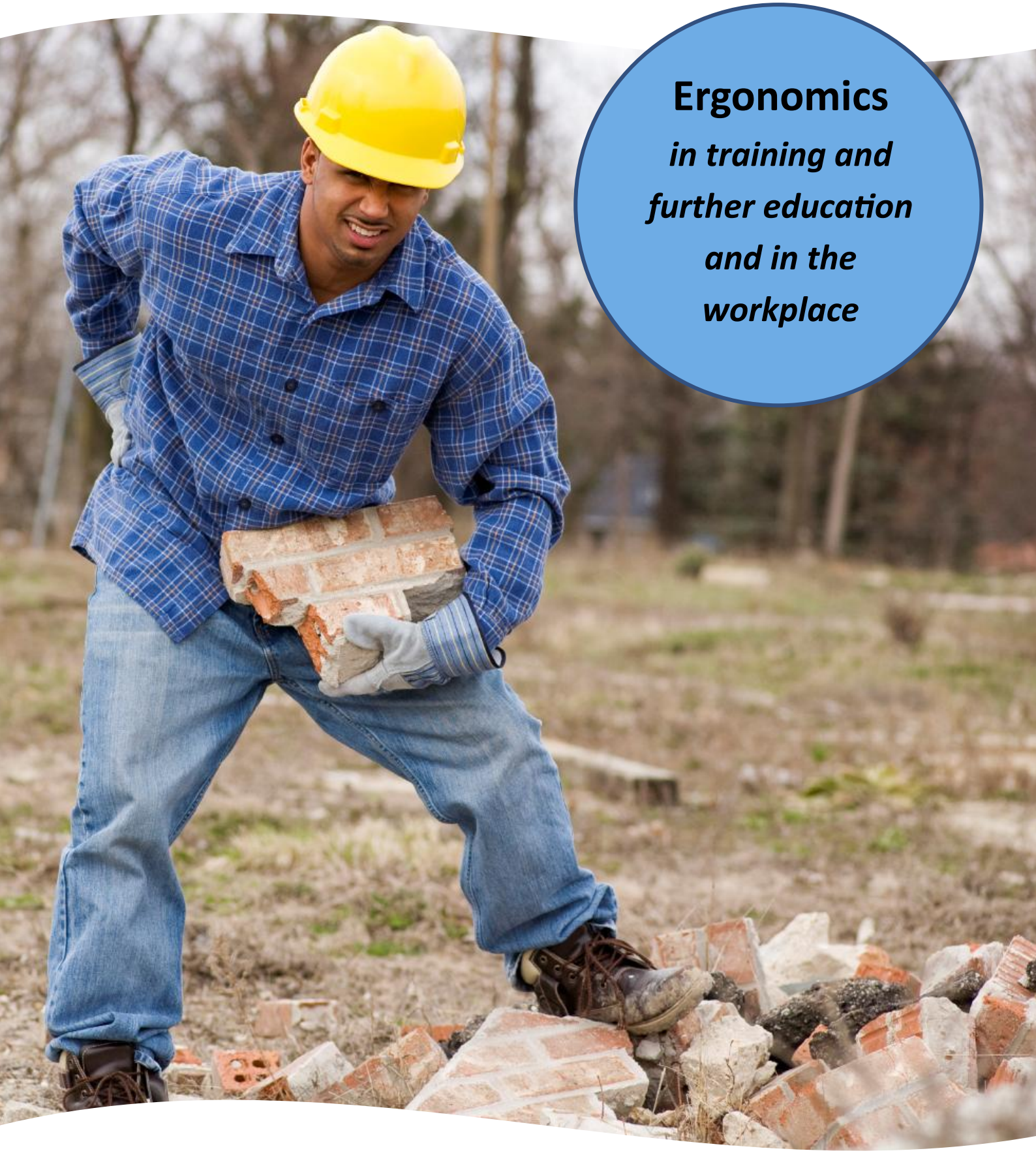
Ergonomics

in training and further education and in the workplace



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Co4 Health

The digitisation of the construction trades has now reached all construction professions, meaning that the professional skills of construction workers now encompass both practical activities on construction sites and digital knowledge.

