

3. Lighting

Section Contents

- [Purpose](#)
 - [Dairy Farm Task Lighting](#)
 - [Livestock Handling Lighting](#)
 - [General Lighting](#)
 - [Energy Utilization Indices \(EUIs\)](#)
 - [Energy Conservation Measures \(ECMs\)](#)
 - [Operator Level Checks](#)
 - [Glossary](#)
 - [Web Page References](#)
-

DISCLAIMER

Neither SCE nor any entity performing the work pursuant to SCE's authority make any warranty or representation, expressed or implied, with regard to this guide, the merchantability or fitness for a particular purpose of the results of the work, or any analyses, or conclusions contained in this guide. The results reflected in the guide are generally representative of operating conditions; however, the results in any other situation may vary depending upon particular operating conditions. Photographs and diagrams provided within this guide by specific manufacturers are used for illustrative and educational purposes only and are not meant to endorse or promote a specific product or manufacturer.

Purpose - Lighting

Although often overlooked and taken for granted, the application of electric lighting is a substantial energy input in the operation of a modern California dairy farm. Lighting represents 16% of total electric energy used on California dairies. The cumulative magnitude of energy use by a broad range of lighting equipment in all areas of the farm complex is somehow perceived to not be as significant as it really is. The use of supplement lighting in every facet of our daily lives tends to lessen our perception of its existence and not consider the full impact on total farm energy consumption.

Lighting sources found on the dairy include:

- Incandescent
- Tungsten Halogen
- Fluorescent
- Mercury Vapor
- Metal Halide
- High Pressure Sodium.

The common theme behind the use of all these sources is the basic need for supplemental light to provide people the visual acuity to perform required functions accurately, efficiently and safely. As the continuing trend toward larger dairies operating around the clock continues the necessity of efficient, well designed and maintained lighting systems becomes even more crucial to successful operation of the farm.

The available energy conservation options for improving lighting efficiency and efficacy on the farm are enormous. New and improved lighting technology is being developed continually. The choices available range from simple lamp replacements to installing new hi-efficiency lighting systems with programmable logic controllers and other computer based control systems.

An integral step to improving lighting on dairy farms is the performance of a specific lighting design for that area or facility. Clearly using an efficient light source in a poor design does not provide optimal lighting. This design should satisfy established criteria for light level, color rendering, efficacy, selection of fixtures suitable for the ambient environment, controls, and proper wiring and circuit protection.

A recent development in the application of lighting technology on dairy farms may involve photoperiod manipulation, or long-day lighting, of dairy cows to increase milk production. This management practice uses an increased light intensity over a defined time interval to stimulate increased milk production. An efficient lighting design and control system must be implemented to obtain the benefits of long-day lighting.

Lighting for a Dairy Facility

Having a good working environment in a modern dairy is an important factor in the optimization of animal and worker efficiency, safety, and comfort. Lighting is an environmental factor that should be given careful consideration throughout a dairy facility, but it is often considered only as an afterthought during the design, construction and maintenance of a dairy facility. Various work tasks on a dairy farm require differing light considerations, as do animal feeding and resting areas. On average, lighting consumes about 16% of the total electric energy used on a typical California dairy farm.

Important factors in developing effective lighting systems include the selection of appropriate luminaires designed for the task lighting required and the room environment where the lighting equipment is installed. The very best lighting systems perform poorly in dark colored, dingy rooms. Many areas within dairy facilities cannot be kept pristinely clean and bright, but where possible, walls and ceilings of lighted areas should be painted or covered with a bright, matte finish that is highly reflective without producing glare. This is especially important in visually intensive work areas such as milking parlors, milkrooms, cow treatment areas, and equipment repair areas. Quality lighting is very much a factor in improving and maintaining productivity.

