Czech Metrology Institute

Okružní 31, 638 00

Brno

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Executive summary for EC (not part of this legal regulation)

Lux metres are placed on the market and put into use in the Czech Republic as specified measuring instruments following type approval and initial validation in accordance with Act No 505/1990 on metrology. The subject of this notified legislation is national metrological regulation of instruments for measuring illuminance via type approval and validation.

This regulation sets forth the metrological level required for the certificates of type approval and verification of measuring instruments issued abroad to be recognised.

(End of executive summary.)

Ref. No: 0313/043/14/Pos.

Compiled by: Engineer Miroslav Pospíšil

Telephone: 545 555 135, -131

As the authority with material and territorial jurisdiction in the establishment of metrological and technical requirements for a specified measuring instrument and the establishment of testing methods for type approval and validation of a specified measuring instrument in accordance with § 14(1) of Act No 505/1990 on metrology, as amended (hereinafter the "Metrology Act"), and in accordance with §§ 172 et seq. of Act No 500/2004, the Code of Administrative Procedure, as amended (hereinafter the "CAP"), initiated ex officio, on 23 June 2014, an administrative procedure pursuant to § 46 of the CAP, as well as on the basis of documentation, the Czech Metrological Institute (hereinafter "CMI"), hereby issues the following:

I.

G E N E R A L M E A S U R E

number: 0111-OOP-C043-14

Reference No 0313/005/14/Pos.,

establishing metrological and technical requirements for specified measurement devices, including testing methods for the type approval and verification of the specified measurement instruments:

"lux metres"

1 Basic definitions

The terms and definitions pursuant to the VIM and VIML[1] as well as the terms and definitions specified in the following shall apply for the purposes of this General Measure:

1.1 lux metre

is a device for measuring illuminance composed of an optical radiation detector and an electronic unit which converts the detector's signal into a value which characterises the radiation incident on the detector.

NOTE: a lux metre is a special type of integral radiometer in which the detector part has a relative spectral responsivity corresponding to effective weighting function $V(\lambda)$.

1.2 photoelectric transducer

converts radiation in the visible range of the spectrum from 380 nm to 830 nm into an electrical signal using external or internal photoelectric effect.

1.3 radiation of CIE standard illuminant A

is black-body radiation at a temperature 2 856 K.

1.4 photopic vision

is the daylight vision conveyed via the retinal cones with which it is possible to discern colours; develops when the eye adapts to radiance greater than 3 cd × m^{-2}

NOTE: the spectral responsivity of radiation transducers in the case of photopic vision is defined by the function $V(\lambda)$. The function $V(\lambda)$ is a conventional function and is depicted in tabular form.

1.5 relative spectral sensitivity / relative spectral responsivity $s_{rel}(\lambda)$

is the proportion of radiant flux at wavelength λ_m to the value of the radiant flux at wavelength λ which actuates perception in the human eye under defined conditions.

NOTE λ_m = 555 nm is the wavelength at which the spectral responsivity of the average human eye is at its maximum in photopic vision.

1.6 integral characteristic f_1'

describes the suitability of a detector's spectral adaptation to the required spectral weighting function $V(\lambda)$.

1.7 directional error of lux metre

is an error caused by inaccurate evaluation of the effects of light incident on the photometric head from a non-perpendicular direction.

1.8 linearity

is property of a detector based on which the output variable is directly proportional to the input variable; a deviation from linearity is non-linearity.

1.9 temperature dependence

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[1]) International vocabulary of metrology – Basic and general concepts and associated terms (VIM) and International Vocabulary of Terms in Legal Metrology (VIML) are part of the technical harmonisation compendium "Terminology in the Area of Metrology", which is publicly accessible at www.unmz.cz

is the change in responsivity depending on temperature is quantitatively described by the temperature coefficient.

1.10 sensitivity in UV range f_{UV}

is an undesired responsivity to radiation in the UV spectral range; a lux metre should not be sensitive to UV radiation; sensitivity to UV radiation may be caused by imperfect filtering of UV radiation or by fluorescent influences.

1.11 sensitivity in infrared range f_{IR}

is an undesired responsivity to radiation in the infrared spectral range; a lux metre should not be sensitive to infrared radiation.

1.12 intrinsic error (of a measuring instrument)

is a measuring instrument's error in measurement determined under reference conditions prior to the commencement of the electromagnetic compatibility (EMC) tests.

1.13 fatal error (during EMC tests)

is a state found in EMC tests in the event that the difference between the measurement error determined during the EMC tests and the intrinsic error (of the measuring instrument) is greater than:

a) a value of one third the value of the maximum permissible error for lux metres with digital displays,

b) the value of the maximum permissible error for lux metres with analogue displays.

2 Metrological requirements

2.1. Operating conditions

The working conditions are defined by the lux metre manufacturer.