*Meanwhile, occupational safety on construction sites is intensifying its focus on digital documentation, stricter standards and improved fire safety regulations.**

*Current risk assessments prior to the start of work, the increased use of digital monitoring technology (drones, sensors) and the promotion of preventive measures (Vision Zero) (e.g. in Germany by BG BAU), particularly to prevent falls, were also taken into account.***

Health protection therefore plays an important role not only on the construction site.

At the same time, one should not ignore the dangers associated with working on a computer.

Important health aspects must be taken into account here.

The health of a person who works at a computer is greatly influenced by their spatial working conditions – the organisation of the workplace.

Irregularities in this area can lead to various illnesses in employees after a certain period of time.

Health risks associated with working at a computer:

- psychological
- somatic

Somatic hazards:

- mechanical damage
- damage caused by radiation

The symptoms can be as follows:

- Eye strain,
- Blurred vision,
- Changes in colour perception,
- Muscle and joint pain,
- Stiffness (pain) in the wrists,
- Pain and stiffness in the neck and shoulders,
- Numbness and cramps in the hands,
- Back pain,
- Pain in the hips and leg muscles,
- Restlessness and nervousness,
- Exhaustion,
- Weakness,
- Burning of the skin.

Space for working on a computer

Workstation layout

Working at a computer screen can be classified as strenuous work due to the strain it places on the eyes and musculoskeletal system, as well as its potential negative effects on health.

Employers are obliged to ensure working conditions that meet the minimum requirements for occupational health and safety in order to minimise these negative effects.

- 13 m3 per workstation
- 2 m2 of free space per employee
- Room height 3 m (2.5 m if additional conditions are met)
- Monitor at least 1 m away from the window
- 60 cm distance between workstations
- 75 cm passage between workstations
- 80 cm distance between the employee and the back of another monitor
- Keyboard at least 10 cm from the edge of the table

Microclimatic conditions

Creating a suitable microclimate in the workplace:

- Recommended temperature: 21–22 °C, min. 18 °C (optimum 20–24 °C in winter and 23–26 °C in summer)
- Humidity: min. 40%, OPT. 50-65%. (>50% prevents the formation of excessive electrostatic field strength near the computer). The higher the temperature, the lower the humidity should be to prevent the room from becoming stuffy.
- The radiation from the screen disturbs the balance between positive and negative ions, to the detriment of the negative ones. The human organism reacts to this with depression, high blood pressure, reduced performance and headaches. These phenomena can be counteracted by using wooden floors and wood panelling in the environment and placing plants in the room (preferably ferns, geraniums, thuja, dwarf juniper, aloe and three-masted flowers).

In winter, the humidity in rooms with central heating drops to 30% and the electrostatic potential of the screen can be particularly high.

Lighting

Blinds or curtains should be used to prevent excessive heating of equipment by sunlight. Monitors, computers and other devices emit a relatively large amount of heat, which leads to a local increase in air temperature and a simultaneous reduction in humidity.

