7.5 Work Stations

1 Credit: Implement 5 of 11

- All work stations have space underneath for knees and toes.
- All work stations have adjustable height chairs.
- All work stations have adjustable height work surfaces and/or can be configured for sitting or standing work upon request.
- All work stations have user-controlled task lighting.
- Where work stations have computers, all such stations have adjustable keyboard trays.
- Where work station shave computers, all such stations have a flat work space on the left and right side of the computer monitor.
- Where work stations have computers, all such stations have a wire management system.
- Where work stations are intended standing work only, all such stations are designed to avoid unnecessary bending, lifting, or twisting.
- Work stations are available for group work, including nontraditional and alternative working styles (e.g., lounge, game rooms, etc.).
- Work stations share a central hub containing shared supplies and resources (e.g., printers, copiers, office supplies, etc.).
- Where work stations are located in factory settings, all such stations have equipment to assist in moving heavy loads.

1. Overview

An eight-hour work day is common for many adults. This means people typically spend half of their waking hours at work (Bureau of Labor Statistics, 2016). The postures someone maintains regularly at work have lasting effects on their body. Chairs, tables, desks, document holders, keyboards, monitors, a mouse, telephones, and other tools are different components that someone may interact with daily, and are typically provided by the employer. It is necessary to consider how the environment and the features in it will affect the worker.

Figure 1: A sit/stand work station allows the user to choose what position is best for them. Image courtesy of UNICOR.

Each worker has different needs that may change over time. Employers should expect to make *adjustments to the work environment over time*. Workers should feel comfortable bringing their needs to the attention of their employer. Recognizing a problem early and making the appropriate adjustments can prevent long term discomfort and pain. Accommodating workers' needs early on can reduce time missed from work, time to hire and train replacement staff, and worker's compensation costs. Additionally, addressing worker needs can make the worker feel valued and more committed to the work they are doing.

2. Issues to Consider

Biomechanics: Research in biomechanics has produced several guidelines that are applicable at all scales of design (Steinfeld and Maisel, 2012). They include:

- Reducing unnecessary and potentially harmful movement
- Reducing unnecessary operating forces
- Reducing effort required for lifting
- Designing to maintain balance

If work stations do not meet these guidelines, the worker may acquire a work-related musculoskeletal disorder, a term for when someone experiences pain or discomfort from activities that they do at their job (Occupational Health and Safety Administration, 1970). It can be the result of an instantaneous or acute event, but may reflect a more chronic development.

Prolonged periods of work and highly repetitious activities wear down employees. Sustained stress or fatigue can lead to injury. It is important for the employer to provide the proper equipment to inhibit any musculoskeletal disorders from developing. Everyone is different, so a single solution may not work for everyone. Therefore, workers should notify the employer when discomfort is developing. The sooner a solution is implemented to address the pain and discomfort, the sooner it will subside. Work should be completed safely and comfortably.

Adjustability: Many employees may use the same work station before someone asks for a modification. This may be due to differences in body size, or anthropometric data. Anthropometric data is commonly used by designers to decide the measurements of a product. Historically, body size averages were used by the Air Force to design fighter jet cockpits (Rose, 2016). Pilots used to be chosen based on their height, ensuring they could fit into the cockpit. As time went on, fewer people met the height requirements and incidents started to occur. It was suspected that incidents occurred because taller pilots were not able to control their planes.

A study was conducted in the 1950s to see how the body averages had changed from the 1920s. Collected anthropomorphic data indicated that not one of the participants fit the anthropomorphic average for any of the ten dimensions measured (Rose, 2016). Designing for the average airmen in the 1920s did not work because the average size of people changed over time (Rose, 2016). This research helped the Air Force to understand that designing for averages was not appropriate. Adjustable settings allow more people use a feature comfortably. Adjustable settings and other design solutions were implemented and pilot performance soared (Rose, 2016). Other branches of the military also made adjustments so that equipment fit a range of body sizes (Rose, 2016).

If a product is not adjustable, then the top and bottom percentile measurements of the populations should be considered during its design. Since different types of people (i.e., men, women, children, etc.) vary in body sizes, the design team should decide what anthropomorphic data is appropriate to use. Employers should be aware that some products may not suit all of their workers. It may be necessary to buy different equipment for different people.

