

# Hygienic Assessment of Working Conditions When Working with Computer Office Equipment

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**Abstract** The article presents the results of a study of the working conditions of operators of one of the call centers in Tashkent and employees of the information technology department of the department for the development and design of telecommunication networks of a communications enterprise. The studies found that the levels of noise, magnetic field in the range of 5 Hz - 2 kHz, electric field in the range of 5 Hz - 2 kHz and illumination at the workplaces of call center operators exceed the requirements of hygienic standards. Non-compliance with regulatory requirements is noted in 50.9% of cases of noise levels, magnetic field - 3.6%, electric field - 67.3% and illumination - 10.9%. At the workplaces The communications enterprise revealed that the standard values of the alternating electric field in the range of 5 Hz – 2 kHz were exceeded by 45%, by illumination by 31.8%, and by noise values by 63.6%.

**Keywords** Hygienic assessment, Working conditions, Computer equipment, Health status, Electromagnetic radiation, Noise, Illumination, Workplaces, Electric field

## 1. Introduction

Processes related to the automation of enterprises, the implementation of information systems, the use of information and communication technologies (ICT) are today the most promising and in demand in all spheres of human activity. Processing, storage and exchange of information occurs many times faster than before, which determines the widespread use of computer technology in the process of performing various types of tasks. The presence of a computer has become commonplace in office and production premises, classrooms and auditoriums of educational institutions, in everyday life [1]. Among the pressing problems of our time, the occupational hygiene of computer users is among the most in demand, since the range of tasks solved by computers is constantly expanding, and ever larger contingents of people are involved in the process of using computing equipment. As information on this problem accumulates and is updated, the cause-and-effect relationships between working conditions and the health of computer users become increasingly obvious.

The term "Computer hardware" is a comprehensive concept that includes the entire range of computer systems produced, as well as auxiliary peripheral or separate equipment that works in conjunction with computers and provides additional functions (printing or scanning documents, access to a data

transmission network, providing protection against voltage surges and power failures, etc.).

Recent studies give grounds to believe that the work of computer operators falls into the category of work associated with hazardous and harmful working conditions. The computer can have an adverse effect on users: wide-range electromagnetic fields, electrostatic field.

In addition, users of computer office equipment may also be negatively affected by low levels of illumination, unfavorable microclimatic conditions, noise, forced working posture, physical inactivity, nervous and emotional stress, and other factors in the production environment [8].

According to researchers, one of the most significant factors of influence can be considered electromagnetic fields of various frequencies and electrostatic fields generated by computer equipment, including wireless data transmission means (WiFi, Bluetooth, USB modems). The electromagnetic environment (EME) at the workplaces of users of modern computer equipment is characterized by increasing complexity and diversity of electromagnetic field sources [3,11,12].

New wireless information technologies such as Wi - Fi, WiMAX, Bluetooth, UMTS, etc., use electromagnetic radiation of the radio frequency range for communication. The number of people using such information transfer technologies is constantly increasing. According to Rosstat, in 2013, 94% of organizations used computers in their work, of which 88.1% were connected to the Internet. The active use of network technologies in the work process leads to a significant change in the composition of the equipment used in the premises where the workplaces of people working

with computer equipment are located.

The use of a wired data transmission network does not lead to a significant change in the electromagnetic environment at workplaces. However, the active introduction of wireless technologies can lead to its significant complication, since most of them use electromagnetic fields in the frequency range above 300 MHz (UHF and microwave) as a data carrier, which has never been previously controlled at the workplaces of computer users [9].

The electrostatic field created by the computer changes the ionic composition of the environment, reduces air humidity and promotes the adsorption of dust on electrified surfaces, which causes an exacerbation of asthmatic symptoms, facial dermatitis, and irritation of the mucous membranes.

Numerous experimental and clinical studies have revealed the adverse effects of electromagnetic radiation of various ranges on the human body, with the greatest impact on the nervous, immune, endocrine, cardiovascular and reproductive systems of the body, and the nature and extent of this impact depends on the power, frequency, direction of radiation and other technical characteristics of the sources.

Research conducted by the Federal State Budgetary Scientific Institution Research Institute of Occupational Medicine has shown that the electromagnetic environment at the workplaces of computer users has changed dramatically due to the active introduction of new equipment and technologies. The normative and methodological documents currently in force in the Russian Federation, regulating electromagnetic fields (EMF) at the workplaces of PC users and other ICT means, are not scientifically substantiated, and the existing methodology does not allow for an adequate hygienic assessment of the electromagnetic environment.