2.2 Measuring range

The manufacturer must precisely specify the lux metre's measuring range.

A lux metre's basic measurement range is from 10 lx to 10 000 lx.

2.3 Metrological parameters

Satisfactory values for the specified metrological properties of lux metres are listed in Table 1.

Table 1 – Defined values for specified metrological properties

Characteristics	Symbol	Satisfactory value
Deviation of correction coefficient k_A from value 1 ascertained for measurements with standard source A.	$\lvert k_A-1 \rvert$	< 8 %
Deviation of correction coefficient k_j from value 1 for other sources of light.	$\lvert k_j-1 \rvert$	< 12 %
Integral characteristic*)	f_1'	< 9 %
Sensitivity in UV range*)	f_{UV}	< 4 %
Sensitivity in infrared range*)	f_{IR}	< 4 %
Index non-linearity	f_3	< 5 %
Temperature dependence index*)	f_6	< 20 %
Directional dependence index*)	f_2	< 6 %

*) For type approval only.

2.4 Relative spectral responsivity

2.4.1 The relative spectral responsivity curve $s_{rel}(\lambda)$ must be adjusted to the function $V(\lambda)$ as well as possible. The spectral responsivity of the lux metre must be known in order to characterise the quality of the lux metre as compared to sources with varying spectral density. This responsivity must be specified in the entire spectral range of the specified spectral weighting function (from 360 nm to 830 nm), which should ideally be depicted in tabular form with increments of 5 nm. If the spectral increment is greater, it will be necessary to select a suitable mathematical form of interpolation. A lux metre's responsivity to radiation outside of the visible spectrum must be suppressed (see Articles 1.10 and 1.11).

2.4.2 Several different parameters can be used to describe the quality of a lux metre's spectral adaptation. The inadaptability of a lux metre's relative spectral responsivity $s_{rel}(\lambda)$ to the weighting function $V(\lambda)$ is generally quantified in the form of the integral characteristic of spectral inadaptability f_1'. Measuring relative spectral responsivity within a range between 380 nm and 780 nm is sufficient for assessing the integral characteristic f_1'.

2.5 Directional dependence

The directional dependence for lux metres and their deviation from the required curve is assessed in the range of angle of incidence from 0° to 85°.

The imperfect nature of the optical-mechanical design of the lux metre's sensor results in an orientation error if the light incidence on the sensor's surface is at an angle β.

The manufacturer must determine the maximum permissible orientation error as the difference between the lux metre's readout of radiation incidence at an angle β and the value measured at a perpendicular angle of incidence multiplied by the value $\cos\beta$. Perpendicular incidence is always used when verifying photometric graduation. Therefore, the influence of the orientation error does not apply in this case. In practice, however, light may fall on the lux metre's sensor at various angles, which means this influence must be quantified.

A lux metre which is intended for measuring illuminance on terrain must be equipped with a corrective optical element to correct the orientation error known as a cosine adapter.

2.6 Linearity

The manufacturer must specify the linearity of response within the specified measuring range.

2.7 Temperature dependence

The manufacturer must specify the measuring instrument's temperature dependence.

Unless the manufacturer states otherwise, the temperature dependence test is conducted by measuring the lux metre's readout at temperatures of 5 °C, 25 °C (reference temperature) and 40 °C.

2.8 Other supplementary characteristics

The photometric head's sensitivity to UV radiation and infrared radiation, the lux metre's polarisation responsivity and the influence of modulated radiation may be specified as supplementary characteristics.

3 Technical requirements

3.1 General

Lux metres must be of solid construction and must be manufactured from suitably strong and sturdy materials in order to withstand the normal conditions of use and environments they are subjected to without malfunctioning or suffering undesired changes in their metrological parameters over time.

3.2 Photoelectric transducer

The photoelectric transducer must be designed so that it cannot be damaged during normal cleaning.

In the case of lux metres in which the transducer's protective housing is made up of parts which conduct electricity and the insulation resistance value (resistance between the internal wiring and the sensor housing) may affect the lux metre's metrological properties, the manufacturer must specify the insulation resistance value in the technical documentation.

3.3 Display device

The analogue display device of a lux metre must have a graduation value of ≤ 5 lx.

The digital display device of a lux metre must have a resolution of 1 lx or better. The numbers on the digital display must be larger than 4 mm.

The unit of measurement for illuminance is 1x.

The outer covering must safely protect the display device from exterior effects which occur during the measuring of illuminance (primarily from moisture condensation).

With devices having dials, all technical information on the device specified on and around the scale must be clear and intelligible.

3.4 Additional equipment

A lux metre may be equipped with a recording device for monitoring illuminance over time.

A lux metre may be equipped with a communication interface which enables additional devices to be connected.

