WORK INSTRUCTIONS ON PHYSICAL AGENCIES

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INDEX

PHYSICAL AGENCIES

Good Hygiene Practices - Reducing the Spread of Infections and Viruses

What can I do to reduce the spread of "germs"?

The most important way to reduce the spread of infections is hand washing - always wash regularly with soap and warm water. Also important is to get a vaccine for those infections and viruses that have one, when available.

See Hand Washing - Reducing the Risk of Common Infections" for more details.

This OSH Answers document will discuss other methods that can also help to slow or stop the spread of infections.

What are good practices to slow the spread of infections?

Ways you can reduce or slow the spread of infections include

- get the appropriate vaccine
- wash your hands frequently
- stay home if you are sick (so you do not spread it to other people)
- cover your nose and mouth when sneezing and coughing (or cough into your elbow)
- use single-use tissues for wiping your nose
- wash your hands after coughing, sneezing or using tissues
- if working with children, have them play with hard surface toys that can be easily cleaned
- do not touch your eyes, nose or mouth (viruses can transfer from your hands and into the body)
- do not share cups, glasses, dishes or cutlery.

What can a workplace do?

Workplaces can help by:

- having an infection control plan
- providing clean hand washing facilities
- offering waterless alcohol-based hand sanitizers when regular facilities are not available (or to people on the road)
- providing boxes of tissues and encourage their use
- reminding staff to not share cups, glasses, dishes and cutlery. Be sure dishes are washed in soap and water after use.
- removing magazines and papers from waiting areas or common rooms (such as tea rooms and kitchens)
- considering cleaning a person's workstation or other areas where they have been if a person has suspected or identified influenza
- making sure ventilation systems are working properly.

In the event of a pandemic flu, the Public Health Agency of Canada states that wearing masks when face-to-face with coughing individuals will not be practical or helpful if the infection or virus has entered the community. Special handling of linen or waste contaminated with secretions from persons thought to be or who are sick is not required.

If cleaning is necessary, how should it be done?

Additional measures may be required during a pandemic to minimize the virus from transmitting by hard surfaces (sinks, door and cupboard handles, railings, objects, counters, etc). While a minor "mode of transmission" (way of spreading), influenza viruses can live on hard surfaces for up to 2 days.

In most workplaces and homes, cleaning floors, walls, doorknobs, etc with soap and water is very adequate. In some workplaces, such as a hospital or health care facility, further cleaning can be done with the following:

- bleach solution of 1 to 100 (1 part bleach in 99 parts tap water). This solution is effective for material contaminated with blood and body fluids. It should be used in well ventilated areas, and wear gloves and goggles especially when pouring or where there is a risk of splashing. Do not mix with ammonia or soaps containing ammonia (will react and form chlorine gas). Bleach is corrosive to metals.
- Alcohol (70% ethanol) can be used on smooth metal surfaces, tabletops, etc where bleach cannot be used. Use with care as it is flammable and toxic. Follow safe procedures as listed on the MSDS or the manufacturers instructions. Keep away from heat sources, electrical equipment, flames and hot surfaces. Allow to completely dry.

What does social distancing mean?

Social distancing is a strategy where you try to avoid crowded places, large gatherings of people or close contact with a group of people. In these situations, viruses can easily spread from person to person. In general, a distance of one metre (3 feet) will slow the spread of a disease, but more distance is more effective.

Should social distancing be recommended, steps to follow include:

- use telephone, video conferencing, or the internet to conduct as much business as possible (including within the same building)
- allow employees to work from home, or to work flexible hours to avoid crowding the workplace
- cancel or postpone any travel, meetings, workshops, etc. that are not absolutely necessary
- drive, walk or cycle to work, but try to avoid public transit. Alternatively, allow staff to arrive early/late so they can use public transit when it is less crowded.
- allow staff to eat at their desks or have staggered lunch hours to avoid crowded lunch rooms.
- Spend as little time as possible in tearooms or photocopy centres.
- When meetings are necessary, have the meeting in a larger room were people can sit with more space between them (at least about one metre apart). Avoid shaking hands or hugging.
- Encourage staff to avoid social gatherings outside of work where they might come into contact with infectious people.

What should a workplace do if an employee becomes ill at work?

Reasons to determine "fitness to work" may depend on a number of issues such as size or type of organization, job responsibilities of employees, ease of working from home (via internet connections, etc).

Generally, employees should be allowed and encouraged to stay at home if they are not feeling well. However, in the event of a pandemic, use screening tools or a list of symptoms as a checklist. If employees are showing any signs, allow them to go or remain at home. I f there is doubt if a person is sick, they should stay home for about 3 days. If symptom free after 3 days, they can resume normal activities. If they are ill, they should stay home until all symptoms are gone.

Hand Washing: Reducing the Risk of Common Infections

Is it important to wash your hands?

Simply put, yes. Hand washing is the single most effective way to prevent the spread of infections. You can spread certain "germs" (a general term for microbes like viruses and bacteria) casually by touching another person. You can also catch germs when you touch contaminated objects or surfaces and then you touch your face (mouth, eyes, and nose).

"Good" hand washing techniques include using an adequate amount of soap, rubbing the hands together to create friction, and rinsing under running water. The use of gloves is not a substitute for hand washing.

There is additional information later on about how the common cold is transmitted by contaminated hands.

When should I wash my hands?

Different situations where people can pick up "germs" include:

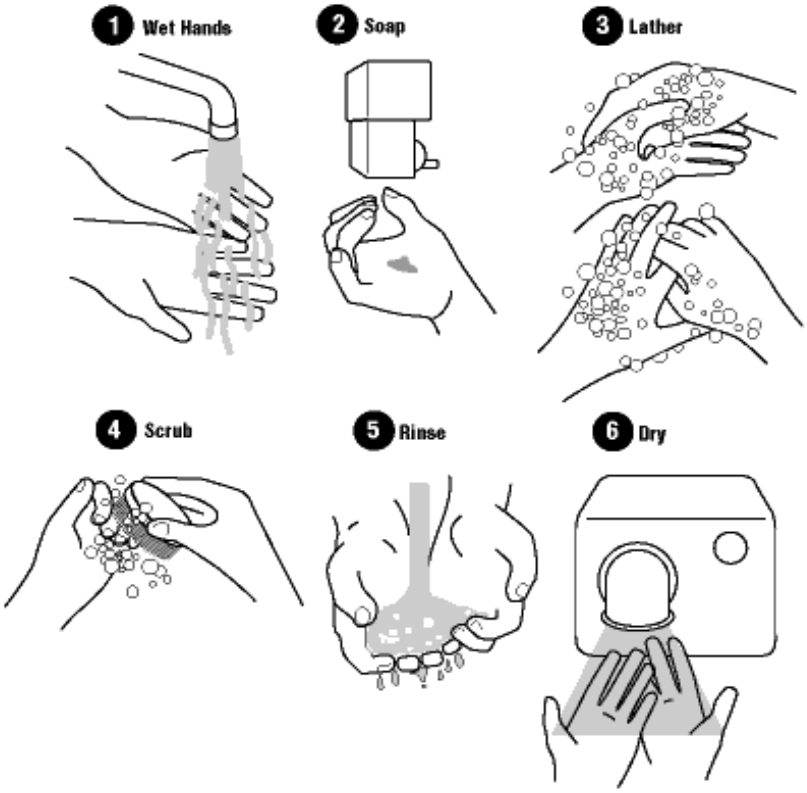
- when hands are visibly soiled,
- after using the washroom (includes changing diapers),
- after blowing your nose or after sneezing in your hands,
- before and after eating, handling food, drinking or smoking,
- after touching raw meat, poultry, or fish,
- after handling garbage,
- visiting or caring for sick people,
- handling pets, animals or animal waste.

