WORK INSTRUCTIONS ON ERGONOMICS

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Ergonomics

Ergonomics is matching the job to the staff/worker and product to the user. Ergonomics and human factors are often used interchangeably in workplaces. Both describe the interaction between the worker and the job demands. The difference between them is ergonomics focuses on how work affects workers, and human factors emphasize designs that reduce the potential for human error.

Ergonomic hazards refer to workplace conditions that pose the risk of injury to the musculoskeletal system of the worker. Examples of musculoskeletal injuries include tennis elbow (an inflammation of a tendon in the elbow) and carpal tunnel syndrome (a condition affecting the hand and wrist). Ergonomic hazards include repetitive and forceful movements, vibration, temperature extremes, and awkward postures that arise from improper work methods and improperly designed workstations, tools, and equipment.

Office Ergonomics

Office - General

What does an office worker do?

Office staff may type or file documents, correspondence, reports, statements and other material. Their workstation usually has a computer/VDT and telephone, among other equipment.

The main duties of an office worker include:

- Answer telephone or personal enquiries
- Photocopy and collate documents
- Maintain and update filing, inventory, mailing and database systems
- Open, sort and route incoming mail and courier packages
- Process reports, applications, receipts, expenditures and other documents, using a computer

What are some health and safety issues for office workers?

Although office environments don't usually present the same physical hazards as some of the more safety-critical industries, there are other hazards to be aware of:

- Perfumes and other scents (potential allergens)
- In some cases, exposure to cleaning products
- Indoor air quality
- Sitting for long periods of time
- Working in from awkward positions, or performing repetitive manual tasks
- Lifting awkward or heavy objects
- Eye strain
- Working in uncomfortable temperatures
- Annoying or distracting noise and vibration from electronic equipment
- Slips, trips and falls
- Risk of violence
- Working alone
- Stress

What are some preventive measures for office workers?

- Learn about how to avoid musculoskeletal pain or injury from repetitive or physically awkward tasks. Take breaks as needed.
- Learn safe lifting techniques.
- Keep all work areas clear of clutter.

What are some good general safe work practices?

- Follow company safety rules.
- Learn about chemical safety, WHMIS and MSDSs
- Know how to report a hazard
- Practice safe lifting
- Follow good housekeeping procedures.

The Modern Office

What makes a modern office different from the traditional one?

Office design, since the introduction of typewriter in the early 1900's up until mid- to late 1970's remained virtually unchanged. Dedicated word processing systems such as WANG, for example, started being used in mid-seventies. This was the beginning of a period of rapid changes in office technology. PCs that from early eighties become the main tool for office workers continue transforming offices at an ever increasing pace. And it's not over yet.

All changes in the office environment were and still are driven by advances in technology. The overwhelming impact of computers on office work has resulted in redesigning the office around, if not for, the computer. In many instances the computers have changed not only the shape of the office and the way office work is done, but it has also affected even the lifestyle of office workers.

Do computers contribute to health problems among their users?

Like many other innovations, computers generated a great deal of resistance at first. People raised concerns about the effects of radiation on everything from their eyes, to their neck, shoulders, arms and back, even to their reproductive fertility and pregnancy outcome. Headaches, eyestrain, muscular tension, and suspicious clusters of miscarriages were widely reported. However, studies which have addressed these concerns have failed to prove that any measurable radiation, no matter how minimal, has been responsible for any of the adverse effects reported.

Nevertheless, one cannot discount the increasing numbers of dissatisfied and/or injured office workers: their discomfort and health problems are very real. There is very little doubt that working with computers (with emphasis on the actual work and not the computers themselves) causes or heavily contributes to these problems.

Why ergonomics for the computer users became so important?

The number of people working with computers is ever growing: some estimate that soon they will account for more than half of the working population, creating the biggest challenge for occupational health and safety. What is even more alarming is the high number of complaints about discomforts and injuries. And, against all expectations, the wider application of ergonomic principles is not dramatically alleviating the problems. This creates a new challenge to convince computer operators and, as a matter of fact, all working people that their own health and well-being depends as much, if not more, upon their own actions rather than upon the institutionalized health care system. Prevention through participation may be the right approach. In other words, "the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals".

Space Requirements for Office Work

What is meant by "working space"?

When planning the amount of "space" needed for people to do their work, most planners remember to include all of the tools, equipment, and furniture needed to complete a job. Office jobs entail a great variety of physical and mental activities. Often, the core activities of any office job take place at the desk or at the workstation.

In addition to the physical dimensions of the workspace, other features should also be considered in any design, reorganization or relocation. Some questions to ask are:

- Does the workspace provide acoustical privacy (for example, can people talk in privacy, according to the level of confidentiality required; do noises and conversations interfere with their concentration; do noises or conversations make it difficult to hear or understand speech if much of their work involves using the telephone?)
- Are the walls permanent (i.e., fixed) or is the workspace in an open office environment?
- Does the workspace provide visual privacy?
- Can an employee personalize his or her individual work space?
- Is there access to natural light or only artificial lighting?
- Is the workplace layout designed to facilitate interpersonal contact?

How much space do we need?

There is no one clear-cut answer to what seems like a simple question, for the answer has to deal with many aspects implied by the question. Major aspects include:

Nature of work If most of the workday is spent on field assignments, meetings, site visits and consultations, a smaller office space may be quite satisfactory. However, for office workers who perform their job at their workstation most of the time, a small space may create discomfort due to feelings of confinement. Some job functions that, for example, include frequent meetings in their office space or require the use of multiple sources of material for consultation, research, writing, etc. may be assigned more work space than.

Cultural aspects influence our perception of sufficient space. Cultures often is associated with dense population, much less space could be considered "adequate", or in other words, enough. This can be a significant issue in a multi-cultural society.

A corporate climate Our perception of a designated personal space is a matter of comparison. Employees generally accept the fact that those at higher levels in management positions may have larger offices. However, regardless of how large an individual's space actually is - if it is not as big as what our peers have - then, it is too small.

Individual perception The amount of space available can have profound psychological meaning. It is natural for people to strive to occupy more space, for "more" space may signify importance, respect and more authority or power. In the workplace the amount of our personal space is often linked with our status within the organization.

Anthropometry **(body dimensions)** Actual office space requirements depend on the size and shape of employees simply because an office has to accommodate them, enable them to move safely and unhindered in the workspace, and allow them to complete their jobs. A more spacious office would be always welcome (to allow for easier movement, accommodating visitors, and storage), but the table below provides some minimum requirements:

Table 1

Application	Minimum Requirement Ranges*	
Two people can meet in an office with a table or desk between them - such as a supervisor and an employee	60-72" x 90-126"	5.78 - 11.7 m^2
An employee has a primary desk, and a secondary surface such as a credenza	60-72" x 60-84"	5.78 - 7.8 m^2
Executive office: 3-4 people can meet around a desk	105-130" x 96-123"	9.75 - 11.4 m^2
A basic workstation - such as call center	45-52" x 60-72"	3.9 - 6.7 m^2

Guidelines on how much space each person needs

The allocation of the amount of working space for offices, and for workplaces in general, is too complex to expect specific, objective standards that would apply to all kinds of work situations. This is why existing standards and guidelines similar to the ones mentioned above which are based on typical or average body dimensions (see Table 1 above) specify only the minimum requirements. An example of this kind can be the Canadian federal Treasury Board's minimum space standard which suggests 2.5 m x 3.0 m (8' x 10') for a personal office. These minimum dimensions are average values per person, which means that some offices can be larger than the average and others smaller. These dimensions also include areas that are allocated to common areas (e.g., corridors, washrooms) and "unoccupied" areas taken up by walls and pillars. This means that the actual working space area will be smaller than the "recommended" dimensions.

The Recommended Allocation is for a comparable amount of space: 8.3 m^2 (89.3 ft^2) for office workers.

However a more generous yet very general guideline of 9.3 m^2 (about 100 ft^2) per person is desirable.

In any case the standards and guides mentioned above and any others should be considered merely as guidelines, rather than absolute standards.

Major Work-Related Risk Factors

Factors that can lead to injuries in an office job

Basic office activities involve sitting in front of a computer terminal and operating it by means of typing or moving a mouse. Still, no matter how harmless these activities may seem, they do set the stage for injuries that can develop over time. While these activities are not particularly hazardous for a worker who does them only occasionally, the situation becomes more critical for those who have no choice but to sit in front of a computer screen and type for long periods every working day.

It is very important to know that musculoskeletal injuries (MSIs), and specifically, repetitive motion injuries (RMIs) rarely originate from one event or a particular factor. As a rule they develop over time from a variety of factors. Some factors are strictly work-related and beyond the workers' control. On the other hand, the workers themselves can have some control on other factors, such as their individual work practices. Other things like body build, age, gender, some medical conditions, types of personality, attitudes and life style can also contribute to RMIs. No matter that such factors may be beyond any control, becoming aware of them is nevertheless important.

Work-related factors that present the greatest risk for MSIs involve:

- **fixed and constrained postures** that are frequently awkward, uncomfortable and maintained for too long a time,
- **repetitious and forceful hand movements**,
- **a high pace of work**,

How does a fixed body posture affect your body

Because the human body was designed to move, it cannot tolerate immobility for long. Merely sitting at a desk for long times can be unhealthy and damaging to the musculoskeletal system. Holding the upper body still in an upright position requires a lot of muscular effort and contributes to what is called a static load. That is the invisible but constant battle against gravity and fatigue, and injury is the price.

Both holding one's head at the optimum distance from the screen and document holder and maintaining one's arms in the proper typing position increase the static load on the whole upper body, and on the neck and shoulders in particular. The reduced blood supply that follows not only accelerates fatigue, but also leaves the musculoskeletal system susceptible to RMIs. To make matters worse, the furniture in most offices does not fit the worker either because it is not adjustable or, where it is adjustable, workers are not properly instructed on how to adjust it.

Where does poor work posture originate?

Poor posture can be a result of:

- Non-adjustable or otherwise unsuitable workstations;
- The layout of the workstation is inadequate or is not suitable for its user;

- Lack of knowledge and experience on how to set up an adjustable workstation properly according to the worker's needs (considering both body build and job tasks);
- Poor working habits that remain uncorrected;
- Unsuitable job design that requires a worker to sit uninterrupted for longer than an hour at a time; and
- Lack of proper training, resulting in a lack of awareness.

How can repetitious and monotonous movements affect your body?

Holding the upper body still allows the upper limbs to engage in such fine hand movements used in typing and operating a mouse (categorized as dynamic load). These are common examples of repetitious and monotonous movements. Repeated hundreds or thousands of times, hour after hour, day after day, year after year, these movements strain and gradually cause "wear and tear" on the muscles and tendons in the forearms, wrists and fingers. People who do repetitive work with their bodies in fixed and static positions are even more susceptible to getting RMIs.

Discomfort, numbness and tingling are the danger signs. If these signals are ignored, pain, chronic problems and long-term disability are likely to follow.

How the high pace of work - "working in the fast lane"- affects your body?

Like repetitive and unvarying movements, a high work pace is quite a common reality in the most offices, even if it happens only occasionally. Regardless, whether it is arises from periodic overload or from uneven distribution of work, a regular high speed of work contributes to the development of MSIs very strongly.

The pace of work determines how much time working muscles have for rest and recovery between movements. The faster the pace, the shorter and less productive the recovery times become. This, in turn, increases the risk for RMIs.

A person may be able to set his or her work pace and adapt to the stresses that result. However, more harmful to one's health are external factors that increase the work pace and which are beyond the person's control, such as:

- having tight or frequently changing deadlines;
- knowing your performance is being monitored by some electronic system; or
- being overloaded with work.

The result is that the worker is denied any control over the timing and the speed of work, creating the feeling of "always being in a hurry." This haste and resulting stress while working cause the body muscles to tense up which, in turns, significantly accelerates the risk for developing RMIs.

Personal or Individual Risk Factors

Do personal factors contribute to musculoskeletal problems?

There are certain factors inherent in work tasks that can increase our risk for the onset of musculoskeletal injuries (MSI), such as fixed and constrained postures that are frequently awkward, uncomfortable and maintained for too long a time, repetitious and forceful hand movements, and a high pace of work.

Other factors of a strictly personal nature also contribute to our risk for MSI. These include our state of health or fitness, our addictions, our life style, our posture, and our work habits. These are the focus of this document.