3.5 Software

With electronic lux metre, the device's software used must be identifiable (except in cases which exclusively involve displaying the measured values without other functions). The software must be secured to prevent random or deliberate influence in the event of damage and must be in compliance with the technical standard document WELMEC 7.2[2)].

3.6 Power supply

Lux metres may be supplied from the mains using an adapter, or may be supplied from an independent source.

A lux metre with an external electricity supply must be able to connect to a power supply with a nominal value of 12 V or 24 V (alternating or direct current). Lux metres must be equipped with a suitable connector.

An independent power source must be defined in the manufacturer's specifications, and the lux metre must indicate that it must be recharged from the power source or that the power source must be replaced, and must be blocked itself or shut off if the source voltage drops below the limit set by the manufacturer.

[2)] WELMEC 7.2 Software Guide; accessible to the public at www.welmec.org

Battery-powered lux metres must be able to indicate the battery level.

3.7 Resistance to the effects of the outside environment

3.7.1 Mechanical resistance

The lux metre's design and materials used must ensure sufficient strength, stability and resistance to mechanical impact and free fall if the manufacturer declares such resistance in the device's technical documentation.

3.7.2 Resistance to boundary conditions for storage and transportation

The lux metre or components thereof must be resistant to the limit temperatures for storage declared by the manufacturer in the device's technical documentation (declared degree of protection offered by the cover) without damage or impairment of its metrological properties.

3.8 Electromagnetic compatibility

Lux metres which contain electronic components may not be influenced by electrical or electromagnetic interference, or must react to such interference by defined means (such as by announcing an error, blocking measurement and similar). In addition, they may not radiate an undesired electromagnetic field.

The electromagnetic environment class E1 is defined for lux metres containing electronic components (i.e. residential or commercial environment or light industry operating environment).

3.9 Resistance to unauthorised tampering

Lux metres may not have properties which would facilitate fraudulent use, and the possibility of unintentional misuse must be minimal. Components which the user is not allowed to disassemble or adjust must be secured to prevent such activity.

The lux metre's adjustment elements must be secured so that the settings cannot be changed during normal use without damaging the official seals.

4 Measuring instrument markings

4.1 General

All writing and symbols must be easily visible, legible and indelible under normal conditions.

Lux metres must be marked with at least the following information:

- the manufacturer's name,
- type designation,
- the serial number of the measuring instrument and sensor (if detachable),
- the measuring ranges and unit of measurement used,
- power supply,
- the type approval mark.

4.2 Marking with official marks

It is necessary to ensure sufficient room for placing the type approval mark and official mark(s) fulfilling the following requirements:

- must be an inseparable part of the measuring device,
- may not cover up other markings on the device,

– placed at a location where the label cannot be damaged during normal use of the device.

If the lux metre is equipped with an aperture for accessing the calibration elements, it must be sealed by a small stamp. Likewise, there must be at least one screw in the cover of the device which, when removed, enables access to the calibration elements.

5 Type approval of the measuring instrument

5.1 General

The type approval process is made up of the following tests:

- external inspection,
- preliminary function test,
- accuracy test,
- linearity test,
- relative spectral responsivity test,
- test of sensitivity to UV and infrared radiation,
- temperature dependence test,
- directional dependence test,
- test of resistance to external effects:
  - test of resistance to boundary temperatures for storage and transportation,
  - test of protection from water seepage and infiltration by foreign particles (degree of protection offered by the cover);
- electromagnetic compatibility tests:
  - test of resistance to radiated high-frequency electromagnetic fields,
  - test of resistance to electrostatic discharge.

5.2 External inspection

The external inspection of the lux metre assesses the following:

- the completeness of the required technical documentation,
- conformity of the metrological and technical characteristics specified by the manufacturer in the documentation with the requirements of this regulation, specified in Articles 2, 3 and 4;
- the completeness and condition of the lux metre according to the specified technical documentation,
- conformity of the lux metre’s software version with the version specified by the manufacturer.

5.3 Preliminary function test

The device must be placed in a temperature stabilised laboratory (at 25 ± 2) °C for a sufficient length of time for its temperature to adjust before measuring commences.

The photoelectric transducer is mounted firmly to a holder at the optical zero of the photometric bench and the display unit is placed in the prescribed position.

A cursory check of the lux metre’s functioning is conducted in an undarkened photometric laboratory by measuring a light background in the laboratory environment.

After the photometric laboratory has been darkened, the device’s zero deviation is checked (and set, if necessary), if the lux metre so allows.

5.4 Accuracy test

5.4.1 General

The accuracy test may be tested using either:

- a reference gauge lux metre, or
- a set of reference photometric lamps with defined colour temperature values.

