STANDARDS FOR DESIGN AND OPERATION OF LOOSE HOUSING SYSTEMS FOR DAIRY CATTLE IN THE NORTH CENTRAL REGION

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GENERAL REQUIREMENTS

Loose housing is a management system for dairy cattle wherein the adult animals are given access to a feeding area, a resting area, and an adjoining open lot. At milking time the lactating animals are passed through a milking room. Other dairy animals may be in separate pens, lots, or buildings.

This set of suggested minimum standards for the design and operation of the loose housing system for dairy cattle in the North Central Region has been developed through the cooperative effort of the staffs of the U. S. Department of Agriculture and the State Agricultural Experiment Stations within the region, and milk sanitarians from federal and state public health agencies. Every effort has been made to standardize the requirements so as to simplify the design, construction and operation of the loose housing system, insofar as present knowledge permits. It is intended that these standards should apply to new construction and insofar as possible to remodeling work.

Variations in climate, differences in farming practices, size of dairy cattle and the number of cows in the herd all have an effect on the acceptable standards. Likewise, the loose housing system is readily adaptable to such a wide variety of plans that many of the advantages of the system would be lost if the standards become unnecessarily restrictive.

The loose housing system can be planned and operated in such a way as to provide suitable housing and yard area for the highly productive dairy herd producing uniform, quality milk with a minimum of man hours per unit of product. This type of housing can be low in cost and flexible as to herd size. The elevated stall milking room provides a sanitary, safe, convenient and effective place for milking the cows properly, and for handling the milk to best advantage. Dairymen should consider the use of improved practices, buildings and equipment, such as the modern milking room equipped for bulk milk production, with the opportunity for producing a better product being one of the most important advantages.

This report lists standards which are *minimum*, and should be used in conjunction with local sanitary regulations in the planning, building and operation of a loose housing system for the production of grade A or other standard quality milk. Current U. S. Public Health Service recommendations should be followed in the planning and operation of all dairy cattle housing and milk handling structures and equipment insofar as they apply.

The complete loose housing system for dairy cattle including buildings, methods and equipment, has been under investigation and study for more than 15 years in the North Central Region. In the last several years a growing number of dairymen have set up this type of housing on their own farms. In addition to the findings of research, the experience gained on these commercial dairy farms has given the system an opportunity to prove its merits both under controlled conditions and under practical farm conditions.

This experience has indicated the need for careful advance planning of the entire layout, including buildings, methods and equipment, which is difficult for dairymen to do if they have had no previous experience with loose housing. Loose housing for dairy cattle is quite different from stall barn housing in its design and management requirements, and there is need for dairymen to study the latest publications on the subject before undertaking the construction of this type of dairy cow housing.

The advantages offered by loose housing are important enough to justify careful study before reaching a decision on the kind of dairy structure to build. If, after studying dairy cattle housing research findings, visiting dairy farms with successful dairy units of this type, and otherwise obtaining full information, one is fully convinced that he should go ahead with loose housing, his next aim should be to plan a layout and management program which will allow him to obtain all the advantages offered by this type of housing.

Plans developed according to these standards should be approved before construction by a representative of the public health or regulatory agency responsible for milk inspection in his area. These representatives will be familiar with any special requirements as well as the general requirements as set forth in the milk regulations in effect, and should approve plans only after these requirements are met.

Information, both verbal and printed, plans from the Midwest Plan Service, and plans prepared by the College of Agriculture in each state are available through county agricultural agents or farm advisors.

In choosing loose housing for his farm, the dairyman should remember that while loose housing can be planned and made to work, it is not a substitute for good dairying practices. Compared to the stall barn it affords a more active life for the cow, is often adaptable to a lower building investment and can save both chore time and chore effort for the dairyman. However, the exacting requirements for the production of high quality milk have still to be met. This set of minimum standards is intended as an aid to farmers in protecting the quality of milk produced, and should be helpful in the orderly development and full acceptance of the loose housing system. The rest is up to each individual dairyman and his desire to produce high quality milk.

Some important points to consider before deciding on loose housing are the following. Loose housing will require the removal of horns from all animals before they are two years old. There is little dust or loose hair on cows in loose housing systems in cold weather; thus, except for early spring, clipping of cows may be limited to lower thighs, inside flanks and udders. Bedding is of greatest importance, especially in northern areas. In most areas more bedding is required than for minimum use in stall barns. It must be provided in sufficient amount to permit satisfactory management of resting areas throughout the housing season. The amount used can be controlled through good management of the resting area such as turning under fresh droppings and by keeping the resting area cold and open or well ventilated. However, one must avoid running out of bedding before the end of the housing season and plans should be made for some carryover from one season to the next. Cows must be kept reasonably clean and free of manure accumulations. It has been amply demonstrated that they can be kept clean in a properly planned and operated loose housing arrangement.

The maintenance of safe, sanitary, healthful conditions in and about all parts of the loose housing barn or structures is essential. Such items as manure removal, odors, fly control, rodent control, drainage, cleanliness and general appearance, as they may affect the health of the herd or the quality of milk, should be given constant attention. A little extra effort in doing the job well will pay off in personal satisfaction as well as in many other ways.

Separation of buildings for loose housing could result in less risk of losing the entire establishment in case of a fire and should be provided where feasible. However, separation of units should not reduce their overall efficiency.

