal management, although the gutter will need cleaning if it has not been used for some time. Watch for islands of solids, especially where excess bedding or feed builds up. Cut these islands free of the walls to keep them flowing.
4. **Cleaning Grates:** Grates need cleaning at least weekly and, preferably, daily. A broom connected to a hose makes the job easy.
5. **Flies and Odors**: Flies have caused little or no problems. Biodegradable oil such as mineral oil may be sprayed on the manure surface to control them. Little or no odors have been observed in barns with good ventilation. There is no need to install fans to ventilate the gutters.

III. CONVALESCENT (MATERNITY) PENS IN MILKING BARNS AND STABLES

While the requirement for concrete floors in milking barns and stables is necessary for good sanitation, climatic conditions in some areas of the country has created a need for convalescent (maternity) pens to be located in milking barns and stables.
Therefore, convalescent pens may be allowed in the milk barn or stable. Provided that the following requirements are met:
1. All floors in the production milking facility, with the exception of the convalescent pens, must be of an impervious surface, with slopes for drainage as currently listed in the regulations.
2. Milk from animals milked in convalescent pens with non-impervious floors must not enter the distribution system or be sold.
3. Routine milking in pens shall not be allowed.
4. Pens must be located in a location so as not to contaminate milk holding transfer facilities or water supplies. Convalescent pens cannot be within 15 meters (50 feet) of a well.
5. A minimum of a 15 centimeters (6 inches) curb shall be provided on all exposed sides of the pen(s).
6. Convalescent pens shall be well bedded, clean and dry at all times.
7. No water faucet or drinking fountain shall be located within the curbed area.
8. State sanitarians, at their discretion, may require cleaning and/or reconstruction of such pens, based at intervals as necessary when the pens present a sanitation problem.
9. It is recommended that the number of pens be limited to one (1) per fifty (50) lactating animals.

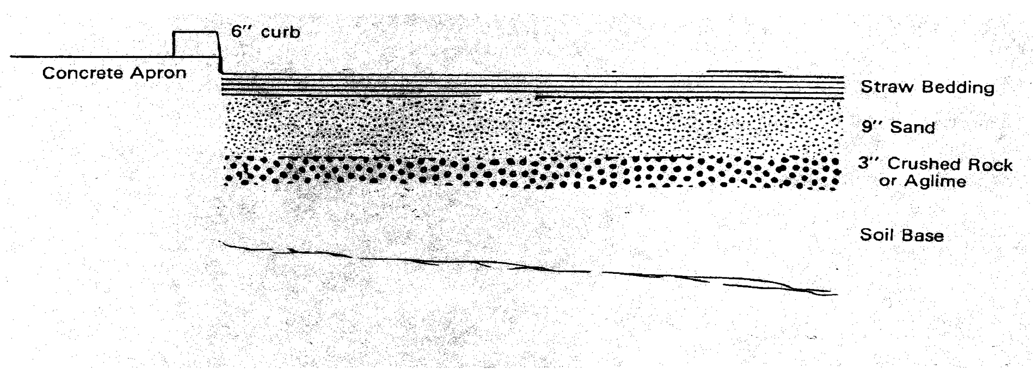

Figure 5. Side Cross Section of a Convalescent Pen

IV. GUIDELINES FOR CONVENTIONAL STALL BARN WITH GUTTER GRATES OVER LIQUID MANURE STORAGE

INTRODUCTION

The use of liquid manure storage under milking barns can be a cost, labor and energy efficient method for handling dairy animal wastes. This type of system can aid in pollution control and will provide a safe and healthy environment for cattle and humans under the following guidelines:

