

#270

## Chapter Ind 19

## ILLUMINATION CODE

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**Ind 19.01 Application and scope.** This code sets forth the minimum lighting requirements for factories, offices, mercantile buildings and all outdoor work areas, theaters and assembly halls, schools and other places of instruction, apartment buildings, hotels and places of detention, and swimming pools. It applies to new construction, reconstruction of, and additions to, existing construction, and to changes in lighting. Existing lighting shall be made to comply with this code as may be directed by the industrial commission and within the time determined by the commission for each project.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.02 Design and installation.** All illumination equipment shall be designed and installed to provide the service and results required by this code.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.03 Definitions.** (1) **BRIGHTNESS, PHOTOMETRIC.** The luminous flux per unit of projected area per unit solid angle either leaving a surface at a given point in a given direction or arriving at a given point from a given direction; the luminous intensity of a surface in a given direction per unit of projected area of the surface as viewed from that direction.

(2) **CANDELA.** The candela (formerly candle) is the unit of luminous intensity. One candela is one-sixtieth of the intensity of one square centimeter of projected area of a black body radiator operating at the temperature of solidification of platinum.

(3) **DIFFUSED REFLECTION.** The process by which a portion of the incident flux is re-emitted in a non-image-forming (diffused) state.

(4) **DIRECT GLARE.** Glare resulting from high-brightness or insufficiently shielded light sources in the field of view.

(5) **EMERGENCY LIGHTING.** A lighting system designed to supply illumination essential to safety of life and property, in the event of failure of the normal supply.

(6) **EYE STRAIN.** A physiological condition of the eye resulting in discomfort, poor vision or fatigue.

(7) **FLUX.** The time rate of flow of light (luminous energy).

(8) **FOOTCANDLE.** The unit of illumination when the foot is the unit of length; the illumination on a surface one square foot in area on which is uniformly distributed a flux of one lumen. It equals one lumen per square foot.

(9) **FOOTLAMBERT.** The unit of photometric brightness (luminance) equal to .3183 candela per square foot. A theoretical perfectly diffusing surface emitting or reflecting flux at the rate of one lumen per square foot would have a photometric brightness of one footlambert in all directions. No actual surface completely fulfills this condition.

*Note:* One candela per square inch equals 452 foot lamberts.

(10) **GLARE.** The effect of brightness or brightness difference within the visual field sufficiently high to cause annoyance, discomfort, or loss in visual performance.

(11) **ILLUMINATION.** The density of luminous flux incident on a surface; the quotient of the flux divided by the area of the surface, when the flux is uniformly distributed.

(12) **ILLUMINATION AT THE WORK.** The illumination of or at the important plane or planes of the actual visual task.

*Note:* The work plane is normally considered to be 30 inches above the floor.

(13) **LUMEN.** The unit of luminous flux; equal to the flux emitted through a unit solid angle (one steradian) from a uniform source of one candela.

(14) **LUMINAIRE.** A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

(15) **MATTE SURFACE.** A surface from which the reflection is predominantly diffuse, with or without a negligible specular component.

(16) **GENERAL LIGHTING.** Lighting units installed above ordinary head level to secure a general illumination over a considerable area.

(17) **PHOTOMETER.** An instrument suitable for making illumination measurements.

(18) **REFLECTANCE.** The ratio of the flux reflected by a surface or medium to the incident flux, expressed in percent.

(19) **REFLECTED GLARE.** Glare resulting from spectacular reflections of high brightness sources on polished surfaces in the field of view.

(20) **SHADED.** Condition in which the lamp is equipped with a reflector, shade, enclosing globe, or other accessory for reducing the brightness in certain directions, or otherwise altering or changing the distribution of light from the lamp.

(21) **SHIELDING.** Refers to those portions of a luminaire which serve to screen out the light source and minimize glare from normal angles of vision.

(22) **SUPPLEMENTARY LIGHTING.** Lighting used to provide a specific amount or quality of illumination which cannot readily be obtained by the general lighting system, and which supplements the general lighting system.

