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**Luminaires — Part 5: Gonio-photometric
methods**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Lighting Manufacturers Association (JLMA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS C 8105-5:2014**), which has been technically revised.

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JIS C 8105 series consists of the following 23 parts under the general title *Luminaires* — :

- Part 1 : General requirements for safety*
- Part 2-1 : Particular requirements for safety — Fixed general purpose luminaires*
- Part 2-2 : Particular requirements for safety — Recessed luminaires*
- Part 2-3 : Particular requirements for safety — Luminaires for road and street lighting*
- Part 2-4 : Particular requirements for safety — Portable general purpose luminaires*
- Part 2-5 : Particular requirements for safety — Floodlights*
- Part 2-6 : Particular requirements for safety — Luminaires with built-in transformers or converters for filament lamps*
- Part 2-7 : Particular requirements for safety — Portable luminaires for garden use*
- Part 2-8 : Particular requirements for safety — Handlamps*
- Part 2-9 : Particular requirements — Photo and film luminaires (non-professional)*
- Part 2-11 : Particular requirements — Aquarium luminaires*
- Part 2-12 : Particular requirements — Mains socket-outlet mounted night lights*
- Part 2-13 : Particular requirements for safety — Ground recessed luminaires*
- Part 2-14 : Particular requirements — Luminaires for cold cathode tubular discharge lamps (neon tubes) and similar equipment*
- Part 2-17 : Particular requirements for safety — Luminaires for stage lighting, television, film and photographic studios (outdoor and indoor)*
- Part 2-19 : Particular requirements for safety — Air-handling luminaires*
- Part 2-20 : Particular requirements for safety — Lighting chains*
- Part 2-21 : Particular requirements for safety — Rope lights*
- Part 2-22 : Particular requirements — Luminaires for emergency lighting*
- Part 2-23 : Particular requirements — Extra low voltage lighting systems for filament lamps*
- Part 2-24 : Particular requirements — Luminaires with limited surface temperatures*
- Part 3 : General requirements for performance*
- Part 5 : Gonio-photometric methods*

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Luminaires — Part 5 : Gonio-photometric methods

1 Scope

This Japanese Industrial Standard specifies the methods for measuring the luminous intensity distributions and luminous flux of general purpose luminaires incorporating electric light sources (incandescent lamps, fluorescent lamps, other discharge lamps and electroluminescent devices such as an LED).

If a specific luminaire product standard specifies other measurement methods than given in this Standard, those methods shall apply.

The “general purpose luminaires” for the purpose of this scope do not include the following. However, this Standard may be applied to luminaires or light sources other than general purpose luminaires where applicability is recognized.

- a) Luminaires used underwater
- b) Luminaires for emergency exit sign in accordance with the Fire Service Act
- c) Luminaires for takeoff and landing of airplanes and obstacle light luminaires

2 Normative references

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 1102-2 *Direct acting indicating analogue electrical measuring instruments and their accessories Part 2 : Special requirements for ammeters and voltmeters*

JIS C 1102-3 *Direct acting indicating analogue electrical measuring instruments and their accessories Part 3 : Special requirements for wattmeters and varmeters*

JIS C 1609-1 *Illuminance meters Part 1 : General measuring instruments*

JIS C 7801 *Measuring methods of lamps for general lighting*

JIS C 8105-3 *Luminaires — Part 3 : General requirements for performance*

JIS Z 8113 *Lighting vocabulary*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions, and those given in JIS Z 8113, JIS C 8105-3 and JIS C 7801 apply.

3.1

rated input voltage

voltage applied to a luminaire when the luminaire is used under the condition specified by the manufacturer or responsible vendor (hereafter referred to as the manufacturer etc.) or voltage between both input terminals declared by the manufacturer etc. when the rated input current is applied to the luminaire

Note 1 to entry It is expressed in volts (V).

Note 2 to entry The “manufacturer etc.” for the purpose of this Standard is a person similar to the “Notifying Supplier” stipulated in the Electrical Appliances and Materials Safety Act and refers to the manufacturer or the vendor (wholesaler etc.) who is engaged in importing of goods in Japan.

Note 3 to entry The “manufacturer etc.” in this Standard is equivalent to the “manufacturer or responsible vendor” specified in **IEC 62560** etc.