Ensuring that employees wash their hands properly after using the washroom is very important in reducing disease transmission of stomach "flus" (which really is not a "flu" or influenza) and other gastrointestinal infections. Using soap and lathering up is very important (rinsing hands in water only is not as effective). Use comfortably warm, running water. Hands should be washed for a minimum of 10 seconds - longer if the hands are visibly soiled. To help people (especially children) wash long enough, one option may be to sing a short song such as "Happy Birthday". The idea of surgeons scrubbing for an operation (as on TV) is very similar.

How do I properly wash my hands?

For effective hand washing, follow these steps:

- remove any rings or other jewelry,
- use warm water and wet your hands thoroughly,
- use soap (1-3 mL) and lather very well,
- scrub your hands, between your fingers, wrists, and forearms with soap for 10 seconds,
- scrub under your nails,
- rinse thoroughly,
- turn off the taps/faucets with a paper towel,
- dry your hands with a single use towel or air dryer,
- protect your hands from touching dirty surfaces as you leave the bathroom.



Other tips include:

- Cover cuts with bandages and wear gloves for added protection (cuts are very vulnerable to infections).
- Artificial nails and chipped nail polish have been associated with an increase in the number of bacteria on the fingernails. Be sure to clean the nails properly.
- Keep your hands away from your eyes, nose or mouth.
- Assume that contact with any human body fluids is infectious.
- Liquid soap in disposable containers is best. If using reusable containers, they should be washed and dried before refilling. If using a bar of soap, be sure to set it on a rack that allows water to drain or use small bars that can be changed frequently.

What about antibacterial soaps and waterless hand scrubs?

While it is true that regular soap and water does not actually kill microorganisms (they create a slippery surface that allows the organisms to "slide off"), antibacterial soaps are typically considered to be "overkill" for most purposes. The exception may be in a hospital where special situations are present (e.g., before invasive procedures, when caring for severely immuno-compromised patients, critical care areas, intensive care nurseries, etc.). Antibacterial agents should be chosen carefully based on their active ingredients and characteristics, and when persistent antimicrobial activity on the hands is desired.

When there is no soap or water available, one alternative is to use waterless hand scrubs. Some of these products are made of ethyl alcohol mixed with emollients (skin softeners) and other agents. They are often available as a rinse, or on wipes or towelettes. They can be used by paramedics, home care attendants, or other mobile workers where hand washing facilities are not available. However, these agents are not effective when the hands are heavily contaminated with dirt, blood, or other organic materials. In addition, waterless hand scrubs may have a drying effect on the skin and may have odours which may be irritating to some users.

Common Cold

What is the common cold?

The common cold is an infection of the upper respiratory tract - the nose, nasal passages and the throat. There are more than 200 viruses that can cause colds. The primary family of viruses that cause common colds in adults are the rhinoviruses. There are more than one hundred kinds of rhinoviruses. These are also called "nose viruses", based on a Greek word "rhino" meaning nose.

What are the symptoms of common cold?

Symptoms usually show up about two days after a person becomes infected. Early signs of a cold are a sore, scratchy throat, sneezing, and a runny nose. Other symptoms that may occur later include headache, stuffy nose, watering eyes, hacking cough, chills, and general malaise (ill-feeling) lasting from 2 to 7 days. Some cases may last for two weeks. The common cold may be accompanied by:

- laryngitis (inflammation of the larynx or "voice box");
- tracheitis (inflammation of the membrane lining the trachea or "wind pipe") or
- bronchitis (inflammation of the bronchial membranes).

These inflammations may make one more susceptible to more serious complications such as

- sinusitis (inflammation of sinus membranes) and
- pneumonitis (inflammation of the lungs).

Although no fatalities have been reported among otherwise healthy workers the disability is important because it affects work performance and industrial absenteeism.

Can someone be infected with a cold virus and not show symptoms?

Yes, it is even possible to be exposed to cold viruses and not become infected. When people are infected, they can be asymptomatic (i.e., showing no symptoms); this is called a sub-clinical infection since the infection is not causing a disease. Most people with colds show mild symptoms but severe colds can send one to bed with all the nasty symptoms of headache, fever, aches and pains all over, stuffy nose and coughing.

How widespread is the common cold?

Common cold infections are so widespread that there can be very few people who escape the infection each year. It has been estimated that adults suffer 2 to 5 colds per year.

In the U. S. there are nearly 61 million cases of common cold annually resulting in approximately 58 million bed-days.

How common cold viruses are transmitted?

Colds are really not very contagious, compared to other infectious diseases. Close personal and prolonged contact is necessary for the cold viruses to spread. The viruses must get into the nose where they can infect the nasal membranes. The virus must attach to nasal cells after which the viruses can multiply. Inhaling contaminated droplets produced when someone else coughs or sneezes may be one way to catch a cold.

Cold viruses can remain infective even if they are outside the body for a few hours. You can catch a cold if you handle something that is contaminated with a cold virus and then stick your contaminated finger up your nose or rub your eyes. The cold viruses can reach the nose when you rub your eyes because the virus can be passed down the tear ducts that go from the eyes into the nasal cavities.

Do chills or exposure to cold temperatures cause colds?

In a word - no. Some people may sneeze if their skin is cooled. More people catch colds when the weather temperature is cold than when it is warm outside because they tend to be inside more often and longer. People tend to blame cool temperatures for getting a cold rather than being in closer, prolonged contact with people who have a cold.

Some people associate exposure to the cool air from air conditioners as a cause of colds. Again, it is not the temperature that is the culprit. Air conditioners remove moisture from the air which, in turn, can dry the mucous on the nasal membrane. Without a sufficient mucous layer covering these membranes, the nose becomes more susceptible to viruses that cause the common cold.

When are people with a common cold most infective?

People are most infective or more likely to be able to pass on a cold around two days after they were infected. This is when the first signs of a cold (sneezing, runny nose and cough) appear. People can cough or sneeze out in droplets of mucus containing the cold virus. People can also spread the cold virus on their fingers when they contaminate them with nasal secretions (for example, someone blows their nose and then shakes hands with someone else, who rubs his or her eyes with the contaminated fingers).

Can you tell the difference between a cold and the "flu"?

You cannot really tell the difference between a cold and the flu (from the word "influenza") from the symptoms alone. Flu symptoms usually occur very quickly after one is infected but the onset of cold symptoms can be up to a couple of days or so. Symptoms like headaches, fever and muscle aches and pains are usually associated with influenza but someone with a severe common cold can also have these symptoms.

How can we control the spread of common colds?

You cannot cure a cold but you can help protect yourself from getting a cold by following good personal hygiene practices. Good hygiene practices include:

- washing hands properly and frequently
- covering the mouth when coughing or sneezing
- wiping noses using disposable tissues in a way that secretions are contained by the tissue without contaminating the hands
- avoiding rubbing the eyes with dirty hands
- avoiding nail biting (especially important for infections that are transmitted orally)

A healthy diet and getting sufficient sleep are also important in helping to prevent colds. Our immune system is also affected by stress. Studies have shown that people are more susceptible to getting colds after times of psychological stress.

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Hot Environments - Health Effects

What is heat stress?

"Heat stress" is the net (overall) heat burden on the body from the combination of the body heat generated while working, environmental sources (air temperature, humidity, air movement, radiation from the sun or hot surfaces/sources) and clothing requirements. Other heat-related terms are at the end of this document in the Glossary of Terms.