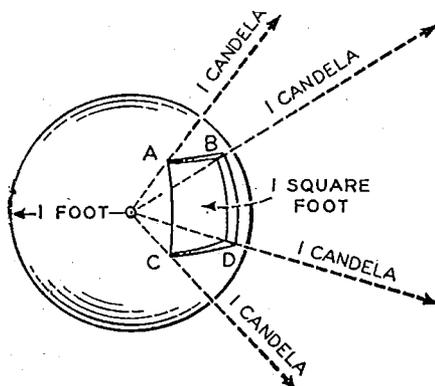


Figure D-1. Relationship between candelas, lumens and footcandles. A uniform point source (luminous intensity or candlepower = 1 candela) is shown at the center of a sphere of 1-foot radius. It is assumed that the sphere is perfectly transparent (*i.e.*, has 0 reflectance). The illumination at any point on the sphere is 1 footcandle (1 lumen per square foot). The solid angle subtended by the area, A, B, C, D is 1 steradian. The flux density is, therefore, 1 lumen per steradian, which corresponds to a luminous intensity of 1 candela, as originally assumed. The sphere has a total area of 12.57 ( $4\pi$ ) square feet, and there is a luminous flux of 1 lumen falling on each square foot. Thus the source provides a total of 12.57 lumens.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

## PART A

### GENERAL

**Ind 19.04 Illumination at the work.** Electric illumination at the work in all occupancies covered by this code shall be provided and maintained in accordance with the minimum values shown in the following table unless specifically covered elsewhere in this code.

Areas	Minimum maintained illumination, footcandles
(1) Stairways, washrooms and other service areas, and public toilets .....	10
(2) Hallways, corridors, passageways, storage and other casual seeing areas .....	5
(a) <i>Exception.</i> Hallways and corridors in dwelling-type occupancies .....	2.5

**Note 1:** Refer to the current I. E. S. Lighting Handbook for recommended illumination intensities.

**Note 2:** The measurements of illumination are to be made at the work with a properly standardized portable color and cosine corrected photometer.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64; cr (2) (a), Register, February, 1965, No. 110, eff. 3-1-65.

**Ind 19.05 Distribution of light.** The reflectors or other accessories, mounting height and spacing employed with lamps for general illumination shall be such as to secure a maximum ratio of highest level to lowest level of general illumination at the work plane of 4 to 1, avoiding objectionable shadow and sharp contrast of brightness. Where

local lighting is used, the general level of illumination shall be not less than  $\frac{1}{2}$  the local level, with both systems operating, measured at the seeing task.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64; am. Register, February, 1965, No. 110, eff. 3-1-65.

## PART B

### FACTORIES, OFFICES, MERCANTILE BUILDINGS AND ALL OUTDOOR WORK AREAS

**Ind 19.06 Illumination at the work.** Electric illumination at the work in factories, offices, mercantile buildings and all outdoor work areas shall be supplied and maintained in accordance with the minimum values shown in the following table.

Tasks and Areas	Minimum maintained illumination, footcandles
(1) VERY DIFFICULT SEEING TASKS ----- Such as: fine assembly, precision grading, high-speed work, fine finish- ing, drafting.	75
(2) DIFFICULT AND CRITICAL SEEING TASKS ----- Such as: ordinary bench work and assembly, machine shop work, finish- ing of medium-to-fine parts, office work, store merchandising areas.	30
(3) ORDINARY SEEING TASKS ----- Such as: automatic machine operation, rough grinding, garage work areas, continuous processes, conference and file rooms, packing and shipping.	20
(4) ACTIVE OUTDOOR WORK AREAS -----	5

**Note:** Refer to the notes following the table in section Ind 19.04.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64; am intro. par., Register, February, 1965, No. 110, eff. 3-1-65.

## PART C

### THEATERS AND ASSEMBLY HALLS

**Ind 19.07 Illumination levels.** Electric illumination in theaters and assembly halls shall be supplied and maintained in accordance with the minimum values shown in the following table. The illumination shall be measured at a plane 30 inches above the floor unless otherwise noted.

Areas	Minimum maintained illumination, footcandles
(1) ART GALLERIES -----	15
(2) AUDITORIUMS	
Assembly -----	10
Exhibition -----	20
Social activities -----	5
(3) CHURCHES	
Choir and chancel area -----	15
Main worship area -----	10

(4) DANCE HALLS AND TAVERNS .....	1½
(5) RESTAURANTS	
Intimate type (See Note 2) .....	3
Leisure type (See Note 3) .....	10
Kitchens	
Active work areas .....	50
Other areas .....	30
(6) THEATERS AND MOTION PICTURE HOUSES	
Auditorium during intermission .....	5
Auditorium during picture	
(measured at aisle floor level) .....	0.1
Lobby .....	15

*Note 1:* Refer to the notes following the table in section Ind 19.04.