SECTION I
THE FARM MILKING PLANT

The farm milking plant may consist of a structure or a part of structure, the main purpose of which is to provide a clean, sanitary and efficient place for milking cows and caring for and storage of the milk. In addition to the milkroom and the milking room or milking barn, one or more of the following may be included: a washroom including toilet, a furnace and utility room, a feed room, an observation room, an office, passageways and/or vestibules.

Location of the farm milking plant, unless contrary to local regulations, may be either all or partly within the barn used for housing and feeding the cows, calves and young stock, or it may be a completely separate unit. To promote sanitation the farm milking plant should be located on the clean side or end of the barn or barnyard, preferably nearest to the dwelling and with access by a short, all weather drive to the highway. It should be located on a well-drained site, and except for the dairy herd, be as far removed from other livestock as conveniently possible.

Access to the dairy barn is essential, but one should not overlook the opportunity for planning an attractive development with a lawn, landscaping, a favorable location, fire protection, safety and for the selection of construction materials which best meet the functional as well as the sanitary requirements of the farm milking plant. All construction of milking rooms and milkrooms should conform to rodent-proofing standards.

The flexibility of loose housing lends itself to expansion at a minimum of cost once the original unit becomes available, and experience has shown that many of the herds under loose housing are increased in

size after the change to loose housing has been made. With this in mind, it may be a good plan to build the milkroom over size for the present so as to accommodate contemplated future expansion. The location of all buildings should be such that future enlargement of them will be possible, or new units may be added. Dairymen should guard against overcrowding part of their facilities when they increase herd size. They are also reminded that when milk surplus is a problem, the shortest path to a satisfactory labor income may be by increasing the production per cow and keeping the herd size at a minimum.

THE MILKROOM

The milkhouse or milkroom is the space set aside for straining or filtering, cooling and storing milk, and for the cleaning and storing of dairy utensils. The milkhouse is a separate structure which is often attached to the milking room. The milkroom is a part of a larger housing structure and/or the farm milking plant.

Milkroom Recommendations.

The milkhouse or milkroom is a subject covered by the U. S. Public Health Service Milk Ordinance and Code with which it should be in full compliance. In existing milkrooms adequate space must permit access for thorough cleaning of all areas and equipment. Recommendations relative to location of the farm bulk tank in the milkroom have been provided by public health officials as their interpretation of satisfactory compliance with the present milk code. Suggested location requirements are as follows:

> The farm tank shall be located in the milkroom so as to provide at least 24 inches of clearance between the rear side of the tank and the wall or any equipment, at least 24 inches of clearance between the rear end of the tank and the wall or any equipment, at least 36 inches of clearance between the working side of the tank and the wall or any equipment, and at least 36 inches of clearance between the outlet valve end of the tank and the wall or any equipment; provided that in the case of existing installations, clearances as specified above may not apply if the producer demonstrates the ability to keep the interior and exterior surfaces of the bulk tank and the milkroom floors and walls in a clean condition. Such tanks shall be located so as to provide at least 6 inches of clearance between the floor and bottom on tanks except that a 4 inch minimum clearance is acceptable if the bottom slopes upward to at least 6 inches in a horizontal distance of 12 inches, or be sealed to the floor in such a manner as to prevent accumulation of milk, water, dust, and harborages of insects or rodents. Remote compressors located in milkrooms shall be installed to be easily cleanable and operate at peak efficiency. Floor drains shall not be located under the farm tank or near the outlet valve.
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> A fixed, properly encased opening not less than 6 inches above the floor of the milkhouse and the outside loading platform shall be provided in an exterior wall of the milkhouse to accommodate the milk conductor tubing used to pump the milk from the farm tank to the truck tank. Such openings shall be provided with a fly tight self-closing device to cause the opening to be protected at all times.
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> When electricity is the motive power for the milk transport tank milk pump, a lock type electrical connection with ground and weatherproof type receptacle located on the outside, or inside of the building with a switch box located on the inside of the buiding shall be provided.

For new construction this committee has agreed upon recommended sizes for milkrooms as shown in Table I. They should provide sufficient space for grade A milk production and satisfy milk code requirements as to size for new construction. In this table bulk milk tanks for every day pickup (E.D.) may be large enough to have a capacity equal to three milkings. The bulk milk tanks for every other day pickup (E.O.D.) may be large enough to hold five milkings.

TABLE I — SUGGESTED FLOOR AREA FOR MILKROOMS
(MINIMUM SUGGESTED WIDTH 12')

Milk production in gallons per day	Floor area in sq. ft. Can milk	E. D. bulk	E. O. D. bulk
50 or less	144	168	168
50 to 100	168	192	216
100 to 160	192	208	240

Milkroom drains should be located where accessible for cleaning, contain deep water seal traps and be provided with a two quart sediment chamber. There should be a smooth, dense concrete floor with a uniform slope to drains of ¼ inch per foot. It is suggested that the maximum distance to drains be 12 feet. When this floor is to support a bulk milk tank in which milk is to be measured, it should be stable in summer and winter and be capable of carrying the load placed on it. This type of floor can be provided by removing all top soil and backfilling with at least 8 inches of sand, gravel or crushed rock. Where top soil is firm, reasonably free of organic material and little affected by freezing, a sand or gravel fill of 4" to 6" may be adequate. A concrete floor reinforced with 6 x 6 #10 welded mesh steel and 5 inches in thickness placed over this stabilized fill should prove adequate.