Return to Top of Section: [Lighting](#)

Dairy Farm Task Lighting

There are three levels of work area or task lighting systems on dairy farms:

- Visually intensive task lighting (generally requires highest lighting levels)
 1. milking parlors and holding areas
 2. equipment washing
 3. equipment maintenance and repair
 4. office lighting
 5. maternity and veterinary treatment area
 6. utility room

- Lighting for livestock handling and equipment operation (high to moderate lighting levels)
 1. Holding area lighting
 2. Feeding area lighting
 3. Animal sorting and observation
 4. General cleanup

- General lighting (low to moderate lighting levels.)
 1. Livestock resting areas
 2. Passageway lighting
 3. General room lighting
 4. Security lighting (indoor and outdoor)

Table 3-1 provides recommended lighting requirement in footcandles (fc) for various areas within a dairy facility. To assist in determining the lights (wattage) needed for a specific area, Table 3-1 gives an estimated coefficient of utilization, the percent of the lumen output from the lamp(s) that actually reaches the work plane. With this information, the lumen output needed to achieve the correct light level can be calculated. The light fixture (luminaire) selected will have a lumen output per rated Watt, see Table 3-2. Combining the lumens required and the lumen output yields the wattage required per sq ft. The energy consumed by the fixture(s) will include both the lamp and the ballast, if one is present. Only incandescent and halogen do not use ballasts. This table is not to be used for designing a lighting system but to highlight the design concepts.

Table 3-1: Suggested Dairy Facility Illumination Levels

Work Area	Recommend Illumination Level ¹ fc	Coefficient Utilization ² Estimate %	Lamp(s) Output lm/sq ft ³	Lamp Output (lm/W) ⁴	Power Required W/sq ft ⁵	Fixture ⁶ Suggested
Milking Center						
Parlor, general lighting	20 fc	35	57	94	0.61	psmh
Operator pit (cows udder)	50 fc	30	167	96	1.7	psmh
Cow return alleys	20 fc	35	57	92	0.62	psmh
Cow holding area	10 fc	35	29	92	0.31	psmh
Milk Room						
General lighting	20 fc	35	57	89	0.64	Fluor 8
Equipment washing area	100 fc	40	250	89	2.8	Fluor 8
Bulk tank/silo interior	100 fc	80	125	82	1.5	
Utility/Equipment Room						
General lighting	20 fc	30	67	89	0.75	Fluor 8
Equipment repair and maintenance	100 fc	45	220	25	8.9	halogen
Maternity/Treatment areas						
General lighting	20 fc	30	67	96	0.69	psmh
Treatment or surgery	100 fc	50	200	25	8.0	halogen
Cattle confinement areas (indoor)						
	20 fc	30	67	96	0.69	psmh
Cattle confinement areas (outdoor)						
	1 fc	20	3.3	115	0.03	hps
Feed Storage areas						
Grain bin areas	5 fc	20	25	115	0.22	hps
Commodity buildings	10 fc	25	40	115	0.35	hps

1. Source: ASAE Lighting Systems for Agriculture Facilities (draft)

2. Coefficient of utilization given for luminaries direct at least 65 percent of light down

3. Lamp output needed to meet recommended lighting level, lumens/sq ft

4. Lumen output of selected lamp, lumens per Watt (rated)

5. Wattage required for selected lamp per sq ft

6. psmh – pulse start metal halide, fluor 8 – fluorescent T8, hps – high pressure sodium

Example: Select the lighting fixtures needed for a milking parlor operator pit that is 8 ft x 45 ft. Referring to Table 3-1, light intensity must be 50 fc or 50 lumens per sq ft and the coefficient of utilization will be 35%. Pulse start metal halide lights will be used.

$$\begin{aligned}
 \text{Area to be lighted at 50 fc:} & \quad 8 \text{ ft} \times 45 \text{ ft} = 360 \text{ sqft} \\
 \text{Lumen output needed:} & \quad \frac{50 \text{ lumens}}{\text{sqft}} \div 0.35 = \frac{143 \text{ lumens}}{\text{sqft}} \\
 \text{Lamp rated output for psmh:} & \quad 96 \text{ lumens/W} \\
 \text{Lamp Watts required:} & \quad \frac{143 \text{ lumens}}{\text{sqft}} \times \frac{\text{W}}{96 \text{ lumens}} = \frac{1.5 \text{ W}}{\text{sqft}} \\
 \text{Lamp Watts required for job:} & \quad \frac{1.5 \text{ W}}{\text{sqft}} \times 360 \text{ sqft} = 536 \text{ W}
 \end{aligned}$$

