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Spectrocolorimeter «TKA-VD»

Calibration technique

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INTRODUCTION

The present technique applies to the Spectrocolorimeters "TKA-VD" of TKA SCIENTIFIC INSTRUMENTS, LLC, Russia (hereinafter referred to as spectrocolorimeters) and defines methods and means of initial and periodical check.

Calibration interval: 1 year.

1. CALIBRATION PROCEDURES

When performing calibration, the operations indicated in Table 1 are to be carried out.

Table 1

Procedures	Calibration technique No.
1. External examination	7.1
2. Testing	7.2
3. Determination of metrological properties of spectrocolorimeters	7.3
3.1 Determination of limits of measurement absolute error in accordance with the chromaticity coordinate scale	7.3.1
3.2 Determination of limits of luminance measurement relative error	7.3.2
3.3 Determination of limits of illuminance measurement relative error	7.3.3

2. CALIBRATION INSTRUMENTS

2.1. When performing calibration, the calibration instruments indicated in Table 2 should be used.

Table 2

Calibration technique No.	Name and type of the basic or auxiliary calibration instrument; designation of the regulatory document controlling engineering requirements, and metrological and principal technical properties of the calibration instrument
7.3	<p><i>A set of self-luminous chromaticity coordinate measures included in the Working Standard of colour and chromaticity coordinate units ВЭТ 81-1-2003.</i></p> <p>The measurement range by the chromaticity coordinate scale corresponds with GOST 8.205-90 (<i>ГОСТ 8.205-90 Государственная поверочная схема для средств измерений координат цвета и координат цветности</i>)</p> <p>Measurement range by the chromaticity coordinate scale: $x=0.004 - 0.734$; $y=0.005 - 0.834$</p> <p>Absolute errors $S_{x\Sigma}=0.0007$; $S_{y\Sigma}=0.0007$</p> <p><i>Working Standard of category 0 of luminance and illuminance intensity units ВЭТ 5-1-2009.</i></p> <p>Illuminance measurement range, lux 10 - 1000</p> <p>Relative measurement error $S_{\Sigma 0}=0.5 \cdot 10^{-2}$</p> <p><i>Luminance source included in ВЭТ 5-1-2009.</i></p> <p>Luminance measurement range, cd/m^2 100 - 1000</p> <p>Relative measurement error $S_{\Sigma 0}=0.5 \cdot 10^{-2}$</p>

2.2. The measurement instruments indicated in the table should be calibrated in due order. Use of other similar calibration instruments providing indicated metrological properties is allowed.

3. REQUIREMENTS FOR VERIFICATION OFFICER'S LEVEL OF PROFICIENCY

Only persons accredited as verification officers in due order and acknowledged with the Maintenance manual who had passed the complete safety training can be admitted for work with the spectrocolorimeters.

4. ENVIRONMENTAL SAFETY AND PROTECTION REQUIREMENTS

4.1. When operating the devices, the electrical safety should be observed in accordance with GOST 12.1.019-79.

(ГОСТ 12.1.019-79 Система стандартов безопасности труда. Электробезопасность. Общие требования и номенклатура видов защиты).

4.2. The room where the calibration is carried out should correspond with the fire safety requirements according to GOST 12.1.004-91 and be furnished with the fire-extinguishing means according to GOST 12.4.009-83.

(ГОСТ 12.1.004-91 Пожарная безопасность. Общие требования.

ГОСТ 12.4.009-83 Пожарная техника для защиты объектов).

5. CALIBRATION CONDITIONS

When performing calibration, the following conditions should be observed:

5.1. The calibration should be carried out under normal conditions according to GOST 8.395 - 80:

ambient temperature	22±2 °C
relative air humidity	65±15%
atmospheric pressure	86...107 kPa

5.2. Any mechanical effects, external electric and magnetic fields influencing the metrological properties of the spectrophotometer should be eliminated.

6. PREPARATION FOR CALIBRATION

The spectrophotometer being calibrated should be prepared for work in compliance with the Maintenance manual.

7. CALIBRATION

7.1. External examination.

The following should be done during external examination:

- inspect visually the appearance of the spectrophotometer and ensure absence of evident damage influencing operability of the spectrophotometer;
- ensure the labelling with a clear specification of type and serial number of the spectrophotometer is available;
- check the package contents of the spectrophotometer.

The spectrophotometer should be considered suitable for use if its appearance corresponds with the photographic images from the set of documentation; its housing, external elements, controls, and indications are not damaged; the package contents comply with the technical specification; and the type and serial number are clearly seen on the labelling.