THE MILKING ROOM

The milking room, sometimes called the milking parlor, is arranged for milking cows on a more or less continuous flow basis, either in floor level or elevated stalls. The cow enters one of the stalls, is fed her concentrates, her udder is washed, and after the milking operation is performed, is released and walks out of the milking room. While this is going

on, a similar sequence is being followed in each of the other stalls in such a way that a continuous pattern of operation is followed.

Insofar as possible, the same general requirements and structural standards set up for the milkhouse or milkroom in the present regulations should apply to the milking room, especially if it is a part of the same building in which the milkroom is located.

The milking barn with a somewhat larger number of floor level milking stalls is operated by changing all, or a part of the cows at a time as a group. They may be fed concentrates as a group and then the milking operation continues until all or enough are milked to require another change. The milking barn may resemble the stall barn in layout except each stall may have to serve for several cows each milking. To help keep cows quiet while being milked, the feed manger is raised 18 inches above floor level. No bedding is used.

For purposes of simplification, where a separate designation is not required, this manuscript will use the term "milking room" to include milking barns.

Floors and Drains.

Floors for the milking room should be of good quality, hard, dense concrete with a wood float finish. Permanent roughness may be obtained by working carborundum aggregate into the surface of the floor before finishing. The platform of the elevated stall should be from 30 to 38 inches above the level of the floor in the operator's area to permit the operator to work in a comfortable position. All floor areas should be well drained to make floor washing with running water possible. This is accomplished by forming (or making) the floor with a uniform slope of ¼″ per foot to shallow "bull nose" type surface floor gutters which in turn have sloping bottoms ¼″ to ½″ per foot to 8 x 12 sediment type deep seal barn and basement drains. A drain of this type with a 4″ wide gutter along the wall in the operator's area will prevent undrained areas of water on the floor. There should be ample toe space of 4″ to 6″ next to the milking stalls. If the 4″ gutter is next to the milking stall wall ample toe space for the operator can be provided by extending the stall floor 8″ horizontally over the supporting wall of concrete or concrete blocks. When concrete blocks are used the cores should be filled with concrete. If desired, a curb may be placed along the edge of the stall floor next to the operator's area. However, where bucket type milkers are used, either for testing or regular milking or where swinging types of milker units are used, a long gap may be provided in this curb in front of the udder for sliding or swinging the milker in or out. Junctions of floor and wall or floor and curb should be coved or rounded to facilitate cleaning.

An alternate to the use of the shallow gutter in the stall areas consists of providing a drain with an 18″ x 18″ grill in the rear end of each cow stall. All floor areas are uniformly sloped ¼″ per foot to the grills. It is possible to reduce the curb height on the stall platform to less than an inch if the edge of the curb is allowed to extend a full 3″ horizontally from the outside edge of the stall pipes in the direction of the operator for his protection as well as that of the cow. This permits the operator to keep the floors washed down during the entire milking operation while the grills reduce splash from droppings.

Wetting down the milking room floor before starting to milk will facilitate the later washing away of any droppings not otherwise removed, into the drain.

After each milking, the milking room or milking barn should be promptly cleaned by (1) scraping and removing any remaining manure or feed, followed by washing; or by (2) scraping, sweeping, removing of any manure or soiled lime, and applying fresh, clean, ground limestone or other suitable material. This is an alternate that should only be used in unheated milking rooms in winter.

HALLS AND VESTIBULES

Halls and vestibules, where used, should be constructed, lighted, ventilated and maintained in sanitary conditions equal to those required for the milkroom. Vestibules should be at least 5 feet long and wide enough to provide passage for a person carrying milking equipment. Vestibules should be provided to prevent direct openings from the milkroom into any housing, barns or domestic living quarters.

These standards recommend the elimination of the ventilated vestibule between the milkroom and milking room. However, a dairyman should consider his present local requirements on this point. Where the vestibule is omitted the passage between milk room and milking room should be equipped with a solid, tight-fitting, self-closing door, opening outward from the milkroom. It is important that flies be kept under effective control, and milking room sanitation be maintained at a high level. It is with this understanding that milk sanitarians have agreed to omit the vestibule requirement.

THE WASH ROOM

A wash room equipped with hand washing facilities and water flush toilet, may wisely be planned to fit into the farm milking plant. Hand washing and sanitary toilet facilities contribute to the production of good quality milk. This room cannot open directly into the milkroom according to milk code recommendations.

HEATER OR UTILITY ROOM

Heating requirements will seldom exceed the practical limits of electric or gas heating, thus necessitating

TABLE 2. — SUGGESTED INSULATION TREATMENT FOR THE FARM MILKING PLANT

Construction	Zone 1	Zone 2	Zone 3
Sidewalls			
Concrete block	8″ + 1″ refrigeration type insulation (cork, foam glass, etc.)	8″ to 12″ — cores filled with insulation	8″
Cinder or light-weight concrete block	8″ to 12″ — cores filled with insulation	8″ — cores filled with insulation optional	8″
Glazed clay tile	8″ + 1″ refrigeration type insulation	8″	8″
Glazed clay tile cavity type	4″ cavity filled with insulation	2″ cavity filled with insulation	—
Wood frame	2″ to 4″ insulation bats[a]	1″ to 2″ insulation bats[a]	½″ insulation[a]
Steel	2″ to 4″ insulation bats[a]	1″ to 2″ insulation bats[a]	½″ insulation[a]
Ceiling Fill or bat insulation	4″ to 6″[a]	2″ to 4″[a]	0 to 2″[a]

[a]Provide vapor barrier.

the use of a central heating plant. If a heating plant is needed it may be placed in a utility room large enough for vacuum pump, heating plant, hot water heater and fuel storage. A chimney will be needed for the heating plant. Where coal is used for fuel, a coal bin and tight fitting door for the utility room should be provided to keep coal dust from entering the milkroom or milking room. Good lighting, ventilation and floor drain are required. The size of the room should be adequate, but not so large as to develop inot a storage or junk room. The room should be of masonry or finished with fireproofing, such as cement plaster on metal lath, or ¼″ cement-asbestos board and fireproof insulation.