The lumen output [96 l/W] for the psmh lamp is the initial lumen output. As with all lamps, lumen output decreases with time. Therefore, when selecting fixtures for a particular project the installed wattage should be increased by 20 percent in order to maintain the required light levels over a period of years. Possible selection of fixtures for this milking parlor: 3 – 250 W psmh [low bay].

To calculate the lamp watts and number of fixtures required, as well as the annual energy consumption, click on the following link: [Calculators](#)

All the lamps listed in Table 3-1 and Table 3-2 (except incandescent and halogen) use a ballast. This ballast consumes energy. To estimate the power consumed by a fixture with a ballast, multiply the lamp wattage by 1.13. Assuming these lights will operate 15 hours per day, what will be the annual energy consumption for lighting system?

$$kWh / yr = (3 \times 250) \text{ W} \times 1.13 \times \frac{kWh}{1000 \text{ W}} \times \frac{15 \text{ hr}}{\text{day}} \times \frac{365 \text{ days}}{\text{yr}} = 4,600 \text{ kWh}$$

Selecting Luminaires

Choosing appropriate luminaires and lamps for a specific lighting task requires an understanding of the relative performance, efficiencies and color rendition of various light types. Table 3-2 provides representative information about lamps commonly used in dairy facilities.

Table 3-2. Lamp types and selection data

Lamp Type	Efficiency* Lm/Watt	Color Rendering Index (CRI)	Rated Life (Hours)
Incandescent	12-20	100	750-2000
Halogen	18-25	100	2000-3000
Fluorescent, T12, CW, MB**	60-71	60-80	12,000-20,000
Fluorescent, T8, CW, EB**	84-94	78-86	15,000-20,000
Fluorescent, compact	50-79	82	10,000-20,000
Mercury Vapor	38-46	15-50	18,000-24,000
Metal Halide, standard	82-90	65-75	12,000-20,000
Metal Halide, pulse start	92-106	65-70	15,000-30,000
High Pressure Sodium	95-125	20	24,000

* Initial lumens per rated Watt

** MB – Magnetic ballast, EB – Electronic ballast

Visually-Intensive Task Lighting

Milking

The milking operation on a dairy farm is a critical, repetitive task that requires excellent visual observations of equipment operations, udder prepping, udder health and cleanliness, and post-milking teat treatment. Inadequate lighting can accelerate fatigue and greatly diminish the performance of the milking staff. Poor milker performance leads quickly to herd health problems and significant drops in milk production.

In the milking parlor, lighting levels in the pit area and near the cow's udder (the work plane) should be 50 footcandles (fc) or more, as recommended by the Illuminating Engineering Society (IES) and the American Society of Agricultural Engineers (ASAE). See Table 3-3. Moisture resistant fluorescent or metal halide luminaires provide the most effective and comfortable lighting. See Table 3-3. If the ceiling is 12 feet or less above the pit, fluorescent luminaires are generally more effective. If the ceiling is higher, metal halide luminaires are very effective. Luminaire layout will vary depending on the parlor design. If fluorescent luminaires are used, generally two rows of continuous (end to end) double tube luminaires mounted over the outer edges of the pit will provide uniform lighting with little or no shadows. (See Figure 3-1).

If metal halide luminaires, a single row of luminaires over the center of the pit will work nicely, assuming there is adequate mounting height (12 feet or more). Luminaire spacing is dependent on the wattage and luminaire design selected. See Figure 3-2.