5.4.2 Accuracy test using a reference gauge lux metre

The photometric transducer of the reference lux metre and test lux metre are set one by one so that the optical axis of the photometric bench passes through the centre of the lux metres' photometric transducer and is parallel to the normal sensitive surface of the photometric transducer. The mutual position of the photoelectric transducer of the test lux metre and reference lux metre is set so that both transducers measure the illuminance at the same plane of measurement. If the photoelectric transducer has a spherical covering, it should be fitted with a "shoe" so the plane can be determined precisely.

A photometric lamp emitting radiation with a colour temperature value corresponding to a temperature of 2 856 K (CIE of standardised source A). The lamp is set so that the centre of the lamp's filament is at the optical axis of the bench and the lamp's filament is perpendicular to the optical axis of the bench. All measurements are conducted over a period of 10 minutes of illumination with lamps being supplied with direct-current stabilised voltage in a vertical position with the screw cap facing downward. The applicable illuminance value is set by moving the lamp along the photometric bench at the level of the photometric transducers and alternately reading the readouts from the reference and test lux metre. According to this method, the validation of the lux metre is conducted at five points of each range at values of 10 %, 30 %, 50 %, 70 % and 90 % of the measurement range.

The measured values are used to calculate the test lux metre's correction coefficient k_{A} for the given illuminance value:

$$k_{\mathrm{A}} = \frac{E_{\mathrm{et}}}{E_{\mathrm{zk}}} \qquad (1)$$

in which

E_{et} is the illuminance measured with the reference lux metre for illumination from source A,

E_{zk} is the illuminance measured with the test lux metre for illumination from source A.

During the test, the ascertained deviation of the average correction coefficient k_{A} from 1 must correspond to the parameters specified in Article 2.3.

5.4.3 Accuracy test using a set of reference photometric lamps

The voltage and current are adjusted continuously on the luminous intensity gauge based on the calibration sheet and allowed to stabilise. After that, they are adjusted at distances of 1 m, 2 m, 3 m, 4 m and 5 m from the photocell of the test lux metre. For each change in distance, the reference lamp is allowed to stabilise for at least 15 seconds and the measured value is read. The whole cycle is repeated for the next two reference lamps. The illuminance value E_i at the individual points is calculated based on the following relation (2):

$$E_i = \frac{I_{\mathrm{v}}}{r_i^2} \qquad (2)$$

in which

r_i is the distance in metres between the photocell and the reference lamp at the i^{th} point,

I_{v} is the luminous intensity specified on the calibration sheet for the reference lamp.

The deviations determined during the test must correspond to the parameters specified in Article 2.3.

5.5 Linearity test

In the case of the specific lux metre accuracy test described above, the test lux metre's linearity of response is tested on a linearity gauge for a minimum of five illumination values for each measurement range of the lux metre. The measurement is repeated at least three times.

The non-linearity index f_3 is calculated based on the following relation (3) and must correspond to the parameters specified in Article 2.3 during the test:

$$f_\varepsilon(Y) = \left| \frac{Y}{Y_{max}} \times \frac{X_{max}}{X} - 1 \right| \quad \text{a} \quad f_3 = \max\left[f_3\left(Y\right)\right] \qquad (3)$$

in which

Y is the lux metre's output signal at an input value of X,

X_{max} is the input signal corresponding to a maximum lux metre output signal of Y_{max}.

5.6 Relative spectral responsivity test

A lux metre's relative spectral responsivity is always measured in a quasi-monochromatic beam, which must be sufficiently homogenous over the entire sensitive surface of the lux metre's photometric transducer. For the selected value of the wavelength of the monochromator's output radiation, the lux metre's readout is compared with the value of the photocurrent measured on the spectral responsivity detectors' working gauge in the given spectral range. The current spectral responsivity values from the work gauge together with the corresponding uncertainties must be specified in the gauge's calibration sheet.

The normalised spectral responsivity function is calculated to determine the value of integral characteristic f_1':

$$\overset{*}{s}_{\text{rel}}(\lambda) = s_{\text{rel}}(\lambda) \cdot \frac{\int_{380\text{nm}}^{780\text{nm}} S_{\text{A}}(\lambda) \cdot V(\lambda) d(\lambda)}{\int_{380\text{nm}}^{780\text{nm}} S_{\text{A}}(\lambda) \cdot s_{\text{rel}}(\lambda) d(\lambda)} \qquad (4)$$

in which S_A (λ) is the function of the spectral density of standardised source A.

The index value of integral characteristic f_1' is defined by:

$$f_1' = \frac{\int_{380\text{nm}}^{780\text{nm}} \left| \overset{*}{s}_{\text{rel}}(\lambda) - V(\lambda) \right| d(\lambda)}{\int_{380\text{nm}}^{780\text{nm}} V(\lambda) d(\lambda)} \qquad (5)$$

The values of integral characteristic f_1' during the test must correspond to the parameters specified in Article 2.3.