INSULATION

Insulation is an important consideration in planning for the economical heating and comfort of a farm milking plant. The amount of insulation necessary will depend upon the zone or part of the region in which it is located. Table 2 may be used as a guide for determining insulation values for the three temperature zones into which the North Central Region is divided. Zone 1 is the area lying north of an east-west line passing through the southern tip of Lake Michigan. The south limit of Zone 2 extends along the Ohio River and the southern borders of the states of Missouri and Kansas. Zone 3 lies to the south of this line.

THE HEATING PLANT

The milkroom in a farm milking plant should be heated enough to prevent freezing in coldest weather. It is most convenient to apply this same rule to the milking room. If a toilet room is included, it too must be protected against freezing temperatures. Any additional heating will tend to increase heating costs although it may add to the operator's comfort, depending upon how he dresses and the speed with which he works.

Where moderate tempering is considered adequate, a heat lamp may be located to warm the operator's feet at each milking stall. There may be some locations where quick "warm up" heating just prior to milking can be obtained through electric radiant heating panels located in the ceiling and sidewalls of the milking room. However, a milking room full of cows soon warms up. Water pipes and drain traps may be protected by electric heating devices. Crushed agricultural limestone may be used on the floor if the drains are covered in cold weather and no heat is used between milkings.

In Zone I and parts of Zone II where considerable use is to be made of the farm milking plant and regular heating other than electric is desired, domestic type space heaters, gas fired unit heaters or a central heating system may be installed as long as air is not circulated from room to room. The type of heating system best suited to this building would be one which has high capacity and quick pickup. For heating economy, temperatures may be held around 35° except when milking is being done.

VENTILATION

Ventilation of the milkroom or milkhouse is necessary to control moisture in winter and temperature in summer. The mechanical milk cooler in the smaller sizes may have an air cooled condenser which will help heat the milkroom in winter but may cause excessively high temperatures in summer.

Mechanical Ventilation.

It is suggested that pressure ventilation be provided in the milkroom by means of a ceiling fan, baffled to spread the fresh air over the ceiling. The supply of fresh air should come from above the roof by means of a suitable intake, screened and, if necessary, equipped with a filter. A louvered and screened opening near the floor will provide a suitable air exhaust. The fan should be equipped with a two-speed motor, one speed to provide 6 air changes per hour for winter operation and a high speed setting for large volume in spring and autumn seasons. Summer ventilation is obtained by opening screened windows if outside air is not dusty. High temperatures can be avoided by using a water cooled condensor on the milk cooler or by using outside air for this purpose. A wall fan may also be used to increase air movement in hot weather.

In the milking room non-pressurized mechanical ventilation is recommended and should provide at least six air changes per hour. For mild weather this rate of air change may be doubled if a two-speed fan is used. The control of moisture, and feed and animal odors is the main winter time requirement. Summer ventilation may be provided by opened, screened windows arranged for cross ventilation or by a large sized exhaust ventilating fan.

Gravity Ventilation.

When gravity ventilation is used provide screened, insulated out-take flues – one for each room with one square inch of cross section area for each square foot of floor area. A suitable roof cupola should be used for gravity systems. It should be pointed out that a well insulated building will permit more ventilation than one not so well insulated, without increasing fuel consumption. In the summer, cooling by well placed, screened, open windows or electric fans of adequate capacity should be arranged.

LIGHTING

It is desirable to provide natural light from well spaced windows having at least one square foot of glass area per ten square feet of floor area in the milkroom and also in the milking room of the elevated stall type. When using glass block, provide one square foot of window area to eight square feet of floor area. This recommendation exceeds the milk code recommendation of 1 sq. ft. of glass area per 15 sq. ft. of floor area for milking barns. In milking rooms with elevated stalls artificial light from lamps (one 100 watt bulb per cow) located well above the operator should be directed from behind the operator if they are to be effective in lighting the cow's udder. At least ten foot-candles of light are required on the working area, in this case, the cow's udder. Some dairymen have installed a shielded light on the curb or under the cow for better lighting. The wiring system should include the power outlets for vacuum pump, milk cooler, water heater, ventilating fan, space heaters and any other special uses as grain meters, electric fence controllers, etc.

INTERIOR WALLS

Interior finish of the milking room should be of approved light color, impervious, washable and easily cleaned. There should be no ledges for the collection of dust or litter. Lighting will be improved by light, clean walls and ceiling. Painted, smooth matched lumber, exterior grade plywood, portland cement plaster on metal lath, or concrete masonry may be used *except no wood surface covering should be used in lining the lower four feet of any wall.* Painted galvanized sheet iron may be used. Durable, waterproof composition board or ¼" cement-asbestos board with solid backing and regular glazed building tile are good. Any wall finish should be smooth, durable and resist damage if bumped, wet down frequently or scrubbed. Glazed tile or filled and painted concrete blocks make ideal wall surfaces to keep clean and to reflect light. A pipe railing, at a height of 36 inches above the floor and about four inches from walls in the passageways for cows will help protect painted surfaces. Whitewash is not as well suited for milking room or milking barn wall and ceiling finish as washable paint.