Figure 3-1. Example of fluorescent milking parlor pit lighting



Figure 3-2. Example of metal halide milking parlor pit lighting

Parlor Stalls and Holding Area

It is important to have reasonably good, uniform levels of illumination in the holding area, parlor stall area, and the cow return lane areas in the milking center. The IES and ASAE recommend a uniform lighting level of 20 fc in the parlor stall area and return lanes. It is recommended that the holding area have a uniform 10 fc illumination level. If the holding area is illuminated at a lower level than the parlor cow traffic area, it will facilitate cow traffic flow. Cows are more comfortable traveling from areas of lower illumination toward areas of higher illumination. See Figure 3-3. If it is important to have color rendition like the parlor pit area, then it would be prudent to use fluorescent or metal halide lighting in the cow traffic areas.

If color rendition is not deemed critical in the cow traffic areas, high-pressure sodium (HPS) luminaires are a good choice. They offer a higher level of lighting efficiency, and are often less expensive to install and maintain. Cow return lanes can often be effectively lighted with “wall pack” luminaires, which are rectangular lighting fixtures that are mounted, at proper spacing, high up on the sidewalls. The lenses on these fixtures aim the light onto the traffic areas.



Figure 3-3. Lighting in parlor stalls, return lane lighting, and holding area lighting

Table 3-3. Milking parlor pit, stall, return lanes and holding area lighting

Milking Parlor Pit at udder	50 fc	Fluorescent, 2 lamp, moisture resistant Metal Halide, moisture resistant
Parlor General Lighting Stalls and Return Lanes	20 fc	Fluorescent, moisture resistant Metal Halide, moisture resistant High pressure sodium, moisture resistant
Holding Area	10 fc	High pressure sodium, moisture resistant Metal Halide, moisture resistant Fluorescent, moisture resistant

Equipment Washing

Milking center equipment washing areas, such as the wash sink in the milkroom, require high levels of illumination. Inspecting equipment for proper cleanliness is important in maintaining low bacteria count and high quality milk. The IES and ASAE recommend lighting levels of 75 – 100 fc in equipment cleaning areas. See Table 3-4. Since much of the milking system is now cleaned in place, this recommendation only applies to those areas where equipment is disassembled and manually cleaned. Generally, fluorescent, moisture resistant luminaires are appropriate to illuminate equipment wash areas. Luminaires should be mounted above work areas to provide shadow-free light at the work surface. See Figure 3-4.

The interiors of bulk tanks or milk storage silos need to be visually inspected for cleanliness. This is best accomplished with a portable moisture resistant luminaire. For some situations a fluorescent wand-type may be appropriate. The luminaire should have a protective sleeve over the lamp to contain any glass pieces, should the lamp break. It is recommended that 100 fc be provided for inspection of the interior of bulk tanks and silos.

General lighting in the milkroom should provide a uniform 20 fc illumination level. Like the equipment washing area, fluorescent luminaires are most common. However, if ceilings are high (12 feet or more), metal halide luminaires work well.



Figure 3-4. Milkroom lighting

Table 3-4. Milkroom and equipment wash area lighting

Task area	Illumination Requirement	Recommended Luminaire
Milkroom (General Lighting)	20 fc	Fluorescent, 2 lamp, moisture resistant Metal Halide, moisture resistant
Equipment washing (Wash sink area)	100 fc	Fluorescent, 2 lamp, moisture resistant Metal Halide, moisture resistant
Bulk Tank/Silo Interior Cleaning and inspection	100 fc	Fluorescent portable wand light, insulated and moisture resistant

Office Lighting

Most milking centers include the farm office space. Proper, glare-free lighting is essential in an office to facilitate the daily activities of record keeping, computer operations, and general office work. Farm office general illumination levels should be at least 50 fc with specific task lighting on the desk surface of 100 fc or more. See Table 3-5. Once again, fluorescent lighting is most suitable to provide glare-free lighting with few shadows.