*Note 2:* Intimate type restaurants are considered to be areas where people congregate as much to visit and to be entertained as to eat and drink.

*Note 3:* Leisure type restaurants are considered to be areas where eating is leisurely, but where time is also important.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

## PART D

### SCHOOLS AND OTHER PLACES OF INSTRUCTION

**Ind 19.08 Character of lighting to be supplied.** (1) The illumination at the work received from the general lighting shall in no case be less than the intensities set forth in Wis. Adm. Code section Ind 19.09.

(2) Where supplementary lighting is used in combination with general lighting, particular care shall be exercised to eliminate glare at other points in the room. Adequate shielding and careful adjustment of the direction shall be provided to minimize both direct and reflected glare. See Wis. Adm. Code section Ind 19.05.

*Note:* The design and operation of an effective visual environment involves more than achieving high lighting levels and compliance with a code. The current American Standard Guide for School Lighting, sponsored by the American Institute of Architects, Illuminating Engineering Society, and the National Council on School House Construction sets forth the desirable goals and procedure in attaining a good visual environment. It represents an effective supplement to this code for school boards and educators as well as architects, engineers, and others designing school lighting systems. The guide is available through the Illuminating Engineering Society, 345 East 47th Street, New York 17, New York.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.09 Illumination at the work.** Electric illumination at the point of work in rooms and spaces of school buildings shall be supplied and maintained in accordance with the minimum values shown in the following table:

Rooms or Space to be Illuminated	Minimum maintained illumination, footcandles
(1) CLASSROOMS. All spaces used for study or instruction except (3) .....	50
(2) DRAFTING, TYPING, SEWING AND LIP READING ROOMS .....	75

(3) GYMNASIUMS AND CAFETERIAS ----- 30

(4) SHOPS. Vocational training and industrial arts ----- 75

*Note:* Refer to the notes following the table in Wis. Adm. Code section Ind 19.04.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.10 Shielding of lamps.** Light sources shall be provided with suitable shielding either as a component of the luminaire or as a structural element, so that occupants will be protected from direct glare.

*Note:* Refer to the current I. E. S. Lighting Handbook and American Standard Guide for School Lighting for other shielding recommendations.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.11 Distribution of light.** Luminaires or luminous ceilings shall be so installed in regard to mounting height, location and spacing as to provide uniform distribution of illumination at the work.

*Note:* This does not apply to toilet rooms, cloak rooms, store rooms, boiler rooms and other spaces devoted to similar purposes.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.12 Diffusion of light.** Luminaires shall be so installed in regard to mounting height, location and spacing as to avoid sharply defined and deep shadows from overhanging structural parts or persons in normal working positions.

*Note 1:* This section does not apply to toilet rooms, cloak rooms, store rooms, boiler rooms and other spaces devoted to similar purposes.

*Note 2:* Deep shadows interfere with work in the shaded area and are a strain on the eyes. In general, some shadows may be present; in fact they aid in observing objects in three dimensions but they should be soft and luminous.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.13 Daylighting.** All daylight sources in spaces used for educational purposes shall be provided with an effective means of brightness control.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.14 Finish of walls and ceilings.** Walls and ceilings of all instruction and study spaces shall be finished with a matte (dull) or semi-matte surface.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

PART E

APARTMENT BUILDINGS, HOSPITALS, HOTELS AND PLACES OF DETENTION

**Ind 19.15 Illumination levels.** Electric illumination in apartment buildings, hotels and places of detention shall be supplied and maintained in accordance with the minimum values shown in the following table. The illumination shall be measured on a plane 30 inches above the floor.

Areas	Minimum maintained illumination, footcandles
(1) APARTMENT BUILDINGS AND HOTELS	
Lobbies and waiting rooms -----	5

(2) PLACES OF DETENTION, HOSPITALS AND  
SIMILAR OCCUPANCIES

Lobbies and waiting rooms .....	15
Nurseries, private rooms and wards .....	10
Examination rooms, laboratories and offices .....	50

*Note:* Refer to the notes following the table in Wis. Adm. Code section Ind 19.04.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

## PART F

## SWIMMING POOLS

Ind 19.16 **Illumination levels.** Electric illumination of swimming pools shall be provided and maintained in accordance with the minimum values shown in Wis. Adm. Code subsections Ind 19.16 (1) (a), (1) (b), (2) (a), or (2) (b). Submarine lighting is optional. The illumination shall be measured at the water level.