CONCENTRATE FEED STORAGE

A feed storage leading to chutes and metering feeders, of sufficient size to hold the amount of feed commonly prepared at one time, is a necessary part of an efficient farm milking plant where cows are to be fed at milking time. This feed storage should be dust tight, dry, well ventilated, rodent proof and arranged for convenient filling. It may be arranged for hand feeding or for metered feeding at each milking stall. Arrangements that have been conveniently used by dairymen include the following:

Overhead storage in hopper bottom bins which have chutes to individual milking stalls. Bulky feeds do not feed down well in hopper bottom bins and, if used, a mechanical agitator may be required.

Feed rooms may be equipped with a feed box at waist height into which the ground feed may be shoveled before milking starts. Feed room or bin with hopper bottom may be built into milking room wall. The feed bin is usually long and narrow, and has a sloping bottom which feeds into the waist high feed box. Such a feed box should be convenient to the operator and it should be equipped with a tight closing door.

Self-contained outdoor steel bin equipped with auger arrangement for delivery of feed to feed box or overhead to chutes leading to individual stalls.

WASTE DISPOSAL FOR THE FARM MILKING PLANT

It is sugested that before constructing a farm milking plant, dairy farmers consult local or state health authorities and their County Agricultural Agent or State Agricultural College. There are three sources of waste from the farm milking plant and each requires individual consideration as listed below:

1. Toilet room wastes must be disposed of as required by state and local plumbing codes. This waste may be taken by appropriate sewer line to the septic tank at the dwelling. Where this is not practical a septic tank and below ground disposal field are generally required.

2. Milking room wastes will vary in amount depending upon the amount of floor washing done and the amount of solids washed down the drains. The volume of such waste may be fairly substantial. Any method of disposal used will most likely require careful and regular attention by the dairyman.

3. Milkroom wastes usually will be low in organic material but also of fairly large volume when in-place cleaning of C. I. P. milk pipelines is followed. This waste may enter the same drains as the milking room wastes and should not be mixed with the domestic sewage.

The combined waste from milking room and milkroom carries a considerable load of fibrous material which may be settled out by means of a settling tank. It will not decompose, thus if a settling tank is used, provisions should be made for pumping or draining out the settled material often enough to keep the settling tank in effective operation. Other disposal methods include surface disposal on broad, well drained, grassed areas (field aeration) or ponding. In northern climates the disposal method must be effective in cold weather and thus, when possible, disposal below ground surface will have a definite advantage in that it would be frostproof. This may be accomplished where soil and ground water conditions permit, by extending the tile leaching system as explained below for the treatment of milkroom wastes.

A settling tank, when used, should be similar to a rectangular concrete septic tank, should be provided with adequate capacity, and should be arranged so it can be readily cleaned through a removable top by dipping or pumping out solids as required. Settling tank capacity should be at least 150 gallons per elevated cow stall, or 20-gallon capacity per cow actually milked, whichever is the greater. These amounts are minimum and for installations where more generous use is to be made of water for washing etc., they should be adjusted accordingly. Operating practices followed in the milking room or milking barn will largely determine the frequency of cleaning the settling tank. Any one of several methods of disposal may be used in conjunction with the settling tank.

Milkroom wastes require oxygen for stabilization. Farm milk wastes are usually small and if there are no milking room wastes with which they may be mixed for treatment, disposal may be successfully carried out in well drained soils by using a two-level tile and gravel leaching trench. The trench, approximately 16 inches wide and 4 feet deep has sloping ends. Its length should be no longer than 75 feet. If necessary, put in parallel trenches. The total length of the trenches should equal approximately 30 feet per stall, or 4 feet per cow actually milked, whichever is the greater. A 4 or 5 inch open jointed or perforated sewer pipe is laid from end to end in this trench. Air is allowed to flow freely through this pipe from end to end. The ends of this aeration pipe should be marked, protected from breakage and screened to keep out rodents.

The next step is to place 16 to 18 inches of ¾ to 1½ inch gravel around and over the sewer pipe. The second level of 4 inch jointed or perforated sewer pipe is laid over this gravel bed and connected with the milkroom waste line. The tile is covered with several inches of the ¾ to ¾ inch gravel followed with a 3 inch layer of pea gravel and soil. This provides a simple, frostproof, aeration bed for milk waste disposal without nuisance or odor.

Drains.

All drains should be connected with 4″ diameter cast iron sewer pipe or vitrified clay sewer pipe which may lead to septic tank, tile absorption field, settling tank, pond or other acceptable disposal area that meets local sanitation requirements. Where the drains in the milking room must meet plumbing code requirements full compliance should be planned. Offensive odors are undesirable in the farm milking plant. These odors can be avoided by using deep water seal traps and venting sewer lines through roof of building by standard plumbing code methods.

HOLDING AREA

Cows waiting to be milked may be held in a pen just outside the milking room so they will be readily available as they are wanted for milking. Outgoing milked cows are thus separated from the unmilked cows. This paved holding area may be partly or entirely roofed, substantially fenced, and equipped with suitable steps into the milking room. Steps should have from 18 to 24 inches run and not more than an 8 inch rise. A minimum of 25 square feet per cow should be allowed. The holding area may be a part of the paved barnyard, the feeding area, or simply an open or partly covered lot next to the milking plant. It should be cleaned or bedded daily or as required to prevent cows from tracking manure into the milking room or milking barn.

