



## DAIRY CATTLE HOUSING AND EQUIPMENT

### COMPLETE INSTRUCTIONS

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Good dairy housing is important for quality milk production. A well-designed barn provides a clean, comfortable home for the herd and a pleasant, efficient workplace for the operator.

Plan carefully for the storage and handling of milk, feed, bedding and manure, as these account for most of your labor. Also remember that a dairy building must satisfy a number of regulations; investigate these before construction begins.

Make sure you have a plentiful, dependable supply of good water, made available 24 h a day. A lactating cow will drink 135 L (30 gal) a day. The ideal water temperature is about 5-10°C. Supply pipes buried deep in the ground will help keep the water cool in summer and prevent freezing in winter. Use automatic heating if the waterer is located where it might freeze. Provide 0.1 m<sup>2</sup> (1 sq ft) of watering tank surface for every 50 head.

A large, mechanized operation also needs dependable electrical power plus a standby system.

#### SITE SELECTION

Choose a high, relatively level, well-drained site that will allow future building expansion. Build the floors above ground level to keep out runoff water.

Where possible, pick a site that allows good snow and wind control. You may have to add windbreaks and snow-and wind-control fences.

Locate the milkhouse and/or milk parlor on the north or east side of the barn to reduce the summer heat load. Locate yards where they are exposed to winter sunlight; those facing south or southeast thaw and dry faster, so are easier to manage.

The barn should be served by a good all-weather driveway, or border on a high, well-drained service yard

with a good gravel base. Consider a circular driveway if milk is shipped in bulk. The truck driver should not have to open or close gates or back up to load. Build the barn close to pasture lanes and where it gives easy access to the house and other work areas.

Remember, if you raise your own replacement stock, you'll have twice as many animals and will need calf barns, maternity areas, dry cow housing, and storage for bedding, feed and manure. Based on the number of milking cows, you can estimate the additional animals

you'll need for replacements as follows:

- Heifer calves (0-3 months)	12%
- Bull calves (0-3 months, if housed)	12%
- Heifers (3-10 months)	20%
- Heifers (10 months-2 years)	35%
- Heifers (2 years to freshening)	0-20%
- Dry cows	12%

#### HOUSING SYSTEMS

Barns must protect cows from wind, moisture and extreme temperatures. Whether you choose warm or cold housing, or loose tie-stall or free-stall management depends on the size of your operation, availability of bedding, climate, existing facilities, the degree of mechanization and personal preferences.

Warm housing is kept no cooler than 4°C (40°F) in winter. It must be well-insulated to retain animal heat. Ventilation (either fan-powered or automated natural ventilation) removes excess moisture in the winter and excess heat in the summer.

Cold housing in winter is only slightly warmer than outdoors. Natural ventilation removes moisture and keeps the barn temperature about 5-10°C above that outside. Insulation under the roof reduces condensation in winter and heat buildup in summer. Cold barns cost less than warm barns but their watering systems must be protected against freezing.

The three basic housing systems are tie-stall, free-stall and loose. Tie-stalls are the most common in Canada. Each cow has a separate stall that permits individual



The Canada Plan Service prepares detailed plans showing how to construct modern farm buildings, livestock housing systems, storages and equipment for Canadian Agriculture.

To obtain another copy of this leaflet, contact your local provincial agricultural engineer or extension advisor.

attention during feeding, grooming and milking. Additional pens are provided for calves, young stock and for freshening cows. Tie-stall barns are generally 9.6-11.4 m (132-138 ft) wide with a ceiling height of 2.4 m (8 ft) or more. Stall dimensions are shown in Table 1.

Free-stalls are the most popular for 50 or more head. The resting area is divided into individual stalls without ties, and the paved alleys are cleaned by scraping. You need much less bedding because it tends to stay in the stalls. Barns with a feeder down the center and one row of stalls down each side should be 12-13.2 m (40-44 ft) wide. Two rows of stalls on each side can be used for larger herds. The minimum ceiling height is 2.7 m (9 ft). Stall dimensions are shown in Table 2 and alley widths in Table 3.