3.2

rated input current

electric current applied to a luminaire when the luminaire is used under the condition specified by the manufacturer etc., or electric current declared by the manufacturer etc. that flows in the luminaire when a rated input voltage is applied to it

Note 1 to entry It is expressed in amperes (A).

3.3

rated electric power consumption

electric power consumed by a luminaire when the rated input voltage or rated input current is applied to it under the condition specified by the manufacturer etc., or electric power declared by the manufacturer etc. that enters the luminaire when it is operated

Note 1 to entry It normally includes the loss of a controlgear. It is expressed in watts (W).

3.4

total luminous flux (of a luminaire)

total sum of luminous flux emitted in all directions by a luminaire

Note 1 to entry It is expressed in lumens (lm).

3.5

controlgear

device consisting of one or more separate components and has functions such as transformation of supply voltage, control of electric current supplied to the light source, power factor correction and radio interference suppression

It is used in combination with a luminaire to drive a light source.

3.6

reference axis

virtual axis used as a reference direction for the goniophotometry of a luminaire

Note 1 to entry It is normally determined by the relation between the structure of the luminaire and the mounting condition of the luminaire.

3.7

photometric centre

point on the reference axis, assumed to be the origin of light that diverges from a luminaire

Note 1 to entry It refers to the point that can be most closely approximated to the inverse-square law in the direction of maximum luminous intensity.

3.8

luminous intensity distributions

change or distribution of luminous intensity or relative luminous intensity as a function of the angle, which represents part of optical characteristics of a luminaire

Note 1 to entry It is expressed in candelas (cd) for luminous intensity, and in candelas per 1 000 lumen (cd/1 000 lm) for relative luminous intensity.

3.9

light-emitting surface

surface that radiates luminous flux in a luminaire

Note 1 to entry It refers to the opening face of the front side or the translucent cover face attached to the opening face of a luminaire.

3.10

field

area that constitutes an electronic file format

Note 1 to entry See Annex D for details of electronic file format.

3.11

maximum luminous intensity

largest luminous intensity in luminous intensity distributions

Note 1 to entry It is expressed in candelas (cd).

3.12

axial luminous intensity

luminous intensity in the reference axis direction

Note 1 to entry It is expressed in candelas (cd).

3.13

beam spread

angle between two directions in which luminous intensity becomes 50 % of maximum luminous intensity, or two directions in which luminous intensity becomes 10 % of maximum luminous intensity in the luminous intensity distributions of the plane including the reference axis

Note 1 to entry It is expressed in degrees (°).

3.14

beam angle

angle between two directions in which luminous intensity becomes 50 % of axial luminous intensity, or two directions in which luminous intensity becomes 10 % of axial luminous intensity in the luminous intensity distributions of the plane including the reference axis

Note 1 to entry It is expressed in degrees (°).

3.15

beam flux

luminous flux included in the solid angle formed by a virtual cone of which the vertex is the photometric centre, the reference axis is the rotation axis and the vertex angle is the beam spread

Note 1 to entry It is expressed in lumens (lm).

3.16

zonal luminous flux

luminous flux included in the spherical zone formed by two vertical angles in the polar coordinate in which the photometric centre is taken as the origin

Note 1 to entry It is expressed in lumens (lm).

3.17

partial luminous flux

luminous flux included in the solid angle formed by a virtual cone of which the vertex is the photometric centre, the reference axis is the rotation axis and the vertex angle is specified

Note 1 to entry It is expressed in lumens (lm).

Note 2 to entry It may be also called cumulative luminous flux.

3.18

luminous intensity conversion factor

factor by which the output of a goniophotometer is multiplied for conversion to luminous intensity

Note 1 to entry It may be expressed in candelas per lux (cd/lx), candelas per voltage (cd/V), candelas per ampere (cd/A), etc. depending on the type of output of the goniophotometer.

4 Calibration of goniophotometer

4.1 General

Different goniophotometers may have different photo detector outputs depending on their structure, the photo detector they employ, etc. It is therefore necessary to determine the luminous intensity conversion factor prior to measurement. For this determination, the method specified in Annex A may be used. The measurement standard to be used shall be as specified in 4.2. The scale of the measurement standard shall be traceable to a national standard.