In foundries, steel mills, bakeries, smelters, glass factories, and furnaces, extremely hot or molten material is the main source of heat. In outdoor occupations, such as construction, road repair, open-pit mining and agriculture, summer sunshine is the main source of heat. In laundries, restaurant kitchens, and canneries, high humidity adds to the heat burden. In all instances, the cause of heat stress is a working environment which can potentially overwhelm the body's ability to deal with heat.

Most people feel comfortable when the air temperature is between 20°C and 27°C and the when relative humidity ranges from 35 to 60%. When air temperature or humidity is higher, people feel uncomfortable. Such situations do not cause harm as long as the body can adjust and cope with the additional heat. Very hot environments can overwhelm the body's coping mechanisms leading to a variety of serious and possibly fatal conditions.

This document contains information relating to the health effects of hot environments. Please see Working in Hot Environments - Control Measures later on for information about the prevention and control from heat related illnesses.

How does the human body react to hot environments?

The healthy human body maintains its internal temperature around 37°C. Variations, usually of less than 1°C, occur with the time of the day, level of physical activity or emotional state. A change of body temperature exceeding 1°C occurs only during illness or when environmental conditions surpass the body's ability to cope with extreme temperatures.

As the environment warms-up, the body tends to warm-up as well. The body's internal "thermostat" maintains constant inner body temperature by pumping more blood to the skin and by increasing sweat production. In this way, the body increases the rate of heat loss to balance the heat burden created by the environment. In a very hot environment, the rate of "heat gain" exceeds the rate of "heat loss" and the body temperature begins to rise. A rise in the body temperature results in heat illnesses.

How does the body control heat gain and heat loss?

The main source of heat gain is the body's own internal heat. Called metabolic heat, it is generated within the body by the biochemical processes that keep us alive and by the energy we use in physical activity. The body exchanges heat with its surroundings mainly through radiation, convection, and evaporation of sweat.

Radiation is the process by which the body gains heat from surrounding hot objects, such as hot metal, furnaces or steam pipes, and loses heat to cold objects, such as chilled metallic surfaces, **without contact** with them. No radiant heat gain or loss occurs when the temperature of surrounding objects is the same as the skin temperature (about 35°C).

Convection is the process by which the body exchanges heat with the surrounding air. The body gains heat from hot air and loses heat to cold air which comes **in contact** with the skin. Convective heat

exchange increases with increasing air speed and increased differences between air and skin temperature.

Evaporation of sweat from the skin cools the body. Evaporation proceeds more quickly and the cooling effect is more pronounced with high wind speeds and low relative humidity. In hot and humid workplaces, the cooling of the body due to sweat evaporation is limited by the capacity of the ambient air to accept additional moisture. In hot and dry workplaces, the cooling due to sweat evaporation is limited by the amount of sweat produced by the body.

The body also exchanges small amounts of heat by conduction and breathing. By conduction, the body gains or loses heat when it comes into direct contact with hot or cold objects. Breathing exchanges heat because the respiratory system warms the inhaled air. When exhaled, this warmed air carries away some of the body's heat. However, the amount of heat exchanged through conduction and breathing is normally small enough to be ignored in assessing the heat load on the body.

What are the effects of hot environments on the body?

When the air temperature or humidity rises above the optimal ranges for comfort, problems can arise. The first effects are subjective in nature - they relate to how you feel. Exposure to more heat stress can cause physical problems which impair workers' efficiency and may cause adverse health effects. (Short-term exposure / Long-term exposure).

Some of the problems and their symptoms experienced in the temperature range between a comfortable zone (20C - 27°C) and the highest tolerable limits (for most people) are summarized in Table 1.

Problems and Symptoms Caused by Hot Temperatures		
Temperature Range (°C)	Effects	
20 - 27°C	Comfort Zone	Maximum efficiency
As temperature increases...	Discomfort: • Increased irritability • Loss of concentration • Loss of efficiency in mental tasks	Mental Problems
	Increase of errors: • Loss of efficiency in skilled tasks • More incidents	Psycho-physiological problems
	Loss of performance of heavy work: • Disturbed water and electrolyte balance • Heavy load on heart and circulation • Fatigue and threat of exhaustion	Physiological problems
35 - 40°C	Limit of high temperature tolerance	

In moderately hot environments, the body "goes to work" to get rid of excess heat so it can maintain its normal body temperature. The heart rate increases to pump more blood through outer body parts and skin so that excess heat is lost to the environment, and sweating occurs. These changes impose additional demands on the body. Changes in blood flow and excessive sweating reduce a person's ability to do physical and mental work. Manual work produces additional metabolic heat and adds to the body heat burden. When the environmental temperature rises above 30°C, it may interfere with the performance of mental tasks.

Heat can also lead to accidents resulting from the slipperiness of sweaty palms and to accidental contact with hot surfaces. As a worker moves from a cold to a hot environment, fogging of eye glasses can briefly obscure vision, presenting a safety hazard.

Several studies comparing the heat tolerances of men and women have concluded that women are generally less heat tolerant than men. While this difference seems to diminish when such comparisons take into account cardiovascular fitness, body size and acclimatization, women have a lower sweat rate than men of equal fitness, size and acclimatization. Laboratory experiments have shown that women may be more tolerant of heat under humid conditions, but slightly less tolerant than men under dry conditions.

What are the illnesses caused by heat exposure?

The risk of heat-related illness varies from person to person. Older and obese people are generally at higher risk. Heat exposure causes the following illnesses.

Heat edema is swelling which generally occurs among people who are not acclimatized to working in hot conditions. Swelling is often most noticeable in the ankles. Recovery occurs after a day or two in a cool environment.

Heat rashes are tiny red spots on the skin which cause a prickling sensation during heat exposure. The spots are the result of inflammation caused when the ducts of sweat glands become plugged.

Heat cramps are sharp pains in the muscles that may occur alone or be combined with one of the other heat stress disorders. The cause is salt imbalance resulting from the failure to replace salt lost with sweat.

Cramps most often occur when people drink large amounts of water without sufficient salt (electrolyte) replacement.

Heat exhaustion is caused by loss of body water and salt through excessive sweating. Signs and symptoms of heat exhaustion include: heavy sweating, weakness, dizziness, visual disturbances, intense thirst, nausea, headache, vomiting, diarrhea, muscle cramps, breathlessness, palpitations, tingling and numbness of the hands and feet. Recovery occurs after resting in a cool area and consuming cool salted drinks.

Heat syncope is heat-induced giddiness and fainting induced by temporarily insufficient flow of blood to the brain while a person is standing. It occurs mostly among unacclimatized people. It is caused by the loss of body fluids through sweating, and by lowered blood pressure due to pooling of blood in the legs. Recovery is rapid after rest in a cool area.

Heat stroke and hyperpyrexia (elevated body temperature) are the most serious types of heat illnesses caused by prolonged work in hot environments. Signs of heat stroke include dry, hot skin (due to failure to sweating), body temperature often exceeding 41^0C, and complete or partial loss of consciousness. The signs of heat hyperpyrexia are similar except that the skin remains moist.

Heat stroke and heat hyperpyrexia require immediate first aid and medical attention. Delayed treatment may result in damage to the brain, kidneys and heart. Treatment may involve removal of the victim's clothing and spraying the body with cold water. Fanning increases evaporation and further cools the body. Immersing the victim in cold water more efficiently cools the body but it can result in harmful overcooling which can interfere with vital brain functions so it must only be done under close medical supervision.

Lack of acclimatization, poor levels of physical fitness and pre-existing diarrhea or fever increase susceptibility to heat stroke and hyperpyrexia. Certain drugs such as tranquilizers and diuretics can also increase an individual's susceptibility. Heat stroke occurs more readily when the body has suffered a previous heat disorder.

What are the illnesses caused by long-term (chronic) heat exposure?