State of health

Although the evidence is not conclusive, there is general agreement among researchers that individuals with medical conditions are more likely to have musculoskeletal injuries. Examples of these conditions include hyper-mobile joints, arthritis, and diabetes or thyroid disease.

Fitness

Poor physical fitness, and the obesity that frequently results from it, also makes us more susceptible to musculoskeletal injuries. For example, poor fitness, particularly when combined with a body weight above the "ideal," is a prime cause of weariness and fatigue which are commonly recognized to be factors that can contribute to the onset of MSI. So, although there is no direct relation between poor fitness (and possible overweight), and muscular discomfort and eventual injury, we can regard a lack of fitness as a strong risk factor for injury, and any feeling of fatigue as a warning signal.

Casual Addictions

Contrary to popular belief, smoking, and the consumption of caffeine or any other comfort food (chocolate, for example), that we commonly practice as temporary stress relievers can actually increase our chances for musculoskeletal injury in the long run.

We may not have control over all of these conditions. However, if we understand the significance of these various factors, it may help us recognize how they are related to the risks in our job activities. Taking this information into account may eventually help us stay injury-free.

Do individual work habits affect your health?

The body positions held while typing and individual typing styles are so significant in the cause of repetitive motion injuries (RMIs) that their impact cannot be overemphasized. Some experts consider that they outweigh any other factors.

How do poor sitting habits undermine your health?

Slouching while sitting with the back slumped against the backrest of the chair compresses the spine and can lead to low back pain. It also puts the head in an imbalanced position, contributing to neck and shoulder problems. Additionally, a slouchy, sitting position encourages the worker to rest the wrists on the edge of the desk in the dorsiflex position (i.e., hands bent upwards or backwards at the wrist). **This is one of the most important MUST NOT DOs in RMI prevention.**

How do typing styles contribute to causing musculoskeletal injuries?

There are many poor typing techniques, even among trained and highly skilled typists. **Pounding** the keys harder than necessary can cause tingling in the fingertips and pain in the finger joints. **Pressing** the keys rather than lightly touching them strains the tendons of the fingers, hands and forearms. **Pecking** at the keys instead of touching them lightly usually requires one to lift the remaining fingers and thumb. Over time, these repetitive movements can lead to forearm tendonitis and de Quervain's disease.

Any typing posture with arms unnecessarily away from the body puts a lot of strain on shoulders and neck makes typing more strenuous (forceful) than need to be. Examples are typing with arms extended forwards or to the sides or with shrugged shoulders.

In addition to the repetitive nature of typing, the **force** used is another risk factor contributing to the occurrence of RMIs: the greater the **effort**, the higher the risk for RMIs.

Work-related Musculoskeletal Disorders (WMSDs)

What are work-related musculoskeletal disorders (WMSDs)?

Work-related musculoskeletal disorders (WMSDs) are a group of painful disorders of muscles, tendons, and nerves. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome are examples. Work activities which are frequent and repetitive, or activities with awkward postures cause these disorders which may be painful during work or at rest.

Almost all work requires the use of the arms and hands. Therefore, most WMSD affect the hands, wrists, elbows, neck, and shoulders. Work using the legs can lead to WMSD of the legs, hips, ankles, and feet. Some back problems also result from repetitive activities.

Are there other names for WMSDs?

WMSDs are very difficult to define within traditional disease classifications. These disorders have received many names, such as:

- Repetitive motion injuries
- Repetitive strain injuries
- Cumulative trauma disorders
- Occupational cervicobrachial disorders
- Overuse syndrome
- Regional musculoskeletal disorders
- Soft tissue disorders

Most of the names do not accurately describe the disorders. For example, the term "repetitive strain injuries" suggests that repetition causes these disorders, but awkward postures also contribute. These terms are used synonymously, and in the absence of agreement, WMSD is used in this document.

How common are WMSDs?

WMSDs are recognized as leading causes of significant human suffering, loss of productivity, and economic burdens on society. However, reliable estimates of the number of WMSDs are not available. The data available are limited and does not represent the magnitude of the problem because there is a great deal of under-reporting of these types of injuries.

What are the risk factors for WMSDs?

WMSDs arise from ordinary arm and hand movements such as bending, straightening, gripping, holding, twisting, clenching and reaching. These common movements are not particularly harmful in the ordinary activities of daily life. What makes them hazardous in work situations is the continual repetition, often in a forceful manner, and most of all, the speed of the movements and the lack of time for recovery between them. WMSDs are associated with work patterns that include:

- Fixed or constrained body positions
- Continual repetition of movements
- Force concentrated on small parts of the body, such as the hand or wrist
- A pace of work that does not allow sufficient recovery between movements

Generally, none of these factors acts separately to cause WMSD. WMSDs commonly occur as a result of a combination and interaction among them.

Heat, cold and vibration also contribute to the development of WMSD.

Body Position

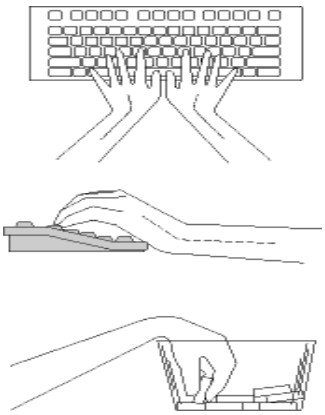
There are two aspects of body position (posture) that contribute to injuries in jobs involving repetitive tasks.

The first relates to the position of the part of the body that performs the actual task, usually the upper limb. For example, tasks that require repetitive movements to the extreme ranges of the joint in the wrist, elbow or shoulder contribute to the occurrence of a painful condition in those areas. Table 1 gives examples of such movements. Poor layout of the workstation and improper selection of equipment and tools can lead to these hazardous body movements.

Table 1

Body Movement	Areas of Pain
repetitive, horizontal or vertical movements of the wrist to the extreme ranges (Fig. 1A)	wrist and palm
moving fingers while the wrist is in an extreme position (Fig. 1B,1C)	
repetitive bending or straightening of the elbow from its neutral position (at a right angle)	elbow
twisting the wrist and forearm (Fig. 2)	
reaching above shoulder level (Fig. 3B)	neck and shoulder
reaching behind the trunk (Fig. 3C)	
reaching far out in front of the body (Fig. 3A)	
twisting the arm (Fig. 3C)	

The other postural aspect that contributes to WMSD is a fixed position of the neck and the shoulders. To perform any controlled movement of an upper limb, the worker must stabilize the shoulder-neck region. Muscles in the shoulder and the neck contract and stay contracted to hold the position stable for as long as the task requires. The contracted muscles squeeze the blood vessels. This restricts the flow of blood all the way down to the working muscles of the hand where the blood, because of the intense muscular effort, is needed the most. The result is twofold. The neck-shoulder muscles become fatigued, even though there is no movement. This contributes to pain in the neck area. At the same time, the reduced blood supply to the remaining parts of the upper limb accelerates fatigue in the moving muscles, making them more susceptible to injury.



Figures 1A, 1B & 1C –
Hazardous movements of the hand

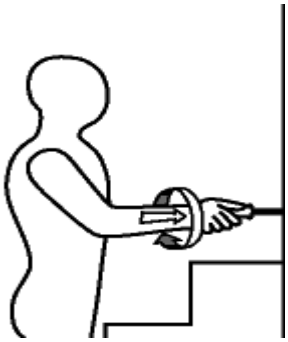
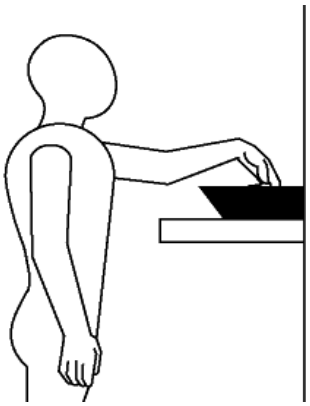


Figure 2 -
Exerting force while extending forearm



Figures 3A
Hazardous reaching movements
- reaching forward

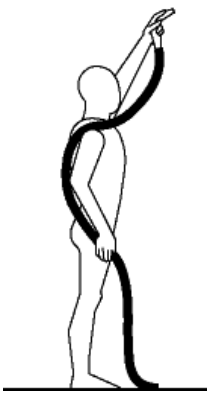


Figure 2 -
Hazardous reaching movements – reaching above shoulder level

Repetition

Workers performing highly repetitive tasks are at the highest risk for WMSD. This shows that repetition of movements, although it never acts separately, is most likely the strongest risk factor. Tasks requiring repetitive movements always involve other risk factors for WMSD such as fixed body position and force: the worker, in order to perform the task, has to maintain the shoulder and neck in a fixed position and to exert some force.

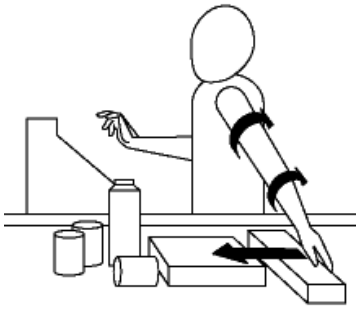


Figure 3C - Hazardous reaching movements - reaching behind the trunk

Work involving movement repeated over and over again is very tiring. This is because the worker cannot fully recover in the short periods of time that are given between tasks. With time, the effort to maintain the repetitive movements, even if they involve minimal forces, steadily increases. When the work activity is continued in spite of the developing fatigue, injuries occur.

Force

The force required to do the task also plays an important role in the onset of WMSD. More force equals more muscular effort, and consequently, a longer time is needed to recover between tasks. Since in repetitive work, as a rule, there is not sufficient time for recovery, the more forceful movements develop fatigue much faster. Exerting force in certain hand positions is particularly hazardous (Fig. 1A-4F). The amount of force needed depends on the weight of the tools and objects that the worker is required to operate or move, and their placement in relation to the worker's body. More strength has to be used, the farther away from the body the force has to be applied. The shape of the tool plays an important role, also. Tools that do not allow the best position of the wrist, elbow and shoulder substantially increase the force required. Worn and poorly maintained tools are very important as well, yet often overlooked. For example, a worn screwdriver, pliers with worn jaws, or dull scissors can increase the operating force as much as tenfold.

Figure 4A - Pulp pinch

Figure 4B - Lateral pinch

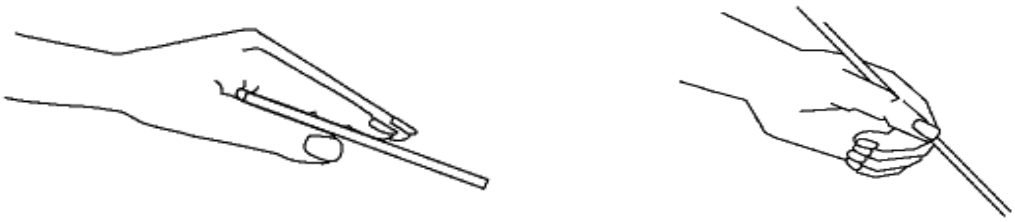


Figure 4A and 4B - Exerting force in various hand positions

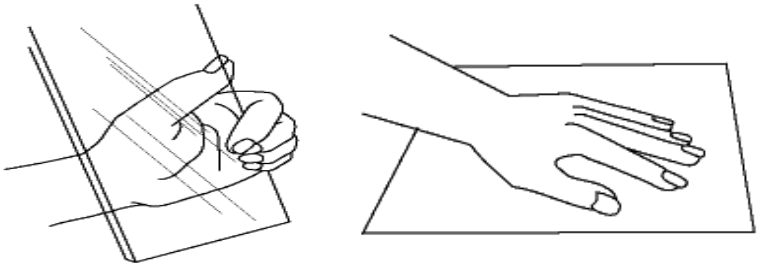


Figure 4C - Palm

Figure 4D – Finger

Figures 4C and 4D - Exerting force in various hand positions

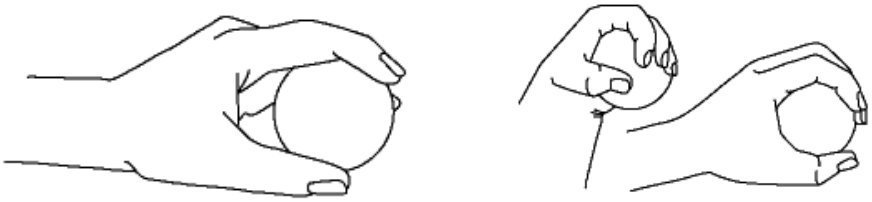
Pinch

Figure 4E - Pulp

Press

Figure 4F - Finger press

grasp



Figures 4E and 4F - Exerting force in various hand positions

Pace of Work

Pace of work determines the amount of time available for rest and recovery of the body between cycles of a particular task. The faster the pace, the less time is available and the higher the risk for WMSD.