NOTE Traceability to a national standard is ensured mainly through calibration by a calibrating agency (registered calibrator) complying with the requirements of Japan Calibration Service System (JCSS) based on the Measurement Act.

4.2 Measurement standard

One of the following shall be used as a measurement standard for determination of luminous intensity conversion factor. When using a standard light source, the same lighting conditions as have been applied for the calibration shall be used.

- a) Photo detector specified in 5.3 having an illuminance scale
- b) Luminous intensity standard light source
- c) Total luminous flux standard light source

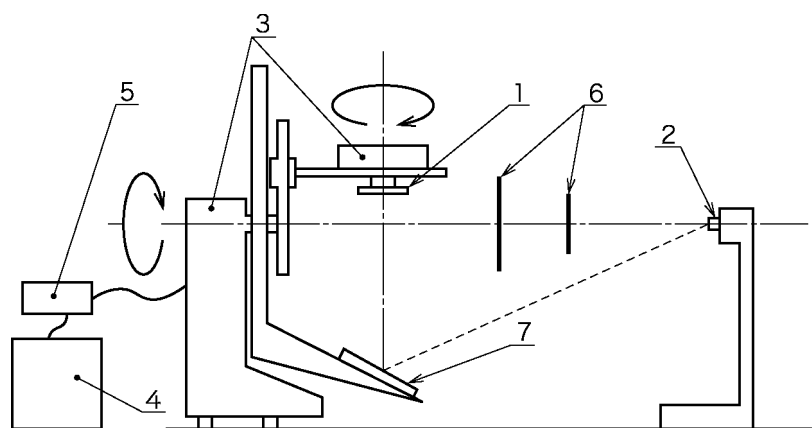
If the goniophotometer has a plane mirror on the measurement optical path, **b)** or **c)** should be used. The standard lamp of luminous intensity specified in **JIS C 7526** may be used as the luminous intensity standard light source.

5 Requirements for goniophotometers

5.1 General

The goniophotometer generally consists of a rotation mechanism, a photo detector, a mount holder for luminaire, a power supply, a controlgear, electric instruments, electric circuits and other components. An example of a goniophotometer is shown in Figure 1. The goniophotometer shall satisfy the requirements for individual components as given in 5.2 to 5.7. The coordinate systems to be used for goniophotometry shall be in accordance with Annex B.

A goniophotometer which rotates or changes the orientation of the luminaire during measurement may only be used if these movements do not substantially affect the luminous intensity distributions of the luminaire.



Key	
1 : mount holder for luminaire	5 : control gear
2 : photo detector	6 : baffle
3 : rotation mechanism	7 : plane mirror
4 : power supply	

Figure 1 Example of goniophotometer

5.2 Rotation mechanism

The rotation mechanism rotates a luminaire, photo detector, plane mirror, etc. around the axis for the goniophotometry of the luminaire, and shall be as follows.

- The rotation mechanism shall be structured so that rotational irregularity, vibration, eccentricity, axis deviation, etc. do not occur.
- When the goniophotometer has two or more rotation mechanisms, two axes, one horizontal and one vertical, determined by the rotation mechanism shall intersect each other at right angles.
- The rotation mechanism shall have a reproducibility of vertical and horizontal angles that is within 1° for vertical angle and 2° for horizontal angle, or within $1/5$ of the measurement angular intervals specified in 6.6, whichever is the smaller.

For the verification of the angle reproducibility in a rotation mechanism, the value of the angle sensor (rotary encoder etc.), or the value stated in the specifications etc. of the goniophotometer may be used.

5.3 Photo detector

The photo detector generally consists of a photoelectric detector that converts light of a luminaire into quantity of electricity, an electronic amplifier and an AD converter, and shall be either **a)** or **b)** with an angular aperture (angle subtended at the light-receiving surface by the photometric centre) smaller than the measurement angular interval specified in 6.6.

- Class AA or better general type illuminance meter specified in **JIS C 1609-1**
- Customized photometer that is equivalent to the general type Class AA illuminance meter in terms of linearity and visible range relative spectral responsivity

characteristics specified in **JIS C 1609-1**, and is equivalent to the general type Class AA illuminance meter in the range of the angle subtended at the luminaire in terms of cosine response ¹⁾.

