

Dairy Housing Lighting Options for Free Stall Housing

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Factsheet

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Figure 1. Proper lighting is important for cow management.

LIGHTING

Proper lighting in the barn is important for the management of your dairy herd, as well as improved operator efficiency, comfort and safety (Figure 1). Lighting can also be used for photoperiod management that can lead to increased milk production.

Illumination

The primary purpose of light is to illuminate the workplace. Light must be bright enough to see properly, uniform to prevent shadows, and a colour as close to natural sunlight as possible to distinguish colours of objects correctly.

Recommended light levels for dairy facilities are shown in Table 1.

Table 1. Recommended light levels for dairy facilities

Work Area or Task	Minimum Light Level
Parlour, pit and near udder	500 lux (50 fc)
Parlour, stalls & return lanes	200 lux (20 fc)
Parlour, holding area	100 lux (10 fc)
Milk room, general	200 lux (20 fc)
Milk room, washing	750–1,000 lux (75–100 fc)
Free stall barn, feed alley	200 lux (20 fc)
Free stall barn, stall area	100 lux (10 fc)

When designing lighting systems it is useful to know some basic lighting terms.

Lumens — Lumens (lm) is the amount of light output from a lamp. A 40-watt (W) incandescent light bulb produces about 13 lumens per watt (13 lm/W).

Footcandle or Lux — Brightness is a measure of the amount of light striking a surface. It is measured in units of footcandles (fc). One footcandle is defined as one lumen of light falling on one square foot. The metric equivalent of a footcandle is a lux (lumen per square metre). One footcandle is about equivalent to 10 lux. Outside on a bright sunny day in mid-summer, the light level will be around 8,000 fc or 80,000 lux.

Average Rated Life — The average time it takes for 50% of the light bulbs to fail.

Colour Rendering Index (CRI) — The measurement of the light sources ability to render colours the same way sunlight does.

Efficiency — The efficiency of a lamp is expressed as the amount of light provided per unit of input energy, or lumens per watt (Table 2). The efficiency of most lamps increases with lamp size.

Table 2. Lighting characteristics of light sources used for indoor lighting of livestock facilities

Lamp Type	Lamp Size (W)	CRI	Efficiency (ballast losses not included) (lumens/W)	Typical Lamp Life (hr)
Incandescent	25–200	100	11–20	750–5,000
Compact fluorescent	5–57	80–90	50–80	10,000
Fluorescent t5 1.2 M (4 foot)	28	85	104	20,000
Metal halide	35–400	60–80	60–94	7,500–20,000
High-pressure sodium	35–400	20–80	63–125	15,000–24,000
Light-emitting diode	1.2–1.4	70–90	16–53	60,000–100,000*

* White is lower.

PHOTOPERIOD MANAGEMENT

Research has shown that milk production can be increased by regulating the dairy cow's exposure to light. Milking cows exposed to 16–18 hr of light followed by 6–8 hr of darkness have consistently shown milk yield increases of 8%–10%.

Long Day Photoperiod

Long day photoperiods (LDPPs) produce a hormonal response in the cow that causes them to increase milk production and consequently increase feed intake. There is no benefit to providing 24 hr of continuous light. Without a period of darkness, cows can't determine the length of the day, which causes them to lose their ability to respond to extra lighting. Cows require 6–8 hr of uninterrupted darkness each day to detect light increases.

Light levels should be uniform throughout the barn, or at least anywhere the cow can see light. Putting lights over the feed alley only severely limits exposure to extra lighting. The light level needed to obtain this photoperiod response is 150–200 lux (15–20 fc).

Short Day Photoperiod

A short day photoperiod (SDPP) is most appropriate for dry cows. Cows that are continually exposed to LDPP will gradually lose their ability to respond with increased milk production. Short days appear to “reset” the cow's ability to respond to a long day photoperiod in the next lactation. This means dry cows should not have the same lighting as lactating cows. Exposing dry cows to less than 12 hr of light each day seems to be enough of a decrease in photoperiod to ensure a response to long days after calving.

Perhaps of greater interest to dry cow management are the apparent effects of SDPP on udder health and disease resistance. Preliminary laboratory studies suggest that cows exposed to SDPP when dry have a greater capacity to resist new infection.

Lighting Design Requirements for Photoperiod Control

The lighting design requirements for photoperiod control are:

- Provide milking cows with light levels of 150–200 lux (15–20 fc) for 16–18 hr/day followed by a dark period of 6–8 hr/day.
- Keep light levels throughout the barn as uniform as possible when measured at cow level.
- Provide dry cows with a dark period of at least 12 hr/day.

LDPP Versus SDPP for Milking and Dry Cows

This creates a big challenge for dairy producers. If milking cows need a LDPP and dry cows need an SDPP, they cannot both be housed in the same barn. Milking cows can continue to be housed in a well-lit naturally ventilated barn with supplemental lighting, but dry cows will need a barn that can be darkened. Since light levels cannot be reduced in naturally ventilated barns, dry cows may require separate housing with fan ventilation.

Even though it may not be possible to obtain the light separation for photoperiod control, 150–200 lux (15–20 fc) of light in all areas of the barn housing cattle is a very bright and comfortable light level to work in.