When the worker has no control over timing and speed of work because of external factors like assembly line speed or quota systems then stress level increases. With higher stress level comes muscle tension causing fatigue and again increased risk for WMSD. Controlling the pace of work externally denies the worker the flexibility to determine their own work speed. It is a human characteristic to work at varying rates at different times of the day.

Temperature and Vibration

Temperature and humidity affect the worker performing repetitive work. When it is too hot and too humid, the workers tire more quickly and thereby become more susceptible to injury. On the other hand, cold temperatures decrease the flexibility of muscles and joints, increasing the likelihood of injury of any kind (refer WI-06- Physical Agencies.

Vibration affects tendons, muscles, joints, and nerves. Workers using vibrating tools may experience numbness of the fingers, loss of touch and grip, and pain. For more information on this subject, refer to document Raynaud's Phenomenon.

How do WMSDs occur?

WMSDs do not happen as a result of a single accident or injury. Rather, they develop gradually as a result of repeated trauma. Excessive stretching of muscles and tendons can cause injuries that only last a short time. But repeated episodes of stretching causing tissue inflammation can lead to long-lasting injury or WMSDs.

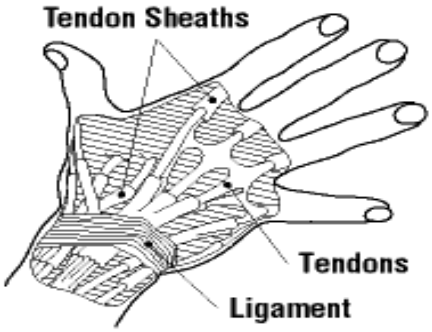
WMSDs include three types of injuries:

- muscle injury
- tendon injury
- nerve injury

Muscle Injury

When muscles contract, they use chemical energy from sugars and produce by-products such as lactic acid which are removed by the blood. A muscle contraction that lasts a long time reduces the blood flow. Consequently, the substances produced by the muscles are not removed fast enough, and they accumulate. The accumulation of these substances irritates muscles and causes pain. The severity of the pain depends on the duration of the muscle contractions and the amount of time between activities for the muscles to get rid of those irritating substances.

Tendon Injury



Tendons consist of numerous bundles of fibres that attach muscles to bones. Tendon disorders related to repetitive or frequent work activities and awkward postures occur in two major categories --tendons with sheaths (Fig. 5), found mainly in the hand and wrist; and tendons without sheaths (Fig. 6), generally found around the shoulder, elbow, and forearm.

The tendons of the hand are encased in sheaths through which the tendon slides.

Figure 5 - Finger tendons and their sheaths

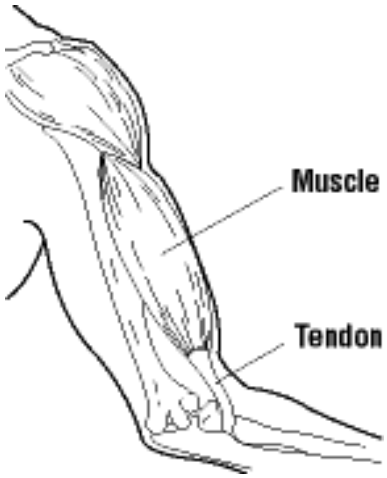


Figure 6 - Tendon, muscle, bone unit

The inner walls of the sheaths contain cells that produce a slippery fluid to lubricate the tendon. With repetitive or excessive movement of the hand, the lubrication system may malfunction. It may not produce enough fluid, or it may produce a fluid with poor lubricating qualities. Failure of the lubricating system creates friction between the tendon and its sheath, causing inflammation and swelling of the tendon area. Repeated episodes of inflammation cause fibrous tissue to form. The fibrous tissue thickens the tendon sheath, and hinders tendon movement. Inflammation of the tendon sheath is known as tenosynovitis.

When inflamed, a tendon sheath may swell up with lubricating fluid and cause a bump under the skin. This is referred to as a ganglion cyst.

Tendons without sheaths are vulnerable to repetitive motions and awkward postures. In fact, when a tendon is repeatedly tensed, some of its fibres can tear apart. The tendon becomes thickened and bumpy, causing inflammation. Tendonitis is the general term indicating inflammation of the tendon. In some cases, such as in the shoulder, tendons pass through a narrow space between bones. A sac called the bursa filled with lubricating fluid is inserted between the tendons and the bones as an anti-friction device. As the tendons become increasingly thickened and bumpy, the bursa is subject to a lot of friction and becomes inflamed. Inflammation of the bursa is known as bursitis.

Nerve Injury

Nerves carry signals from the brain to control activities of muscles. They also carry information about temperature, pain and touch from the body to the brain, and control bodily functions such as sweating and salivation. Nerves are surrounded by muscles, tendons, and ligaments. With repetitive motions and awkward postures, the tissues surrounding nerves become swollen, and squeeze or compress nerves (Fig. 7A, 7B).

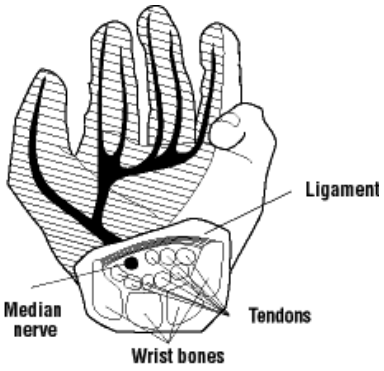


Figure 7A - Wrist in natural condition

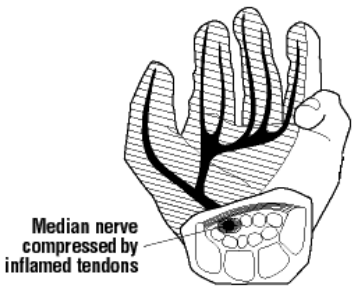


Figure 7B - Wrist showing symptoms of Carpal Tunnel Syndrome

Compression of a nerve causes muscle weakness, sensations of "pins and needles" and numbness. Dryness of skin, and poor circulation to the extremities, may also occur.

What are the symptoms of WMSDs?

Pain is the most common symptom associated with WMSDs. In some cases there may be joint stiffness, muscle tightness, redness and swelling of the affected area. Some workers may also experience sensations of "pins and needles," numbness, skin colour changes, and decreased sweating of the hands.

WMSDs may progress in stages from mild to severe.

Early stage: Aching and tiredness of the affected limb occur during the work shift but disappear at night and during days off work. No reduction of work performance.

Intermediate stage: Aching and tiredness occur early in the work shift and persist at night. Reduced capacity for repetitive work.

Late stage: Aching, fatigue, and weakness persist at rest. Inability to sleep and to perform light duties.

Not everyone goes through these stages in the same way. In fact, it may be difficult to say exactly when one stage ends and the next begin. The first pain is a signal that the muscles and tendons should rest and recover. Otherwise, an injury can become longstanding, and sometimes, irreversible. The earlier people recognize symptoms, the quicker they should respond to them.

Table 2 outlines occupational risk factors and symptoms of the most common disorders of the upper body associated with WMSDs.

Table 2
Identified disorders, occupational risk factors and symptoms

Disorders	Occupational risk factors	Symptoms
Tendonitis/tenosynovitis	Repetitive wrist motions Repetitive shoulder motions Sustained hyper extension of arms Prolonged load on shoulders	Pain, weakness, swelling, burning sensation or dull ache over affected area
Epicondylitis (elbow tendonitis)	Repeated or forceful rotation of the forearm and bending of the wrist at the same time	Same symptoms as tendonitis
Carpal tunnel syndrome	Repetitive wrist motions	Pain, numbness, tingling, burning sensations, wasting of muscles at base of thumb, dry palm
DeQuervain's disease	Repetitive hand twisting and forceful gripping	Pain at the base of thumb
Thoracic outlet syndrome	Prolonged shoulder flexion Extending arms above shoulder height Carrying loads on the shoulder	Pain, numbness, swelling of the hands
Tension neck syndrome	Prolonged restricted posture	Pain

How are WMSDs recognized?

The evaluation of WMSDs includes identifying workplace risks. Evaluation begins with a discussion of the person's employment and requires a detailed description of all the processes involved in a typical workday. Consideration is given to the frequency, intensity, duration, and regularity of each task performed at work.

Diagnosis of WMSDs is confirmed by performing laboratory and electronic tests that determine nerve or muscle damage. One such test, electroneuromyography (ENMG), encompasses two areas: electromyography (EMG) and nerve conduction velocity (NCV). Magnetic resonance imaging (MRI), an alternative to x-rays, provides images of tendons, ligaments, and muscles and improves the quality of the diagnostic information.

How are WMSDs treated?

The treatment of WMSDs involves several approaches including the following:

- Restriction of movement
- Application of heat or cold
- Exercise
- Medication and surgery

Restriction of Movement

The first approach to treatment of WMSDs is to avoid the activities causing the injury. This often requires work restrictions. In some cases, transfer to a different job should be considered. A splint can also be used to restrict movements or to immobilize the injured joint. However, the use of splints in occupational situations requires extreme caution. If used inappropriately, splints can cause more damage than good. Splints are usually used for two reasons: to mechanically support a joint where an excessive load on the joint is anticipated, or to restrict the movement of the injured joint.

In the occupational context, splints should not be used as a mechanical support for the joint. Instead, the job should be redesigned to avoid the extreme load on the worker's joint in the first place. To be effective, the use of splints to immobilize an affected joint also requires that the work activity that caused the injury be stopped or changed. If injurious work continues, then the worker is exposed to risk of injury to other joints that have to compensate for the one that is splinted.

Application of Heat or Cold

Applying heat or cold seems to relieve pain and may accelerate the repair process. Heat is recommended for pain relief of minor injuries. It is not recommended for injuries with significant inflammation and swelling.

Heat increases the flow of blood and increases swelling. Ice reduces pain and swelling.

Exercise

Stretching is beneficial because it promotes circulation and reduces muscle tension. However, people suffering from WMSDs should consult a physical therapist before exercising. Stretching or exercise programs can aggravate the existing condition if not properly designed.

Medication and Surgery

Anti-inflammatory drugs can reduce pain and inflammation. The doctor may try more elaborate treatments or even surgery if all other approaches fail.

How can we prevent WMSDs?

Hazards are best eliminated at the source; this is a fundamental principle of occupational health and safety. In the case of WMSDs, the prime source of hazard is the repetitiveness of work. Other components of work such as the applied force, fixed body positions, and the pace of work requiring repetition of the same movements over and over again, are also contributing factors to WMSDs. Therefore the main effort to protect workers from WMSDs should focus on avoiding repetitive patterns of work through job design which may include mechanization, job rotation, job enlargement and enrichment or teamwork. Where elimination of the repetitive patterns of work is not practical, prevention strategies involving workplace layout, tool and equipment design, and work practices should be considered.

Job Design

Mechanization

One way to eliminate repetitive tasks is to mechanize the job. Where mechanization is not feasible or appropriate, other alternatives are available.

Job Rotation

Job rotation is one possible approach. It requires workers to move between different tasks, at fixed or irregular periods of time. But it must be a rotation where workers do something completely different. Different tasks must engage different muscle groups in order to allow recovery for those already strained.

However, job rotation alone will not be effective in reducing WMSDs if not combined with the proper design of workstations. And it will not be effective while the high pace of work persists.

Job Enlargement and Enrichment

Another approach is job enlargement. This increases the variety of tasks built into the job. It breaks the monotony of the job and avoids overloading one part of the body. Job enrichment involves more autonomy and control for the worker.

Team Work

Team work can provide greater variety and more evenly distributed muscular work. The whole team is involved in the planning and allocation of the work. Each team member carries out a set of operations to complete the whole product, allowing the worker to alternate between tasks, hence, reducing the risk of WMSDs.

Workplace Design

The guiding principle in workplace design is to fit the workplace to the worker. Evaluation of the workplace can identify the source or sources of WMSD. Proper design of the workstation decreases the effort required of the worker to maintain a working position. Ideally, the workstation should be fully adjustable, providing a worker with the options to work in standing, sitting or sitting-standing positions, as well as fitting the worker's body size and shape. Detailed information about proper workplace design can be found in the documents "Working in a Standing Position" and "Working in a Sitting Position" (WI-05-Working Position).

