



ISA Recommendation

Recommendation of Lighting Environment of Broiler Farming

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International Solid State Lighting Alliance

Technical Committee on Standardization



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Foreword

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Technical Requirements for Lighting Environment of Broiler Farming

1 Introduction

Light environment is an important factor affecting broiler growth. With appropriate parameters, light environment can greatly improve the growth rate and quality of broilers. Especially in the era of high development of modern broiler breeding technology, it is urgent to optimize and standardize the breeding light environment technology.

This document specifies the general technical requirements of lighting environment of broiler, including terminology, definitions, classification and test requirements.

2 Scope

This document specifies the general technical requirements of lighting environment of broiler, including terminology, definitions, classification and test requirements.

This document is applicable to special tasks requiring different light colors/spectra, illuminance and photoperiod and is used to promote the production capacity of broilers, providing reference for the formulation of related technical standards, test methods, detection rules and technical documents for the control of LED light environment in broilers farming.

3 Terms and Definitions

3.1 Broiler farming

3.1.1 Broiler

Breeds of chickens raised artificially for human chicken consumption.

3.1.2 Broiler farming

Broiler farming refers to the farming of chickens specially bred for human chicken consumption. The main purpose of broiler farming is to improve the feed conversion rate, reduce the average feed intake, and improve the quality of chicken.

3.1.3 Farming stage

According to the characteristics of livestock and poultry production use, the production cycle is divided into different ages or several production stages, and different environment and nutrition supply measures are implemented according to each stage.

3.1.4 Illumination mode

3.1.4.1 Artificial illumination mode

The illumination of broiler coops is completely unaffected by natural light and is dependent on artificially light sources providing light throughout the broiler farming phase.

3.1.4.2 Natural combined with artificial illumination mode

Broiler coops receive light translucent windows or roof, mainly illuminated by natural light during the day and artificial light at night.

3.2 Illumination

3.2.1 Natural light

Natural light is the optical radiation produced by nature usually refers to the sunlight and the light diffused by the moon at night.

3.2.2 Artificial light

Artificial light is the optical radiation produced by manmade devices such as electric light sources.

3.2.3 Optical Radiation

Electromagnetic radiation at wavelengths between the region of transition to X-rays ($\lambda \approx 1$ nm) and the region of transition to radio waves ($\lambda \approx 1$ mm).

[CIE S 017:2020 ILV: International Lighting Vocabulary]

3.2.4 Spectrum

Display or specification of the monochromatic components of the radiation considered

NOTE 1 There are line spectra, continuous spectra, and spectra exhibiting both these characteristics.

NOTE 2 This term is also used for spectral efficiencies (excitation spectrum, action spectrum).

[CIE S 017:2020 ILV: International Lighting Vocabulary]

3.2.5 Photoperiod

Natural or artificial cycle of light and darkness to which living organisms may be exposed.

Broilers involved in a natural or artificial cycle in which day and night alternate.

NOTE: For example, the natural cycle of daylight at the equinox, the ratio of daylight duration ($L = 12$ h) to night duration is expressed as LD = 12:12.

[CIE S 017:2020 ILV: International Lighting Vocabulary]

3.2.6 Illuminance uniformity [U_o]

Ratio of minimum illuminance to average illuminance on a surface

Unit: 1

Equivalent term: “uniformity ratio of illuminance”

[CIE S 017:2020 ILV: International Lighting Vocabulary]

3.2.7 Flicker

Perception of visual unsteadiness induced by a light stimulus the luminance or spectral distribution of which fluctuates with time, for a static observer in a static environment.

NOTE: The fluctuations of the light stimulus with time include periodic and non-periodic fluctuations and can be induced by the light source itself, the power source or other influencing factors.

[CIE S 017:2020 ILV: International Lighting Vocabulary]

3.2.8 Flicker index

<of a [source](#) run on alternating current>

I_F

Quotient of the above-average luminous energy to the total luminous energy over a period of time.

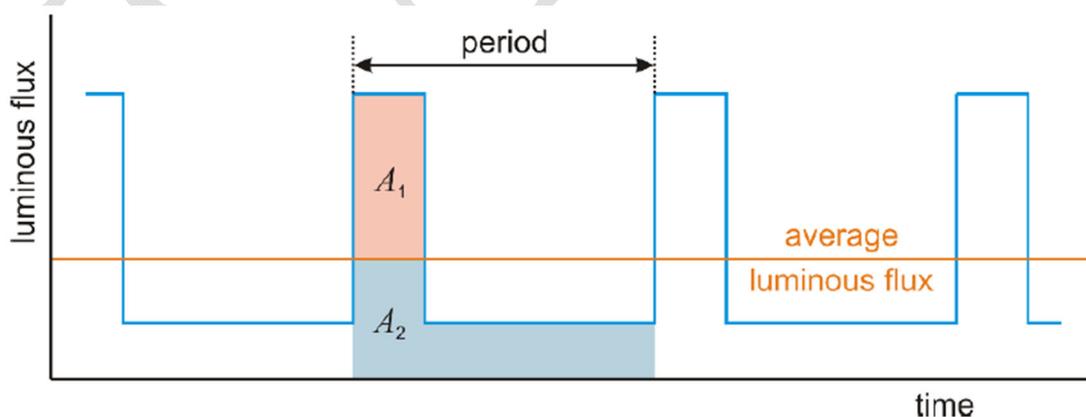
NOTE 1: The above-average luminous energy is the luminous energy calculated from the amount that the instantaneous luminous flux exceeds the average luminous flux. When the instantaneous luminous flux is less than the average luminous flux, the above-average luminous energy is zero, i.e. it does not add negatively.