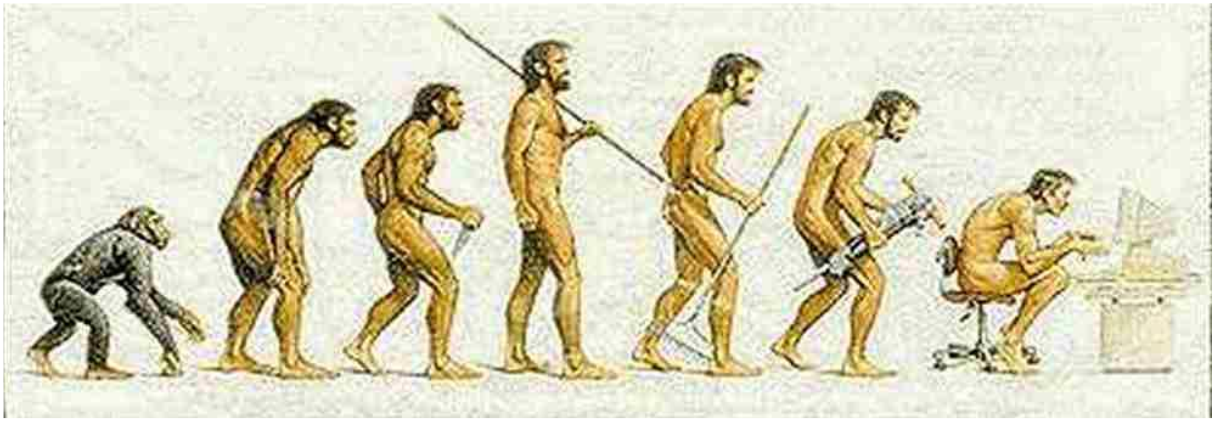
Artificial ionisation of the air

Ionisers should be placed at a distance of 1-2 m from the workplace. Relatively short ionisation times (60-110 minutes) and two one-hour breaks in the operation of the ioniser are recommended.

Incorrect posture at work

An incorrect posture is not just a problem during the completion of work tasks on the construction site.

The average computer worker uses the same furniture for 80,000 hours (8 years!). If the chair does not provide sufficient support for the lumbar region of the spine, the back has to “adapt” to the unergonomic backrest. This unnatural posture causes the neck and shoulders to stiffen. Incorrect positioning of the hands on the keyboard can lead to chronic, dangerous hand disorders.



"Something, somewhere went terribly wrong " image by an unknown artist (Localoaf, 2011)

Spinal injuries as a result of incorrect sitting posture over a long period of time

When working at a computer, we adopt a wide variety of strange and, from an anatomical point of view, unbelievable postures. We adjust our spine unnaturally and thus cause deformities in its structure. A healthy spine has curves that provide adequate cushioning for the rest of the body, especially the head.

Changes in the position of the collarbones

The anatomical position of the clavicles is associated with an upright posture and allows for proper ventilation of the lungs. Incorrect posture can lead to permanent deformities. When working at a computer, our upper arms are held in an unnatural position (the hands are slightly apart, which leads to incorrect posture of the rest of our body).

The cardiovascular system (practical)

The negative effects of prolonged sitting on the cardiovascular system as a whole are well-known, and sitting is the basic posture when working at a computer. Sitting forces people into an unnatural posture of the lower limbs, which is a direct cause of reduced blood flow to our legs.

Impaired blood circulation can lead to many dangerous conditions, such as:

- Heart failure
- Formation of peripheral oedema – mainly in the lower parts of the body
- Prolonged blood circulation time
- Enlargement of the liver
- Increased venous pressure, manifested by congestion in the jugular veins
- Thrombosis

The correct posture at work

1. Keep your head straight so that your neck is not bent and there is no deformation of the cervical spine.

2. Lean your back against the backrest of the chair to avoid fatigue of the spine in the back area. It is advisable to use a special back support.

3. Keep your elbows close to your body or rest them on the armrests of the chair to avoid putting additional strain on your back.

4. Adopt an ergonomic working posture by adjusting the backrest and height of the chair.

5. Use the keyboard in such a way that your wrists are not bent.

6. Raise the chair, making sure that your feet are flat on the floor.

7. Your legs should be bent at a right angle.

8. Your feet should be flat on the floor or on a suitable footrest.

9. The keyboard should be about 10 cm from the edge of the desk. It is advisable to use keyboards with stands. If the keyboard is not equipped with such a stand at the factory, a suitable stand, e.g. made of gel, can be purchased separately.

10. Position the monitor at a reasonable distance from your eyes, with the top edge of the monitor slightly below eye level.