7.2. Testing.

The spectrophotometer is tested by switching on in correspondence with the Maintenance manual. Calibrate the spectrophotometer.

The spectrophotometer is considered ready for operation if switching on and preparation of the spectrophotometer for work had been carried out without any deviations from requirements of the Maintenance manual.

7.3. Determination of metrological properties of the spectrophotometers.

7.3.1. Determination of limits of absolute error of chromaticity coordinates measurement.

In order to define the root mean square deviation of the chromaticity measurement result, direct measurements of the chromaticity coordinates of standard measures should be performed. The observation results are processed in compliance with the requirements of GOST 8.207-76 considering the confidence probability of 0.95 and the measuring count $n=5$. The arithmetic mean of the observation results separately for each measure is counted as the chromaticity coordinates measuring result.

$$\tilde{A}_k = \frac{1}{5} \sum A_{ki},$$

where A – chromaticity coordinates x and y,

i – number of observation,

k – number of measure.

The confidence limit of the residual bias of the device is calculated from the formula:

$$\Theta_A = 1,1 \sqrt{S^2 + \Theta_{np}^2};$$

$$\Theta_{np} = \left| \tilde{A}_k - A_{np} \right|,$$

where S – error conditioned by the standard measure error ($S_{x\Sigma}=0.0007$; $S_{y\Sigma}=0.0007$),

$\Theta_{\text{ип}}$ – error introduced by the device.

The spectrophotometer passes the inspection if the absolute error of measuring according to the chromaticity coordinate scale does not exceed $\Delta_{x,y}=0.02$.

7.3.2. Determination of limits of relative error of luminance measurement.

In order to determine the relative error of the luminance measurement, direct measurements of the standard measure luminance are carried out. The observation results are processed in compliance with the requirements of GOST 8.207-76 considering the confidence probability of 0.95 and the measuring count $n=5$. The arithmetic mean of the observation results is counted as the luminance measuring result:

$$\tilde{L}_k = \frac{1}{5} \sum L_{ki},$$

where L – luminance,

i – number of observation,

k – number of measure.

The confidence limit of the assumed value of the luminance measuring relative error is calculated from the formula:

$$\Delta_0 = 1,1\sqrt{S^2 + \delta_{\text{ип}}^2};$$

$$\delta_{\text{ип}} = \left| \frac{\tilde{L}_k - L_0}{L_0} \right| \times 100\%,$$

where S – error conditioned by the standard measure error

($S_{\Sigma 0} = 0.5 \cdot 10^{-2}$),

$\delta_{\text{ип}}$ – error introduced by the device.

The spectrophotometer passes the inspection if the relative error according to the luminance scale does not exceed 10%.

7.3.3. Determination of limits of relative error of illuminance measurement.

In order to determine the relative error of the illuminance measurement, direct measurements of the standard measure illuminance are carried out. The observation results are processed in compliance with the requirements of GOST 8.207-76 considering the confidence probability of 0.95 and the measuring count $n=5$. The arithmetic mean of the observation results is counted as the luminance measuring result:

$$\tilde{L}_k = \frac{1}{5} \sum E_{ki},$$

where E – illuminance,

i – number of observation,

k – number of measure.

The confidence limit of the assumed value of the illuminance measuring relative error is calculated from the formula:

$$\Delta_0 = 1,1\sqrt{S^2 + \delta_{\text{ип}}^2};$$

$$\delta_{\text{ип}} = \left| \frac{\tilde{L}_k - L_0}{L_0} \right| \times 100\%,$$

where S – error conditioned by the standard measure error

($S_{\Sigma 0} = 0.5 \cdot 10^{-2}$),

$\delta_{\text{ип}}$ – error introduced by the device.

The spectrophotometer passes the inspection if the relative error according to the illuminance scale does not exceed 10%. (ГОСТ. 8.207-76 Государственная система обеспечения единства измерений).

8. CALIBRATION RESULTS EXECUTION

8.1. In case of a favourable calibration result, the calibration certificate in due form is issued in correspondence with PR 50.2.006-94. (ПР 50.2.006-94 ПОРЯДОК ПРОВЕДЕНИЯ ПОВЕРКИ СРЕДСТВ ИЗМЕРЕНИЙ).

8.2. If unfavourable results are obtained, the certificate of inadequacy is issued with specification of the reasons for inadequacy.

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