Tools and Equipment Design

Proper design of tools and equipment significantly decreases the force needed to complete the task.

Providing the worker with the proper jigs or fixtures for tasks that require holding elements saves a lot of muscular effort in awkward positions.

Good tools, maintained carefully and where necessary frequently changed, can also save a lot of muscle strain. More information about hand tools and preventing WMSD resulting from their use can be found in the document "Hand Tool Ergonomics" (WI-07-Hand Tools).

Work Practices

A well-designed job, supported by a well-designed workplace and proper tools, allows the worker to avoid unnecessary motion of the neck, shoulders and upper limbs. However, the actual performance of the tasks depends on individuals.

Training should be provided for workers who are involved in jobs that include repetitive tasks. Workers need to know how to adjust workstations to fit the tasks and their individual needs. Training should also emphasize the importance of rest periods and teach how to take advantage of short periods of time between tasks to relax the muscles, and how to consciously control muscle tension throughout the whole work shift.

Conclusion

WMSDs of muscles, tendons and nerves are a major cause of lost work in many labour-intensive industries. Occupational risk factors include continual repetition of movements, fixed body positions, forces concentrated on small parts of the body, and lack of sufficient rest between tasks.

Prevention must aim at eliminating the repetitiveness of the work by proper job design. Where this is not possible, preventive strategies such as good workplace layout, tool and equipment design, and proper work practices should be considered. Early recognition of these disorders is very important because medical treatments are unlikely to be effective once these injuries become longstanding.

Preventive and control measures, in order to be truly effective, require significant involvement on the part of the workers, their representatives, and management to improve occupational health and safety.

Work-related Musculoskeletal Disorders (WMSDs) - Risk Factors

What are the risk factors for work-related musculoskeletal disorders (WMSDs)?

Work-related musculoskeletal disorders (WMSDs) are associated with these factors:

- work postures and movements,
- repetitiveness and pace of work,
- force of movements,
- vibration, and
- temperature.

Certain workplace conditions, for example, the layout of the workstation, the speed of work (especially in conveyor-driven jobs), and the weight of the objects being handled influence these factors.

How are work postures and movements a risk for WMSDs?

Any body position can cause discomfort and fatigue if it is maintained for long periods of time. Standing, for example, is a natural body posture, and by itself poses no particular health hazards. However, working for long periods in a standing position can cause sore feet, general muscular fatigue, and low back pain. In addition, improper layout of work areas, and certain tasks can make workers use unnatural standing positions.

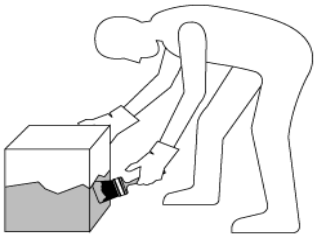


Figure 1 - Bending forward

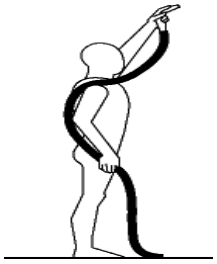


Figure 2 - Reaching above shoulder

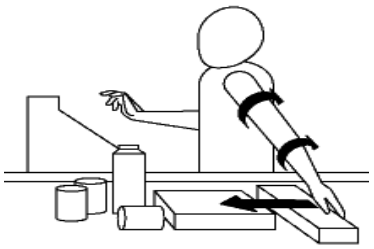


Figure 3 - Reaching

Two aspects of body position can contribute to injuries. The first relates to body position. For example, working with the torso bent forward (Figure 1), backward or twisted can place too much stress on the low back. Other examples of stressful body positions include reaching above shoulder level (Figure 2), reaching behind the body (Figure 3), rotating the arms (Figure 4) and bending the wrist forward, backward, or side to side (Figure 5).

When parts of the body are near the extremes of their range of movements, stretching and compression of tendons and nerves occur. The longer a fixed or awkward body position is used, the more likely we are to develop WMSDs.

The second aspect that contributes to WMSDs is holding the neck and the shoulders in a fixed position. To perform any controlled movement with the arm, muscles in the shoulder and the neck contract and stay contracted for as long as the task requires.

The contracted muscles squeeze the blood vessels, which restricts the flow of blood all the way down to the working muscles of the hand.

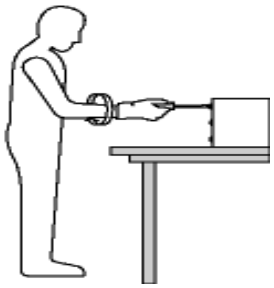


Figure 4 - Rotating the arms

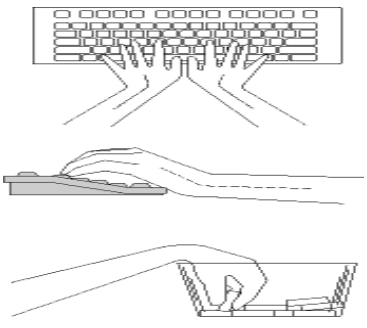


Figure 5 - Bending the wrist

However, this is where the blood is needed the most because of the intense muscular effort. Two things happen as a result. The neck/shoulder muscles become overtired even though there is little or no movement. At the same time, the reduced blood supply to the rest of the arm accelerates fatigue in the muscles that are moving, making them more prone to injury.

How does repetitiveness and pace of work influence WMSDs?

Repetitive movements are especially hazardous when they involve the same joints and muscle groups over and over and when we do the same motion too often, too quickly and for too long.

To analyze how repetitive a task is, we need to describe it in terms of steps or cycles. For example, the bottle packing operation (Figure 6) requires workers to pack boxes with twenty-four bottles.

Figure 6 - Packing bottles

One cycle can be described as follows:

- reach for bottles
- grasp bottles
- move bottles to box
- place bottles in box

If a worker grasps four bottles each time, the same cycle would have to be repeated six times to fill a box. Assuming that one cycle lasts two seconds, it would take twelve seconds to pack a box with twenty-four bottles.

There are no rules to judge movements as either high or low in repetition. Some researchers classify a job as "high repetitive" if the time to complete such a job was less than 30 seconds or "low repetitive" if the time to complete the job was more than 30 seconds. Although no one really knows at what point WMSDs may develop, workers performing repetitive tasks are at risk for WMSDs

Work involving movement repeated over and over is very tiring because the worker can not fully recover in the short periods of time between movements. Eventually, it takes more effort to perform the same repetitive movements. When the work activity continues in spite of the fatigue, injuries can occur.

What should I know about force of movements?

Force is the amount of effort our bodies must do to lift objects, to use tools, or to move.

The amount of force we use to do a job depends on many factors such as the weight of the objects and their placement in relation to the body. It requires more force to lift and carry a box with arms outstretched and held away from the body (Figure 7) or to lift the same objects in a "pinch" position (Figure 7a) than in a "hook" position (Figure 8, 8a).

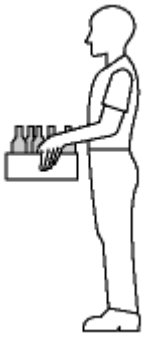


Figure 7 - Lifting in a "pinch"

Figure 7a - Pinch position

A force of more than four kilograms, or nine pounds, is considered significant. This is the force used to hammer a nail, for example. Although no one really knows when WMSDs will develop, workers performing

forceful movements are at risk. Work involving forceful movements is very tiring again because there is not time for a full recovery between movements. Eventually it takes effort to perform the same task. When the work activity continues in spite of the developing fatigue, injuries occur.

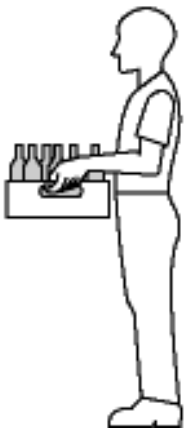


Figure 8 - Lifting in a "hook"

Figure 8a -Hook position

How does vibration encourage WMSDs?

Vibration affects tendons, muscles, joints and nerves. Workers can be exposed to either whole body vibration or localized vibration.

Whole body vibration is experienced by truck and bus drivers for example. Localized vibration exposure can be caused by power tools. In addition the worker may use more force and awkward body positions because vibration hand tools are harder to control.

Exposure to too much vibration can also cause us to lose the feeling in our hands and arms. As a result, we may misjudge the amount of force we need to control the tools and use too much which increases fatigue.

How does temperature affect WMSDs?

In general, when it is too cold, or when we touch cold materials, our hands can become numb. With numbed hands, we are more likely to misjudge the amount of force we need to do our work and use too much. A cold environment also makes our bodies less flexible. Every movement we make and every position we hold takes a lot more work, and then WMSDs are more likely to develop.

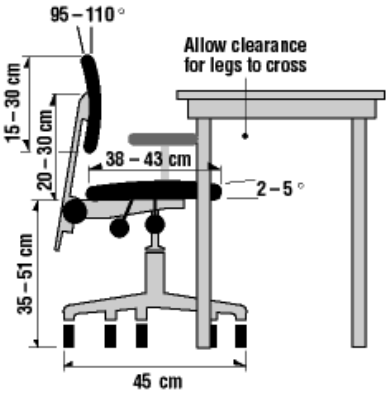
Most people feel comfortable when the air temperature is between 20°C and 27°C and when relative humidity ranges from 35 to 60%. When air temperature or humidity is higher, people feel uncomfortable (refer WI-06- Physical Agencies).

Ergonomic Chair

What is an "ergonomic" chair?

Finding the right ergonomic chair is a common problem especially for people who want to purchase new equipment to make workstations safer and healthier places. There are many "ergonomic" chairs available but it can be a mistake to purchase one simply because it is labelled "ergonomic".

Ergonomic chairs are designed to suit a range of people; however, there is no guarantee that they will suit any one person in particular. For example, a chair could be too high and the arm rests too far apart for a short, slim person. In addition, chairs may not suit every task or arrangement at the workstation. A chair becomes ergonomic only when it specifically suits a worker's size (body dimensions), his or her particular workstation, and the tasks that must be performed there. It is possible to find the right chair although it is not always easy.



Ergonomic Chair

Why is finding the right chair so important?

Today, in industrialized countries, many people sit for most of the time that they are awake. They sit while having breakfast, while going to work in cars or buses, in school classrooms, in meetings, in offices, during dinner, and at home while watching television. Many people also sit at work operating machines which new technology has developed to replace manual work. Although sitting requires less physical effort than standing or walking it puts a lot of stress on lumbar area. Combined effects of a sedentary lifestyle and a job that requires sitting can lead to many health problems.

What do you need to know about selecting a good "ergonomic" chair?

The selection of a suitable chair is a critical step in preventing health problems in people who work in a sitting position. With the ergonomics approach, sitting is viewed as a specific, specialized activity which is influenced by the way that a sitting person interacts with the working environment.

Several basic concepts should be considered:

- One chair does not fit everyone. The users' body dimensions must be used when selecting a chair so that it does not strain one part of the body while fitting another.
- Collect data about the user's body height. The optimal seat height is about one quarter of the body height. This is only a rule of thumb since the torso-to-leg ratio can vary widely..
- No one chair is suitable for every activity. For example, dentists require a different chair than do industrial workers or computer operators
- Consider maintenance and repair costs. Check with the manufacturer for items to inspect for and how often inspection should be done.

What are the features of a "good" chair?

Some features are mandatory for a good chair regardless of how you intend to use it:

- **Adjustability** - Check to see that seat height is adjustable.
- **Seat height range** - Check whether the seat height can be adjusted to the height recommended for the worker(s) who will use it. Other chairs may have to be selected for very short or tall workers.
- **Backrest** - Check to see that the backrest is adjustable both vertically and in the frontward and backward direction.
- **Seat depth** - Select the seats that suit the tallest and the shortest users
- **Stability** - Check for the stability of the chair; a five-point base is recommended.

Other features to consider

- See if the selected chair has features that will help someone do their job better. Arm rests with adjustable heights are good for computer operators. Wider or narrower arm rests may also be required depending on the worker's dimensions and tasks they do.
- See if the selected chair has features that will make doing a job more difficult. An example may be that someone may be using a chair with casters or wheels when a stable and stationary work position would be better. If chairs with casters are needed, choose ones that match the type of flooring you have (carpeting or hard floors).

Who should pick out the chair?