Carpal tunnel syndrome, RSI (repetitive strain injury) and cumulative trauma disorder

Occurs when the hands are bent upwards for many hours. Using a mouse without wrist support can also lead to the health problems described. This causes progressive irritation of the main nerve in the hand. Typing on a computer keyboard increases the risk of developing carpal tunnel syndrome, in which repetitive injuries and strain lead to compression of the nerves passing through the wrist. The use of a computer keyboard is one of the most common causes of repetitive strain injuries in the workplace.

This condition occurs after many years of daily work lasting several hours in conditions that do not comply with ergonomic principles. It is to be expected that in the coming years, more and more people will suffer from RSI and other conditions caused by working with a keyboard and mouse in a manner that does not comply with the recommendations of experts.

Symptoms:

- Numbness, pain and tingling in the thumb, index finger, middle finger and possibly ring finger, which often worsen at night.
- Pain that radiates from the hand through the forearm and upper arm to the shoulder.
- Sensory disturbances in the fingers, which are not always noticed by the patient.

Workplace equipment

The desk should be at least 80–90 cm wide and at least 120–160 cm long. The width of the tabletop should be large enough to accommodate a keyboard, mouse, document tray and monitor. There must be a space of 5–10 cm between the front edge of the tabletop and the keyboard so that the hands can rest comfortably. The height of the desk should be adjusted to your height and be adjustable within a range of 65–75 cm. The surface of the tabletop should be matt or semi-matt. The more free space remains on the desk after all the necessary items have been placed on it, the better.

The desk should provide sufficient legroom under the tabletop. No wastepaper baskets, computer units or other devices that restrict leg movement should be placed under the desk in the leg area.

Important: The tabletop should have a non-slip surface!

Chair / Seating

It must be stable and swivel, should have a five-legged frame with castors and offer the option of adjusting the seat height and backrest. The seat should be upholstered with a thick layer of soft, elastic, preferably natural material. It must ensure freedom of movement. It should have armrests so that you can rest your elbows comfortably on them. It should have an adjustable backrest and support the lumbar spine.

Vision

Optimal field of vision – this is the area where we place the elements we look at most often while working, such as documents or the screen. The field forms a cone with a vertex angle of approximately 30 degrees. The screen should be placed in this field. The illuminance should be approximately 500 lx.

The Eye Clinic of the Medical Academy in Wrocław conducted a nationwide study on the impact of computer work on vision and general well-being. The study included determining the quality and frequency of complaints related to working on computers, analysing the impact of monitor filters on the frequency of their occurrence, and analysing the monitors used in Poland. Over 5,000 people took part in the study. The research conducted shows that among people who work at computers, 96 out of 100 have visual complaints. Research conducted in the USA on a group of people who work at computers for more than three hours a day has shown that almost 80% of them have acquired visual impairments and practically 100% suffer from other complaints directly related to computer use.

Particularly strenuous for the eyes are: prolonged, precise staring at an image at close range in conjunction with concentrated thinking and constant changes in the direction of gaze and the point of fixation. It is estimated that the average speed and range of eye movements when working at a computer is about 2.5 times greater than during other activities that require visual activity. Not everyone is aware that our eyes make around 30,000 movements during an eight-hour workday spent looking at details on a screen. The changes observed on the screen are more stressful for the eyes when using monitors with larger diagonals and very bright images. When adjusting the settings, it is important to remember that increasing the brightness is better than increasing the contrast. Too much contrast causes the eyes to tire quickly. Reading is least tiring when the image is displayed on a brighter background.

Above all, *attention should be paid to the correct setting of the monitor and lighting.* It is recommended to use diffuse general lighting and, if necessary, local lighting (e.g. to make it easier to read the document to be transcribed) at an intensity that does not create excessive contrast between the illuminated area and the monitor. Natural light is best for the eyes, and if this is not available, artificial light with a spectrum similar to daylight is recommended. As a rule, an illuminance of 500 lux is sufficient, although for data entry, for example, this value must be increased to up to 700 lux. The need for light increases with age. Studies have shown that people with healthy eyes aged 50 need almost twice as much light for the same work as 20-year-olds. Older people should therefore provide additional lighting for their workplace.