TABLE 1 DIMENSIONS FOR TIE STALLS

Animal size		Stall width		Stall platform length with trainer*	
kg	(lb)	mm	(in.)	mm	(in.)
400	(880)	1000	(40)	1450	(58)
500	(1100)	1100	(44)	1500	(60)
600	(1320)	1200	(48)	1600	(64)
700	(1540)	1300	(52)	1700	(68)
800	(1760)	1400	(56)	1800	(72)

\* Make stalls 100 mm (4 in.) shorter if used without trainers.

TABLE 2 DIMENSIONS FOR FREE STALLS

Animal size		Stall width		Stall length including curb	
kg	(lb)	mm	(in.)	mm	(in.)
100	(220)	700	(28)	1200	(48)
200	(440)	800	(32)	1400	(56)
300	(660)	900	(36)	1650	(66)
400	(880)	1000	(40)	2100	(84)
500	(1100)	1100	(44)	2250	(90)
600	(1320)	1200	(48)	2250	(90)
700	(1540)	1200	(48)	2250	(90)

and over

TABLE 3 LITTER ALLEY WIDTHS BETWEEN FREESTALL CURBS

Stalls per row	Solid floors tractor scraper		Slotted floors or automatic alley scraper	
	m	(ft)	m	(ft)
Up to 5	2.1	(7)	2.1	(7)
6 to 16	2.4	(8)	2.1	(7)
17 to 36	3.0	(10)	2.4	(8)

Loose housing uses a deep-bedded resting area plus separate feeding, holding and milking areas. Bedding requirements are very high, so it is seldom used now except where bedding is inexpensive and abundant. Barns should provide 6 m<sup>2</sup> (60 sq ft) per head for milking cows and 4 m<sup>2</sup> (40 sq ft) for dry cows and heifers. A ceiling at least 3 m (10 ft) high permits manure pack buildup and cleaning. Allow a minimum of 6 m<sup>2</sup> (60 sq ft) per head in paved exercise yards for milking cows, dry cows and heifers. If unpaved, provide 30 m<sup>2</sup> (300 sq ft) per head for milking cows and 20 m<sup>2</sup> (200 sq ft) for dry cows and heifers. Unpaved yards are not suitable for heavy traffic areas or where annual precipitation exceeds 50 cm (20 in.).

### THE MILKING CENTER

This must be a sanitary, efficient place to milk cows and handle, cool and hold milk. It demands the greatest investment, the most time and labor, and the strictest sanitation. Since sanitation regulations vary by region, contact local health or dairy officials before construction begins.

The milkhous must meet strict sanitary requirements. It is attached to, but partitioned off from, the barn and the milking parlor. Here milk is cooled and held for pickup and equipment is cleaned and stored. If milk must be carried, locate the milkhous to minimize the walking distance to the milking area. Make sure you can move the bulk tank in and out, by installing double doors or removable panels that extend to the floor.

The milking parlor is used for regular milking. It reduces labor by bringing the cows to the operator, generally standing them on a platform 750-900 mm (30-36 in.) high. Layout will depend upon required capacity, personal preferences, economics and design. Parlors can be as simple as a few stanchion milking stalls beside the milkhous, with the milk carried out by hand, to something as complex as a rotary system with automated equipment and transfer systems. Herringbone or side-opening stalls in two rows are the most common.

Cows wait to be milked in the holding area. This may be part of the regular animal traffic area or a separate space used only for this purpose. It should be surfaced with rough-textured pavement, and provide 1.1-1.7 m<sup>2</sup> (12-18 sq ft) per cow. If the holding area slopes, make sure it rises toward the milking parlor entrances. Design the holding area so cows can enter the parlor easily and without sharp turns.

### MATERNITY, HOSPITAL, SERVICE AND CALF PEN AREA

Most operators prefer this area in a building (or section of a building) where they can control the environment. Often you can convert part of the stable in an existing barn. The area must be dry, draft-free, well lighted, insulated and ventilated.

