

Development of experimental research installations with led light sources

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Abstract. The article describes the experimental research unit, which allowed to conduct research on studying of influence of led lighting on the organ and the whole body with different color temperatures and levels of illumination of the working surface. One for examination observers with the reflection coefficients of protecting surfaces (ceiling $\rho_c=0.7$; walls $\rho_w=0.5$; floor $\rho_f=0.3$) and three experimental areas. In two pilot areas were mounted lighting with led lamps, and in one - lighting systems with conventional fluorescent lamps. In pilot areas to create the necessary level of vertical light on the screen test the object is to measure the time achromatic disperarii and campimetry on the wall of each room behind the observer, above his head, were mounted lamps and simulated lighting options in the program DIALux. Modeling in DIALux program allowed to create standard quantitative and qualitative indicators - horizontal illuminance on the working surface, the uneven distribution of light and the indicator of the UGR.

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Introduction

The creation of energy efficient lighting systems (OS) is one of the urgent tasks of lighting technique [1]. One way of solving this problem is the use in the shelter of led light sources have a number of advantages in comparison with thermal and gas-discharge sources of radiation, as the service life of more than 50 thousand hours of burning, they are economical, have a high energy efficiency (the luminous efficiency of more than 100 lumens•W [2]), high durability, absence of toxic mercury. Thanks to the compact lighting with LEDs have the ability to change the direction of the flow of radiation in space illuminated object [3].

However, in domestic and foreign literature of the impact of radiation LEDs on the functional state of the organ of vision little studied [4, 5]. For research of the conditions of led lighting has been designed and created experimental research unit (ERU) General lighting [6], mounted in the laboratory corps of the MINISTRY of education Mordovia state University. N.P. Ogarev. The laboratory consists of four rooms, one for the examination of the observers the reflection coefficients of protecting surfaces (ceiling $\rho_c=0.7$; walls $\rho_w=0.5$ and sex $\rho_s=0.3$) and three experimental areas, two of which were installed OS with led lights, in the third - OS with conventional fluorescent lamps. In the room for examination of three light openings were closed blinds $p=0.1$, in the experimental areas of the natural light was absent. Height of the premises is three meters Coefficients of reflection of

the ceiling, walls, floor, and the working surface of, respectively: $\rho_c = 0.7$; $\rho_w = 0.5$; $\rho_s = 0.3$ and $\rho_{ws}=0.3$. Walling and the working surface of the pilot areas were diffuse-reflective.

In the experimental areas in order to create the necessary level of vertical light on the screen with the test object to measure the time achromatic disperarii and campimetry on the wall of each room behind the observer, above his head, were mounted lamps.

For experimental studies were selected lamps of the following manufacturers:

- the joint Russian-Korean enterprise society with limited liability "Nepes Rus" (lamps with led - Cap Flat 66-16);
- the open joint stock company "Ardatovo lighting factory" (ASTZ) (lamps with led recessed for public and administrative premises DVO12-38-001 Prizma and the Fluorescent lamp - LVO04-4 x 14-041 PRS, LO04-4 x 18-041 PRS).

The list selected for pilot studies lamps presented in table 1.

Before equip experimental premises lamps, were simulated lighting options in the program DIALux to fulfil the requirements of SP 52. 13330.2011 "Natural and artificial lighting" and SanPiN 2.2.1/2.1.1.1278-03 "Hygienic requirements to natural, artificial and combined illumination of residential and public buildings" and SanPiN 2.2.1/2.1.1.2585-10 Changes and additions # 1 to the sanitary rules and norms SanPiN 2.2.1/2.1.1.1278-03 "Hygienic requirements to natural, artificial and

combined illumination of residential and public buildings” General illumination of public and

administrative buildings.