Personal preference is essential to the process of selecting a chair.

- After some suitable chairs have been identified, allow the person who will use the chair most to try out the chair in a real work situation. It is especially useful to obtain several sample chairs for a trial comparison by those who will be using them.
- Make sure that the chair meets the needs of the workers and their jobs before any final selection is made.

Can a chair solve all of the ergonomic problems of working in a sitting position?

A well-designed chair allows the user to sit in a balanced position. Buying an ergonomic chair is a good beginning but it may not bring the benefits expected. The actual sitting position depends on an individual's personal habits; he or she has to learn and practice how to sit properly.

Also, remember that the chair is only one of the components to be considered in workstation design. All the elements such as the chair, footrest (if needed), work surface, document holders, task lighting and so on need to have flexibility and adjustability to be "designed in."

Forward Sloping Chair

What is new in the ergonomics of sitting at an office workstation and office chair design?

People sit rather than stand for obvious reasons of comfort; only lying down is more comfortable, but hardly practical for working.

The problem arises when we sit for too long at a desk or any workstation for hours and hours, day after day, year after year. The office is one environment where sitting typically takes the highest toll. The most common adverse effects of such prolonged sitting are discussed in the OSH Answers document "Working in a Sitting Position - Overview".

Despite much research and study over the last few decades, health effects associated with working in a sitting position persist. The number of people suffering postural problems and back pain through excessive sitting is not decreasing. Even the concept of an "ergonomic chair" that was developed in the mid 80s, and widely adopted since then, has not contributed to any dramatic improvement in such health problems reported by seated workers.

Some experts believe it is time to re-think the entire concept of "proper" sitting and good chair design, but such notions are not entirely new.

Mandal's core belief is that maintaining the lumbar curve found in the small of the back is absolutely essential to a healthy pain-free back. The majority of guidelines, including our own OSH Answers document (Working in a Sitting Position - Good Body Position, and How to Adjust Office Chairs) however, suggest sitting upright with an angle of approximately 90 degrees between the torso and thighs which actually flattens the lumbar curve. A flattened lumbar curve increases both the mechanical load on your lumbar spine as well as back muscle activity. As a consequence, sitting upright with the thighs horizontal (i.e., parallel to the floor), may lead in the long run to chronic low back pain (LBP).

It was also found that while you lower your body to sit down, the lumbar curve stays unchanged until the last 20 degrees before your thighs become horizontal.

In conclusion, without going further into a detailed biomechanical analysis of how the curvature of the spine works, people who need to sit at work could try using a chair with a forward-sloping seat pan as an option (especially if they are experiencing pain with a horizontal (flat) seat pan / 90 degree angle between the thighs and back). Such a chair should allow you to maintain the angle between your torso and thighs at about 105 degrees while keeping your feet flat on the floor or supporting them on a footrest if it is more suitable - see Figure below.

What are benefits of a sloping seat?

It decreases the load on your lower back and minimizes the risk for lower back pain (LBP).

Sitting with your thighs in a downward slope increases the activity of your lower leg muscles. As a result return blood flow from the lower legs is improved, and there is less pooling of the blood and pain in the lower legs by the end of the workday. Consequently, in the long run, it can reduce the likelihood of your contracting varicose veins.

Much more than a horizontal seat pan, a sloping seat pan not only makes rising from the chair easier, but also allows your leg muscles to recover sooner because any postural changes and shifts are also easier.

Once you make the transition from a conventional horizontal seat to one that tilts forward, the next step is to consider using a slanted desk surface, which would reduce bending in the neck and upper torso, thus improving your postural comfort.

Yet, of all advantages of the forward sloping chair, it is most beneficial to have more freedom (choices, options) of body positions (or work postures). Frequent changes makes sitting more dynamic rather than static (maintaining fix position) and easiness arising (standing instead of sitting) allows loaded muscles recover faster and postponing fatigue and discomfort.

What are disadvantages of a sloping chair?

The major disadvantage reported is the feeling that you have to constantly counteract gravity to avoid sliding off the chair.

The seat pan of such a chair has to be curved from front to back to allow sitting on chair without sliding. Nevertheless, you do have do exert some muscular effort in your lower legs to remain seated. This effort is in fact beneficial (providing the slope is not greater than 15 degrees) because it improves the return blood flow from your lower legs.

The other disadvantage frequently quoted, of having your clothing ride up your legs can be overcome if the chair is properly designed with a non-slip covering.

What is the possible future of seated jobs?

Over the last few decades we see more and more sedentary jobs where workers are seated throughout much of their working day. The traditional design of office furniture and poor job design often result in lower back pain. While a forward-slopping chair seat may not be the ultimate remedy, it is one viable option that may be beneficial (and a new chair is much less expensive than the cost and suffering a person experiences with low back pain).

How to Adjust Office Chairs

What is the most important part about having a good workstation?

The office workstation should let the worker sit and carry out their duties in comfort while allowing for voluntary changes in the working position.

There are three contact areas in the work space that affect the worker's posture: the seat, the work surface (commonly it is a desk top or keyboard) and the floor. To ensure the most comfortable posture possible, two of these factors have to be adjustable.

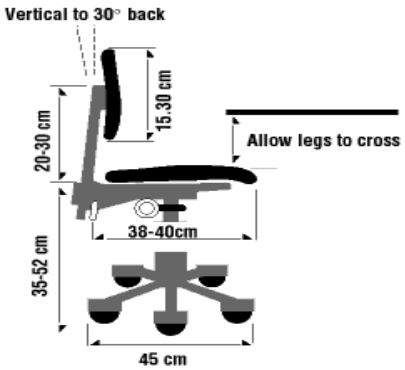
If you can afford to do nothing else, **a fully adjustable chair is the undisputable "must".** The other, and perhaps the most preferable option, would be a fully adjustable desk. However the price of such a desk may not make this option practical. Another effective (and cheaper) option is to use an adjustable chair and footrest to secure postural comfort.

What should I consider when selecting a chair?

A basic rule of ergonomics is that there is no such thing as an "average" person. However, providing a chair specifically designed for each individual is not practical. The only solution is to provide workers with fully adjustable chairs that can accommodate a maximum range of people (typically around 90 percent of the population; workers falling in the ranges of 5% of the shortest and the tallest will need custom-made chairs).

Choose a chair with:

- controls that are easy to operate from sitting position
- a seat that adjusts for both height and tilt
- a seat that does not put pressure the back of thighs or knees
- a seat with a front edge that curves towards the floor
- breathable, non-slippery fabric on the seat
- a backrest shaped to support the lower back
- a stable five-point base
- wheels or casters suitable for the type of flooring
- a swivel mechanism
- armrests that can be adjusted to the elbow height when your upper arms are hanging down and your forearms are at about a 90 degree angle to the upper arms
- armrests that do not interfere with free movements within the workstation



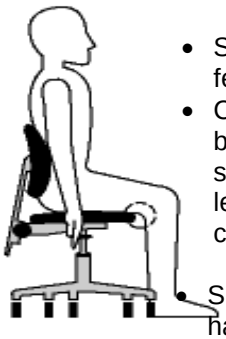
What is so controversial about armrests?

Armrests are traditionally not recommended because they can prevent the users from getting close to the desk. However, now there are armrests that extend 25 cm (10 inches), or less, from the back of seat. People using chairs fitted with these shorter armrests can move their chairs closer to their workstations.

The armrests gives them a place to rest their arms which, in turn, takes some of the load off their shoulders and neck.

How do I adjust a chair for my height?

- Stand in front of the chair. Adjust the height so the highest point of the seat, (when in the horizontal position), is just below the kneecap.



- Sit on the chair and keep your feet flat on the floor.
- Check that the clearance between the front edge of the seat and the lower part of the legs (your calves) fits a clenched fist (about 2 inches).

- Adjust the backrest forwards and backwards as well as up and down so that it fits the hollow in your lower back.

- Sit upright with your arms hanging loosely by your sides. Bend your elbows at about a right angle (90 degrees) and adjust the armrest(s) height until they barely touch the undersides of the elbows.
- Remove the armrests from the chair if this level can not be achieved or if armrests, in their lowest adjustment, elevate your elbows even slightly.

- Tilt the seat itself forwards or backwards if you prefer.

Different office tasks require different equipment, accessories and layouts.

Nonetheless, the chair and its adjustment remain constant for the majority of setups in a typical office environment.

What adjustments should I make if the workstation (desk) is at a fixed height?

Once your chair is properly adjusted for your height, check if you can sit at the workstation comfortably with your legs crossed underneath.

- If you cannot fit your legs under the workstation or there is not enough space to move them freely, your workstation is too low for you and **you should not use such a workstation on a regular basis!**
- If you can sit comfortably but need to elevate your arms in order to place them over the work surface, your workstation is too high. Adjust the chair height so your elbows are about the same height as the work surface. **Use a footrest if you cannot place your feet flat on the floor.**
- The footrest should be adjustable and support both feet. Keep feet flat and firm on the footrest.

Eye Discomfort in the Office

What is the significance of "good" lighting?

Office work is visually demanding and has always required good lighting for maximum comfort and productivity. "Good" lighting means providing enough illumination so that people can see printed, handwritten or displayed documents clearly but are not blinded by excessively high light levels (a cause of glare).

The introduction of computers in the 1970's increased the visual demands of office work and made lighting design even more challenging. While typewriters were being exchanged for computers, the need for redesigning or rearranging office lighting was commonly overlooked.

What are signs of poor lighting?

The most common complaints resulting from poor lighting are:

- eyestrain,
- eye irritation,
- blurred vision,
- dry burning eyes, and
- headaches.

Poor lighting affects not only the ocular system but can also contribute to stiff necks and aches in shoulder area. These problems can occur when people adopt poor or awkward postures when trying to read something under poor lighting conditions.

Are there any non-visual effects of poor lighting?

When people are exposed to glare or have uncorrected vision problems, they tend to lean forward or backward in an attempt to compensate. An awkward body position leads to eye strain and accelerates postural fatigue that, in turn, contributes to musculoskeletal injuries (MSI).

How can eye discomfort be reduced?

Overhead lighting

- Use filters to diffuse overhead lighting.
- Dim overhead lights.
- Keep in mind that recommended level of light in offices 300 - 500 lux **is not a must.** It applies in the situation where there is no task lamp in use.

Windows and walls

- Cover windows with adjustable blinds.
- Use matte finishes on walls, floors and furniture.

Monitor 0f computer

- Adjust the brightness and contrast according to your preference.
- Use a light colour for the background.
- Place the monitor parallel (not directly below) with overhead lights.
- Angle the monitor away from lights and windows.
- Make sure that the task lamp illuminates the document and not the monitor.

Should anti-glare screens be used?

In general, anything between the operator and screen compromises the quality of the image. It is far better to control glare by proper lighting design and placement of the monitor than by use of an anti-glare screen. Many monitors currently available are already equipped with low reflective screens.

What can you do to reduce eye strain?

The ability to focus on objects at various distances decreases with age (presbyopia). Commonly, by their forties people cannot clearly see objects at close range with the naked eye. This is a gradual change, and has to be regarded as an important component in designing visual environments, particularly when the job involves computer work. Uncorrected vision may be an additional source of eye discomfort. It may have further consequences resulting in aches and pains because of awkward postures or positions adopted to "see better".

- Check your vision every one or two years, as recommended by your eye specialist.
- Provide your eye examiner with information about your job.
- Consider using task-specific computer glasses.

Depending on the amount of time you work at a keyboard, the kind of vision correction needed, and your personal preferences, your eye specialist may recommend bifocals, trifocals or even a separate pair of glasses for computer work.

Focusing your eyes on objects at the same distance and angle for prolonged periods of time can contribute to eye strain.

- Every few minutes look away from the screen for a few seconds.
- Look around.
- Focus your vision on distant objects.
- Blink several times.

Frequently "stretching" your eyes like this will prevent feelings of fatigue from accumulating.

Lighting Ergonomics - General

Why is lighting important?

Whether in industrial or office settings, proper lighting makes all work tasks easier. People receive about 85 percent of their information through their sense of sight. Appropriate lighting, without glare or shadows, can reduce eye fatigue and headaches. It highlights moving machinery and other safety hazards. It also reduces the chance of accidents and injuries from "momentary blindness" while the eyes adjust to brighter or darker surroundings.