Certain kidney, liver, heart, digestive system, central nervous system and skin illnesses are thought by some researchers to be linked to long-term heat exposure. However, the evidence supporting these associations is not conclusive.

Chronic heat exhaustion, sleep disturbances and susceptibility to minor injuries and sicknesses have all been attributed to the possible effects of prolonged exposure to heat.

The lens of the eye is particularly vulnerable to radiation produced by red-hot metallic objects (infrared radiation) because it has no heat sensors and lacks blood vessels to carry heat away. Glass blowers and furnace-men have developed cataracts after many years of exposure to radiation from hot objects. Foundry workers, blacksmiths and oven operators are also exposed to possibly eye-damaging infrared radiation.

A possible link between heat exposure and reproductive problems has been suggested. Data from laboratory experiments on animals have shown that heat stress may adversely affect the reproductive function of males and females. Exposure of males resulted in reduced rate of conception. Exposure of females caused disruption of the reproductive cycle until they became acclimatized to heat. When animals are simultaneously exposed to heat and toxic chemicals, the influence of heat exposure seems to accelerate the chemical reactivity.

In men, repeatedly raising testicular temperature 3 to 5C decreases sperm counts. There is no conclusive evidence of reduced fertility among heat-exposed women. There are no adequate data from which conclusions can be drawn regarding the reproductive effects of occupational heat exposure at currently accepted exposure limits.

Laboratory study of warm-blooded animals has shown that exposure of the pregnant females to hyperthermia may result in a high incidence of embryo deaths and malformations of the head and the central nervous system (CNS). There is no conclusive evidence of teratogenic effects of hyperthermia in humans. The NIOSH criteria document (1986) recommends that a pregnant worker's body temperature should not exceed 39-39.5C during the first trimester of pregnancy.

(Reference: Occupational exposure to hot environments. Revised Criteria. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1986)

What are some of the terms used in this document (Glossary of Terms)?

Acclimatization - Physiological changes which occur in response to several days of heat exposure and make the body accustomed to a hot environment.

Convection - Process of heat exchange between the body and the surrounding air or fluid as a result of bulk flow of that air or fluid.

Dehydration - Loss or deficiency of water in body tissues caused by sweating, vomiting or diarrhea. Symptoms include excessive thirst, nausea, and exhaustion.

Heat cramps - Painful and often incapacitating cramps in muscles. Heat cramps are caused by depletion of salt in the body as a result of heavy sweating, and ingestion of water without replacing salt.

Heat exhaustion - Weakness, lassitude, dizziness, visual disturbance, feeling of intense thirst and heat, nausea, vomiting, palpitations, tingling and numbness of extremities after exposure to a hot environment.

Heat hyperpyrexia - Rise in body temperature with moist skin and mental dysfunction, caused by exposure to an extremely hot environment.

Heat rash (prickly heat or milliaria) - An itchy rash of small raised red spots on the face, neck, back, chest and thighs caused by a hot and moist environment.

Heat strain - Physiological and behavioural responses of the body as a result of heat exposure.

Heat stroke - Acute illness caused by overexposure to heat. Symptoms are dry, hot skin, high body temperature (usually over 105F) and mental dysfunction.

Heat syncope - Temporary loss of consciousness induced by insufficient flow of blood to the brain. Recovery is normally prompt and without any long-term ill effects.

Metabolic rate - Rate of energy (heat) production of the body which varies with the level of activity.

Natural Wet Bulb Temperature - Air temperature measured using a thermometer in which the bulb is covered with wet cotton wick and cooled by the natural movement of air.

Nausea - The feeling that one is about to vomit as experienced in seasickness.

Prickly heat - See Heat rash.

Radiation (heat) - Transfer of heat between hot and cold bodies without contact between them.

Relative humidity - The ratio of the water vapour content of air to the maximum possible water vapour content of air at the same temperature and air pressure.

Extreme Hot or Cold Temperature Conditions

Is there a temperature at which work becomes dangerous and should be stopped?

The short answer is yes. Both very cold and very hot temperatures could be dangerous to your health.

Excessive exposure to heat is referred to as heat stress and excessive exposure to cold is referred to as cold stress.

In a very hot environment, the most serious concern is heat stroke. In absence of immediate medical attention, heat stroke could be fatal. Heat stroke fatalities do occur every summer. Heat exhaustion, and fainting (syncope) are less serious types illnesses which are not fatal but interfere with a person's ability to work.

At very cold temperatures, the most serious concern is the risk of hypothermia or dangerous overcooling of the body. Another serious effect of cold exposure is frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes. Hypothermia could be fatal in absence of immediate medical attention.

What are the warning signs of heat stroke and hypothermia?

The victims of heat stroke and hypothermia are unable to notice the symptoms, and therefore, their survival depends on co-workers' ability to identify symptoms and to seek medical help.

While symptoms can vary from person to person, the warning signs of heat stroke can include complaints of sudden and severe fatigue, nausea, dizziness, lightheadedness, and profuse and prolonged sweating. If a co-worker appears to be disorientated or confused (including euphoria), or has unaccountable irritability, malaise or flu-like symptoms, the worker should be moved to a cool location and seek medical advice.

Warning signs of hypothermia can include complaints of nausea, fatigue, dizziness, irritability or euphoria. Workers can also experience pain in their extremities (hands, feet, ears, etc), and severe shivering. Workers should be moved to a heated shelter and seek medical advice when appropriate.

What are the exposure limits for working in hot environments?

Two types of exposure limits are often used: occupational exposure limits and thermal comfort limits. Occupational exposure limits are to protect industrial workers from heat-related illness. Thermal comfort limits are for office work to ensure productivity and quality of work.

ASHRAE Standard 55-1992 Thermal Environmental Conditions for Human Occupancy recommends the following acceptable temperature ranges at relative humidity (RH) of 50% and air speed less than 0.15 m/sec. (30 fpm).

Table 1
Acceptable Temperatures

Season	Clothing	Temperature
Winter	Heavy slacks, long sleeve shirt and/or sweater	20-23.5°C (68-75°F)
Summer	Light slacks and short sleeve shirt	23-26°C (73-79°F)

Threshold Limit Values (TLVs) for working in hot environments as recommended by The American Conference of Governmental Industrial Hygienists (ACGIH) is advised to follow. These limits are given in units of WBGT (wet bulb globe temperature) degrees Celsius (°C). The WBGT unit takes into account environmental factors namely, air temperature, humidity and air movement, which contribute to perception

of hotness by people. In some workplace situations, solar load (heat from radiant sources) is also considered in determining the WBGT. Some Canadian jurisdictions have adopted these TLVs as occupational exposure limits and others use them as guidelines to control heat stress in the workplace.

The ACGIH publication "2000 TLVs and BEIs" provides recommended screening criteria for heat stress exposure for workers acclimatized to heat and for workers who are not acclimatized to heat (Table 2). The publications "2000 TLVs and BEIs" and "Documentation of TLVs and BEIs" should be consulted for more detailed information on these screening criteria, categories of work demands, guidelines for limiting heat strain and heat strain management.

Table 2
Screening Criteria for Heat Stress Exposure
(WBGT values in °C)
for 8 hour work day with conventional breaks

	Acclimatized				Unacclimatized			
Work Demands	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
100% work	29.5	27.5	26		27.5	25	22.5	
75% Work; 25% Rest	30.5	28.5	27.5		29	26.5	24.5	
50% Work; 50% Rest	31.5	29.5	28.5	27.5	30	28	26.5	25
25% Work; 75% Rest	32.5	31	30	29.5	31	29	28	26.5

Many countries occupational health and safety regulations specify upper and lower temperature limits for work performed inside buildings which are normally heated (see Table 4).