1. Plans for the construction of a conventional stall barn, with gutter grates over liquid manure storage, shall be submitted to the Regulatory Agency for approval before work is begun. Upon completion of the work, the builder shall furnish the purchaser with a signed written statement certifying that the system is constructed so as to be in full compliance with these guidelines.
2. The storage capacity of the liquid manure tank shall be for a minimum of nine months.
3. A negative pressure mechanical ventilation system must be installed to meet the following requirements: (Refer to Figures 6 and 7)
   a. Provide a maximum exhaust capacity of forty (40) air changes per hour from the occupied area. Of this total, about one-half, twenty (20) air changes per hour shall be considered the cold weather part of the system and shall be exhausted through the manure storage area. The remaining twenty (20) air changes per hour shall be considered the warm weather part of the system and shall be exhausted through the barn walls.
   b. Of the twenty (20) air changes exhausted through the manure storage area there shall be a minimum continuous exhaust of four (4) air changes per hour. The additional cold weather capacity of about sixteen (16) air changes per hour shall be thermostatically controlled. All fans exhausting from the manure storage area shall be installed in permanent fan houses built on the exterior wall of the barn and connected directly to the manure storage area. These fans must be single-speed with a certified delivery rating against 6 millimeters (¼ inch) water gauge static pressure. One pit fan must operate continuously. Airflow must be from the occupied area through the gutters. The use of variable-speed fans is prohibited.
   c. Fans supplying the additional summer capacity shall be mounted to discharge directly through the barn walls. They may be mounted on the outside of the building and the openings closed with insulated panels in cold weather, or when mounted in the walls be protected with an inside insulated cover to eliminate condensation and frost formation on the shutters and mountings. Warm weather fans are to be located on the same side of the barn as the pit fans. They must have a certified delivery rating against 3 millimeters (⅛-inch) water gauge static pressure and should be single speed.
   d. All fans, except those providing the minimum continuous exhaust rate are to be controlled by thermostats located away from the barn walls. All pit fans are to be in operation before any of the wall fans are started. An electrical thermal overload device of the proper size shall protect each fan.
   e. Calculation Method: To calculate the fan capacity in cubic feet per minute (cfm) for a particular barn, multiply the length times the width times the average ceiling height, all in feet, to obtain the volume. Divide the volume by fifteen (15) to obtain the minimum continuous capacity of four (4) air changes per hour in cfm (4 x 15 = 60 minutes).

$$\frac{W \times L \times H}{15} = \text{cfm}$$

For Example: Barn width 36', length 160' and average ceiling height 8'-6". This would be a reasonable size for sixty (60) stalls and two (2) pens. The calculation of the minimum continuous exhaust for this example would be:

$$\frac{36 \times 160 \times 8.5}{15} = 3{,}264 \text{ cfm}$$

Total cold weather capacity of twenty (20) air changes per hour equals five (5) times the minimum capacity: 3,264 x 5 = 16,320 cfm.

Use two (2) fans of 3,264 each and two (2) fans of 4,896 cfm each to make up the total. Build two (2) fan houses. Mount one 3,264 cfm and one 4,896 cfm fan in each. Operate one 3,264 cfm fan continuously. Thermostatically control the second 3,264 cfm fan at 4.4ºC (40°F). Control the two (2) larger fans with thermostats set at 6°C (43°F) and 8°C (46°F). Divide the summer capacity of an additional twenty (20) air changes per hour among three (3) fans of 5,440 cfm each. Locate these fans in the walls. Control them with thermostats set to 10°C–13°C (50°F–56°F). (Refer to Figure 6 for the approximate locations for all fans) Fans of the exact calculated capacity are usually unavailable. Always select those having a slightly higher rather than lower capacity.

f. Adequate incoming fresh air, to enable the fan exhaust system to function as designed, must be provided. A continuous slot inlet with manual adjustment on one (1) side is recommended to provide uniform fresh air distribution throughout the barn. (Refer to Figure 7) Adjustment of the slot opening opposite the fans is to be done manually for cold and warm weather conditions. Careful construction of the fresh air intake system is essential to the satisfactory performance of the ventilation system.

4. A stand-by generator to supply electric current to the ventilation system, in the event of a power failure, shall be provided.