The viewing angle of the monitor should be perpendicular to the direction of light.

It is not recommended to sit facing the window or with your back to the window, as this will cause large irregularities in luminance in your field of vision, forcing you to adopt an uncomfortable posture. If there is no other option, people sitting facing the window should use special screens for their monitors.

The eye can only see a tiny section clearly – so it is best if it is constantly in motion. If it remains still for a long time, the light-sensitive cells become tired and we perceive the image less clearly.

• *Let's try to learn a new technique for looking at the screen. The idea is to use willpower to force your eyes to constantly scan your field of vision.*

• When we are thinking intensely or are busy following something interesting on the monitor, we stop blinking. This is because the eyeball and eyelids are controlled by common areas of the brain. Frequent blinking allows the eyes to relax, and the eyelids can then perform their natural function of cleaning and moistening the eye.

Time measurements have shown that when typing on a computer, we spend an average of 64% of our time looking at the screen, 21% at the keyboard, 14% at paper documents and only 1% at other places. When working for long periods of time, it is necessary to look at a distant object from time to time. It is advisable to increase the font size and line spacing (if possible). Avoid frowning when looking at the monitor. Although this helps some people to concentrate, it also increases the effort required for correct vision.

If you find yourself doing this, you should massage your forehead and eyebrows.

Chemical hazards

Electrosmog

Both computers and monitors emit odourless gases – oxides and furans – that are harmful to our health. These compounds, which are among the most dangerous toxins in the environment, are carcinogenic. They are part of a polybrominated fireproof emulsion used to coat the housings of monitors and control centres. New devices should be kept in a well-ventilated room for a few days to allow the chemicals contained in the components to escape.

Ventilation: The room should therefore be air-conditioned or frequently ventilated and humidified.

When working on a computer, we are exposed to various fields and radiation. These include:

- Alternating electromagnetic fields (EM) with different frequencies, which emanate from the power supply and the horizontal and vertical deflection coils of the monitor.
- Electrostatic fields (ES) caused by a strong positive charge on the screen, which arises between the monitor and the person sitting in front of it.
- Weak but detectable X-rays emitted by the high-voltage system.
- Ultrasound associated with the operation of the transformer.