Provide one 3 x 3 m (10 x 10 ft) maternity pen, or one maternity tie-stall without gutter, for every 20 to 25

cows (in loose housing, add a treatment tie-stall for every 20 to 25 cows). You'll also need an isolation pen for every 40 animals; it should have minimum dimensions of 3 x 3 m (10 x 10 ft), be separate from the main livestock area and have a stanchion or tie-stall in one corner.

Calves up to 3 months old should have individual stalls with 600 x 1500 mm (2 x 5 ft) minimum dimensions. Calves 3 to 10 months old should each have 2.2 m<sup>2</sup> (24 sq ft) of pen with bedding or 1.5 m<sup>2</sup> (16 sq ft) with slotted floors. Alternatively, they may be housed in free stalls. See Table 2 for stall sizes.

#### AREAS FOR YOUNG STOCK AND DRY COWS

Keep this stock separate from the milking herd. Most operators use loose housing to save work. It is best to separate the large and small heifers. If you can't, leave liberal amounts of feeding space so that smaller animals will not be crowded out. Heifers 10 to 24 months old should each have 3.2 m<sup>2</sup> (35 sq ft) with bedding or 2 m<sup>2</sup> (22 sq ft) with slotted floors.

#### MANURE MANAGEMENT

The most common way to remove manure from a tiestall barn is with a mechanical gutter cleaner. The manure is either moved directly into a spreader for field spreading, or stacked outside on a paved slab that has low curbs or earth banks to confine runoff.

Free-stall barns with solid alley floors are scraped to a collection point. The manure can then be moved to storage by gutter cleaner, pump or gravity pipe. With slotted floors, manure is tramped down into a concrete gutter.

Provide enough room for storage and handling (Table 4), as well as good access to the storage for removing and transporting manure to the field. Locate the storage so prevailing winds carry odors away from the house.

#### FEEDING AND BEDDING

Plan feed storage for each milking cow based on 13.6 kg (30 lb) of hay per day if no silage is fed, or 40.8 kg (90 lb) of silage if no hay is fed. If you feed silage and hay in combination, substitute at the ratio of three units of silage to one of hay, by weight. Concentrate storage should allow for 3-7 kg (6-15 lb) per cow per day, or one unit by weight per three of milk produced. Provide about 50% additional storage for the rest of the herd.

Allow 700 mm (28 in.) of feed bunk per animal if the cows are fed on a timetable. If they are self-fed and feed is available at all times, you can reduce feeder space to as little as 300 mm (12 in.) per milking cow and 200 mm (8 in.) for each dry cow and heifer. Feed bunks should be 750 mm (30 in.) wide if animals feed from one side and 1500 mm (60 in.) wide if they feed from both sides. The maximum height at the throat should be 550 mm (22 in.) and the maximum reach (measured

diagonally from the top of the throat board) should be 850 mm (34 in.). For cows and heifers, leave at least 3.3 m (11 ft) from bunk to wall or fence, 3.6 m (12 ft) from feed bunk to free-stall heel curb, and 4.8 m (16 ft) from feed bunk to parallel feed bunk.

Use Table 5 to plan storage for bedding.

**TABLE 4 MANURE STORAGE REQUIRED PER ANIMAL /DAY**

Class of animal	Manure produced L (cu ft)	Liquid manure storage L (cu ft)	Solid manure storage (including bedding)
			L (cu ft)
Dairy calves (0-3 months)	5.4 (0.19)	5.4 (0.19)	
Dairy calves (3-6 months)	7.1 (0.25)	9.9 (0.35)	
Dairy heifers (6-15 months)	14.2 (0.50)	19.8 (0.70)	17.0 (0.60)
Dairy heifers (15-24 months)	21.2 (0.75)	31.1 (1.1)	22.6 (0.80)
Dairy cows	45.3 (1.6)	62.3 (2.2)	
450 kg (1200 lb) Open-pen housing			56.6 (2.0)
Free-stall housing		67.9 (2.4)	48.1 (1.7)
Tie-stall housing			50.9 (1.8)