Table 3-5. Dairy office lighting

Task Area	Illumination Requirement	Recommended Luminaire
General Office lighting	50 fc	Fluorescent with prismatic lens
Reading, writing, keyboard and other desk tasks	50 – 100 fc	Fluorescent with prismatic lens

Maternity and Veterinary Treatment Area

The maternity and veterinary treatment area in a dairy facility requires general lighting levels of 20 fc to facilitate observations of sick cattle and cows ready to calve. Intense visual and often delicate tasks such as operating procedures or other animal treatment require minimum lighting levels of 100 fc. See Table 3-6. Fluorescent or metal halide luminaires are most appropriate for these areas. For surgery, portable halogen spotlights may be required to provide adequate task lighting. In the treatment/operating area, the luminaires need to be more concentrated and arranged to minimize any shadows.

Table 3-6: Maternity and treatment area lighting (indoors)

Task Area	Required Illumination	Recommended Luminaire
Maternity/treatment area (general lighting)	20 fc	Fluorescent or Metal Halide moisture resistant
Veterinary Treatment and Surgery area	100 fc	Fluorescent or Metal Halide moisture resistant Portable halogen spot lights for lighting surgical area

Utility Room Lighting

The utility room in a modern milking center houses most of the key operating systems that makes the milking parlor/milkroom area function. Vacuum pumps, refrigeration compressors, condensers, air compressors, electrical distribution panels, and, often, the standby power system are all found in the utility room. It is recommended that a uniform general illumination level of 20 fc be provided in the utility room. See Table 3-7. Portable task lighting is also required to raise local illumination levels to 100 fc when maintenance and repair is conducted on individual pieces of equipment. General lighting is commonly provided by fluorescent luminaires. If ceilings are 12 feet or more in height, metal halide luminaires will also provide excellent, uniform lighting.



Figure 3-5. Fluorescent lighting in a utility room

Table 3-7. Utility room lighting

Task Area	Illumination Requirement	Recommended Luminaire
General lighting	20 fc	Fluorescent with prismatic lens Metal Halide, low bay
Equipment Maintenance and repair	100 fc	Portable incandescent or halogen trouble light

Return to Top of Section: [Lighting](#)

Livestock Handling Lighting

Lighting for Dairy Cattle Confinement Structures

General lighting systems for dairy cattle confinement structures, whether freestall barns or simple loafing shelters, should provide 10 fc of light. See Table 3-8. This is important for the performance of general work tasks such as separating cattle, observing cattle for illness or heat detection, and performing general maintenance and cleanup operations. This lighting level is also necessary to provide safe operator movement throughout the facility. High pressure sodium luminaires provide the most effective and efficient illumination for this lighting need. If good color rendition is desired, metal halide luminaires are commonly used. See Figure 3-6. If the structure has a very low ceiling (less than 12 feet), fluorescent luminaires may be more appropriate. If ambient temperatures are likely to dip below 50° F., the fluorescent fixtures should have high output ballasts and lamps to reduce cold temperature light degradation.

Illumination levels in feeding areas within confinement structures should be 20 fc. This facilitates the operation of feeding wagons or trucks and encourages cows to move to the feeding area and eat. A heavier concentration of the same type of fixtures used for general lighting can be used to provide the higher illumination level.



Figure 3-6. Example of metal halide lighting in a dairy cattle confinement feeding barn

Long-day Lighting

Numerous university studies suggest that supplemental lighting that provides lactating dairy cows with a uniform light level of 15 to 20 footcandles for 16 to 18 hours per day will increase milk production. Generally, in freestall resting barns, long day lighting systems utilize high-pressure sodium or metal halide light fixtures. These high efficiency fixtures provide sufficient lighting while using less energy than other fixture types. To gain the full benefit of this supplemental lighting, the dairy cows must have a 6 to 8 hour dark period every 24 hours. When herds are on 3x milking schedules, it is often difficult to achieve the required dark period. When considering a long day lighting system, it is important to note that 2 to 3 times as many light fixtures are required compared to conventional freestall barn lighting recommendations. See Figure 3-7.