5.7 Test of sensitivity to UV and infrared radiation

Sensitivity to UV and infrared radiation is a critical factor for measurements in which it is expected that infrared and/or UV radiation will be present, such as in daylight or with certain vacuum tubes or light bulbs. Lux metres should not be sensitive to UV and infrared light.

Sensitivity to UV radiation is determined by irradiating the lux metre with a source of UV radiation which primarily emits irradiation within the UV spectral range. The ratio of illuminance in the spectral range of visible radiation to the intensity of radiation in the UV spectral range should be 35 lx·(W · m^{-2})$^{-1}$. The radiation source should have a spectral characteristic similar to that in Figure 1. Sensitivity is defined as the ratio of the lux metre's signal Y_{uv} when irradiated by a UV source in combination with a UV filter and the lux metre's signal Y when irradiated by the same radiation source without a filter, according to relation (6). The recommended characteristic of the filter is specified on the graph in Figure 2.

$$f_{UV} = \left| \frac{Y_{UV}}{Y} \right| \qquad (6)$$

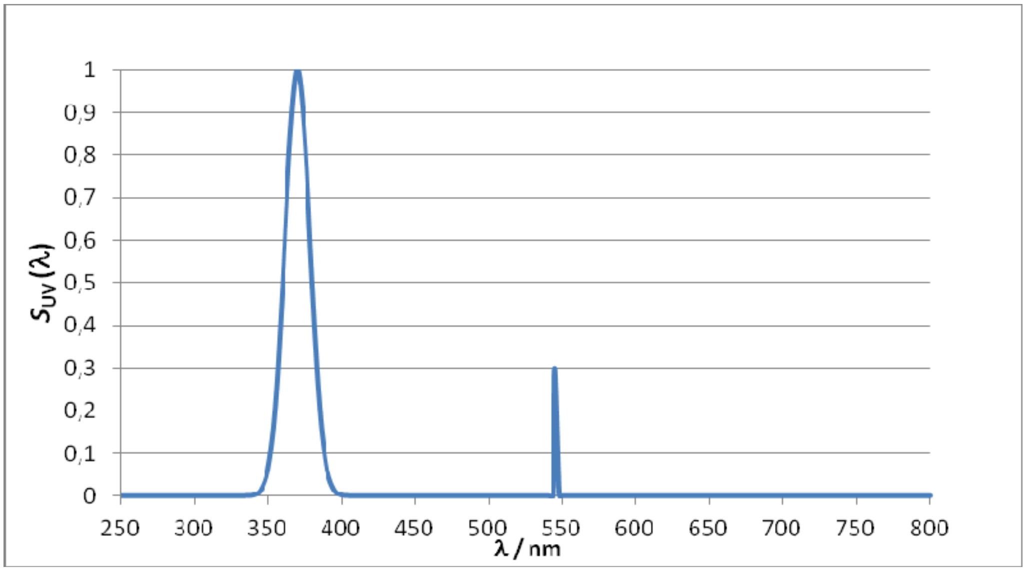

Figure 1 – Recommended spectral characteristic of the UV radiation source

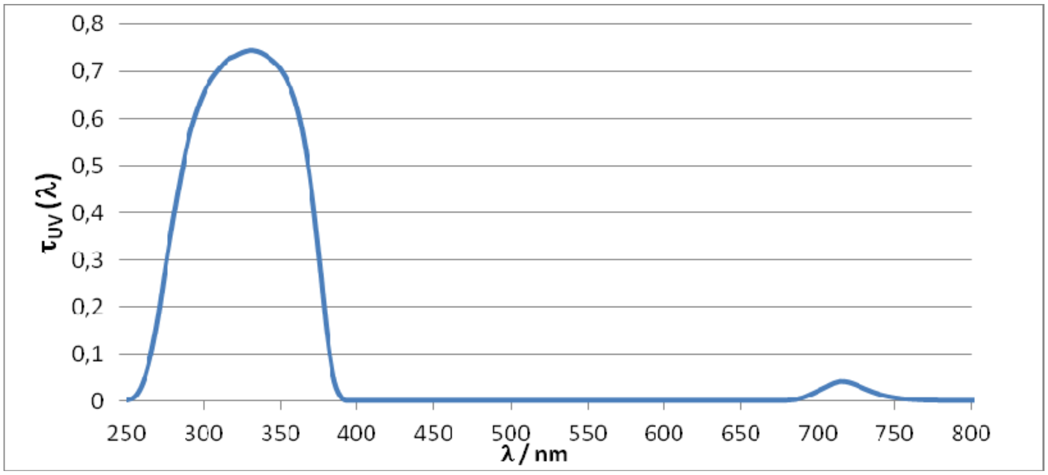

Figure 2 – Recommended characteristic of the UV filter

Sensitivity to infrared light is determined by irradiating the lux metre with a lamp (CIE standardised source A). Sensitivity is defined as the ratio of the lux metre's signal $Y_{IČ}$ when irradiated by source A in combination with an infrared filter and the lux metre's signal Y when irradiated by the same radiation source without a filter, according to relation (7). The recommended characteristic of the filter is specified on the graph in Figure 3.