## (1) INDOOR POOLS

(a) *With submarine lighting*

1. General overhead .....	10 footcandles
2. Submarine .....	30 lamp lumens per square foot

(b) *Without submarine lighting*

1. General overhead .....	20 footcandles
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(2) OUTDOOR POOLS (WHEN USED  
AFTER DAYLIGHT HOURS)(a) *With submarine lighting*

1. General overhead .....	2 footcandles
2. Submarine .....	20 lamp lumens per square foot

(b) *Without submarine lighting*

1. General overhead .....	5 footcandles
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*Note 1:* Refer to Note 2 following the table in Wis. Adm. Code section Ind 19.04.

*Note 2:* Refer to Wis. Adm. Code Ch. E 680, in Volume 2, Wisconsin State Electrical Code, for wiring requirements of underwater lighting.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

Ind 19.17 **Distribution of light.** Luminaires shall be so installed in regard to location and spacing as to provide uniform distribution of illumination.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

## PART G

## EMERGENCY LIGHTING

Ind 19.18 **Exit signs.** Illuminated exit signs shall be located as required by Wis. Adm. Code Chs. 50-59, Wisconsin State Building Code.

*Note:* See Wis. Adm. Code subsections, Ind 51.15 (5), Ind 54.06 (2), and sections Ind 55.11, Ind 56.08 and Ind 57.11.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.19 Emergency supply systems.** All illuminated exit signs and other required emergency lighting luminaires or units shall be supplied from an emergency supply system recognized by Wis. Adm. Code Ch. E 700, Wisconsin State Electrical Code.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.20 Emergency wiring.** All wiring to illuminated exit signs and other required emergency lighting luminaires or units shall be installed in accordance with the appropriate sections of Wis. Adm. Code Ch. E 700, Wisconsin State Electrical Code.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.21 Spaces requiring emergency lighting.** Emergency lighting other than exit signs shall be required in the following areas of buildings:

- (1) Theaters and assembly halls except church naves, with lobbies serving same, and public indoor swimming pools and dressing rooms.
- (2) Halls, corridors, stairways and other means of egress from areas specified in Wis. Adm. Code subsection Ind 19.21(1).
- (3) Halls, corridors, stairways, passageways, work aisles and other means of egress from factories, offices and mercantile buildings, and apartment buildings, hotels and places of abode or detention.

**Note 1:** The requirements of this section apply only when a standby emergency supply is required for the particular area by Wis. Adm. Code Ch. E 700, Wisconsin State Electrical Code. Refer to the notes following sections E 700.09 and E 700.10, electrical code.

**Note 2:** It is recommended that an emergency light be placed over the exterior of required exits.

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64.

**Ind 19.22 Required intensity of emergency lighting.** (1) Where fixed luminaires supplied from a generator or storage battery, other than unit equipments, provide the emergency lighting, the maximum distance between adjacent luminaires shall not exceed 50 feet and the minimum total operating lamp load after ½ hour of emergency operation shall be:

(a) One-tenth (0.1) watt per square foot of floor area for those spaces specified in Wis. Adm. Code subsection Ind 19.21(1).

(b) Two-tenths (0.2) watt per square foot of floor area for those spaces specified in Wis. Adm. Code subsections Ind 19.21(2) and Ind 19.21(3).

(2) Where spot type emergency lighting units supplied from unit equipments provide the emergency lighting, the maximum distance between adjacent lighting units shall not exceed 100 feet. The projectors shall be directed towards the exits and located to provide distribution of light over the entire floor area. Glare and sharp shadows shall be held to a minimum. The minimum total operating lamp load after ½ hour of emergency operation shall be:

(a) Two and one-half hundredths (0.025) watt per square foot of floor area for those spaces specified in Wis. Adm. Code section Ind 19.21(1).

(b) Five hundredths (0.05) watt per square foot of floor area for those spaces specified in Wis. Adm. Code sections Ind 19.21(2) and Ind 19.21(3).

**History:** Cr. Register, August, 1964, No. 104, eff. 9-1-64; am (2) (a) and (b), Register, February, 1966, No. 110, eff. 3-1-66.

Register, October, 1970, No. 178  
Illumination