The specifics of computer users' work are characterized by the impact on the visual analyzer of the worker. According to statistics, up to 70% of users in the world experience vision problems and discomfort when working on a personal computer. As a result of long-term work, there is a high risk of developing or progressing existing myopia. This professional disease is called "computer vision syndrome" (Computer Vision Syndrome (CVS)). Asthenopia (eye fatigue) is one of the varieties of computer vision syndrome. Burning and pain in the eyes, lacrimation, redness of the eyelids and eyeballs, pain in the forehead, rapid fatigue are clear signs of asthenopia, which often occurs in computer users [5,7].

Functional disorders associated with the musculoskeletal system are caused by long-term static loads caused by poor organization of the user's workplace. The most common are: uncomfortable or unsuitable furniture, inconvenient mutual arrangement of components of the personal computer system, or lack of sufficient space for free movement and change of posture. When working at a computer, a person often sits for a long time in an uncomfortable position, which in turn leads to a feeling of fatigue and general exhaustion. Manifestations of unfavorable symptoms from the cervical spine and upper shoulder girdle are noted. The main diseases of the spine that develop as a result of prolonged sitting at the computer are osteochondrosis and curvature of the spine [2,13].

Working at a computer is also associated with constant psycho-emotional stress, leading to a stressful state, the source of which can be both the type of activity and the information features of the computer, the software used, the organization of work, and social aspects. A long stay in a state of psycho-emotional stress can lead to the formation of disturbances in the balance of the physiological systems of the body [4].

Hygienic studies in the Republic of Uzbekistan were conducted as part of the certification of workplaces of people working with computer equipment. Regulatory documents governing work on computers were developed [6,10]. However, the identification of the professional risk of health damage to workers with computer equipment, taking into account the influence of a complex of production factors, and the determination of the mechanism of the adverse impact of working conditions on the body have not been carried out to date.

## 2. Materials and Methods

Comprehensive hygienic studies were conducted at 94 workplaces. persons professionally associated with work on computer equipment. The research covered 39 workplaces of office employees at the facility of the Branch Management of TShTT JSC "Uzbektelecom" and 55 workplaces of telephone operators of the "Call center" facility. Instrumental measurements of the parameters of harmful factors of the industrial environment at the workplaces were carried out: noise, illumination, brightness of monitor screens, microclimate parameters (temperature, relative humidity, air velocity, atmospheric pressure), low-frequency (LF) electric and magnetic fields (from 5 Hz to 400 kHz), electromagnetic fields of the radio frequency range (over 300 MHz), electric fields of industrial frequency (50 Hz), electrostatic fields.

Noise level measurements were carried out using an integrated averaging noise meter "SVAN -943 B" of the 2nd accuracy class according to requirements of GOST 17187-2010 "Noise meters. Part 1. General requirements".

Measurements of artificial illumination and brightness levels were carried out using a combined device: the luxmeter-brightness meter "TKA-PKM-02. The measurement limit of the device for illumination is from 10 to 200 thousand lux, the measurement limit of the device for brightness is from 10 to 200 thousand cd/m<sup>2</sup>.

Microclimate parameters (temperature, relative humidity, air velocity, atmospheric pressure) at workplaces were determined by the Meteoscope-M microclimate parameter measuring device. Low-frequency alternating electric and magnetic fields were measured by the Cyclone-05M (B) device set, consisting of the IEP-05 alternating electric field meter, the IMP-05/1 and IMP-05/2 alternating magnetic field meters, and the IESP-01 (B) electrostatic field strength meter.

Electromagnetic fields of the radio frequency range over 300 MHz were measured using a broadband electromagnetic radiation level meter "PZ-41". Determination of levels of industrial frequency electric fields at workplaces was carried

out using a near field strength meter of the "NFM -1" type, equipped with a measuring probe E (electric field).

Measurements of electrostatic field levels at workplaces were carried out using a universal electrostatic field strength and potential meter ST-01.

The measurement time was chosen when the computer being examined was switched on for at least 20 minutes, with the surrounding peripheral equipment switched on. The alternating electric fields were measured by the IEP-05 device with a disk probe included in the Cyclone-05M measuring kit. The measuring probe was placed at a distance of 50 cm from the monitor screen surface (the location of the computer operator's case), the readings were taken at three height levels: 1.2 m, 1 m and 0.5 m from the floor. The maximum root-mean-square value of the electric field measured at each point was taken as the standardized indicator.

Alternating magnetic fields were measured in the frequency ranges of 5 Hz - 2 kHz and 2 kHz - 400 kHz with the measuring probe positioned at a distance of 50 cm from the monitor screen surface, the root-mean-square readings along three axes were taken at a height of 1.2 m, 1 m and 0.5 m from the floor level at the computer operator's workplace. The maximum root-mean-square value of the alternating magnetic field measured at each point was taken as the standardized indicator.