Note ¹⁾ For the example of the cosine response, see Informative table 1 in **JIS C 1609-1**.

Instead of using an illuminance meter or a photometer, a spectrophotometer meeting the conditions specified in **JIS Z 8724** as well as the performance requirement in **b)** may be used as a photo detector.

For the performance evaluation of a photo detector, respective evaluation methods specified in **JIS C 1609-1** for the photo detector reference surface of the illuminance meter, polarization property, uniformity of responsivity on light-receiving surface, response time or light modulation may be used. For example, for the response characteristics of rippling light, the evaluation method of light modulation may be used.

5.4 Mount holder for luminaire

The mount holder for luminaire is used for mounting and lighting a luminaire, and shall be as follows.

- a) The mount holder for luminaire shall be free from perceivable shakes or vibration during measurement, and have such a mounting structure that the mounted luminaire is free from shakes or vibration.
- b) The mount holder for luminaire shall be of the smallest size where it does not intercept the light of measurement angular range or emit scattering light that may affect the measurement.
- c) Fixing of a luminaire to the mount holder for luminaire shall use a method that does not affect the luminaire temperature.

5.5 Power supply and controlgear

The power supply and controlgear shall be as given in Table 1.

Table 1 Power supply and controlgear

Measurement device	Required performance
Stabilized DC power supply	The voltage fluctuation shall be within 0.1 % of the test voltage.
Stabilized AC power supply	- The voltage fluctuation shall be within 0.5 % of the test voltage. - The frequency fluctuation shall be within 0.2 % of the frequency of the test voltage. - The total harmonic content ^{a)} shall be within 3 % of fundamental.
Controlgear	- The voltage ripple ^{b)} of a stabilized DC power supply shall be within 5 % of the average voltage value when the luminaire with a current control function is tested. - The current ripple ^{b)} shall be within 5 % of the average current value when the luminaire without a current control function is tested. - The connection for the luminaire with a separately installed controlgear shall be performed in accordance with the method specified by the manufacturer etc.
Note ^{a)} The total harmonic content is taken as the ratio of the effective value of summation of the individual harmonic components contained in the supply voltage to the effective value of fundamental. It is expressed in percentage (%). Note ^{b)} The ripple of voltage and current is taken as the ratio of the difference between the maximum and the minimum of the waveform of voltage or current to the effective value of voltage or current. It is expressed in percentage (%).	

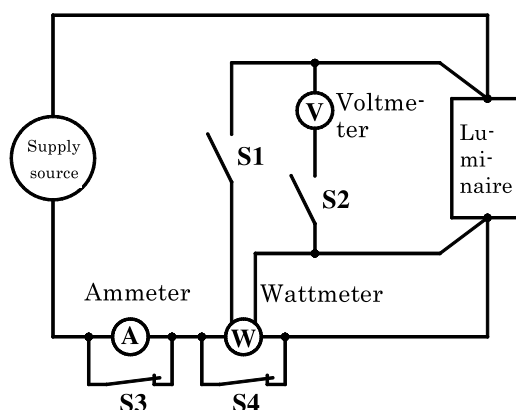
5.6 Electric instruments and electric circuits

The electric instruments and electric circuits shall be as given in Table 2. Examples of electric circuits to measure electric characteristics (input voltage, input current and input power) are shown in Figure 2.

The terminal for voltage measurement, aside from a lighting circuit, should be directly connected to a lampholder, the input terminal of a luminaire, etc.