Figure 3-7. Freestall resting barn with supplemental long day lighting

Open Corral Confinement Systems

Open corral confinement systems present a special lighting challenge. It is difficult to provide effective, uniform lighting in large open areas. A low level (less than 1 fc) of general lighting can be achieved by locating high pressure sodium HID luminaires around the perimeter of the corral. The luminaires would have to be weather-proof with wide beam angle reflectors to aim the light over a broad area of the corral. See Figure 3-8. Lighting at feeding areas in corrals should be 3 fc. Again, this facilitates nighttime feeding operations and encourages animal movement to the feeding area. Corral lighting can best be accomplished by mounting luminaires on very tall poles, which would allow luminaire mounting heights of at least 40 to 50 feet. Taller poles allow wider beam spread and the use of higher wattage, more efficient luminaires, thus reducing the total energy requirement for the lighting task.



Figure 3-8. Example of 1,000 W floodlight for feeding corral lighting

Table 3-8. Cattle Confinement and Feeding Area Lighting

Task Area	Required Illumination	Recommended Luminaire
Confinement Structures (General Lighting)	10 fc	High pressure sodium, Metal halide Fluorescent (All moisture resistant)
Feeding areas (in confinement buildings)	20 fc	High pressure sodium Metal halide Fluorescent (All moisture resistant)
Corrals (general lighting)	0.25 fc	High pressure sodium (weatherproof with wide beam angle reflectors) on tall poles
Corral Feeding areas	3 fc	High pressure sodium, (weatherproof with wide beam angle reflectors) on tall poles.
Special Pens and Chutes		
General (outdoors)	10 fc	High pressure sodium
Sick Animal Treatment (outdoors)	50 fc	High pressure sodium (provided from several directions to reduce shadows)

Return to Top of Section: [Lighting](#)

General Lighting

Feed Storage and Processing Areas

Feed storage areas such as commodity storage buildings and grain bins generally require less light than other areas because little work is done within the storage areas. Table 3-9 provides recommended light levels for these areas. Grain bins should have 2 – 5 fc of light around them to facilitate safe walking and equipment operations around them at night. Commodity storage buildings should have up to 10 fc of light in front of and within the storage facility to facilitate commodity removal and mixing operations at night. High pressure sodium luminaires will provide the most efficient light source for these areas. See Figure 3-9. These lighting systems can be set up on dusk to dawn timers or photoelectric controls, since they are only needed for nighttime operations.



Figure 3-9. High pressure sodium fixture in commodity storage shed

Table 3-9. Feed and grain storage area lighting

Task Area	Required Illumination	Recommended Luminaire
Grain Bin area	2-5 fc	High pressure sodium, weather-proof, with dusk to dawn control
Commodity Storage	10 fc	High pressure sodium, weather-proof with dusk to dawn control

Return to Top of Section: [Lighting](#)

Lighting Energy Utilization Indices (EUIs)

The largest portion of all electrical energy used for lighting on the dairy farm occurs within the milking center and mainly in the milking parlor. Maintenance of acceptable lighting levels in this area is crucial to providing operators visual acuity to perform their tasks.

The energy use to provide lighting on a dairy farm is driven by a number of factors. These include:

- Illumination levels required
- Proper design, selection, placement and installation of lighting system
- Duration of time period lighting is used
- Energy efficiency (lumens per watt) of lighting system selected
- Maintenance of lighting system.

The kilowatt-hours used per cow-year for operating all lighting equipment on the dairy establish the EUI for lighting. A reasonable range for lighting EUI's on California dairies would be from 30 to 75 kWh per cow-year.

The advent of photoperiod manipulation or long day lighting (LDL) to increase milk production can significantly increase the EUI for lighting. Dairies utilizing LDL technology in their freestall barns would be expected to have lighting EUI's range from 100 to 175 kWh per cow-year. Although lighting EUI's will increase appreciably on those dairies adopting LDL, relatively modest increases in milk production make the supplementary lighting very cost-effective.

Return to Top of Section: [Lighting](#)

Lighting Energy Conservation Measures (ECMs)

The most effective energy conservation measure for dairy lighting systems is to replace inefficient luminaires with higher efficiency types. For example, if lighting for outdoor corrals and feeding areas is provided by incandescent or halogen flood lights, converting to high pressure sodium lighting at the same lighting level would save a significant amount of energy. High-pressure sodium lamps produce 5 to 6 times more lumens/watt of energy used compared to incandescent or halogen lamps. Table 10 below illustrates energy conservation measures for lighting and the percentage savings each measure will provide.