Ergonomic Products Labels: Keyboards often come with tabs on the bottom that can be flipped to tilt the surface. When the tabs are in use, the forward most side of the keyboard is tilted higher. This common feature actually exposes the user to a much higher risk of attaining tendinitis in the wrist. Tendinitis can be caused by contact stress to the tendon sheath. Keeping the wrist in a neutral or relaxed position helps to prevent tendinitis, but using a keyboard that tilts up can cause contact strain on the wrist (Occupational Safety and Health Administration, n.d.). Even when a designer creates a product intended to be easy to use, however, in some cases there may be unintended consequences. In fact, a product may help certain users, while impairing others. Large companies and organizations should have a Health and Safety

Department that should be contacted to evaluate issues and suggest products. Smaller organizations may need to hire a consultant who has specialized knowledge and can suggest possible solutions to a problem.

Figure 2: Upward bending of the wrist can cause damage to the tendons in the wrist. Image courtesy of OSHA.

Education of Users: Providing universally designed workplaces is a major component of taking care of employees. Besides providing a well-designed workspace, the employee needs to be educated on how to use the features. For example, employees may be unaware that computer monitors are adjustable in height. They also may not know the appropriate height the monitor should be at to reduce health risks. Employers should provide an orientation for new hires that address healthy use of the features in the work environment.

3. Relatedd Standards

ISO 6385:2016 Ergonomics principles in the design of work systems supplies a general knowledge of ergonomics (human factors), engineering, design, quality, and project management (International Organization for Standardization, 2016). This can help the reader understand different ways to recognize hazards and how to mitigate them.

American National Standards Institute (ANSI)/ Human Factors and Ergonomics Society (HFES) 100-2007 Human Factors Engineering of Computer Workstations addresses the design of workstations, furniture, and computer systems to reduce workplace-induced back pain and eyestrain among American workers (Torres, 2008). Acoustics, temperature, ventilation, product emissions, hardware components, and lighting are covered by this standard. Larger organizations that have an environmental, health, and safety department; workstation installation companies; and ergonomic consulting companies would likely find this resource useful. Alternatively, it may be advisable for a company to find a consultant to work with.

Center for Disease Control and Prevention (CDC) and National Institute for Occupational Safety and Health (NIOSH) provides a booklet called *Elements of Ergonomic Programs*. The book covers management commitment, worker participation, and training for identifying, evaluating, and controlling risk factors for work-related musculoskeletal disorders (Centers for Disease Control and Prevention, 1997). Workers should be informed how to use their equipment to prevent injuries. NIOSH is a research agency that was established by the OSH Act of 1970 and is part of the CDC. They have a wealth of articles detailing study outcomes that an employer could use to help prevent musculoskeletal disorders from effecting workers.

OSHA—Section 5 General Duty Clause stipulates that the employer shall provide a workplace free of all recognized hazards that are likely to cause death or serious physical harm (Occupational Health and Safety Administration, 1970). Recognized hazards include equipment with frayed wiring and unhygienic workplaces. This organization is part of the United States Department of Labor. They enforce the OSH Act and are able to fine companies that disregard the regulations. OSHA provides a Computer Workstations eTool for employers to reference, which lists risk factors so people can recognize early warning signs of health risks. A checklist is provided so that someone can perform a layman's evaluation of a work station (Occupational

Health and Safety Administration, 1970). OSHA believes employees who are not adequately trained are at potential risk for musculoskeletal disorders. The users should be aware of general ergonomics related to their work station, and learn to correctly use and adjust components.

The above standards can be used as resources for designing work stations. The *isUD Solutions* provide specific actions that can be done to ensure the health and safety of a worker (reference *isUD Solutions 9.2 Health and Safety Polices*). The standards listed here provide more in-depth explanations and examples of strategies to mitigate workplace injuries.