$$f_{IR} = \left|\frac{Y_{IR}}{Y}\right| \quad (7)$$

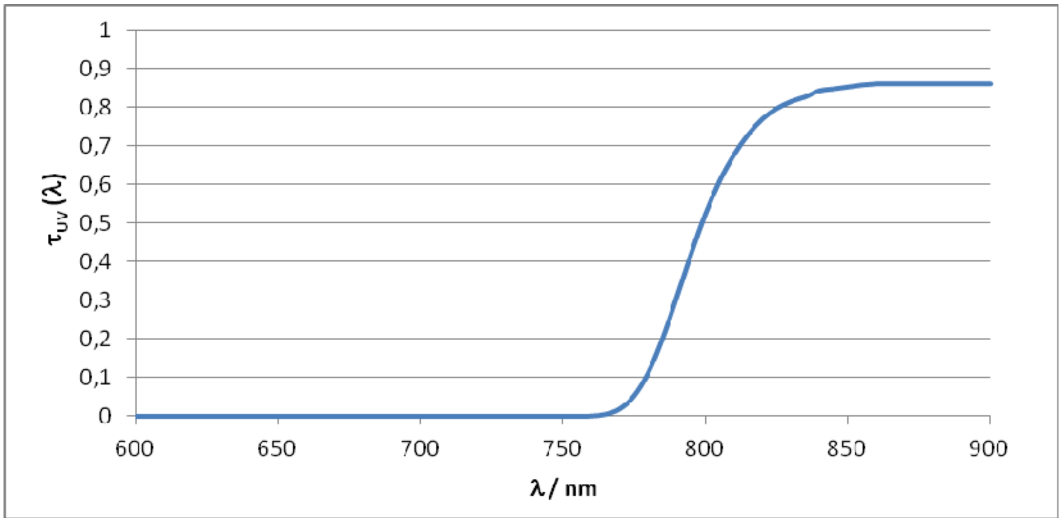

Figure 3 – Recommended characteristic of the infrared filter

5.8 Temperature dependence test

The photometric transducer is placed into a suitable climatic chamber on the moveable carriage of the photometric bench. A photometric lamp is switched on in the chamber at a stable temperature of 5 °C (generally after one hour) and the illuminance values are measured for 5 different distances of the photometric transducer.

Afterward, the temperature in the climatic chamber is increased to 40 °C and the photometric lamp is switched back on after a stabilisation period (generally one hour) and the illuminance values are measured for 5 different distances of the photometric transducer.

The illuminance values are also measured at a reference temperature of $T_0 = 25$ °C. The temperature dependence index f_6 is calculated based on relation (8) and must correspond to the parameters specified in Article 2.3 during the test.

$$f_{6,T} = \left|\frac{Y(T_2) - Y(T_1)}{Y\,(T_0)} \times \frac{\Delta T}{T_2 - T_1} - 1\right| \quad (8)$$

in which

$Y(T)$ is the output signal at temperature T,

$T_0 = 25$ °C; $T_1 = 5$ °C; $T_2 = 40$ °C; $\Delta T = 10$ °C.

5.9 Directional dependence test

During the test, the transducer is fastened to a turntable which can rotate along two axes which are perpendicular to one another. Standardised light source A is used for the test. A collimated beam with a divergence of less than 1° is used for the measurement. The transducer is set so that the turntable's axis passes through the centre of the transducer's sensitive surface and is perpendicular to the optical axis of the photometric bench. Directional dependence index f_2 is measured on two orthogonal planes. Directional dependence is measured within a range ε from 5° to 85° at increments of 5° or less, according to the manufacturer's requirements.

The directional dependence index f_2 of lux metres with a planar transducer is calculated based on relation (9) and must correspond to the parameters specified in Article 2.3 during the test.

$$f_2(\varepsilon, \varphi) = \frac{Y(\varepsilon, \varphi)}{Y(0, \varphi) \cdot \cos \varepsilon} - 1 \qquad (9)$$

in which

$Y(\varepsilon, \varphi)$ is the output signal in dependence on the angle of incident,

ε is the angle measured in relation to a normal/perpendicular measurement surface or in relation to the optical axis,

φ is the azimuth angle.

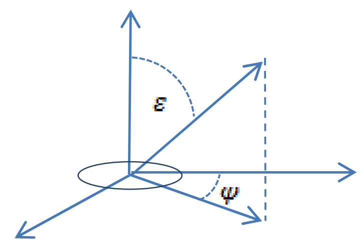

Figure 4 – Coordinates for defining function f_2 (ε, φ)

5.10 Tests of resistance to external effects

5.10.1 Test of resistance to limit temperatures for storage and transportation

The entire lux metre in an inoperative state (switched off, if relevant) must be placed in a climatised chamber for a period of three hours at both boundary storage temperatures according to the technical conditions specified by the manufacturer.