The ability to "see" at work depends not only on lighting but also on:

- the time to focus on an object. Fast moving objects are hard to see.
- the size of an object. Very small objects are hard to see.
- brightness. Too much or too little reflected light makes objects hard to see.
- contrast between an object and its immediate background. Too little contrast makes it hard to distinguish an object from the background

What are other documents about lighting?

Please also see:

- Eye Discomfort in the Office (given earlier)
- Lighting Ergonomics - Checklist(HSF-OHS-08)

What are different sources of light?

Daylight: How much daylight reaches inside a building depends on the amount and direction of sunlight, cloud cover, local terrain, and the season. As well, the size, orientation and cleanliness of the windows is important. The amount of daylight entering the workplace can be controlled with tinted glass, window blinds, curtains, and awnings. Daylight is desirable in the workplace providing it does not cause glare or make the work area too bright.

Remember, not enough light can also be a problem so even in workplaces where daylight is available, it is essential to have a good electric lighting system.

Electric Lighting: The amount of light, the colour of the light itself and the colour that objects appear vary with the type of electric lighting. The lighting must match the workplace and the task. The following are common types of bulbs.

Table
Light Bulbs*

Type	Common Application	Efficiency	Colour Rendering**
Incandescent	homes	poor	good
Fluorescent	offices	good	fair to good
Mercury	factories, offices	fair	fair to moderate
Low pressure sodium	roadway	good	poor
High pressure sodium	factories, commercial	good	fair to good
Metal Halide	factories, commercial	good	good

* Bulbs are often referred to as lamps in many technical publications.

** Colour rendering is the effect of light on the colour of objects.

What should you know about insufficient light?

Poor lighting can be a safety hazard - misjudgment of the position, shape or speed of an object can lead to accidents and injury.

Poor lighting can affect the quality of work, specifically in situation where precision is required, and overall productivity.

Poor lighting can be a health hazard - too much or too little light strains eyes and may cause eye discomfort (burning, etc.) and headaches.

How much light is needed for various situations or activities?

The amount of light we need varies and depends on:

- the type of task being done (such as demands for speed and accuracy),
- type of surfaces (does it reflect or absorb light),
- the general work area, and
- the individual's vision.

The amount of light falling on a surface is measured in units called lux. Depending on the factors noted above, adequate general lighting is usually between 500 and 1000 lux when measured 76 cm (30 inches) above the floor.*

Examples of industrial and office tasks and the recommended light levels are in the table below.

Table
Recommended Illumination Levels*

Type of Activity	Ranges of Illuminations (Lux)**
Public spaces with dark surroundings	30
Simple orientation for short temporary visits	50
Working spaces where visual tasks are only occasionally performed	100
Performance of visual tasks of high contrast or large scale	300
Performance of visual tasks of medium contrast or small size	500
Performance of visual tasks of low contrast or very small size	1000
Performance of visual tasks near threshold of person's ability to recognize an image	3000-10000

**Lux = Lumens (quantity of light) per square metre.

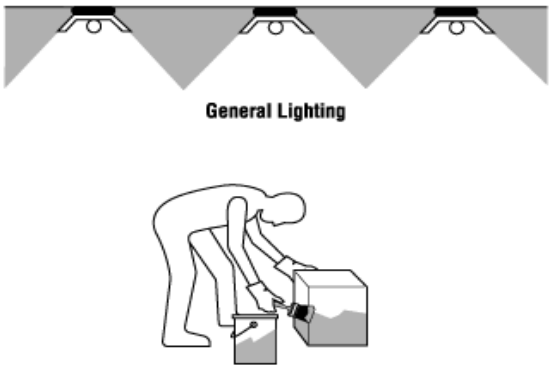
To reach proper light levels, many light fixtures are designed to reflect light off walls, ceilings and objects.

What are basic types of artificial lighting?

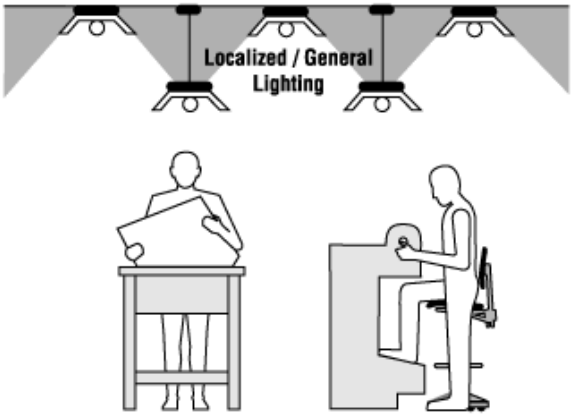
There are three basic types of lighting:

- general,
- localized-general, and
- local (or task).

General lighting provides fairly uniform lighting. An example would be ceiling fixtures that light up large areas.



Localized-general lighting uses overhead fixtures in addition to ceiling fixtures to increase lighting levels for particular tasks.



Local (or task) lighting increases light levels over the work and immediate surroundings. Local lighting often allows the user to adjust and control lighting and provides flexibility for each user.

What are different types of light fixtures?

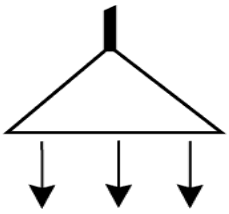
The complete lighting unit (also called the light fixture) controls and distributes the light. (Light fixtures are often referred to as "luminaires" in technical publications.)

Various types of light fixtures are designed to distribute light in different ways. These fixtures are known as:

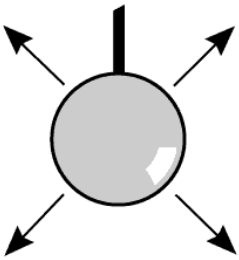
- direct,
- direct-indirect,
- indirect and
- shielded (various types).

No single type of light fixture is appropriate in every situation. The amount and quality of lighting required for a particular workstation or task will determine which light fixture is most suitable.

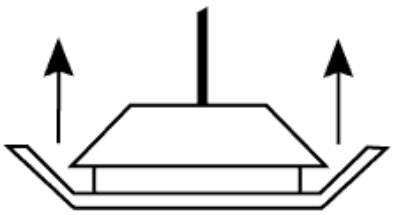
Direct light fixtures project 90 to 100 percent of their light downward toward the work area. Direct lighting tends to create shadows.



Direct-indirect light fixtures distribute light equally upward and downward. They reflect light off the ceiling and other room surfaces. Little light is emitted horizontally meaning direct glare is often reduced. They are usually used in "clean" manufacturing areas.

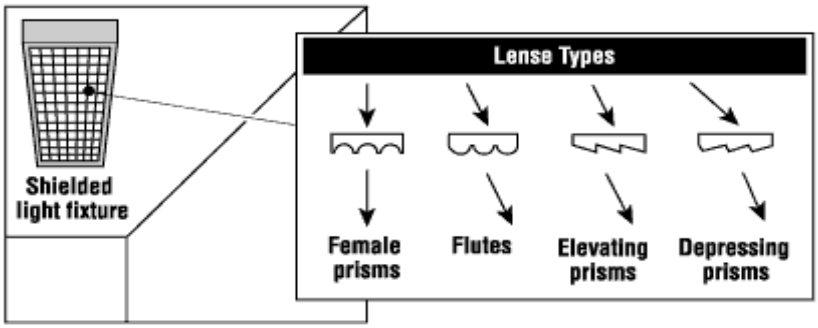


Indirect light fixtures distribute 90 to 100 percent of the light upward. The ceiling and upper walls must be clean and highly reflective to allow the light to reach the work area. They provide the most even illumination of all the types of fixtures and the least direct glare. Indirect light fixtures are usually used in offices.

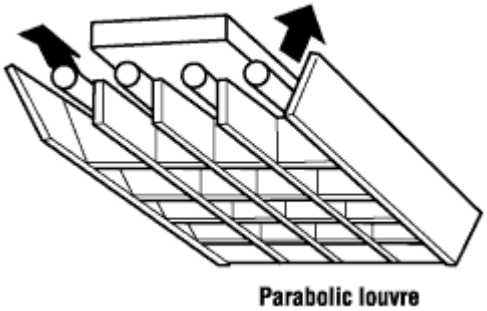


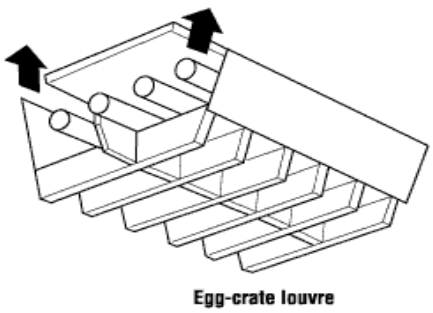
Shielded light fixtures use diffusers, lenses and louvers to cover bulbs from direct view; therefore, helping to prevent glare and distribute light.

- Diffusers are translucent or semi-transparent (see-through) covers made usually of glass or plastic. They are used on the bottom or sides of light fixtures to control brightness.
- Lenses are clear or transparent glass, or plastic covers. The lens design incorporates prisms and flutes to distribute light in specific ways.



Louvers are baffles that shield the bulb from view and reflect light. The baffles can be contoured to control light and decrease brightness. Parabolic louvers are specially shaped grids that concentrate and distribute light.


Parabolic louvre


Egg-crate louvre

Can electric lighting affect what we "see" as the colours of an object?

Yes. The "colour" of an object actually depends upon the colour composition of the light itself as well as the colours of the light that the object reflects and absorbs.

Natural sunlight is made up of all the colours of the rainbow (spectrum) red, orange, yellow, green, blue, indigo and violet. Most electric lights do not "make" of all these colours even though the lights appear to be emitting "white" or "normal" light. In fact, different lights give different colour rendering characteristics. As a result, the true colour of an object can only be determined when viewed under sunlight or under lighting, such as full spectrum lighting, that has the same spectral composition as sunlight.

For most work situations, colour rendering is not an issue. However, full spectrum lighting may be needed when colour judgment is important; for example, in a fabric manufacturing or sewing environment.

Lighting Ergonomics - Survey and Solutions

What are some of the most common lighting problems?

Poor lighting can cause several problems such as:

- insufficient light - not enough (too little) light for the need,
- glare - too much light for the need,
- improper contrast,
- poorly distributed light, and
- flicker.

This document summarizes general ways to detect and solve some of the more common lighting problems. Information on how to conduct a more detailed (or formal) lighting survey is located at the end of this document.

What are other OSH documents about lighting?

What should you know about insufficient light?

Poor lighting can be a safety hazard - misjudgement of the position, shape or speed of an object can lead to accidents and injury.

Poor lighting can affect the quality of work, specifically in situation where precision is required, and overall productivity.

Poor lighting can be a health hazard - too much or too little light strains eyes and may cause eye discomfort (burning, etc.) and headaches.

How much light is needed for various situations or activities?

The amount of light we need varies and depends on:

- the type of task being done (such as demands for speed and accuracy),
- type of surfaces (does it reflect or absorb light),
- the general work area, and
- the individual's vision.

The amount of light falling on a surface is measured in units called lux. Depending on the factors noted above, adequate general lighting is usually between 500 and 1000 lux when measured 76 cm (30 inches) above the floor. *

Examples of industrial and office tasks and the recommended light levels are given in the table below.