For large dairy herds it is not advisable to hold cows on resting areas for milking because this tramps-up and soils the bedded area making it more difficult to keep the cows clean. In smaller herds, if cows are to be held on the resting area, some extra bedding will be required to absorb the droppings. In most areas and states holding on the resting area is not recommended.

SECTION II
THE ROUGHAGE FEEDING AREA

The feeding area for hay and silage and for watering the herd may be under roof or in the open barn lot. Convenience in feeding both hay and silage is important. In most cases, time can be saved if hay and silage are fed in separate mangers. Feeding stored or stacked hay with a movable feeding fence or manger has been used successfully. Silos located next to feed mangers in the paved portion of the barn lot are most convenient.

Clean Feeding Area.

The feeding area for the cows should be paved, sloped away from the manger, and be readily accessible for cleaning. For larger herds, cleaning with tractor scraper is highly desirable. During the winter months, snow and manure accumulation may inconvenience outside feeding operations, making it difficult to maintain normal operations. When thaws come, a considerable amount of manure and slush must be removed quickly. If the site provides sufficient fall for drainage, convenient manure storage in the form of a paved manure platform along the back side of the yard, 3 or 4 feet below yard level is possible. As the slush forms, a roll-over scraper can also be used to remove it from the barn lot to an adjoining field.

Amount of Feeding Space.

Provide at least 30 inches of feed manger per cow for batch feeding of hay and silage where all must feed at the same time. With this practice, both hay and silage may be fed in the same manger. This practice tends to make extra work for the operator. This arrangement requires about 45 square feet per cow when manger and feed alley are included. Provide some sort of short stanchions, V-notch openings or posts to prevent boss cows from chasing other cows from the manger.

For free choice feeding hay and silage separate managers which provide 12 to 18 inches of manger per animal for each kind of feed will be enough. Silage fed in the morning in a deep feed manger will last nearly all day without serious difficulty from freezing. If there is too much freezing, it should be fed twice a day. Dairymen indicate that a foot of manger space per cow out in an open paved lot and from 4 to 6 inches of feeding space in self feeding bunker silos may be satisfactory for feeding silage. Where limited amounts of corn silage are fed, it is best to have feeding space for all cows to eat at one time or some will get more than their share.

Mangers for feeding hay should be constructed so the cows will not pull hay out onto the feeding area. Hay may be self fed direct from storage or it may be fed in conveniently located mangers filled once or twice a day, depending upon the kind of feeder.

The feeding area is not bedded or allowed to become partially covered with wasted hay as cows may lie down there and get extremely dirty. The feeding area should be cleaned as required and be kept free of hay or litter which might encourage cows to bed down on it. Failure to observe this rule has caused more than one dairyman to criticize his loose housing system. This situation is not difficult to correct as cows do not often choose to lie down on a bare paved concrete floor. An inside feeding area may be bedded for smaller herds if adequate space is available. Inside feeding reduces the number of animals permitted within the given area. Success with inside feeding requires good light and ventilation. Self-feeding from a hay shed open to the south or east is recommended. In this case there should be no ventilation problem so long as strong, prevailing winds have been screened out.

Water.

Watering need not be difficult if properly planned. This may be an electrically heated drinking bowl, or a small, banked, float-controlled stock tank located in a somewhat sheltered place in conjunction with the feeding area. It may also be an open stock tank conveniently located in the cattle yard. If the tank is filled with warm well water in the morning with enough water to last 24 hours only, the small amount of ice in the tank the following morning will melt when the tank is filled. In the colder climates some banking, and even a tank heater, may be required. The Milk Code requires that all water connections must have an air break or other protection against back-siphoning of contaminated water supplies.

SECTION III
THE RESTING AREA

In the North Central Region, a suitable resting place for the dairy herd that is dry, sheltered from the wind, and well bedded, is a definite requirement. Provide an open or well ventilated barn with from 40 to 60 square feet of area per animal. The larger area is for larger breed types in northern states (Zones 1 and 2). Avoid a tight, warm, resting area where high humidity is a serious problem. The resting area should have a ceiling or roof high enough to accommodate a manure pack 3 or 4 feet in depth. The well bedded manure pack remains at from 60 to 100 degrees F. throughout the winter. In northern areas (Zone 1) the manure pack must be established early in the fall so it will be warm when cold weather arrives. It should be open and available to the herd at any time the cows prefer to use it when autumn arrives. To keep the cow free from any accumulation of manure on the udder and flanks, the bedded area must be given daily at-

tention. Enough bedding must be used to prevent the manure pack from becoming soft and punched up. The resting area should be free of all feeding, watering and cross traffic. All other kinds of livestock should be excluded from it.

Location.

The resting area may be a part of the same building in which the feeding area is located, or it may be a separate structure. The resting area shelter should face south or east, and form one side of the barnyard. The openings to the area should be protected from the sweep of prevailing winds in northern areas. As in arranging all buildings for loose housing, it is well to provide as much protection for the barn lot as possible. A well drained site that is high and protected on all sides from any sort of flooding is extremely important. Once a portion of the bedded area becomes soaked with water the bedding pack will have to be completely removed and a fresh bedding pack started from the floor. Insofar as possible, choose the most favorable site, then fill, if necessary, to raise the floor level at least 6 to 8 inches above outside grade. Finally grade the area outside the building so all ground slopes away from the building.