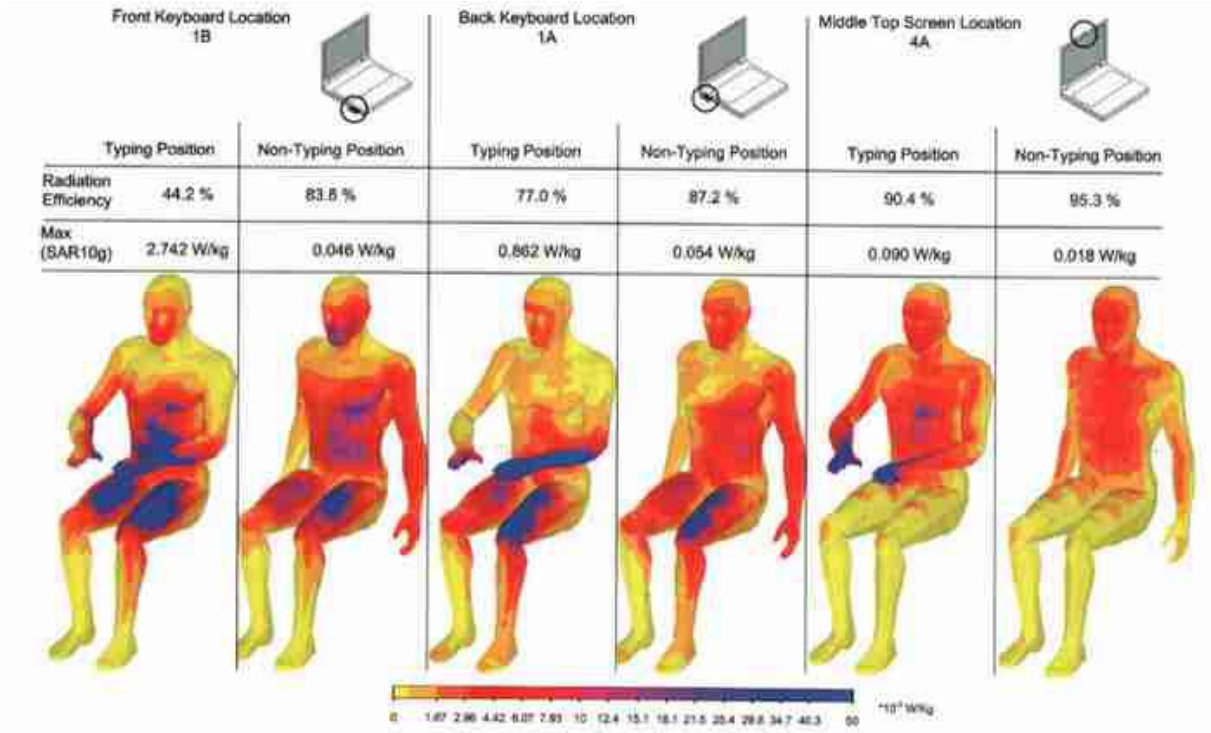


Figure 22. The absorption of electromagnetic energy in human tissue: the resulting antenna radiation efficiencies and SARs in the operator's body at 2.44 GHz for different inverted-F antenna (IFA) element locations.

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The biological effects of ionising radiation can be divided into two groups:

- **Somatic effects** – occur immediately after irradiation of the entire body. Later effects of such irradiation include leukaemia, malignant tumours of the bones and skin, cataracts, digestive tract disorders and infertility.

- **Genetic effects** – are related to mutations in genetic material. Low doses of radiation absorbed once only become apparent in subsequent generations in the form of mutated organisms. High doses, on the other hand, are usually fatal.

People who work in areas of high exposure to radiation are particularly susceptible to what is known as 'radio frequency sickness', also called 'microwave sickness', which has been confirmed by medical examinations.

This syndrome is characterised by the following symptoms:

1. Burning under the eyelids and watery eyes,
2. Headaches,
3. Nervous irritability,
4. Hair loss,
5. Dry skin,
6. Nystagmus,
7. Sexual impotence,
8. Disorders of the vestibular system,
9. Decreased sex drive,
10. Cardiac arrhythmia,
11. Neurotic symptoms.

PRACTICAL TIPS

1. Do a short warm-up before you start working – warm up your wrists, elbows, shoulders, spine and legs.

2. Make sure your wrists stay warm – don't let your muscles and tendons cool down after warming up. This puts you at greater risk of strain.

3. Take frequent breaks to stretch and relax your muscles.

4. Take up a sport that exercises the whole body, such as swimming – this has an excellent effect on the development of virtually all muscle groups and strengthens them, making them less prone to injury.

5. 20-20-20 – take a break from working at the screen every 20 minutes. During the break, look at a point at least 6 metres (20 feet) away for 20 seconds.

6. When typing on the keyboard, do not press the keys too hard – press them gently.

7. Hold the mouse loosely – do not press it too hard. Position it so that you do not have to reach far for it. Consider using a trackball (mouse with a large ball). This type of mouse puts significantly less strain on the wrist. If you use a conventional mouse, use wrist rests.

8. Use a good keyboard – well-shaped, made of good materials.

9. Buy an ergonomic chair with an adjustable backrest in the lumbar region. You can also use special backrests. It is good if the armrests are padded with a soft material – foam or sponge. This prevents damage to the elbow nerves.

10. Limit the amount of time you spend at the computer. If you work at the computer for too long, neither correct posture, exercises, good furniture nor other equipment will help you if you are working beyond your body's limits.

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