**TABLE 5 BEDDING REQUIRED PER ANIMAL PER DAY**

Class of animal	Manure pack loose housing		*Free-stall loose housing		Tie-stall housing	
	kg	(lb)	kg	(lb)	kg	(lb)
Milk cows	4.5	(10)	0-0.9	(0-21)	3.6	(8)
Dry cows and heifers	2.2	(5)	0-0.9	(0-2)	1.8	(4)
Calves (3-10 months)	1.4	(3)	0-0.5	(0-1)	1.4	(3)

\* Some operators use sand instead of bedding materials but not with liquid manure.

#### CONSTRUCTION MATERIALS

The general trend is toward single-story, light woodframe dairy buildings. Select materials for sanitation, durability, strength, fire-resistance and thermal insulation.

Building and maintenance costs are largely determined by the construction materials. Concrete is good

for footings, floors, ramps and steps because it costs little to maintain, is workable before it sets, is durable, and (above all) is sanitary. Generally, wood framing is used for walls, partitions and roofs because it is readily available, is easily cut, and practically all building panels can be attached directly. Good insulation is necessary for proper ventilation in enclosed buildings. Durable weatherproof materials are recommended for exterior surfaces. Interior surfaces exposed to high humidity like that in a milkhouse must be waterproof and easily cleaned. Windows lose heat and often get dirty and wet from condensation. Many new dairy barns have few or no windows unless local regulations require them.

the barn and encourages it to mix well throughout the room, without drafts on the animals.

In a well-insulated barn housing the milking herd, you'll need little or no heat other than that produced by the animals until the outside temperature falls below -20°C (-4°F). Calf and maternity areas will require supplementary heat. Heat the milkhouse and milk parlor to keep them dry and above freezing.

The parlor must also be ventilated to remove excess heat produced during milking.

## HEATING AND VENTILATION

Fans are generally used to exhaust stale air from a barn. They must be selected to provide air flow rates that range from the winter minimum to the summer maximum (Table 7).

Inlet location and design are more important than fan location. A good inlet allows enough fresh air to enter

**TABLE 6 TEMPERATURE AND HUMIDITY REQUIREMENTS**

Class of animal	Recommended inside temperature °C (°F)		Recommended inside relative humidity (%)	
	Min.	Max.	Min.	Max.
Cows	-7 (20)	24 (75)	25	75
Calves	10 (50)	27 (80)	25	75
Calves over 6 weeks (if draft free)	-18 ( 0)	27 (80)		

**TABLE 7 VENTILATION REQUIREMENTS**

Type of livestock	Type of housing	Step 1 continuous	L/s (cfm) per animal			Total ventilation required
			Step 2 moisture control	Step 3 temperature control		
Dairy cows						
450 kg cow (1000 lb)	Conventional fall to spring stabling - ventilation by windows during summer	9.4 (20)	9.4 (20)	47 (100)		65.8 (140)
450 kg cow (1000 lb)	Year-round insulated windowless housing or barn with non-opening windows	11.8 (25)	11.8 (25)	94 (200)		117.5 (250)
450 kg cow (1000 lb)	Insulated free-stall barn without windows - ventilation by doors during summer	9.4 (20)	9.4 (20)	47 (100)		65.8 (140)
Dairy calves						
50 kg av wt. (110 lb)	Continuous in well-insulated building	3.3 (7)	3.3 (7)	17 (36)		23.6 (50)
63 kg av wt. (139 lb)	Continuous in well-insulated building	4.7 (10)	4.7 (10)	23.5 (50)		32.9 (70)
45 kg (100 lb)	Batch housing in well-insulated building	2.4 (5)	2.4 (5)	19 (40)		23.8 (50)
135 kg (300 lb)	Batch housing in well-insulated building	5.6 (12)	5.6 (12)	47 (100)		58.2 (134)

\* Stea 3 (temperature control) should be in two or three stages when possible.