There are some hillside locations where well drained soils will permit, and topography will require, lowering floor levels below outside grade for some parts of the structure. Where this can be done so as to keep out all surface and seepage water, there should be no objection to it.

The Resting Area Floor.

Floor for the resting area may be earth, although concrete makes the removal of manure easier. Adequate paved yards are more important than paved floors in the resting area. The paved barn yard should extend into the opening to the resting area. Local requirements on this point should be checked with your plant fieldman. It is more important to pave the feeding area and barn lot first. This will keep the cows from tracking mud onto the bedding, and it will make manure removal easier. The lot should provide ample space for the manure spreader and the tractor mounted blade and manure loader to operate efficiently. The resting area will need head room of about 9 to 10 feet. Since the tractor mounted manure loader operates on the solid footing afforded by the floor, this head room is sufficient for its operation. Accessibility to all parts of the resting area requires unobstructed door openings 10 to 14 feet wide, clear span construction or post or column spacings 14 to 16 feet apart in both directions, and removable panels for any pen or partitions.

Special Foundation Requirements.

The foundation walls and posts should be designed for a 3 to 4 foot depth of manure. For the frame building, concrete or masonry walls should be 4 feet or more above the floor level in the bedded area. The pole type barn, constructed with pressure treated poles set four or five feet into the ground, may be enclosed at the bottom with two-inch pressure treated planking to a height of 3 feet-six inches or 4 feet. These planks should be fastened on the inside or outside surface of the poles. Lag screws or deformed nails should be used if planks are fastened to the outside to prevent the manure from pushing them off. For additional support, extra posts may be set between framing poles. If the planks in the lower wall are matched so they are tight, the siding need not extend down over them. Any wood in contact with moist earth or moist manure should be pressure treated, or treated by soaking in an effective preservative for the control of rot, decay and termites.

Manure Removal.

There is no one best date for manure removal. Cows do not seem to like to rest on warm manure packs in late winter and early spring when warm weather arrives. They are used to rigorous winter weather conditions. One solution is to remove the manure pack at this time. Dairymen usually have time at this season and hauling can be arranged to use frozen ground or wait for periods when ground is firm. An early cleaning date will beat the fly season. However, much valuable nitrogen is lost unless manure from the barn can be plowed under immediately after spreading. Each individual dairyman will have to work out his cleaning dates with his milk plant fieldman or milk sanitarian if he wishes to deviate from standard practices.

Bedding storage for an adequate supply of bedding over or alongside the resting area is most desirable. Storage for at least one and one-half to two tons of bedding per cow in the northern zone should be provided.

Lighting.

Adequate natural and artificial light should be available to permit the operator to bed the area properly and care for his herd. For the open front shed, windows are not needed. For closed structures, provide one square foot of glass area, or open doorways, per twenty square feet of floor area. For artificial lighting, provide at least one 100 watt bulb, or equal, for each 400 to 500 square feet of floor area.

Ventilation.

The warm manure pack keeps cows comfortable in cold weather. Temperatures not more than from 5 to 8 degrees above outside temperatures are desirable in order to reduce humidity and keep the bedding crisp and dry. Cows do better when sheltered in an open or thoroughly ventilated area provided drifting snow

and cross drafts are controlled. Barns constructed with barn boards without battens provide well ventilated resting areas. All parts of all metal buildings must be at least as well ventilated. Tightly enclosed buildings of any material are to be avoided for loose housing. Barns open to the south or east are comparatively free of condensation unless of tight construction. Under such conditions provide louvered gable ends or ridge ventilators.

SECTION IV
THE PAVED BARNYARD

While a generous sized barn yard is desirable, there are a few weeks in the year when the cows can be kept cleaner if confined to the paved area. It is suggested that at least 100 square feet of paved barn lot area be provided for each cow and the minimum should not be less than 60 to 70 square feet and it should be arranged for access by power equipment for regular cleaning. The total lot area should be from 130 to 150 square feet per cow when feeding out of doors. Paved feeding areas are essential in humid regions if cows are to be kept clean.

Since continued use of the barn yard is necessary in all seasons, it should be surfaced with a suitable material which will permit cleaning of congested areas at any time except when frozen. Cows must be kept clean and this can be done only when accumulations of manure, wasted feed and water are regularly removed, and they must especially be removed at the time of the spring thaw. While concrete paving is generally considered best for the barn lot that is used in all seasons, other materials such as crushed rock have been used with varying degrees of success. This material may serve as a temporary treatment over which concrete paving may be eventually placed. All manure, mud and other organic material should be removed from the surface before any surfacing material is applied. All grading should be completed to allow for a coarse crushed limestone or coarse road bed gravel fill of 6 to 8 inches in thickness. After thorough wetting and rolling, a 2 inch to 4 inch layer of finer material may be placed, wet down and rolled or packed.

Concrete Paving.

When concrete paving is used, a 4 inch to 6 inch layer of sand, gravel or clean crushed rock will provide excellent support for the pavement and prevent heaving from frost action. Provisions should be made for thickening the pavement on all edges. A layer of good quality concrete 4 inches thick may be used if loadings are light in spring seasons. When laying concrete paving on silt loam or saturated clay soils without the above mentioned fill as a sub-base, a 5-½ inch thickness of concrete is suggested and where frost heaving is a problem, this slab should be reinforced with a 6 x 6 – No. 10 welded steel mesh.