The weather broadcast service of Environment Canada uses the humidex scale to inform the public about hot weather conditions. The humidex scale quantifies human discomfort due to perceived heat taking into account the effect of air temperature and relative humidity. For a given temperature, the humidex increases as the relative humidity (moisture content) of the air becomes higher. The following table gives ranges of humidex for various degrees of thermal effect on people.

Table 3
Humidex and Thermal Comfort

Humidex Range (°C)	Degrees of Comfort
20 - 29	Comfortable
30 - 39	Varying degrees of discomfort
40 - 45	Uncomfortable
46 and Over	Many types of labour must be restricted

Humidex is measure of thermal conditions in office accommodations. "An unsatisfactory condition is deemed to exist when the humidex reading exceeds 40°C [inside the building - not based on "weather information" or outdoor air temperatures] or when the air temperature (dry bulb) falls below 17°C. In these cases, operations shall be stopped and employees released from the workplace if relocation is not practicable." Direct comparison between WBGT and humidex is not possible - there are no standard conversion tables or mathematical formulas to do such conversions.

Table 4
Canadian Health and safety requirements with respect to thermal conditions in the workplace

Jurisdiction	Regulation	Temperature
Canada, Federal	Personal service food preparation area Materials handling: operators' compartment First aid room	18°C min./29°C max. 27°C max. 21°C - 24°C ACGIH TLVs for heat stress, cold stress
Treasury Board Guidelines	Thermal conditions in office work	20-26°C Humidex 41°C max.
British Columbia	Heat Stress Regulations Indoor Air Quality Regulation, ASHRAE 55-1992 Standard	Limits in WBGT units similar to ACGIH TLV
	Summer Indoor Winter Indoor	23.3 - 27.2°C or 74 - 81°F 20.5 - 24.4°C or 69 - 76°F
Alberta	(Guidelines only)	Similar to ACGIH TLVs for heat stress and cold stress
Saskatchewan	Thermal environment	Reasonable and appropriate to nature of work
Manitoba	Thermal environment	ACGIH TLVs for heat stress, cold stress
Ontario	Construction projects:	
	Change room for underground workers Work chamber Medical locks	27°C min. 38°C max. 18°C min./27°C max.

	Enclosed workplace, Industrial Establishment Regulations	18°C min.
Quebec	Safety in mines: Dryhouse temperature Occupational exposure limits	 22°C min. WBGT similar to ACGIH TLVs
New Brunswick	Enclosed place of employment:	
	Light work while sitting, mental work	20°C min.
	Light work while sitting, work with small machine tools	18°C min
	Moderate physical work, standing	16°C
	Heavy physical work	12°C min.
	Work conditions	1991-92 ACGIH TLVs for heat stress and cold stress
Nova Scotia	Construction safety regulations: Working chamber	80°F max. (27°C) ACGIH TLVs for heat stress and cold stress
Prince Edward Island	Enclosed workplace:	
	Light work while sitting, mental work	20°C min.
	Light work while sitting, work with small machine tools	19°C
	Light work, standing	17°C
	Moderate work standing	16°C
	Heavy work	12°C min.
	Occupational exposure limit	ACGIH TLVs for heat and cold exposure
Newfoundland	Occupational exposure limit	ACGIH TLVs for hot and cold environment
Northwest Territories	Overnight minimum temperature only, Camp Sanitation Regulation	18°C min
Yukon Territory	Thermal environment	Heat Stress limits similar to ACGIH TLVs

Maximum Temperature Limit for Working

Is there a maximum temperature to which workers can be exposed at work?

Actually, no. In legislation, there is no single value for the maximum temperature to which you can be exposed at work, **nor** is there a single value above which work should stop. Of course, some temperature and relative humidity combinations cause discomfort. However, in some situations, exposure to excessive heat can lead to heat stress that could lead to heat exhaustion, fainting, heat stroke, and other conditions which should be addressed.

Why is there no maximum temperature?

Occupational exposure limits or guidelines for exposure to high temperatures actually depend on a number of factors, not just the temperature. These other factors include:

- relative humidity
- exposure to sun or other heat sources
- amount of air movement
- work demands i.e. how physically demanding the work is
- is the worker acclimatized or unacclimatized to the work load under the conditions of work
- what clothing is worn (including protective clothing)
- what is the work-rest regimen (% time work vs. % time rest break).

Are there any general guidelines about temperature?

For non-office workplace situations, occupational health and safety agencies generally use the Threshold Limit Values for Heat Stress published by the American Conference of Governmental Industrial Hygienists (ACGIH). The units of heat stress exposure are expressed as Wet Bulb Globe Temperature (WBGT) values in C. The WBGT measurement takes into account air temperature, air movement, radiant heat and humidity. There are direct-reading WBGT meters that are commercially available. These are also called "heat-stress indicators". The WBGT measurements can then be related to the physical demands of the job. Only qualified professionals, whether they are in-house staff, consultants, or from the local occupational health and safety regulatory agency, should perform the measurement.

Unfortunately, direct comparison between WBGT and humidex is not possible - there are no standard conversion tables or mathematical formulas to do such conversions. More information about WBGT is available in the document "Working in Hot Environments - Control Measures" (next page)
In addition, while there is no maximum temperature, legislation does provide a range of acceptable temperatures for various circumstances. See "Working in Extreme Hot or Cold Temperature Conditions" in page 11 for more information.

Are there any general guidelines about maximum temperature conditions in offices?

The document Thermal Comfort for Office Work (given in page 20) discusses 'comfortable' temperature and humidity conditions for work is done mainly while seated or does not involve much physical activity. Table 4 under the heading “What are the exposure limits for working in hot environments” summarizes limits or guidelines for workplace thermal conditions in the Canadian health and safety regulations.

When the humidex rating is in the 40 - 45°C range, most people would it uncomfortable. However, many kinds of work must be restricted when the humidex is above 45°C.

Only one jurisdiction that we know of that has a directive about the temperature and humidity conditions when employees should be relocated or released from the office workplace. If the humidex reading exceeds 40°C [measured inside the building - not based on weather reports or outdoor air temperatures], it is considered to be an unsatisfactory condition. "In these cases, operations shall be stopped and employees released from the workplace if relocation is not practicable."

What should be done when it is very hot and/or humid?

Employers have a duty to take every reasonable precaution to ensure the workplace is safe for the worker. This duty includes taking effective measures to protect workers from heat stress disorders if it is not reasonably practicable to control indoor conditions adequately, or where work is done outdoors.

Certain steps can be taken to reduce discomfort. These include:

- using fans or air conditioning
- wearing light, loose fitting clothing
- taking more frequent rest breaks
- drinking cold beverages (ones that do not have caffeine or alcohol)
- allowing flexibility to permit less physically demanding activities during peak temperature periods.
- using screens or umbrellas to create shade.

More information about ways to control heat stress is available in the document "Working in Hot Environments - Control Measures" (next page)

Please note: An employee always has the right to refuse unsafe work. If they believe that the degree of heat stress being experienced may be hazardous to the health and safety to themselves or a co-worker, then a work refusal could be initiated.

Hot Environments - Control Measures

How can I measure occupational heat exposure?

Feeling of hot or cold depends on:

- air temperature
- relative humidity of air
- presence of hot or cold objects in the surrounding area
- presence of air movement (breeze, ventilation)

Various methods of measuring occupational heat exposure combine these environmental factors to obtain a single number as a measure of overall heat load. The most commonly used measure in the workplace is the wet bulb globe temperature (WBGT) index.

Please Note: This document contains information relating to prevention from and control of heat related illnesses. Please see Working in Hot Environments - Health Effects in page 8 for information about the effects on the body from working in hot environments.