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Performance of visual tasks near threshold of person's ability to recognize an image	3000-10000

**Lux = Lumens (quantity of light) per square metre.

Recommended of illumination

As recommended by Bangladesh National Building code, following values is to be maintained

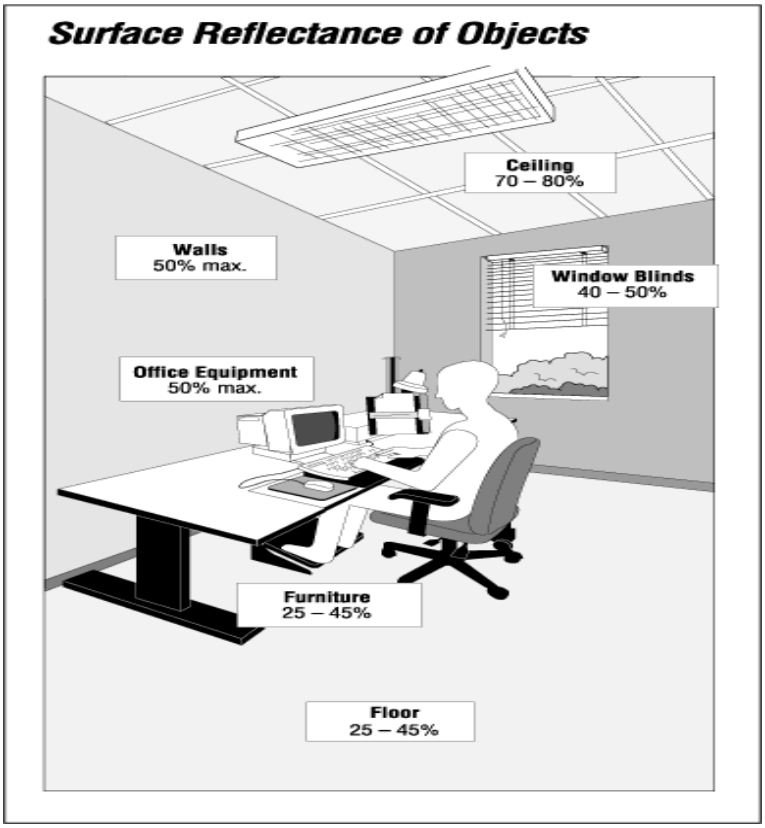
Area of Activity	Illuminance (lx)
Offices & conference room	300
Staff rooms and common rooms	150
Corridors	70
Stairs	100

Library	300
Dinning rooms	300
Cutting	300
Embroidery & Sewing	450
Inspection area	450
Transformer and switchgear	100
Warehouse	250

To reach proper light levels, many light fixtures are designed to reflect light off walls, ceilings and objects. The amount of light reflected off a surface can be measured. Suggestions for the percent of light reflected off surfaces in a typical office include:

- window blinds (40-50%),
- walls (50% maximum),
- business machines (50% maximum),
- ceiling (70-80%),
- floor (20-40%), and
- furniture (25-45%).

The percent value refers to the amount of light that a surface reflects relative to the amount that falls on the surface.



In addition, light fixtures that are too widely spaced or wrongly positioned can create shadows. Objects between the light fixture and work being done can block the light and cast shadows. Likewise, workers sitting with their backs to windows, with light fixtures directly overhead or to the rear, cast shadows on their own work surfaces.

How do you test and correct for insufficient light problems?

To detect insufficient light, try the following:

- Wipe light fixtures with a damp cloth to check for cleanliness. An evenly deposited film of dust is hard to detect by sight alone.
- Measure the average illumination throughout the workplace. Compare this to the recommended levels.
- Look for shadows, especially over work areas and on stairways.
- Ask workers if they suffer from eye strain or squint to see.

Workers should sit in their normal working positions during measurement to give you accurate results.

To correct insufficient light:

- Replace bulbs on a regular schedule. Old bulbs give less light than new ones so replace them before they burn out. Follow manufacturers' instructions.

- Clean light fixtures regularly. Dirt on light fixtures reduces the amount of light given off. Light fixtures with open tops allow air currents to move dust up through the fixture so dust and dirt do not accumulate on the fixture.
- Add more light fixtures in appropriate places.
- Paint walls and ceilings light colours so light can be reflected.
- Use more reflected light and local lighting to eliminate shadows. For example, a covered light mounted under a transparent guard on a grinding wheel provides the added light needed to clearly see the task.
- Do not position work station with light fixture directly behind worker.

What should you know about glare?

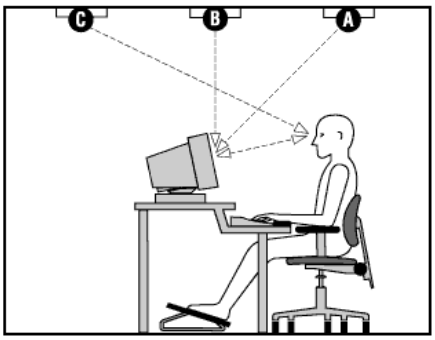
Glare is a common lighting problem. Glare is what happens when a bright light source or reflection interferes with how you are 'seeing' an object. In most cases, your eyes will adapt to the brightest level of light. When this adaptation happens, it becomes harder to see the details in the duller or darker areas of the work space (even though they are actually sufficiently lit!). Glare can cause annoyance and discomfort, and can actually decrease a person's ability to see.

Reflected glare is caused by:

- Light reflected from polished, shiny or glossy surfaces
- the glass on picture frames, or windows at night and
- VDT screens.

Direct glare is caused by:

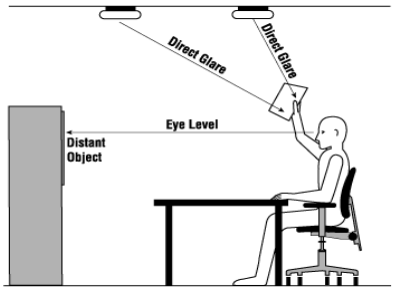
- very bright light from poorly positioned light fixtures, or
- sunlight.



How do you detect glare?

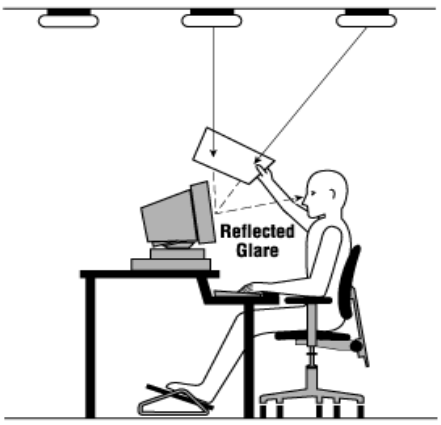
There are several ways to find sources of glare.

- When in your normal working position, look at a distant object at eye level. Block the light "path" from the fixtures with a book or cardboard. If the distant object is now easier to see, the light fixtures are probably producing glare.



- To detect reflected glare, look at the task from your normal working position. Block the light falling on it from the front or above. If details are now easier to see, reflections are a problem.
- Place a small mirror face up on the work surface. The mirror reflects light from above, the light fixture is responsible for glare.

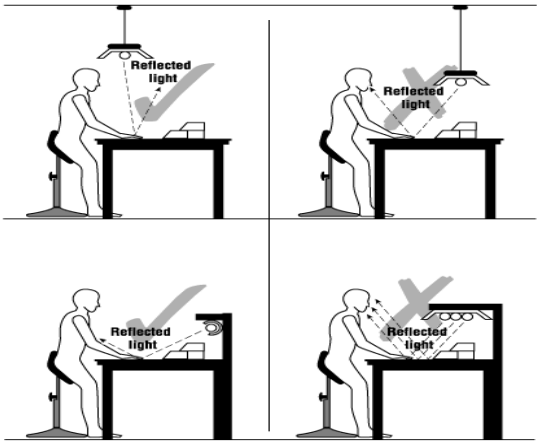
- Look for shiny objects that reflect light. Glass in picture frames, glossy table tops and VDT screens are common examples.
- Ask workers if they experience sore or tired eyes, headaches or if they need to squint to see.



How do you correct glare problems?

To correct glare, try:

- Using several small low-intensity light fixtures rather than one large high-intensity light fixture.
- Using light fixtures that diffuse or concentrate light well. Indirect light fixtures or direct light fixtures with parabolic louvres are two possibilities.
- Covering bare bulbs with louvers, lenses or other devices to control light.
- Increasing the brightness of the area around the glare source.
- Using adjustable local lighting with brightness controls.
- Positioning light fixtures to reduce reflected light that is directed toward the eyes.



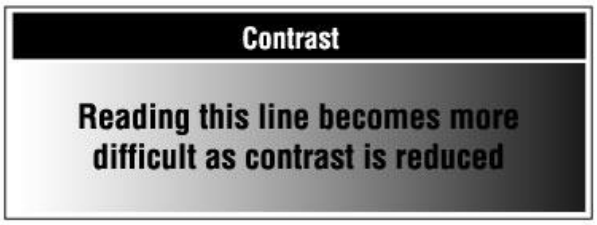
- Using low gloss paper or apply flat or semi-gloss paint and matte finishes on 'offending' surfaces. Remove highly polished and shiny objects.
- Keeping general lighting levels at recommended levels.
- Positioning the work station so that windows and fluorescent light tubes are parallel to the worker's line of sight.
- Do not position the work station so that light fixtures are to the front or directly overhead.

How can you detect if there is "improper contrast"?

There are two types of contrast problems - the first occurs when there are very different light levels from one area to another, and the other is contrast between the colours of objects.

The immediate work area should be brighter than surrounding areas. If the surrounding area is brighter than the work area, your attention is distracted away from the work area.

The contrast between colours of objects, such as between the print itself and paper or text and background on computer screens, can also cause problems. Too little contrast between print and the paper - or characters on a VDT screen and the background - makes reading tasks difficult. In an industrial setting an example would be that moving and stationary machine parts are hard to distinguish if they are the same colour.



How do you check and correct for poor contrast?

- Look for areas with great differences in light levels.
- Look for objects that are hard to distinguish from the background.
- Look for reading materials and VDTs where it is hard to make out the print or characters from the background.

To correct for poor contrast:

- Increase the contrast between objects and the background. Use ink pens rather than pencils, and white paper rather than grey. Adjust photocopier exposure, VDT brightness and contrast controls.
- Decrease reflected glare. Use matte finishes on surfaces and move shiny objects out of view.
- Use contrasting colours for objects and the background. Paint stationary and moving machine parts in contrasting colours to improve visibility and decrease the risk of accident.

What should you know about poorly distributed light?

When light is poorly distributed, parts of the ceiling and general surroundings will seem dark and gloomy. Substantial differences in light levels force your eyes to readjust when moving from one light level to the other. Workers may find it difficult or impossible to see properly.

You can detect poorly distributed light by:

- Looking for dark areas and uneven lighting.
- Using a light meter to check the illumination at various points throughout the workplace. With uniform general lighting, the minimum reading should not be less than two-thirds of the average value.

Correct for poorly distributed light by:

- Supplementing or replacing light fixtures with ones that distribute some light upwards.
- Painting ceiling and walls in light colours that reflect light.
- Cleaning ceilings, walls and light fixtures.

How do you conduct a more detailed lighting survey?

A complete lighting survey may be needed to identify and solve more subtle or complicated problems. A complete lighting survey requires complex equipment and practical experience.

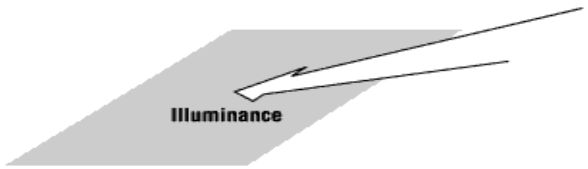
Follow the manufacturer's instructions for the proper handling, care and maintenance of instruments. Many different techniques and instruments are available. Each of them has its own advantages and disadvantages.

A checklist is available under "Lighting Ergonomics" (SF-OHS-07).

A complete basic lighting survey includes the following:

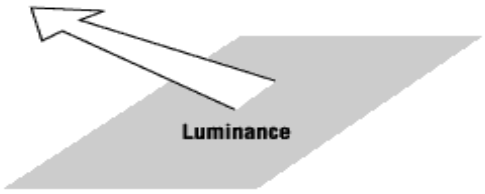
Illuminance

Illuminance is the amount of light falling on a surface. The unit of measurement is lux (or lumens per square metre = 10.76 foot candles, fc). A light meter is used to measure it. Readings are taken from several angles and positions.



Luminance

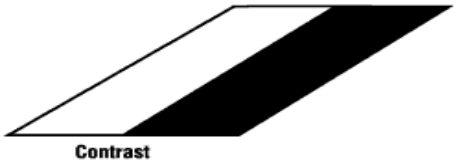
Luminance is the amount of light reflected from a surface. The unit of measurement is candela per square metre (equals 0.29 foot-lamberts). An illuminance meter is used to measure it. Several measurements are made and averaged. Luminance tables are consulted for reference values.



Contrast

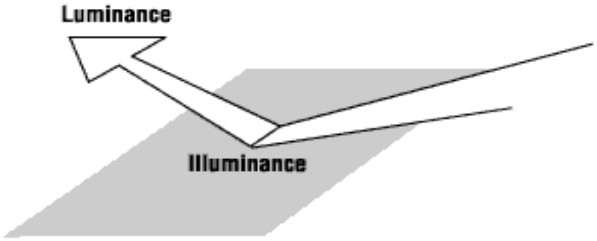
Contrast is the relationship between the brightness of an object and its background. A luminance meter is used to measure it. The following formula is used to calculate contrast and provides a number between 0 and 1. The average contrast should be above 0.5:

$$\text{Contrast} = \frac{\text{Luminance object - Luminance background}}{\text{Luminance background}}$$



Reflectance

Reflectance is the ratio of light falling on a surface to the light reflected from a surface, expressed as a percentage. A light meter is used to measure it. Reflectance can also be measured using a reflectometer or by comparing the surface of interest with colour chips of known reflectance.