5. Construction Requirements:

a. The floor system over the pit shall be designed to safely support all animal weight, plus the possibility of a tractor that may be needed to remove a sick or dead animal. Agitating and pumping of the stored manure shall be done through annexes built outside the barn. (Refer to Figures 6 and 7) Service alley floor and lactating animal stall platforms shall be constructed to drain to the grated gutter tank opening, located between the lactating animal stall and the service alley.

b. Waste water from the milkhouse can be discharged into the pit. Sanitary (toilet) waste shall not be disposed of in the manure storage tank. When wastewater from the milkhouse is discharged into the pit, a drop pipe must be connected to the discharge line so that the liquid waste will be deposited beneath the surface of the tank contents to prevent turbulence and possible odor production.

c. Grates over the gutters, tank slot openings, shall be of sufficient strength to support all applied loads. A suitable grate design is one using 16 millimeters (⅝ inches) smooth steel bars running the length of the open gutter. The distance between the center of the first bar and the vertical face of the stall platform should be 57 millimeters (2¼ inches). The remaining bars should be spaced 63 millimeters (2½ inches) center-to-center. Support bars crossing the gutters should be 19 millimeters (¾ inch) diameter and spaced 40 centimeters (16 inches) center-to-center.

6. Little or no bedding can be used with this system, rubber mats or equivalent, and lactating animal trainers shall be installed at the time the barn is constructed. Daily cleaning of grates with a stiff broom or scraper is recommended.

7. Other construction criteria and management practices recommended for stall dairy barns should be followed.

8. Requirements for emptying holding tanks:

   a. Remove all animals and post signs on all doors that no one is to enter the milking barn during the time the tank is being agitated;

   b. All pit fans must be operating during agitation and emptying;

   c. All milkhouse and feed storage area openings, doors, windows, etc., must be closed; and

   d. The milking barn must remain evacuated by animals and people for at least one (1) hour, after agitation of the holding tank is completed.

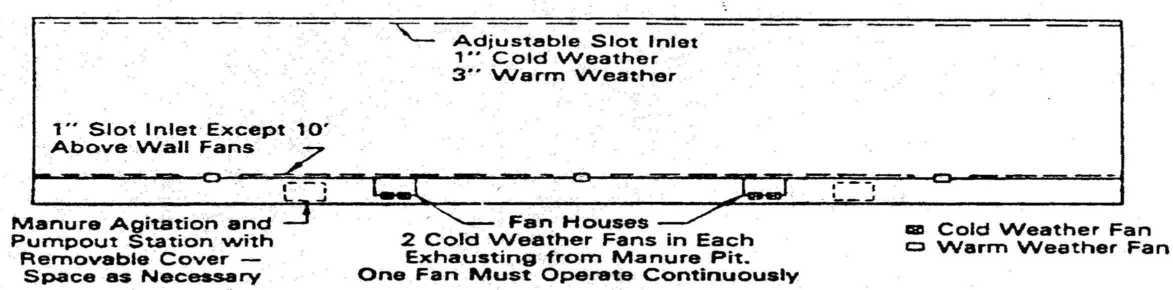

Figure 6. Schematic Diagram Showing Suggested Exhaust Fan Locations for a Typical Stall Dairy Barn with Gutter Grates Over Liquid Manure Storage