Table 1. The list of lamps used in experimental studies

| Lamp type brief technical | Description, manufacturer | Type IP manufacturer |
|---------------------------|---|---|
| LVO04-4 x 14-041 PRS | IP20, prismatic diffuser under T5, ballast management protocol DALI, power factor PF = 0,99, “ASTZ” | Osram FH 14W/830 HE; Master TL5 HE 14W/840, Philips |
| LVO04-4 x 18-041 PRS | IP20, prismatic diffuser, ballast management protocol DALI, PF = 0,98, “ASTZ” | Osram L 18W/950 |
| DVO 12-38-001 Prizma | IP 40, prismatic diffuser, the driver-controlled DALI protocol, PF = 0,96, “ASTZ” | SD STW8Q14B, Seoul Semiconductor |
| Cap Flat 66-16 | IP 20, technology "remote phosphor", the driver with control protocol DALI, PF = 0,94, "Nepes Rus" | SD, the temperature color; $T_c = 4094$ Kelvin, "Nepes Rus" |
| Cap Flat 66-16 | IP 20, technology "remote phosphor", the driver with control protocol DALI, PF = 0,94, "Nepes Rus" | SD, the temperature color $T_c = 3045$ Kelvin, "Nepes Rus" |

Requirements to quantitative and qualitative indicators of the General lighting in the premises of public and administrative buildings, where are the visual discharge A-2, we have chosen as the base, are presented in table 2.

To determine based applications of led lamps in the shelter of different functional purposes, experimental investigations were carried out at three levels of illumination: 200, 400 and 1000 Lux, which is most typical for the execution of the visual work in the premises of various functional purposes [7].

In table 3 presents the analyzed variants of illumination.

Table 2. Standard quantitative and qualitative indicators light environment of the main premises of public and administrative buildings

| Premises | The plane rationing light H - horizontal, V-vertical), m | Resrad and podrastet visual work | Illumination of the working surface with the General illumination, Lux | Supports the United indicator discomfort UGR, not more than | Coefficient light pulses, not more than |
|---|--|----------------------------------|--|---|---|
| Main areas of the public and administrative buildings | H-0,8 | A-2 | 400 | 21 | 10 |

Table 3. Analyzed variants of light

| Base lighting option | Investigated lighting option | Level illumination, Lux |
|-------------------------------------|---|-------------------------|
| ЛВО 04-4×14-041 PRS, $T_c = 2953$ K | Cap Flat 16-66, correlated $T_c = 3045$ K | 200 |
| ЛВО 04-4×14-041 PRS, $T_c = 2953$ K | Cap Flat 16-66, correlated $T_c = 3045$ K | 400 |
| ЛВО 04-4×14-041 PRS, $T_c = 2953$ K | Cap Flat 16-66, correlated $T_c = 3045$ K | 1000 |
| ЛВО 04-4×14-041 PRS, $T_c = 3917$ K | Cap Flat 16-66, correlated $T_c = 4094$ K | 200 |
| ЛВО 04-4×14-041 PRS, $T_c = 3917$ K | Cap Flat 16-66, correlated $T_c = 4094$ K | 400 |
| ЛВО 04-4×14-041 PRS, $T_c = 3917$ K | Cap Flat 16-66, correlated $T_c = 4094$ K | 1000 |
| ЛВО 04-4×18-041 PRS, $T_c = 4914$ K | ЛВО 12-38-001 Prizma, correlated $T_c = 5033$ K | 200 |
| ЛВО 04-4×18-041 PRS, $T_c = 4914$ K | ЛВО 12-38-001 Prizma, correlated $T_c = 5033$ K | 400 |
| ЛВО 04-4×18-041 PRS, $T_c = 4914$ K | ЛВО 12-38-001 Prizma, correlated $T_c = 5033$ K | 1000 |

The change in the level of illumination of the working surface was achieved through the use of variable ballast and drivers. In the case of all used fluorescent and led lighting dimming of the light flux produced by DALI Protocol. The brightness of the outlet fixtures in all variants of illumination with an equal light was always the same.

Modeling of lighting options with DIALux program has allowed to determine the height of hanging lamps, providing on the working surface illumination $E = 1000$ Lux, other, lower light levels, up to $E=100$ Lux, was created by the dim light flux.

Modeling in DIALux program have established a standard quantitative and qualitative indicators of ERU (horizontal illuminance on the working surface, the uneven distribution of light and indicator UGR).

Held psycho-physiological and hygienic study of the conditions of led illumination on the basis of developed by ERU given in [8 - 10].

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