To identify new sources of electromagnetic radiation not covered by the existing SanPiN 0224-07, a study was made of the characteristics of modern computer equipment used at the investigated workplaces and measurements of electromagnetic radiation levels in the frequency range above 300 MHz. The measurements were made in accordance with the existing methodology according to the normative document GOST 12.1.006-84 "OSBT. Electromagnetic fields of radio frequencies. Permissible levels at workplaces and requirements for monitoring". An isotropic measuring probe was placed at a height of 1.2 m, 1.0 m and 0.5 m from the floor level.

### 3. Research Results

More than 87% of call center employees were women, the average age of employees was 35 years, and more than 39% of employees were under 30 years old, with work experience ranging from 5 to 10 years in 34% of cases. When studying the working conditions in 2 workrooms (the main hall of the support and service center and the supervisors' (senior operators') room), it was found that the ratio of the area of the premises to the number of computers located in the main hall of the support and service center does not meet the requirements of the current SanPiN 0224-07, which is 6 m<sup>2</sup> per 1 computer. At 28 workstations, we found that the average noise levels exceeded the permissible level by up to 5 dB (65 dB, according to SanPiN 0325-16), while the average illumination levels, monitor screen brightness, and microclimate parameters corresponded to the permissible

levels. The average values of the alternating magnetic field (2 kHz – 400 kHz), alternating electric field (2 kHz - 400 kHz), electrostatic field, industrial frequency electric field (50 Hz) at workplaces, as well as at the point of closest proximity of parts of the worker's body to a standard computer (10 cm from the system unit) did not exceed the standard values, while the average levels of the alternating electric field (5 Hz - 2 kHz) exceeded the permissible levels (25 V/m) and amounted to 37.4 V/m. The values of electromagnetic radiation in the frequency range of 2.4 GHz and 5.1 GHz (the operating frequencies of the interface of wireless peripheral devices and wireless data transmission network installations of the "WiFi" standard) did not exceed the permissible values and were background.

Research of working conditions of employees at workplaces of the department of information technology service and the department of development and design of telecommunication networks of the Branch "TShTT" of JSC "Uzbektelecom" showed that men make up more than 81% of the total number of employees, the average age of employees was 33 years. The length of service of employees in 45% of cases is from 5 to 10 years.

The working conditions in the office of the head of the RPTT department, information technology service rooms No. 1 and No. 2, as well as in the office of the telecommunications network development and design department, the ratio of the area of the room to the number of computer systems located in the information technology service room does not meet the requirements of the current SanPiN 0224-07.

The illumination level indicators did not correspond to the permissible values at 7 workplaces, while the noise levels were found to be exceeded at 14 workplaces compared to the permissible parameters (50 dB, according to SanPiN 0325-16). The microclimatic indicators of the working environment, atmospheric pressure and brightness levels of monitor screens corresponded to the permissible values.

The average value of the parameters of the alternating magnetic field (5 Hz-2 kHz; 2 kHz-400 kHz), alternating electric field (2 kHz – 400 kHz), electrostatic fields and electric fields of industrial frequency (50 Hz) does not exceed the maximum permissible levels (MPL). At the same time, the average value of alternating electric fields (5 Hz-2 kHz) exceeds the maximum permissible values (25 V/m) and is 32.8 V/m.

The levels of electromagnetic radiation in the frequency range of 2.4 GHz and 5.1 GHz (the operating frequencies of the interface of wireless peripheral devices and wireless data transmission network installations of the WiFi standard) did not exceed the permissible limits and were background levels.

### 4. Conclusions

1. The working conditions of call center workers do not meet the hygienic requirements for noise levels

(50.9%), magnetic field in the range of 5 Hz – 2 kHz (3.6%), electric field in the range of 5 Hz – 2 kHz (67.3%) and illumination (10.9%).

2. Exceeding the standard values of noise levels is due to the peculiarities of the work process of the support and service center, and the electric field indicator is associated with over-compression and close location of computer systems relative to each other.
3. The working conditions of the employees of the communications enterprise are characterized by exceeding the standards for alternating electric field (5 Hz - 2 kHz) by 45%, for illumination by 31.8% and for noise levels by 63.6%.
4. Exceeding the levels of intelligence in the workplace is associated with communication between employees in the process of performing work functions, and insufficient lighting is due to a decrease in the luminous flux due to outdated lamps based on LED assemblies.

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