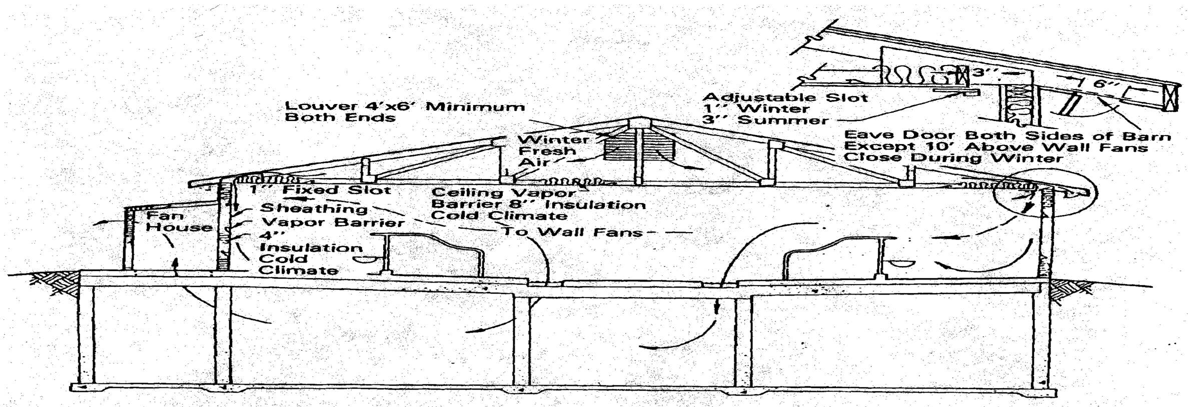

Figure 7. Schematic Diagram Showing General Pattern of Ventilation Air Movement, Slot Inlet Design and Fan House for Pit Fans

V. DAIRY - CONSTRUCTION AND OPERATION

MILKING BARN, STABLE OR PARLOR

Numerous factors, including the size and topography of the farm, the availability of utilities, the condition and disposition of existing buildings, the dairy operator's ultimate goals for the enterprise, and the operator's construction budget serve to make each milk producer's herd housing problems individual and unique.

While there has been a tendency for workers to develop strong convictions about the practicability of given housing or milking systems, there is little doubt that the success or failure of most dairy farm operations may be traced to good or poor planning. When the unique problems of each system in its individual applications are given proper consideration, the job of producing clean milk is made easier and compliance with regulations is simplified. For example, operators of barns in which lactating animals are housed and milked will find that efficient ventilation not only reduces condensation but also relieves the problem of dust and mold on walls, ceilings and windows. When window sills are sloped or windows set flush with interior walls in stanchion barns, the accumulation of dust and unwanted miscellaneous items is similarly lessened. Covered recessed light fixtures remain clean longer and are less subject to damage than those projecting from the ceiling.

Operators of milking parlor loose-housing systems, on the other hand, will value design features such as mechanically operated doors, which speed up animal traffic, and glazed wall finishes, which cut down the time required for proper post-milking wash-up of the parlor. Cleaner lactating animals result from proper planning and management of exercise yards and bedded areas. At least 9 square meters (100 square feet) of surfaced yard and not less than 5 square meters (50 square feet) of bedded space are recommended for each animal to be accommodated. Provisions must also be made for the removal at least daily of manure from exercise yards and traffic lanes. Operators utilizing loose housing have shown considerable interest in free-stall housing. Many workers have concluded that it provides the solution to the problems of unclean lactating animals and excessive bedding demands that have plagued loose housing in past years. Milk producers planning new construction or large-scale changes in existing housing should carefully study its features.

Adequate light must be available in all work areas in the milking barn, stable or parlor. Because many dairy functions are frequently performed after dark, it is important that the required minimum of ten (10) foot-candles (110 lux) of illumination be available from artificial sources. While absolute certainty of compliance with this requirement can only be confirmed by the use of a light meter, experience has shown that milking barns which otherwise meet the standards of this *Ordinance* will be properly lighted when equipped with one (1) 100-watt bulb (or its fluorescent equal) for each three (3) stanchions or per 3 meters (10 linear feet) of walkway behind each row of lactating animals in face-in barns or between rows of lactating animals in face-out barns. In addition, a smaller number of bulbs, equally spaced, are recommended for feed alleys in front of the lactating animals. When natural light is utilized, a minimum of .37 square meter (4 square feet) of window space for each 5.6 square meter (60 square feet) of floor space is recommended.

Construction plans and suggestions for the various systems of animal management are available to the sanitarian and the dairyman from numerous sources, including the USDA, the county extension agent, farm periodicals and the trade associations serving the building supply industry.

MILKHOUSE

Milkhouses should be large enough to provide adequate space to meet present needs and should take into account the prospect of future expansion. Installed milkhouse equipment should be readily accessible to the operator. Aisles should be at least 76 centimeters (30 inches) wide, with added allowance at the outlets of bulk milk tanks, adjacent to wash-and-rinse vats and where operational conditions warrant. It is especially important that the space available to bulk milk tanks and mechanical cleaning systems be adequate to permit their disassembly, inspection and servicing.