Table 3-10. Lighting Energy Conservation Measures and Savings

Lighting Type	Energy Conservation Measure	% Energy Savings
Incandescent	Convert to halogen lamps	20-38%
Incandescent	Convert to compact fluorescent, if appropriate	75%
Incandescent	Convert to fluorescent tube luminaires	80-85%
Fluorescent T-12 Magnetic ballasts	Convert to fluorescent T-8 with energy efficient ballasts	25%
Mercury vapor	Convert to Metal Halide, if appropriate	43-54%
Mercury Vapor	Convert to High Pressure Sodium, if appropriate	44-59%

Converting to higher efficiency luminaires may not always be cost effective. Buying and installing new higher efficiency luminaires may cost more than is saved in energy costs. For example, it may not pay to replace existing fluorescent T-12 luminaires with new T-8 luminaires with high efficiency ballasts. However, it would pay to convert the existing ballasts and lamps from T-12 to T-8 while keeping the existing fixture.

The most important point to make about lighting energy conservation is to install the most appropriate, most efficient luminaire for the task. Purchasing high quality, energy efficient luminaires generally results in better lighting with continued energy savings over the life of the luminaire.

To calculate light conversion savings, click on the following link: [Calculators](#)

Return to Top of Section: [Lighting](#)

Operator Level Checks - Lighting

In a dairy farm environment, even the best lighting systems lose their effectiveness quite rapidly if not properly maintained. There are many factors that influence the coefficient of utilization. Dust and dirt accumulation on lamps and luminaire refractors will significantly reduce the effective light output of the fixture. This is known as luminaire dirt depreciation (LDD). Luminaires in very dirty locations should be cleaned monthly. Luminaires in less dirty environments should be thoroughly cleaned at least twice per year.

Since light reflectance of ceilings and walls is an important factor in lighting system performance, it is important to keep reflective surfaces clean. As dirt accumulates on these surfaces, they will absorb light rather than reflect it, thus reducing the quality of light in the task area. This is known as room surface dirt depreciation (RSDD). In lighted dairy facilities, it is important to keep walls and ceilings cleaned. They should be painted or covered with bright white or other reflective colors.

The light output for all common lamps diminishes over the life of the lamp. This loss of light output over time is known as lamp lumen depreciation (LLD). For example, a typical incandescent lamp will produce 89% of its initial lumen output at 70% of its normal life. A

metal halide lamp may only produce 60% or less of its initial lumen output at 70% of its life. To maintain proper light levels, it is appropriate to replace lamps before they burn out. Some will say that a HID lamp will never burn out. This is not true but the light output will be a fraction of the original lumen output. While a depreciated lamp will still “work”, less light will be received and the energy consumed remains nearly unchanged.

As lighting system output diminishes due to dirt depreciation factors and lamp lumen depreciation factors, it may be difficult to sense the light loss with the naked eye. This is because the light loss is gradual, and the operator tends to get used to diminished levels until the light levels are far too low. To monitor lighting system performance, use a light meter to measure footcandle levels in each lighted area when the system is new. Then check footcandle levels in the same areas on a monthly basis to determine diminished system performance. The light meter readings will indicate when cleaning and relamping should occur. Best to make these measurements at night when ambient light will not interfere with the readings.

Adequate lighting is not always a priority on dairy farms, but a well designed and maintained lighting system pays dividends in improved employee and animal performance.

Return to Top of Section: [Lighting](#)

Glossary of Lighting Terms

Ballast: A device used with an electric-discharge lamp to obtain the necessary conditions (voltage, current and waveform) for starting and operating the lamp.

Ceiling Cavity Ratio (CCR): A number indicating ceiling cavity proportions calculated from length, width and height.

Coefficient of Utilization: The ratio [percent] of the lumens emitted from the luminaire(s) to the lumens received on the work plane.