To determine reflectance, the light meter probe is placed on the test surface to measure light falling on the surface. Next, place the probe 5-7 cm away facing the surface to measure the light reflected from the surface. The following formula is used to calculate reflectance:

$$\text{Relectance (\%)} = \frac{\text{Luminance}}{\text{Illuminanc e}} x100$$

Medical History Checklist: Symptoms Survey for Work-Related Musculoskeletal Disorders (WMSDs)

What is a symptoms survey for work-related musculoskeletal disorders (WMSDs)?

One element of an effective ergonomics program for the prevention of WMSDs is to ask workers questions about their health. A symptoms survey helps to find out when workers are experiencing any discomfort, pain or disability that may be related to workplace activities.

Medical History Sheet

All the employees are checked at least once in two years for any complain for WMSD disorder (SF-OHS-10).

Workplace Housekeeping - Basic Guide

Why should we pay attention to housekeeping at work?

Effective housekeeping can eliminate some workplace hazards and help get a job done safely and properly. Poor housekeeping can frequently contribute to accidents by hiding hazards that cause injuries. If the sight of paper, debris, clutter and spills is accepted as normal, then other more serious health and safety hazards may be taken for granted.

Housekeeping is not just cleanliness. It includes keeping work areas neat and orderly; maintaining halls and floors free of slip and trip hazards; and removing of waste materials (e.g., paper, cardboard) and other fire hazards from work areas. It also requires paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance. Good housekeeping is also a basic part of accident and fire prevention.

Effective housekeeping is an ongoing operation: it is not a hit-and-miss cleanup done occasionally. Periodic "panic" cleanups are costly and ineffective in reducing accidents.

What is the purpose of workplace housekeeping?

Poor housekeeping can be a cause of accidents, such as:

- tripping over loose objects on floors, stairs and platforms
- being hit by falling objects
- slipping on greasy, wet or dirty surfaces
- striking against projecting, poorly stacked items or misplaced material
- cutting, puncturing, or tearing the skin of hands or other parts of the body on projecting nails, wire or steel strapping

To avoid these hazards, a workplace must "maintain" order throughout a workday. Although this effort requires a great deal of management and planning, the benefits are many.

What are some benefits of good housekeeping practices?

Effective housekeeping results in:

- reduced handling to ease the flow of materials
- fewer tripping and slipping accidents in clutter-free and spill-free work areas
- decreased fire hazards
- lower worker exposures to hazardous substances
- better control of tools and materials
- more efficient equipment cleanup and maintenance
- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work
- improved morale

How do I plan a good housekeeping program?

A good housekeeping program plans and manages the orderly storage and movement of materials from point of entry to exit. It includes a material flow plan to ensure minimal handling. The plan also ensures that work areas are not used as storage areas by having workers move materials to and from work areas as needed. Part of the plan could include investing in extra bins and more frequent disposal.

The costs of this investment could be offset by the elimination of repeated handling of the same material and more effective use of the workers' time. Often, ineffective or insufficient storage planning results in materials being handled and stored in hazardous ways. Knowing the plant layout and the movement of materials throughout the workplace can help plan work procedures.

Worker training is an essential part of any good housekeeping program. Workers need to know how to work safely with the products they use. They also need to know how to protect other workers such as by posting signs (e.g., "Wet - Slippery Floor") and reporting any unusual conditions.

Housekeeping order is "maintained" not "achieved." This means removing the inevitable messes that occur from time to time and not waiting until the end of the shift to reorganize and clean up. Integrating housekeeping into jobs can help ensure this is done. A good housekeeping program identifies and assigns responsibilities for the following:

- clean up during the shift
- day-to-day cleanup
- waste disposal
- removal of unused materials
- inspection to ensure cleanup is complete

Do not forget out-of-the-way places such as shelves, basements, sheds, and boiler rooms that would otherwise be overlooked. The orderly arrangement of operations, tools, equipment and supplies is an important part of a good housekeeping program.

The final addition to any housekeeping program is inspection. It is the only way to check for deficiencies in the program so that changes can be made. The documents on workplace inspection checklists provide a general guide and examples of checklists for inspecting offices and manufacturing facilities.

What are the elements of an effective housekeeping program?

Dust and Dirt Removal

In some jobs, enclosures and exhaust ventilation systems may fail to collect dust, dirt and chips adequately. Vacuum cleaners are suitable for removing light dust and dirt. Industrial models have special fittings for cleaning walls, ceilings, ledges, machinery, and other hard-to-reach places where dust and dirt may accumulate.

Dampening floors or using sweeping compounds before sweeping reduces the amount of airborne dust. The dust and grime that collect in places like shelves, piping, conduits, light fixtures, reflectors, windows, cupboards and lockers may require manual cleaning. Special-purpose vacuums are useful for removing

hazardous substances. For example, vacuum cleaners fitted with HEPA (high efficiency particulate air) filters may be used to capture fine particles of asbestos or fibreglass.

Compressed air should not be used for removing dust, dirt or chips from equipment or work surfaces.

Employee Facilities

Employee facilities need to be adequate, clean and well maintained. Lockers are necessary for storing employees' personal belongings. Washroom facilities require cleaning once or more each shift. They also need to have a good supply of soap, towels plus disinfectants, if needed.

If workers are using hazardous materials, employee facilities should provide special precautions such as showers, washing facilities and change rooms. Some facilities may require two locker rooms with showers between. Using such double locker rooms allows workers to shower off workplace contaminants and prevents them from contaminating their "street clothes" by keeping their work clothes separated from the clothing that they wear home.

Smoking, eating or drinking in the work area should be prohibited where toxic materials are handled. The eating area should be separate from the work area and should be cleaned properly each shift.

Surfaces

Floors: Poor floor conditions are a leading cause of accidents so cleaning up spilled oil and other liquids at once is important. Allowing chips, shavings and dust to accumulate can also cause accidents. Trapping chips, shavings and dust before they reach the floor or cleaning them up regularly can prevent their accumulation. Areas that cannot be cleaned continuously, such as entrance ways, should have anti-slip flooring. Keeping floors in good order also means replacing any worn, ripped, or damaged flooring that poses a tripping hazard.

Walls: Light-coloured walls reflect light while dirty or dark-coloured walls absorb light. Contrasting colours warn of physical hazards and mark obstructions such as pillars. Paint can highlight railings, guards and other safety equipment, but should never be used as a substitute for guarding. The program should outline the regulations and standards for colours.

Maintain Light Fixtures

Dirty light fixtures reduce essential light levels. Clean light fixtures can improve lighting efficiency significantly.

Aisles and Stairways

Aisles should be wide enough to accommodate people and vehicles comfortably and safely. Aisle space allows for the movement of people, products and materials. Warning signs and mirrors can improve sight-lines in blind corners. Arranging aisles properly encourages people to use them so that they do not take shortcuts through hazardous areas.

Keeping aisles and stairways clear is important. They should not be used for temporary "overflow" or "bottleneck" storage. Stairways and aisles also require adequate lighting.

Spill Control

The best way to control spills is to stop them before they happen. Regularly cleaning and maintaining machines and equipment is one way. Another is to use drip pans and guards where possible spills might occur. When spills do occur, it is important to clean them up immediately. Absorbent materials are useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

Tools and Equipment

Tool housekeeping is very important, whether in the tool room, on the rack, in the yard, or on the bench. Tools require suitable fixtures with marked locations to provide orderly arrangement, both in the tool room and near the work bench. Returning them promptly after use reduces the chance of being misplaced or lost. Workers should regularly inspect, clean and repair all tools and take any damaged or worn tools out of service.

Maintenance

The maintenance of buildings and equipment may be the most important element of good housekeeping. Maintenance involves keeping buildings, equipment and machinery in safe, efficient working order and in good repair. This includes maintaining sanitary facilities and regularly painting and cleaning walls. Broken windows, damaged doors, defective plumbing and broken floor surfaces can make a workplace look neglected; these conditions can cause accidents and affect work practices. So it is important to replace or fix broken or damaged items as quickly as possible. A good maintenance program provides for the inspection, maintenance, upkeep and repair of tools, equipment, machines and processes.

Waste Disposal

The regular collection, grading and sorting of scrap contribute to good housekeeping practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities.

Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing scrap containers near where the waste is produced encourages orderly waste

disposal and makes collection easier. All waste receptacles should be clearly labelled (e.g., recyclable glass, plastic, scrap metal, etc.).

Storage

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one metre (or about three feet) of clear space under sprinkler heads.

Stacking cartons and drums on a firm foundation and cross tying them, where necessary, reduces the chance of their movement. Stored materials should not obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations. All storage areas should be clearly marked.

Flammable, combustible, toxic and other hazardous materials should be stored in approved containers in designated areas that are appropriate for the different hazards that they pose. Storage of materials should meet all requirements specified in the fire codes and the regulations of environmental and occupational health and safety agencies in your jurisdiction.

Purchasing Ergonomic Office Furniture

Do you have to spend a lot of money?

Buying always involves spending and many people generally believe that you have to spend a lot of money when buying ergonomic office furniture. This belief is not necessarily true. With a little effort and preparation, you can make a wise investment that will pay back health dividends in the future. However, you cannot approach this project casually. The reason? **Ergonomics is not a product but a process:** a process of matching furniture (including tools, workstation, equipment, and environment) to the workers (and their work tasks) to reduce the hazards for injury and discomfort without undermining productivity.

What should you know about the workers who will be using furniture?

Knowing the prospective users is critical. Individual characteristics can make a significant difference. Always consider the following points:

- Body size
- Height
- Gender
- Right- or left-handedness

What should you know about the job where the furniture will be placed?

Different office tasks require different equipment, different accessories and different layouts. Understanding the basics of the work carried out helps one to understand more clearly what the workers need in order to make their job better "ergonomically". Consider the nature of the tasks to be done:

- a lot of typing or very little
- typing combined with other desk work (e.g., taking notes, using a phone, filing, etc.)
- using a mouse or other input devices (e.g., graphics tablet, a stylus, voice input).

Which factors of the work environment are important?

Many aspects of the work environment must be considered. You should take into account:

- available space and office dimensions
- layout or arrangement of existing furniture
- light sources, specifically task lamps
- type and size of computers to be used
- table-mounted or floor-mounted CPUs
- accessories such as standalone hard drives, CD-ROM drives, storage devices, copy- holders, mice, graphics tablets, CAD/CAM input devices, etc.
- interaction with co-workers

What should you focus on when selecting office furniture?

Having made the initial assessment, you may start looking for a suitable purchase. We suggest that you focus your attention on:

- furniture with an adjustability range that can fit all prospective users. Some chairs have interchangeable cylinders to accommodate very tall or short people.
- a fully adjustable chair with height-adjustable armrests.
- an adjustable desk is preferable
- a footrest is highly recommended if you decide on a non-adjustable desk
- accessories, such as a copyholder, mouse, task lamps, etc. (discuss these with staff and get their feedback as personal preferences are very important).

What should you know about maintaining chairs?

When buying chairs, consider any maintenance and repair costs. Some chair manufacturers will recommend an inspection and maintenance schedule. Normal wear problems may include:

- bolts and screws loosening and falling out
- hydraulic cylinders can fail to hold or seize, or
- hair and lint in the casters (chair may not roll properly)

What is your next step after selecting suitable products?

Do not assume that your job is done once you have found suitable products. Before you make a final decision, you should give your staff an opportunity to test them. Remember that people accept change with differing degrees of ease. Therefore, having the staff actively involved in the decision-making process is very important for the selection of furniture and equipment that is suited to them and their work tasks. Interactive training on how to use, adjust, and readjust new equipment is also crucial for the successful introduction of new equipment and furniture into the workplace.

Keep in mind that the supplier's claim that his products are "ergonomically" correct is no guarantee of comfort. Arming yourself with valid information from reliable sources will help you make the right investment that will benefit an employer and employees equally. Consulting a specialist, specifically when you have little or no understanding of ergonomics can be a valuable investment in the entire purchasing process.