Floor drains should not be located under bulk milk tanks unless there is sufficient room for servicing. Floor drains should not be located directly under the outlet of a bulk milk tank. Drains and waste disposal systems should be adequate to drain the volume of water used in rinsing and cleaning.

Milkhouses should be well ventilated. Proper ventilation not only avoids the obvious disadvantages of condensation on equipment and walls, it also lengthens the useful life of the building and its equipment. The constant need for renewal of painted surfaces, the repair of wooden fixtures and frames and the removal of algae and mold from walls and ceilings of poorly ventilated milkhouses can represent a continuing expense to the operator.

Where possible, windows should be placed to provide cross ventilation. In addition, one (1) or more ceiling vents should be located to receive water vaporizing from wash-and-rinse vats and other sources of evaporative moisture.

Glass brick is sometimes substituted for windows in milkhouse construction. In these instances, mechanical ventilation must be provided. A system affording filtered positive air pressure is recommended over exhaust ventilation, as the latter frequently draws dust, insects, and odors into the milkhouse.

The great demand for water under pressure in milkhouse operations has emphasized the importance of protecting plumbing from freezing. Devices that have proved effective, include the insulation of water lines, the use of wrap-around heat tape, infrared lamps, and thermostatically controlled space heaters.

Insulated milkhouses make protection against freezing easier and more economical, and offer the additional advantage of greater comfort for the operator. The factor of personal convenience frequently results in better performance by the operator, with subsequent benefits to milk quality.

Automated milking and mechanical cleaning systems of milking equipment has increased the use of hot water in the milkhouse. The following Table indicates the volumes of water required to fill 30 meters (100 feet) of pipeline of varying diameters:

Table 9. Work Water Volume of Various Sized Pipelines

Pipe Diameter (Inches)	Gallons
1	4.7
1.5	9.2
2	16.3

Since most cleaning installations employ a pre-rinse, followed by wash-and-rinse cycles, this Table actually represents only one-third (⅓) the usual milking-time demand for heated water. Also, it does not include the "take up" of collecting jars, pumps, rubber parts, etc.

Udder washing, bulk milk tank cleaning and similar milkhouse tasks offer additional uses for hot water.

Sanitarians should compute the hot water demand of the individual milking systems under their supervision and require that not less than the minimum amount be available at all times. Milk producers should be made aware of the fact that effective cleaning of mechanically cleaned installations is impossible without adequate hot water and should be encouraged to provide a supply which exceeds their expected need. Such planning avoids emergency shortages and allows for normal expansion of the herd and facilities.

Detailed plans for milkhouses, as well as recommendations on hot water needs, insulation, lighting and ventilation are available from power companies, building supply associations, County Agricultural Extension Agents and State Universities.

Refrigeration, electrical or mechanical systems powered by gasoline or diesel engines, have no place in a milkhouse, milking barn, or in any communicating passageway between the milkhouse and milking barn. Such equipment is characteristically given to oil leakage and the discharge of fumes. The space occupied by it is difficult to keep clean and frequently becomes a gathering place for trash and flammable materials. With effective planning, these engines and their accessory equipment can be located, without detriment to their performance, in a separate room or building adjacent to the barn or milkhouse.

MILKING METHODS

Milking methods must be geared to permit the efficient withdrawal of milk without introducing undue numbers of bacteria or causing injury to the udder.

In addition to assessing the nation's milk producers a cost, which has been estimated to approach $500 million annually, mastitis has been found to pose serious public health hazards. The most widespread of these is a gastrointestinal disorder caused by toxins produced by certain strains of staphylococci.

It has been known for many years that a relationship exists between mastitis and milking practices. While not all the facts are known about mastitis, it is abundantly clear that its control is enhanced by use of mechanically sound milking equipment and good milking practices. The National Mastitis Council (NMC) has described a satisfactory milking system as one which:

1. Maintains a stable vacuum in the teat cup and at a level adequate for completely milking most udders in three (3) to five (5) minutes;
2. Does not stress the tissues of the teat by excessive stretching and ballooning;
3. Produces massage without harsh action; and
4. Is designed so that the entire system can be sanitized efficiently and satisfactorily.