Color Rendering Index (of a light source) (CRI): A measure of the degree of color shift objects undergo when illuminated by the light source as compared with those same objects when illuminated by a reference source of comparable color temperature. The higher the CRI, the more “natural” colors appear when illuminated by the light source.

Diffuser: A device to redirect the illumination of a lamp.

Footcandle: A measure of the level of illumination on a surface. One footcandle is light intensity produced by one lumen of light per square foot.

General lighting: Lighting designed to provide a uniform level of illumination throughout the area involved exclusive of any provision for special localized lighting requirements.

Glare: The effect of brightness or brightness differences within the visual field sufficiently high to cause annoyance, discomfort, or loss in visual performance.

High-bay Lighting: Interior lighting where the roof truss or ceiling is more than 25 ft. above the floor.

High Intensity Discharge (HID) Lamp: An electric-discharge lamp using a temperature stabilized light producing arc. Common HID lamps include mercury vapor, metal halide and high pressure sodium.

High Pressure Sodium (HPS) Lamp: A high intensity discharge (HID) lamp in which light is produced by radiation from sodium vapor operating under partial pressure.

Incandescent Filament Lamp: A lamp in which light is produced by a filament heated by an electric current.

Lens: A glass or plastic element used in luminaries to change the direction and control the distribution of light rays.

Light: Radiant energy that is capable of exciting the retina and creating a visual sensation.

Light Loss factor (Maintenance Factor): A ratio comparing the amount of light on the task surface provided by a lamp to the value if the lamp operated at its initial (rated) lumen output and if no appreciable variation or depreciation had occurred.

Localized General Lighting: Lighting utilizing luminaires above the visual task and contributing also to the illumination of the surrounding area.

Low-bay Lighting: Interior lighting where the roof truss or ceiling height is 25 ft or less above the floor.

Lumen: A unit of measure of the quantity of light emitted from a lamp. One lumen impinging on an area one foot square will produce a light intensity of one footcandle.

Luminaire: (light fixture) A complete lighting unit consisting of a lamp (or lamps), ballasting (when applicable), together with the parts designed to distribute the light, to position and protect the lamps and to connect the lamps to the power supply.

Luminous Efficacy of a Source of Light (Luminous Efficiency): The total radiant power emitted by a lamp divided by the total lamp power (watts) input. It is expressed in lumens per watt.

Mercury Vapor Lamp: A high intensity discharge (HID) lamp in which the major portion of the light is produced by radiation from mercury operating at a partial pressure.

Metal Halide Lamp: A high intensity discharge lamp in which the major portion of the light is produced by radiation of metal halides possible in combination with metallic vapors such as mercury.

Photoperiod: The environmental (natural or artificial) light-dark cycle to which living organisms may be exposed.

Portable Lighting: Lighting involving equipment designed for manual portability.

Rated Life: Standard HID and most lamps – number of operating hours at which 50 percent will still be operating. For pulse start metal halide, the value is set at 70.

Room Cavity: The cavity formed by the plane of the luminaires, the workplane, and the wall surfaces between these two planes.

Room Cavity Ratio: A number indicating room cavity proportions calculated from length, width and height.

Task Lighting: Lighting directed to a specific surface or area that provides illumination for visual tasks.

Work Plane: The plane at which work usually is done or at which the illuminance (fc) is specified. For example, the cow's udder for milking parlors or the cow's eye for long-day lighting would locate the work plane.

Return to Top of Section: [Lighting](#)

Lighting Web Page References

Light Equipment Manufacturers

- General Electric Lighting - GE Lighting – www.gelighting.com
- Osram-Sylvania – www.osram.com
- Phillips Lighting - www.lighting.phillips.com
- Ruud Lighting – www.ruudlighting.com
- Lithonia - www.lithonia.com
- Cooper Lighting - www.cooperlighting.com
- Venture Lighting – www.venturelighting.com
- HIDirect – www.hidirect.com - lamps
- Holophane - www.holophane.com

Return to Top of Section: [Lighting](#)