NOTE 2: For the region under the curve of a graph of the instantaneous luminous flux versus time, the flicker index is equivalent to the ratio of the area above the average luminous flux to the total area. This is expressed mathematically as

$$I_F = \frac{A_1}{A_1 + A_2}$$

where A_1 is

the area above the average luminous flux and A_2 is the area below the average luminous flux as indicated in the following figure:



[CIE S 017:2020 ILV: International Lighting Vocabulary]

3.2.9 Lamp luminous flux maintenance factor [f_{LLM}]

Quotient of the luminous flux of a lamp at a given time in its operational life and the initial luminous flux

NOTE 1: The lamp luminous flux maintenance factor has unit one.

NOTE 2: Initial luminous flux of lamps is usually declared at 1 h for incandescent and 100 h for discharge lamps.

[CIE S 017:2020 ILV: International Lighting Vocabulary]

4 Classification of farming stages

Broiler farming is generally divided into two stages: from 0 to 2 weeks for posthatch period, from 3 weeks to the time of slaughter for growth period.

5 Technical requirements (general requirements for the light environment).

5.1 Spectra

Under the same illuminance, it is advisable to use light products with peak wavelength ranging from 415 nm to 560 nm, which is more favorable to promote the growth rate of broilers.

5.2 Illuminance

Under the artificial illumination mode, the average illumination should be 20 lx ~60 lx. If the chicks from young coops cannot reach the standard weight, the illumination can be increase 20 %~25 %.

Under the natural combined with artificial illumination mode, it is advisable to gradually reduce the illumination to 5 lx ~10 lx in the shading chicken house or semi-closed chicken house at the age of 5~10 days.

5.3 Photoperiod

Broiler farming photoperiod settings can refer to Table 1.

**Table 1: Reference for the photoperiod in broiler farming.
(Take white feather chicken as an example)**

Day age (days)	Slaughter weight less than 2.1 kg		Slaughter weight above 2.1kg	
	Lighting (hours)	Non-lighting (hours)	Lighting (hours)	Non-lighting (hours)
1~3	24	0	24	0
4~7	18	6	18	6
8~14	14	10	12	12
15~21	16	8	14	10
22~28	18	6	16	8
29~35	22	2	18	6
36~42	22	2	20	4
43~such	22	2	22	2

5.4 Illuminance uniformity

5.4.1 In the broiler coop, U_0 , the ratio of the minimum illuminance to the maximum, should not be less than 0.5.

5.4.2 In the broiler coop, U_1 , the ratio of the minimum illuminance to the average, should not be less than 0.7.

5.5 Flicker index

Stroboscopic value, the flicker frequency of the lighting products, in the chicken house should not be less than 300Hz.

Note: The visual sensitivity of poultry is 2 to 3 times that of the human eye, and the safety stroboscopic value of the human eye is over 100Hz.

5.6 Lamp luminous flux maintenance factor

Clean the lamps and the environment regularly. The maintenance factor should not be lower than 0.7.

6 Light environment indicator measurement method

6.1 Spectral distribution

Instrument: spectroradiometer

Direct measurement: Use a spectroradiometer to measure the spectrum of light emitted by LED lamps.

6.2 Illuminance

Instrument: Photometer

Direct measurement method: According to the size of the layout of the chicken coop and the positions of troughs and sinks, multiple monitoring points were set. 1 monitoring point was set for each trough and sink. The placement height of monitoring point r should be set according to the eye height of broilers at different growing periods or the bottom of the food trough. Special periods should be determined according to the actual situation.

6.3 Illuminance uniformity

Instrument: Photometer

Light uniformity U_0 = minimum illuminance value for broiler house troughs and water troughs / average illuminance value for broiler house troughs and water troughs

Light uniformity U_1 = minimum illuminance value for broiler house troughs and water troughs / maximum illuminance value for broiler house troughs and water troughs

Determination method: according to 6.1.2 method to measure the maximum illumination, minimum illumination, calculate the average illumination, to calculate the uniformity of light.

6.4 Flicker index

Equipment: flicker photometer

Measurement method: the application of direct measurement method, the LED lamp in the working condition, with the stroboscopic measuring instrument directly for the determination of stroboscopic value.

Appendix A

Evaluation of broiler farming results

A.1 Overview

The evaluation of broiler farming performance is not directly related to light conditions, but is influenced by multiple factors such as temperature, humidity, and immunity.

A.2 Broiler farming evaluation indicators

A.2.1 Survival rate

Survival rate = number of live animals listed / number of live animals entering the coop of the same batch x 100 %.

The annual survival rate should generally be not less than 95 %.

A.2.2 Feed conversion rate

Feed conversion rate= Chicken flock feed/ Chicken flock weight gain.

Different broiler breeds follow their requirements of feed conversion rate.