The NMC considers proper milking procedure to include the following:

1. Before the milking unit is applied to the udder, the operator takes thirty (30) seconds to prepare the lactating animal in the recommended manner to obtain milk letdown, and the milking machine should be applied immediately thereafter;
2. The teat cups are attached in a manner to limit the volume of air drawn into the system;
3. The teat cups are positioned as low on the teats as practicable;

4. The operator stays near the machine and, at the end point of milk removal, the claw is briefly pulled down to open the teat cavity and remove the strippings. Stripping by machine should not extend over a period of more than fifteen to twenty (15-20) seconds. Prolonging stripping can be injurious to the udder;
5. Before removing the machine, the vacuum to the teat cups is broken and the cups removed in a gentle manner; and
6. To avoid over-milking, the operator should limit the number of machines in use. Two (2) bucket-type units, two (2) movable pipeline units or three (3) fixed units, in a walk-through barn, usually represent maximum workloads with conventional milking systems.

Hooded, or small-mouthed pails may be used for carrying only that milk which has been drawn into them by hand-milking. Their extended use as carrying pails is considered hazardous in view of their inability to be covered or otherwise protected from flies, dust, splash, etc.

REVERSE FLUSH SYSTEMS

Systems are acceptable if they are designed, installed, and operated in accordance with the following parameters for reverse flush systems:

1. All product-contact surfaces shall conform to the construction criteria of Item 9r of this *Ordinance*.
2. An intervening break to the atmosphere shall be provided between the water and/or chemical solution and the product and/or product-contact surfaces at all times.
3. If a pre-rinse cycle is used it shall be with safe water.
4. The system shall provide for:
    a. A chemical solution cycle with a chemical solution complying with provisions of Appendix F. of this *Ordinance*;
    b. The chemical solution strength shall be limited to that strength necessary to accomplish its intended effect and shall not leave a significant residual in the milk;
    c. A post-rinse cycle with safe water. The use of treated water to prevent psychrophilic microorganism contamination should be considered; and
    d. A drain cycle with sufficient time to drain or remove all moisture from the product-contact surfaces of the reverse flush system.
5. When air under pressure is used in contact with product or solution-contact surfaces, it shall comply with the requirements for air under pressure contained in Item 14r of this *Ordinance*, provided that an exception to the piping requirement for the air piping downstream from the terminal filter may be granted when:
    a. The piping is used only for filtered air;
    b. At least one (1) access point is available to determine cleanliness of the air piping; and
    c. The piping is of a smooth, non-absorbent, corrosion-resistant, non-toxic material, including any adhesives used in joints.

In some installations, a check-valve may be required to prevent water and/or chemical solution from entering these airlines.

DRUG RESIDUE AVOIDANCE CONTROL MEASURES

Animal identification and record keeping are critical for avoiding milk drug residues. Producers should establish systems to ensure that animal drugs are used properly and be able to provide evidence that adequate control over the administration of drugs to prevent residues in milk and/or meat has been implemented. These control systems should accomplish the following objectives:

1. Lactating animals treated with medicinal agents are:
    a. Identified, i.e., leg bands, chalk marks, etc.; and/or
    b. Segregated; or
    c. Other means provided to preclude the adulteration of milk offered for sale.
2. Treatment Records include the following information:
    a. Identity of the animal(s) treated;
    b. Date(s) of treatment;
    c. Drug(s) or other chemicals administered;
    d. Dosage administered;
    e. Milk discard time; and
    f. Withdrawal time prior to slaughter, even if zero.

NOTE: Records may consist of paper and file folders, card files, appointment book-type calendars, monthly paper calendars, chalk boards (temporary records), electronic computer records, etc.