The Wet Bulb Globe Temperature (WBGT)

The wet bulb globe temperature is calculated using a formula that takes into account air temperature, speed of air movement, radiant heat from hot objects, sunshine and body cooling due to sweat evaporation.

Air temperature is measured using a conventional thermometer.

The contribution due to radiant heat is measured using a black globe thermometer. A conventional thermometer is inserted through a rubber stopper into a hollow, six-inch diameter copper ball which is coated with a flat black paint. The thermometer bulb is positioned at the centre of the copper ball. The black globe thermometer normally requires at least 20 minutes to come to equilibrium reading.

The cooling effect of evaporation and air movement is taken into account using a natural wet bulb thermometer. A natural wet bulb thermometer is a conventional thermometer with its bulb wrapped with an absorbent cotton wick. The wick extends 30 to 35 millimetres above the thermometer bulb, and the lower end of the wick is immersed in distilled water. About 25 mm of moistened wick is exposed between the water and the bulb of the thermometer. The moist wick continuously provides water for evaporation. As with the black globe thermometer, the natural wet bulb thermometer also requires at least 20 minutes to reach equilibrium.

Two different methods are used to calculate WBGT in the workplace: one for workplaces with direct sunlight, and the other for workplaces without direct sunlight.

When conditions of the workplace fluctuate widely, time-weighted WBGT is often used. The question below gives worked examples of WBGT calculations. WBGT direct reading meters, often called heat stress analyzers, are now available - these meters give direct WBGT reading and no calculations are necessary.

What are exposure limits for heat stress?

Exposure limits intended to minimize the risk of heat-related illnesses are set by provincial and territorial governments for most Canadian workplaces, and by Labour Canada for workplaces under the federal

jurisdiction. These agencies generally use the exposure guidelines recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). (see Table 1).

Table 1
Screening Criteria for Heat Stress Exposure
(WBGT values in °C)
for 8 hour work day five days per week with conventional breaks

	Acclimatized				Unacclimatized			
Work Demands	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
100% work	29.5	27.5	26.0	-	27.5	25.0	22.5	-
75% work; 25% rest	30.5	28.5	27.5	-	29.0	26.5	24.5	-
50% work; 50% rest	31.5	29.5	28.5	27.5	30.0	28.0	26.5	25
25% work; 75% rest	32.5	31.0	30.0	29.5	31.0	29.0	28.0	26.5

* For unacclimatized workers, the permissible heat exposure TLV should be reduced by 2.5°C

Examples of work loads:

Light work -- sitting or standing to control machines, performing light hand or arm work

Moderate work -- walking about with moderate lifting and pushing

Heavy work -- pick and shovel work, digging

The ACGIH exposure limits are intended to protect most workers from heat-related illnesses. The limits are higher than they would have been if they had been developed to prevent discomfort. If you are wearing heavier clothing then the exposure limit should be lowered. ACGIH recommendations for such situations are suggested in Table 2.

Table 2
Correction of TLV for Clothing

Clothing Type	WBGT Correction (°C)
Summer work uniform	0
Cloth (woven material) overalls	-3.5
Double-cloth overalls	-5

What control measures can be used to reduce the effects of heat?

The risk of heat-related illnesses can be reduced by:

- engineering controls to provide a cooler workplace
- safe work practices to reduce worker exposure
- by training employees to recognize and prevent heat illnesses.

Table 3 (below) provides a summary of these controls.

Engineering Controls

Engineering controls are the most effective means of reducing excessive heat exposure. The examples which follow illustrate some engineering approaches to reducing heat exposure.

- **Reducing Metabolic Heat Production (heat produced by the body)**: Automation and mechanization of tasks minimize the need for heavy physical work and the resulting buildup of body heat.
- **Reducing the Radiant Heat Emission from Hot Surfaces**: Covering hot surfaces with sheets of low emissivity material such as aluminum or paint that reduces the amount of heat radiated from this hot surface into the workplace.
- **Insulating Hot Surfaces**: Insulation reduces the heat exchange between the source of heat and the work environment.
- **Shielding**: Shields stop radiated heat from reaching work stations. Two types of shields can be used. Stainless steel, aluminum or other bright metal surfaces reflect heat back towards the source. Absorbent shields, such as a water-cooled jackets made of black-surfaced aluminum, can effectively absorb and carry away heat.
- **Ventilation and Air Conditioning:** Ventilation, localized air conditioning, and cooled observation booths are commonly used to provide cool work stations. Cooled observation booths allow workers to cool down after brief periods of intense heat exposure while still allowing them to monitor equipment.
- **Reducing the Humidity**: Air conditioning, dehumidification, and elimination of open hot water baths, drains, and leaky steam valves help reduce humidity.

Personal Protection

Ordinary clothing provides some protection from heat radiated by surrounding hot surfaces. Specially designed heat-protective clothing is available for working in extremely hot conditions. In hot and humid workplaces, light clothing allows maximum skin exposure and efficient body cooling by sweat evaporation.

Workers who move back and forth between very hot, dry indoor environments and cold winter outdoor environments find that long underwear moderates the extremes in temperatures.

Eye protection which absorbs radiation is needed when the work involves very hot objects, such as molten metals and hot ovens.

Work that requires the wearing of impermeable clothing presents an added heat burden as the clothing reduces the body's ability to dissipate heat. Under such circumstances, it is often necessary to reduce the exposure limit values of WBGT to levels below those appropriate for workers wearing light clothing.

Table 3
Summary of Control Measures

Method of Control	Action
Engineering controls	
Reduce body heat production	Mechanize tasks.
Stop exposure to radiated heat from hot objects	Insulate hot surfaces. Use reflective shields, aprons, remote controls.
Reduce convective heat gain	Lower air temperature. Increase air speed if air temperature below 35°C. Increase ventilation. Provide cool observation booths.
Increase sweat evaporation	Reduce humidity. Use a fan to increase air speed (movement).
Clothing	Wear loose clothing that permits sweat evaporation but stops radiant heat. Use cooled protective clothing for extreme conditions.
Administrative controls	
Acclimatization	Allow sufficient acclimatization period before full workload.
Duration of work	Shorten exposure time and use frequent rest breaks.
Rest area	Provide cool (air-conditioned) rest-areas.
Water	Provide cool drinking water.
Pace of Work	If practical, allow workers to set their own pace of work.
First aid and medical care	Define emergency procedures. Assign one person trained in first aid to each work shift. Train workers in recognition of symptoms of heat exposure.

Can we become acclimatized to hot environments?

The body adapts to a new thermal environment by a process called acclimatization. Complete heat acclimatization generally takes six to seven days, but some individuals may need longer. Loss of acclimatization occurs gradually when a person is moved permanently away from a hot environment. However, a decrease in heat tolerance occurs even after a long weekend. As a result of reduced heat tolerance, it is often not advisable for anyone to work under very hot conditions on the first day of the week.

New employees should acclimatize before assuming a full workload. It is advisable to assign about half of the normal workload to a new employee on the first day of work and gradually increased on subsequent days.

Although well-trained, physically fit workers tolerate heat better than people in poor physical condition, fitness and training do not substitute for acclimatization.

Some medications interfere with acclimatization. For example, hypotensives (drugs causing low blood pressure), diuretics, antispasmodics, sedatives, tranquilizers, antidepressants and amphetamines decrease the body's ability to cope with heat. Workers should seek a doctor's advice on the suitability of a medication for them if they work in hot environments. Consumption of alcohol also interferes with acclimatization.

How can I prevent heat related illnesses?

If practical, workers in hot environments should be encouraged to set their own work and rest schedules. Infrequent or irregular tasks such as emergency repairs of hot process equipment often result in heat exposure. Experienced workers can often judge heat strain and limit their exposure accordingly. Inexperienced workers may need special attention as they may continue to work beyond the point at which signs of heat strain appear.