The lux metre is immediately inspected for changes in appearance upon concluding the test. There may be no change in the measurement instrument's appearance; the material and surface may not be frosted or blistered and may not exhibit a change in colour.

The lux metre must meet the requirements specified in Article 2.3 at the reference temperature once two hours have elapsed as of the test's completion.

5.10.2 Test of protection from water seepage and infiltration by foreign particles (degree of protection of the covering)

If the manufacturer's technical conditions state that the lux metre has a protective cover which makes it resistant to water seepage and infiltration by foreign particles, then it is verified during the test whether the measuring instrument meets the specified degree of protection.

5.11 Electromagnetic compatibility (EMC) tests

5.11.1 Resistance to electrostatic discharge

Resistance to electrostatic discharge is tested on a lux metre when it is switched on, preferably using voltage of ±6 kV for contact discharge and ±8 kV for air discharge if contact discharge cannot be used. The discharges are applied to the lux metre's covering and to the coupling panels in the vicinity of the lux metre.

In this test, the lux metre must demonstrate normal functioning within the limits of the maximum permissible error pursuant to Article 2.3, or it must ascertain a fatal error and react to it by the means defined.

5.11.2 Resistance to high-frequency electromagnetic field radiation

Resistance to high-frequency electromagnetic field radiation is tested on a lux metre when it is switched on in the following frequency zones and at the following test field intensities:

- frequency 80 MHz to 800 MHz, intensity 3 V/m;
- frequency 800 MHz to 960 MHz, intensity 10 V/m;
- frequency 960 MHz to 1 400 MHz, intensity 3 V/m;
- frequency 1 400 MHz to 2 000 MHz, intensity 10 V/m;

The test field's specified intensity values apply to measurement without modulation. The test field's amplitude is modulated with a depth of 80 %; the modulation signal has a sine wave with a modulation frequency of 1 kHz. The frequency step during the frequency sweep of the test field is maximum 1 %. The dwell time at each frequency may not be shorter than the time necessary to test the lux metre, including its ability to react to interference. However, it may not be shorter than 0.5 s under any circumstances. The test field is applied to all sides of the lux metre's covering.

In this test, the lux metre must demonstrate normal functioning within the limits of the maximum permissible error pursuant to Article 2.3, or it must ascertain a fatal error and react to it by the means defined.

6 Initial validation

6.1 General

The initial validation process is made up of the following tests:

- visual inspection,
- preliminary function test,
- accuracy test,
- linearity test,
- determination of the correction coefficients for types of light sources other than standardised source A.

6.2 Requirements for test equipment

Testing lux metres requires the following measuring instruments with verified metrological traceability, as well as other tools:

a) a luminous intensity gauge, which may be:
   - a reference gauge lux metre,
   - reference photometric lamps with sufficient luminous intensity values to achieve the required range of illumination intensity values on the useable length of the photometric bench,

b) a photometric bench with accessories, consisting of a set of membranes, adjustable holders, cross slides and adjustment tools. The photometric bench must be at least 3 m long and must be able to indicate distances down to increments of 0.5 mm. The total uncertainty of distance readouts may not exceed ±2 mm,

c) linearity gauge (reference detector/lux metre with defined linearity),

d) a stabilised regulatable source of direct-current voltage to supply the photometric lamps, laboratory voltmeter and amperemeter for measuring the electrical voltage and current of the photometric lamps

e) a time measurement device (electronic or mechanical stopwatch),

f) thermometer with a measurement range of (15–40) °C,

g) a photometric current gauge (nano-amperemeter or current to voltage converter) with a sensitivity and input impedance adjusted to the parameters of the optical radiation detector,

h) agents for cleaning the photometric lamps and photometric bench,

i) source of standardised light A, temperature 2 856 K – tungsten lamps of the necessary wattage,

j) Light sources used for artificial illumination (sodium vapour lamp, source of daylight and white fluorescent tube),

k) photometric "dark laboratory" allowing measurements to be conducted without the influence of daylight and disruptive backgrounds from artificial sources.

6.3 Visual inspection

In the visual inspection, it is checked whether the lux metre submitted for validation (including software version) conforms to the approved type. Special attention must be paid to checking the correctness of the markings as defined in Article 4.1.

The lux metre is also inspected to determine whether or not it is mechanically damaged. Lux metres with an electronic display are checked to determine whether all characters on the display are visible after the device is connected to the mains power supply.

Lux metres which are not in conformity with the approved type are not tested further, nor are lux metres which are damaged.