4. Measurement and Verification

Many companies have specifications for their products listed online. These specifications can help the buyer compare products. Reviews and comparisons of similar products may be found on websites such as Consumer Reports and The Wire Cutter. These sites can help someone find products that will suit their needs, but for them to be useful, it is important to know who wrote the article, what the author's expertise is, and what specifications best fit your current and future needs. It is best to consult someone with an understanding of ergonomics, such as a health and safety department member or an occupational therapist. This person should know the potential hazards associated with different designs and can help create a customized solution. It may be necessary to try a product before knowing if it is right, so warranties and return policies should be considered when choosing a product. Verification that the product is helping someone may take time. The user will have to report on the modifications. Verification will be a process. People's needs may change over time. The employer and employee should recognize the process is iterative.

5. Design Considerations

1. *All work stations have space underneath for knees and toes.* Adequate space under a work station allows people of all body sizes and abilities to comfortably utilize the features of the space. The *isUD Solutions 2.3 Knee and Toe Clearance* can be referenced for specific measurements.

2. *All work stations have adjustable height chairs.* Average dimensions of body parts can be computed from a set of data. Most people are not average in size, so using average measurements is an ineffective way to meet the needs of users. It is important that each person be able to work in a way that fits them. Adjustable chairs can allow more users to sit properly, minimizing the risk of injury.

3. *All work stations have adjustable height work surfaces and/or can be configured for sitting or standing work upon request.* There should be a balance of standing and sitting throughout the day. Continuous sitting or standing can result in injuries such as back, knee, and foot pain. Switching between sitting and standing throughout the day reduces the risk of such injuries.

An article in *Occupational Health and Safety* details several guidelines for work stations:

- Limit continuous sitting to 4 hours per day.
- Limit continuous standing to 1 hour per day.
- Limit cumulative standing to 4 hours per day.
- Promote variation between sitting and standing positions throughout the day.
- Design the work station for active movement while sitting and standing[9].

These guidelines acknowledge that people have varying needs. The user will feel empowered to be able to choose to stand or sit and will feel healthier for it.

4. *All work stations have user-controlled task lighting*. Most work spaces utilize overhead lighting. For more detailed work, it may be necessary to add task lighting. A worker may find it easier to read, write, or do fine motor skill tasks with direct lighting. Natural daylighting and overhead lighting may not be sufficient for all users.

5. *Where work stations have computers, all such stations have adjustable keyboard trays*. The worker should be able to place the keyboard so that their upper arm can rest perpendicular to the floor. The forearms should be positioned so that the wrist can maintain a neutral position while working. *Figure 3* shows the OSHA recommended range of placement for a keyboard. The worker may switch between standing and sitting throughout the day, and an adjustable keyboard should accommodate both positions. Proper placement of the keyboard can prevent contract stress and musculoskeletal disorders.

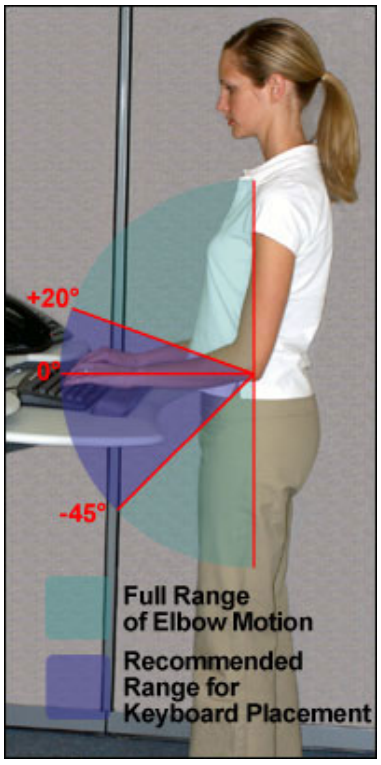

Figure 3: Diagram from OSHA showing the recommended range of keyboard placement.

6. *Where work stations have computers, all such stations have a flat work space on the left and right side of the computer monitor*. Worker may need reference books, tea mugs, or paperwork near them while they work. A flat work space on both sides of a computer work station allows both right and left-sided dominant users to place items where they would like. It could also allow the user to change positions to mitigate repetitive motions.