3. Maintenance of Records: The proper use or misuse of some animal drugs may cause prolonged residues in milk (4 to 45 days) and meat (18 to 24 months). Verification of drug treatment records may be necessary in the event of an investigation or traceback by the industry or Regulatory Agency to identify specific treated animal(s) that may be related to a milk or dairy beef residue. Producers should maintain all treatment records for a minimum of two (2) years in the event of a need to traceback or follow up on a confirmed milk or meat residue.
4. Quarantine/segregation of treated animals or other means to preclude the sale of milk or offering of treated animals for sale for slaughter prior to the end of the prescribed withdrawal time.
5. Education of all farm personnel involved in treating animals on proper drug use and methods to avoid marketing adulterated milk or meat for human food.

INSECT AND RODENT CONTROL

The complete elimination of flies from the farm premises is practically unattainable. However, a major reduction of fly infestation is obtainable by the dairy farm operator who conscientiously follows a sustained program of sanitation, screening and the proper use of insecticides.

The milk producer or milk plant operator must be continually aware of the potential hazard to people and animals which is inherent in most pesticides, including insecticides and rodenticides. It is important that they employ only those insecticides and rodenticides that are recommended by competent authority for the insect and rodent problems they seek to overcome, and that they follow implicitly the manufacturer's label directions for their use. Questions on the use of pesticides should be referred to the appropriate Regulatory Agency and/or County Agricultural Extension Agent.

Intermittent, time release, high-pressure insect fogging or spraying systems shall be installed and operated in accordance with the following guidelines:

1. The insecticide must be registered with the EPA.
2. The label on the insecticide container shall specify that the insecticide may be used on dairy farms and in milking areas.
3. The label shall contain adequate instructions for the safe use of the insecticide.
4. The insecticide shall be designated for use in an intermittent, time release, high-pressure insect fogging system and used in accordance with the labeling directions.
5. The container, tank or barrel of concentrated insecticide or use solution and the pumping or pressurizing equipment shall not be located in the milkhouse.
6. Nozzles, which would emit, spray or fog the insecticide shall not be located in the milkhouse.
7. Nozzles shall be located, positioned and operated so that they will not spray, fog, drip or drain any insecticide on milk pipeline and return solution line openings, milking machine appurtenances, including milk claws, inflations, flow sensors and interconnecting flexible milk tubing, milk receivers or releasers, milk pumps, weigh jars, milk measuring equipment or over any area where milk is poured, strained or transferred.
8. Nozzles shall be located, positioned and operated so that they will not contaminate any feed or water.
9. The fogging or spraying systems, which have nozzles located in the milking barn or parlor shall not be operated during milking. In addition, the system shall not operate during the washing and sanitizing of milking equipment in a milking barn or parlor. This may be accomplished by inter-wiring the system so that it will not operate when the vacuum pump is operating or by a master cut-off switch with a conspicuously posted sign warning the operator that the switch must be turned off while milking and cleaning and sanitizing.
10. The fogging or spraying system shall operate so that only the amount of insecticide necessary to accomplish the intended purpose of reducing fly and other insect populations is used. Excessive insecticide, which leaves a film on exposed walls, floors, and equipment, should be considered a violation of Item 19r of this *Ordinance*.
11. These systems should be considered an adjunct to and not a replacement for good sanitary practices of proper manure removal and disposal to adequately control fly and other insect breeding on dairy farms.

Effective rodent control, like insect control, is dependent on sanitation for much of its success. The careful elimination of trash and woodpiles; the rodent-proofing of feed bins, corn cribs and similar structures; the prompt removal of spilled feed and manure to places of ultimate disposition; and the deliberate elimination of protected harborage areas in farm buildings, all tend to discourage rodents near the dairy farm. Such a program, also pays excellent dividends in feed savings, lowered maintenance costs for farm buildings, reduced fire hazards and lessened risk of disease outbreaks among farm animals.

Anticoagulant poisons, Warfarin, Fumarin, etc. have offered improved means of controlling rodents on the farm. Used according to directions, and with due precaution against their consumption by domestic animals, these chemicals should keep the rodent population in check while additional preventive programs are instituted.

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