People are generally unable to notice their own heat stress related symptoms. Their survival depends on their coworker's ability to recognize these symptoms and seek timely first aid and medical help.

Salt and Fluid Supplements:

A person working in a very hot environment loses water and salt through sweat. This loss should be compensated by water and salt intake. Fluid intake should equal fluid loss. On average, about one litre of water each hour may be required to replace the fluid loss. Plenty of cool (10-15C) drinking water should be available on the job site and workers should be encouraged to drink water every 15 to 20 minutes even if they do not feel thirsty. Drinks specially designed to replace body fluids and electrolytes may be taken. Alcoholic drinks should NEVER be taken as alcohol dehydrates the body.

An acclimatized worker loses relatively little salt in their sweat and, therefore, the salt in the normal diet is usually sufficient to maintain the electrolyte balance in the body fluids. For unacclimatized workers who may sweat continuously and repeatedly, additional salt in the food may be used. Salt tablets are not recommended because the salt does not enter the body system as fast as water or other fluids. Too much salt can cause higher body temperatures, increased thirst and nausea. Workers on salt-restricted diets should discuss the need for supplementary salt with their doctor.

Emergency Action Plan:

In extreme environments, an emergency plan is needed. The plan should include procedures for providing affected workers with first aid and medical care.

More information is available in document Working in Extreme Hot or Cold Temperature Conditions. (page 11)

How do I calculate the WBGT Index**?**

The wet bulb globe temperature (WBGT) is calculated by using the following equations.

- For outdoors **with** direct sun exposure:

$$WBGT = 0.7 \times Temp_{wet\ bulb} + 0.2 \times Temp_{globe} + 0.1 \times Temp_{air}$$

- For indoors or outdoors **without** direct sun exposure:

$$WBGT = 0.7 \times Temp_{wet\ bulb} + 0.3 \times Temp_{globe}$$

where:

$Temp_{wet}$ bulb natural wet bulb temperature measured by using a thermometer whose bulb is covered with wet cotton cloth and is cooled by the natural air movement

$Temp_{globe}$ temperature measured using a black globe thermometer

$Temp_{air}$ temperature measured using a conventional thermometer

All temperatures are to be expressed in ^{0}C.

Example

Workers employed in an outdoor workplace with direct exposure to the sun. Measurement of workplace conditions produced the following results.

$Temp_{wet}$ bulb = 24^{0}C

$Temp_{globe}$ = 42^{0}C

$Temp_{air}$ = 40^{0}C

WBGT = 0.7 x 24 + 0.2 x 42 + 0.1 x 40 = 29.2^{0}C

Time-Weighted Average (TWA)

When thermal conditions of the workplace fluctuate widely, time-weighted average (TWA) WBGT is used to assess heat exposure.

$$\text{TWA WBGT} = \frac{WBGT_1 X t_1 + WBGT_2 X t_2 + ... + WBGT_I X t_I}{t_1 + t_2 + ... + t_I}$$

$WBGT_1$, WBGT2, etc. the wet bulb globe temperatures measured or calculated

t_1, t_2, etc. the elapsed time spent in the corresponding conditions described by $WBGT_1$, $WBGT_2$, etc., respectively.

Example

Measurement and/or calculation of WBGT during a two-hour job produced the following results.

Exposure duration (hours)	WBGT (^{0}C)
0.5	25
1.0	27
0.5	28

These data would yield the following time-weighted average.

$$\text{TWA WBGT} = \frac{25 X 0.5 + 27 X 1.0 + 28 X 0.5}{0.5 + 1.0 + 0.5} = 26.75C$$

Humidex Rating and Work

What is humidex?

Humidex is a measure of how hot we feel. It is an equivalent temperature intended for the general public to express the combined effects of warm temperatures and humidity. It provides a number that describes how hot people feel, much in the same way the equivalent chill temperature, or "wind chill factor," describes how cold people feel. Humidex is used as a measure of perceived heat that results from the combined effect of excessive humidity and high temperature.

Humidex Range	Degree of Comfort
20-29	comfortable
30-39	some discomfort
40-45	great discomfort; avoid exertion
above 45	dangerous
above 54	heat stroke imminent

What is the importance of humidity?

The body attempts to maintain a constant temperature of 37°C at all times. In hot weather, the body produces sweat, which cools the body as it evaporates. As the humidity or the moisture content in the air increases, sweat does not evaporate as readily. Sweat evaporation stops entirely when the relative humidity reaches about 90 percent. Under these circumstances, the body temperature rises and may cause illness.

What are some of the hazards of working in hot environments?

There are several common heat-related illnesses. Some are more severe than others.

Heat rash, or prickly heat, occurs when blocked sweat glands become inflamed. This painful rash reduces the body's ability to sweat and to tolerate heat.

Heat cramps are painful spasms of the muscles. The muscles used in doing the work are most susceptible. The spasms are caused by the failure of the body to replace its lost body salts and usually occur after heavy sweating.

Heat exhaustion results when the body loses large amounts of fluid by sweating during work in hot environments. The skin becomes cool and clammy. Symptoms include profuse sweating, weakness, dizziness, nausea, and headaches.

Heatstroke is the most serious condition and requires immediate medical attention. The body stops sweating, and its temperature become very high (even exceeding 41°C). Symptoms include hot and dry skin, and can progress to delirium, convulsions, coma and death.

Can workplaces use humidex to monitor conditions that may result in heat-related illness?

Generally speaking, no. Humidex is intended for the general public to express the combined effects of warm temperatures and humidity.

Heat-related illnesses depend on many workplace factors in addition to air temperature and humidity. Wind speed or air movement, workload, radiant heat sources and a person's physical condition are also important.

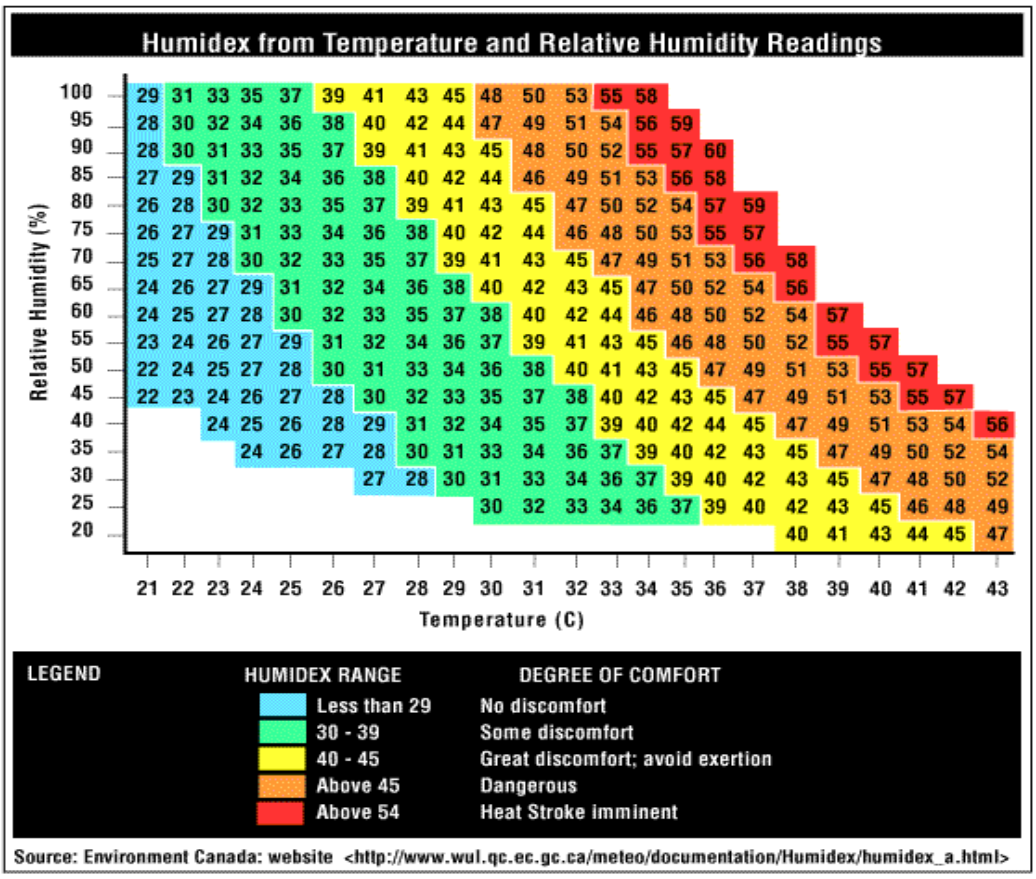
When can humidex be used?