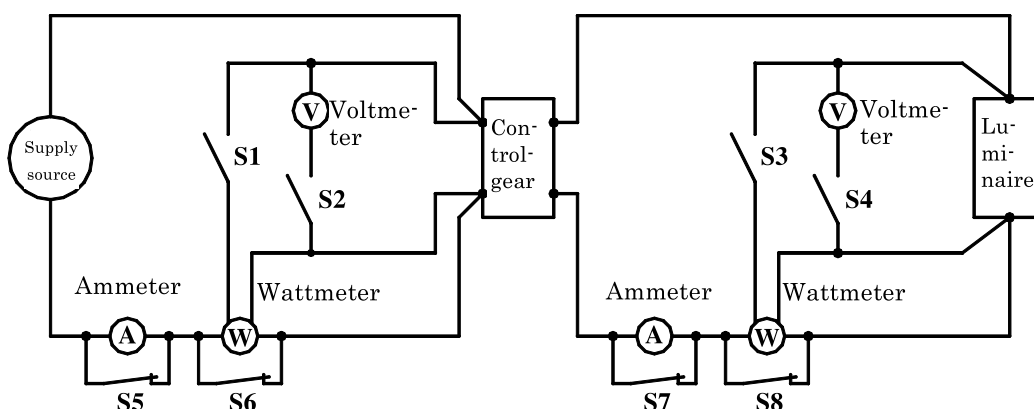
Table 2 Electric instruments and electric circuits

Measurement device	Required performance
Electric instrument	- The electric instrument shall be a direct acting electric indicating meter with a class index of 0.5 or better specified in JIS C 1102-2 or JIS C 1102-3, or a digital instrument with an accuracy equivalent or superior to this. - The total of electric current that flows into the instrument connected in parallel with the input terminal etc. of the luminaire shall be within 3 % of the rated input current, and the sum of voltage drop by the instrument connected in series shall be within 2 % of the rated input voltage. - The instrument using AC shall be an instrument that measures and indicates the effective values.
Electric circuit	The connecting conductor and the conductor of a lighting circuit used shall have sufficient current capacity.



Switching operation is performed for each measuring instrument.
At the time of measurement, S1 and S2 are turned on, and S3 and S4 are turned off.

a) Luminaire with built-in controlgear



Switching operation is performed for each measuring instrument.
At the time of measurement, S1 to S4 are turned on, and S5 to S8 are turned off.

b) Luminaire without built-in controlgear

Figure 2 Example of measurement circuit diagram of electric characteristics of luminaire

5.7 Other components

Other components shall be as follows.

- Wiring** Wiring from a luminaire to a controlgear shall be given at a location where it does not obstruct the light of the luminaire.
- Monitor detector** A monitor detector which corrects the light output fluctuation, if used, shall have small temporal change and temperature fluctuation, and be installed in a location where it does not interfere with operation and measurement of the goniophotometer.
- Baffle** A baffle to suppress the effect of stray light, if used, shall be installed at a suitable location between the luminaire and the photo detector [or a monitor detector described in b)].

- d) **Plane mirror** The plane mirror shall be flat, and free from scratches on the surface that may affect the measurement.

It should have a uniform reflectance in the visible wavelength region.

6 Measurement parameters

6.1 General

The measurement parameters of luminous intensity distributions shall be in accordance with 6.2 to 6.6. Where other conditions are specified by the measurement client or the manufacturer etc., those conditions shall apply.

6.2 Environment of test room

The environment of a test room shall be as follows.

- a) The test room shall be substantially free from draughts during measurements.
- b) The test room shall be under relative humidity of not more than 75 %, and free from electrostatic disturbance.
- c) The ceiling, walls, floor, etc. of the test room shall be given a coating of lusterless black paint or other treatment to minimize the reflection from surroundings and to prevent the influence of stray light.
- d) The test room shall be free from vibration from its surroundings that may affect the measurement. Care should also be taken that the goniophotometer, while in operation, does not give the luminaire a vibration that may affect the measurement results.

6.3 Ambient temperature of luminaire

The ambient temperature of the luminaire shall be as follows.

- a) The temperature in the ambience of measurement, or the temperature of the moving range of the luminaire if the goniophotometer moves the luminaire during measurement, shall be as given in Table 3.
- b) The measurement point of ambient temperature shall be at a distance of 0.5 m to 2 m from the end of the luminaire on the horizontal plane passing through the photometric centre. The sensor of the thermometer shall not be directly subjected to light irradiation of the luminaire.

NOTE In the case of a luminaire for electroluminescent devices such as an LED, the manufacturer etc. may specify the temperature condition at a specific location regardless of ambient temperature.

Table 3 Ambient temperature

Unit: °C	
Types of light source	Ambient temperature
Incandescent lamp, HID lamp, low-pressure sodium lamp	20 to 30
Other lamps	23 to 27