Figure 4: Computer work station

7. *Where work stations have computers, all such station shave a wire management system*. When wires become frayed, they are more likely to spark and cause a fire. The employee should know to notify the employer of frayed wires. The employer should have the wire removed immediately and replaced as soon as possible. A wire management system can help to prevent fraying and makes the system safer and easier to use. The system can also reduce tripping hazards and extend the lifespan of the wires.

8. *Where work stations are intended standing work only, all such stations are designed to avoid unnecessary bending, lifting, or twisting*. Excessive bending, lifting, or twisting while standing can cause undue stress on the body. A back or knee injury could occur if these movements are done improperly, too often, or too quickly. These movements can lead the worker to develop musculoskeletal disorders and should be avoided. The layout of the work station can help to prevent these movements. Someone trained in ergonomics can observe the worker to see if these movements are occurring, and bring

Figure 5: Group work tables and a work lounge

it to the attention of the worker. They can also suggest better work methods, or equipment that may better serve their needs.

9. *Work stations are available for group work, including nontraditional and alternative working styles (e.g., lounge, game rooms, etc.).* Workers may have contrasting preferences for working in groups. These different styles can enrich the team, and it may be helpful to provide various nontraditional work areas to properly include them (Tate, 2015). By providing alternative working spaces, the employees are likely to be more productive and comfortable. The group work tables, on the left in *Figure 5*, are in a shared lounge. The group work tables are enclosed on one side with glass so that the noise from the space does not travel, however, the space stays visually connected with the office. The lounge on the right, in *Figure 5*, offers more plush seating. A worker may prefer to sit on the couch, rather than a desk, while working. These spaces add interest to the office and can create a more productive environment.

10. *Work stations share a central hub containing shared supplies and resources (e.g., printers, copiers, office supplies, etc.).* Placing shared supplies and resources in one location makes it easier for workers to navigate the space. If the worker needs multiple items, their centralized location make it easier to gather what they need in a single trip. Organizing the space in this way leads users to intuitively understand where to go for resources.

11. *Where work stations are located in factory settings, all such stations have equipment to assist in moving heavy loads*. Manual materials handling is the most common cause of occupational fatigue, low back pain, and lower back injuries (Canadian Centre for Occupational Health and Safety, 2017). Providing proper equipment to move heavy loads can reduce the strain put on a worker. Workers should be trained to use lifting equipment and given enough time to transport loads safely. Rushing the transportation of a load may increase the chances of the worker committing inappropriate postures to complete the job on time. The employer may consider purchasing equipment to avoid additional unnecessary costs. When an injury occurs there is a potential loss of profits from lost time at work, rise in cost for workers' compensation insurance, and the possible need to hire and train a new worker. These expenses are usually much steeper than the cost of equipment that could have helped prevent the injury. OSHA's Safety Pays

Program can help an employer estimate the total direct and indirect cost of a workers injury. One of the outputs of the Safety Pays Program can be seen in Figure 6. This program can be used to justify buying new equipment in order to prevent an injury and the costs associated with it.

Estimated Total Cost

The extent to which the employer pays the direct costs depends on the nature of the employer's workers' compensation insurance policy. The employer always pays the indirect costs.

Injury Type	Instances	Direct Cost	Indirect Cost	Total Cost	Additional Sale (Indirect)	Additional Sale (Total)	
Strain	1	$ 33,140	$ 36,454	$ 69,594	$ 1,215,133	$ 2,319,800	Remove

Figure 6: A strain injury has been put into OSHA's Safety Pays Program. These are the projected cost that the employer will take on from this injury type. Assuming the office operates with a 3% profit margin, additional sales needed to recoup the loss are also given.

6. Definitions

The following definitions are adapted from OSHA .

Anthropometry	The study of human body measurements. Used in developing design standards and requirements for manufactured products to ensure they are suitable for the intended audience.[3]
Biomechanics	Effort produced by the human body while moving or resisting force
Ergonomic	The study of work, includes designing a process to fit a human rather than making the human adapt to the process.[3]
Musculoskeletal Disorders	Injuries and disorders of the muscles, nerves, blood vessels, ligaments and tendon. May be caused by awkward body postures, repetitive motion, and/or applying force.[3]
Tendinitis	Inflammation or irritation of a tendon caused from repeated tensing[3]

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