6.4 Preliminary function test

The preliminary function test is conducted in accordance with Article 5.3.

6.5 Accuracy test

The accuracy test may be tested using either:

- a lux metre as defined in Article 5.4.2, or
- a set of reference photometric lamps (as defined in Article 5.4.3) with defined colour temperature values.

6.6 Linearity test

The test linearity on the lux metre being validated is conducted in accordance with Article 5.5.

6.7 Determination of the correction coefficients for types of light sources other than standardised source A

The spectral adaptation of a lux metre's spectral responsivity to the relative spectral luminous efficiency for photopic vision $V(\lambda)$ is verified by comparing the lux metre being evaluated to the reference on working sources other than CIE standardised source A.

Working light sources used to verify the spectral adaptation of a lux metre's spectral responsivity to the relative spectral luminous efficiency for photopic vision $V(\lambda)$:

- sodium vapour lamp light source,
- a light source similar to standardised source D_{65} (with a colour temperature of roughly 6 500 K), which, in spectral terms, is akin to daylight,
- light source of a white fluorescent lamp with luminescent material (with a colour temperature of roughly 2 800 K),

– light source of a white fluorescent lamp with luminescent material (with a colour temperature of roughly 5 500 K).

Correction coefficients are determined for a single value of luminous intensity of a photometric lamp; the value is selected based on the range of the lux metre being validated. The correction coefficient value k_j for the type of light j is established according to relation (10):

$$k_j = \frac{E_{\mathrm{et}}^{\mathrm{A}}}{E_{\mathrm{zk}}^{j} \cdot k_{\mathrm{A}}} = \frac{E_{\mathrm{zk}}^{\mathrm{A}}}{E_{\mathrm{zk}}^{j}} \quad (10)$$

in which

$E_{\mathrm{zk}}^{\mathrm{A}}$ is the value of the illuminance measured with the reference lux metre for illumination from source A,

$E_{\mathrm{zk}}^{\mathrm{j}}$ is the value of the illuminance measured with the reference lux metre for illumination from source j,

$E_{\mathrm{zk}}^{\mathrm{A}}$ is the value of the illuminance measured with the reference lux metre for illumination from source A,

The values of the correction coefficients k_j for each individual type of light source j are specified on the validation sheet.

7 Follow-up validation

The follow-up validation procedure is identical to that for initial validation under Chapter 6.

8 Notified standards

For the purposes of specifying the metrological and technical requirements for measuring instruments and specifying the testing methods for verification arising from this General Measure, the CMI shall provide notification of the Czech technical standards, other technical standards or technical documents of international or foreign organisations, or other technical documents containing more detailed technical requirements (hereinafter “notified standards”). The CMI announces a list of these notified standards assigned to the applicable measure together with the General Measure by means accessible to the public (at the internet site www.cmi.cz).

Compliance with notified standards or parts thereof is considered to be, to the extent and under the conditions stipulated by a measure of a general nature, to be compliant with those requirements stipulated by this measure to which these standards or parts thereof apply.

II.

GROUNDS

The CMI has issued this General Measure laying down metrological and technical requirements for specified measuring instruments and testing methods for the type approval and verification of these specified measuring instruments so as to implement § 24c of the Metrology Act.

Decree No 345/2002 laying down measurement instruments for mandatory validation and measurement instruments subject to type approval, as amended, classifies lux metres as measurement instruments subject to type approval and validation of specified measuring instruments under Item 5.1.2 in the annex to the Second List of Specified Measurement Instruments.

The CMI has issued this General Measure laying down metrological and technical requirements for lux metres and testing methods for the type approval and verification of these specified measuring instruments in order to implement § 24c of the Metrology Act for the specific type of measuring instruments “lux metres.”

This legislation (General Measure) was notified in accordance with European Parliament and Council Directive 98/34/EC of 22 June 1998 on the procedure for the provision of information in the field of technical standards and regulations and rules on Information Society services, as amended.

III.

LEGAL INSTRUCTIONS

In accordance with § 173(2) CAP, no appeals may be made regarding general measures.

In accordance with the provisions of § 172(5) CAP, decisions on objections are final and appeals may not be made against them.

Compliance of the General Measure with legislation may be subject to a review process in accordance with §§ 94 to 96 CAP. A party to the proceedings may initiate review proceedings to be conducted by the administrative authority which issued the General Measure. If the administrative authority finds no reason to commence the review proceedings, it shall communicate and provide grounds for this within 30 days. Rulings on the initiation of a research procedure may be issued within three years as of the General Measure’s entry into legal effect in accordance with the provisions of § 174(2) CAP.

IV.

ENTRY INTO LEGAL EFFECT

This General Measure shall enter into legal effect on the fifteenth day as of its date of publication (§ 24d of the Metrology Act).

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RNDr. Pavel Klenovský

Director General