Wind protection of the barn yard can often be obtained by properly locating the buildings. Tight board fences can be used to complete the protection. Good exposure to the south or east for sun is also essential.

Drainage.

Drainage of the paved barn lot is essential. A uniform slope of one inch in four feet is a minimum, and should lead away from the buildings and have an adequate outlet. An open, concrete-lined ditch, or curbs along the paved area to a grassed waterway outside the cow lot is advisable to prevent the formation of mud holes and gullies.

SECTION V
HOSPITAL, CALF AND YOUNG STOCK SHELTER

The loose housing system used for calves, young stock, dry cows and hospital facilities should be planned, located, constructed and operated in such a way that they will not interfere with, or detract from, the requirements and facilities for housing, feeding and milking the dairy herd. While cattle other than milking cows may be fed in their pens, the location of these pens and the cleaning of them should meet the same requirements set up for the resting area for the cows.

Hospital Section.

For the purpose of working the herd for blood testing, udder clipping or other necessary handling operations, enough stanchions for 10 per cent of the herd or a cattle chute with the necessary holding area and the gate arrangement should be provided. A convenient time to cut out cows needing attention is as they leave the milking room. If a gate can be swung across the exit lane to direct the cow into a covered holding pen equipped with stalls or stanchions, this operation can be most convenient.

In the section with the stalls it is convenient to also have one hospital pen for each 20 cows in the herd. However, gates can be used to enclose cow pens as required on the resting area. When these pens are to be used in cold weather it is best to have an active, warm manure pack in them. Young stock may be rotated in these pens early in the autumn and as much as required throughout the winter to build up manure packs in the cow pens and to keep them active so as to produce warmth.

When manure packs are allowed to build up in pens, the pens should be arranged for tractor fork cleaning. If steel stanchion equipment is used it should be set into a concrete curb from 12 inches to 18 inches above pen floor level. Before the pens become filled with a manure pack that approaches the top of the curb it should be cleaned out. This means that at least one side of the pen will have a removable panel for

tractor fork cleaning and be accessible without removal of a major part of the manure in the resting area.

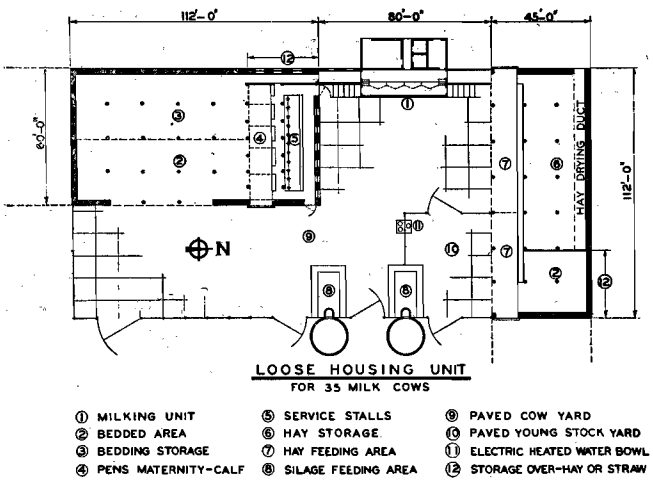
Calf Pens.

Calves have been born and successfully raised in open shelters. Hospital stalls and calf pens that have warm manure packs seem to be essential for the protection of the calf in cold weather and to insure rapid gains. When there are strong air currents within the area it will be advisable to use tight partitions for the sides of the pen not equipped with feeding manger. When a calf is not claimed by its dam at birth in cold weather, it may be advisable to move the calf into an unoccupied pen long enough for one or two heat lamps to warm and dry it.

Convenience in caring for calves is an important consideration. They may be located close to hospital stalls and milking room. Hay and bedding storage may often be conveniently located overhead. Ground feed storage should be ratproof, dry and convenient for filling and for use. Water may be supplied by use of frostproof water bowls, one for each two pens. The pens may be arranged with permanent stanchions, a concrete feed manger and concrete feed alley. However, since a deep manure pack is necessary for the comfort of the calves, the pens should be enclosed with partitions that can be lifted as the manure pack builds up. This may be accomplished by hanging on chains from above. These partitions should also be removable to permit complete removal of the manure pack by using the power loader on a tractor.

For the control of flies in the summer calf pens will need thorough cleaning every few days. A concrete floor will aid in the cleaning of the pens with a tractor loader and it will facilitate fly control.

The calf pen section should be well ventilated and lighted. South exposure is preferable. Frequent exercise in sunshine and fresh air may also prove advantageous.



This schematic layout of a 35 cow loose housing system is presented to aid the reader in interpreting the written text. The plan should be expanded to 75 or 100 cows if desired by increasing the length of the resting or bedded area and the hay storage unit.

SECTION VI

FLY CONTROL

The control of flies is a public health requirement. For loose housing, the complete removal of all manure accumulation before fly season is recommended and is usually required. Greatest benefit from manure is obtained in this way. Modern tractor operated equipment simplifies the entire operation so it can be readily fitted into the spring seasons work schedule.

If the resting area is used for summer shade, adequate bedding and frequent cleaning should be arranged to control cleanliness of cows and eliminate the breeding of flies. A summer entrance into the milking room should be provided for the paved yard in arrangements where the resting area is used for a winter holding area. Calf pens should receive twice a week cleaning in the summer for control of fly breeding. Older calves and young stock may be kept on pasture as an aid in fly control if creep fed concentrates, provided shelter in cold, damp weather and shade in hot weather.