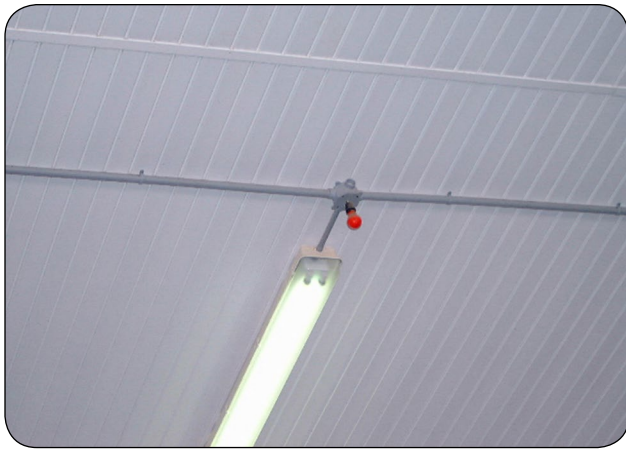


Figure 2. Dim red light in cow barn.

How Dark is Dark?

A common misconception is that cows require a low level of illumination (night light) in order to find feed and water during darkness. This is not true. Cows can find their way around in the dark. However, some light may be necessary for management purposes. Dim red lights don't appear to affect the cow's perception of darkness (Figure 2). Low-intensity red lighting (7.5W bulbs) mounted 6–9 m (20–30 ft) apart and 3 m (10 ft) above the floor provide adequate lighting for observing cows without upsetting the photoperiod response.

LIGHTING EFFICIENCY

Designing an energy-efficient lighting system is another design goal. Lighting accounts for about 15% of the energy use on a dairy farm. A variety of lighting options are available, and new and more efficient systems continue to evolve.

The more energy-efficient lamps also have the longest useful life (Table 2). A longer lamp life reduces the maintenance cost of a lighting system due to replacement costs.

LAMP TYPES

Three types of lights are commonly used on dairy farms. Each type has individual properties of light output, maintenance, colour, efficiency and cost that affect selection for a particular task (Table 2).

Incandescent Lamps

Consider incandescent fixtures when light is needed for short periods and when they are turned on and off frequently. Their initial cost is relatively low and they operate well in most conditions, including low temperatures.

Fluorescent Lamps

A fluorescent lamp is a low-pressure mercury electric discharge lamp. A fluorescent lamp consists of a glass tube filled with a mixture of argon gas and mercury vapour at low pressure. When current flows through the ionized gas between the electrodes, it emits ultraviolet (UV) radiation from the mercury arc. The UV radiation is converted to visible light by fluorescent coating on the inside of the tube.

Turning these lights on and off frequently or leaving them on for only 2–3 hr at a time reduces lamp life. Near the end of its life, a typical fluorescent lamp emits only 60%–80% of its initial light output. Use moisture-resistant fixtures for fluorescent bulbs that are installed in livestock barns.

High Intensity Discharge (HID)

HID lamps include mercury, metal halide, high-pressure sodium and low-pressure sodium. They tend to have long lives and to be very energy efficient. They operate well in cold temperatures. Light output is coloured (i.e., mercury is greenish-blue, and sodium is golden yellow).

HID lamps require 5–15 min to start and are not usable where lamps are turned on and off frequently. HID lamps work best when mounted at least 30.5 cm (12 in.) high and lamps are on for at least 3 hr.

Light Emitting Diode (LED)

LED systems are just starting to be used in dairy barns and poultry facilities. The energy efficiency of LED lamps can be very high (50 lumens/W), and life is much longer (up to 100,000 hr) than other light systems. LED lighting comes in various forms — spot, linear or strip. They are available in monochromatic colours and can be dimmed. LED lights contain no mercury and, since they last longer, there is less waste.

Induction Lighting — Another form of lighting that is just starting to be used in dairy housing is induction lighting. The light emitting gas inside the bulbs is energized when located within a sufficiently strong electro-magnetic field, which is induced by passing alternating current through a coil, or inductor. This means that electricity-conducting metal contacts are not necessary on the bulb, and the bulb will experience longer life. The lamps are capable of saving 40% over fluorescent bulbs, and some models have a life expectancy of up to 100,000 hr.

Other advantages of induction lighting are better colour rendition and better control of the bulbs' colour range from daylight to soft white.

Lighting Design

Not all the light that is emitted from a fixture falls on the work area. The amount of light that can be used depends on the fixture design, reflectivity of the surroundings, mounting height, reduction of lamp output over time and the cleanliness of the fixture. The goal of lighting design is to determine the number of light fixtures needed to provide the lighting levels required in the free stall barn.

Fluorescent lighting is commonly used in dairy barns and milking parlours. Only totally enclosed, watertight fixtures are recommended for use in dairy buildings. These types of fixtures have a reflective housing and a gasketed, refractive lens that covers the lamps. Fluorescent lights are usually used when the mounting height is less than 3 m (10 ft).

High intensity discharge (HID) fixtures are used when mounting heights of 3–6 m (10–20 ft) are required. Low bay models are available that use 35W–150W lamps at mounting heights of 3–5 m (10–16 ft). Fixtures that are designed for use with 250W–400W lamps typically have a minimum mounting height of 4.6 m (15 ft). LED lighting is becoming more common and more reliable for use in dairy barns. There is less electrical interference with LED lighting because they use solid-state components.

Maintenance

For good lighting, it is important to follow a regular maintenance program, as the light output of most bulbs decreases near the end of their life. It is also very important to keep the light fixtures and the surrounds as clean as possible.

SUMMARY

The primary purpose of lighting is for illumination. Design lighting systems for appropriate output and colour for the job.

Light can be used for photoperiod control that can increase milk production. Use LDPP for milking cows and SDPP for dry cows. House milking and dry cows in separate facilities.

Lighting efficiency is different for different light sources. LED and induction lights may be the best option in the future for efficiency, although at this point more testing is needed.

Design parameters for lighting systems include:

- Adjust mounting height and spacing to provide uniform light.
- Avoid creating shadows.
- Allow for lights deteriorating with age.
- Set mounting height according to the desired light level.
- Keep fixtures clean.
- Keep surroundings clean.

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