Under certain workplace conditions, the humidex may serve as an indicator of discomfort resulting from occupational exposures to heat.

For example, when humidity is high, but when workload, wind speed and radiant heat sources do not significantly contribute to the heat burden, humidex may be useful. Offices are typical of workplaces where humidex could be used. It is important to use the values of the temperature and relative humidity obtained by actual measurements taken in the workplace. Conditions inside the workplace may significantly differ from those given by the Weather Service.

How do I know what the humidex is?

If you know the temperature and relative humidity, the following chart can be used to determine the humidex rating. For example, if the temperature is 30°C and the relative humidity is 70%, the humidex rating is 41. This level is considered a level of "great discomfort" and exertion should be avoided.



How is humidex interpreted?

The relation between humidex and comfort is subjective. It varies widely between individuals. Environment Canada provides the following guide as a measure of discomfort according to humidex:

- Where humidex levels are less than 29, most people are comfortable.
- Where humidex levels range from 30 to 39, people experience some discomfort.
- Where humidex levels range from 40 to 45, people are uncomfortable.
- Where humidex levels are over 45, dangerous conditions exist and many types of labour must be restricted.
- Where humidex exceeds 54, heat stroke is imminent.

Workplaces must use caution when applying the humidex. A high humidex can serve as a cue to assess workplace conditions more precisely. The following are some examples of guidelines used by various agencies for office work:

- The Public Works Canada guideline, "Environmental standards for office accommodation," recommends a minimum temperature of 20°C when heating and a maximum temperature of 26°C when cooling.
- The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard "Thermal environmental conditions for human occupancy" recommends temperature ranges of 20°C to 26°C at 50% relative humidity as comfortable for sedentary work. An air temperature of 26°C at 50% relative humidity corresponds to a humidex of 29.

What index should workplaces use to monitor conditions that may result in heat-related illness?

Occupational (Industrial) hygienists recommend using the Wet Bulb Globe Temperature (WBGT) index to measure workplace conditions. This method closely relates to the human body's response to heat.

The WBGT measurement takes into account air temperature, air movement, radiant heat and humidity. There are direct-reading WBGT meters. These are also called "heat-stress indicators," commercially available. The WBGT measurements can then be related to the physical demands of the job. Only qualified professionals, whether they be in-house staff, consultants, or from the local occupational health and safety regulatory agency, should perform the measurement.

Direct comparison between WBGT and humidex is not possible--there are no conversion tables or mathematical formulas to do such conversions. However, one can estimate WBGT and humidex for a given ambient air temperature and humidity when radiant heat sources (hot and cold surfaces) are absent and air movement is less than 0.5 m/sec. (100 feet per minute). Under these conditions the globe temperature equals room temperature and the natural wet bulb temperature (on the WBGT apparatus) is approximately 2°F (1.1°C) higher than the wet bulb temperature measured using a psychrometer.

Standard charts are available to determine wet bulb temperature from given air temperature and relative humidity values. For indoor or outdoor conditions with no direct sunlight, WBGT is calculated by using the following formula:

WBGT = 0.3 x globe temperature + 0.7 x natural wet bulb temperature

Thermal Comfort for Office Work

What is meant by thermal comfort?

To have "thermal comfort" means that a person wearing a normal amount of clothing feels neither too cold nor too warm. Thermal comfort is important both for one's well-being and for productivity. It can be achieved only when the air temperature, humidity and air movement are within the specified range often referred to as the "comfort zone".

Where air movement is virtually absent and when relative humidity can be kept at about 50%, the ambient temperature becomes the most critical factor for maintaining thermal comfort indoors. However, temperature preferences vary greatly among individuals and there is no one temperature that can satisfy everyone. Nevertheless, an office which is too warm makes its occupants feel tired; on the other hand, one that is too cold causes the occupants' attention to drift, making them restless and easily distracted. Workers begin worrying about how to get warm again.

Maintaining constant thermal conditions in the offices is important. Even minor deviation from comfort may be stressful and affect performance and safety. Workers already under stress are less tolerant of uncomfortable conditions.

What temperature should an office be?

A general recommendation is that the temperature be held constant in the range of 23±3°C. In summertime when outdoor temperatures are higher it is advisable to keep air-conditioned offices slightly warmer to minimize the temperature discrepancy between indoors and outdoors.

What humidity level and air velocity should an office be?

When relative humidity is kept at about 50%, office workers have fewer respiratory problems (specifically in the winter) and generally feel better. Higher humidity makes the office feel "stuffy". More important, it can contribute to the development of bacterial and fungal growth (especially in sealed buildings).

Humidity lower then 50% causes discomfort by drying out the mucous membranes, contributing to skin rashes. Dry conditions cause electrostatic charge on both office equipment and their users.

Air velocities below 0.25 metres/second (or about 50 feet/minute) do not create any significant distraction even in tasks requiring sustained attention.

Are there any standards on office temperatures?

The CSA Standard CAN/CSA Z412-00 - "Office Ergonomics" gives acceptable ranges of temperature and relative humidity for offices. These values are the same as recommended by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 55 - 2004 "Thermal Environmental Conditions for Human Occupancy". The recommended temperature ranges have been found to meet the needs of at least 80% of individuals. Some people may feel uncomfortable even if these values are met. Additional measures may be required.

Table 1
Temperature / Humidity Ranges for Comfort

Conditions	Relative Humidity	Acceptable Operating Temperatures	
		°C	°F
Summer (light clothing)	If 30%, then If 60%, then	24.5 - 28 23 - 25.5	76 - 82 74 - 78
Winter (warm clothing)	If 30%, then If 60%, then	20.5 - 25.5 20 - 24	69 - 78 68 - 75

Source: Adapted from ASHRAE 55-2004.

Table 2 shows acceptable temperatures ranges for relative humidity levels of 30% and 60%, as recommended by the National Research Council of Canada.

Table 2
Examples of acceptable operative temperature ranges based on comfort zone diagrams in ASHRAE Standard-55-2004

Conditions	Acceptable operative temperatures	
	°C	°F
Summer (clothing insulation = 0.5 clo)		
Relative humidity 30%	24.5 - 28	76 - 82
Relative humidity 60%	23 - 25.5	74 - 78

Winter (clothing insulation = 1.0 clo)		
Relative humidity 30%	20.5 - 25.5	69 - 78
Relative humidity 60%	20 - 24	68 - 75

In general, what temperature is 'right' for various activities?

Table 3 summarizes some typical responses to various temperatures.

Table 3		
Temperature		
°F	°C	
78	25	Optimal for bathing, showering. Sleep is disturbed
75	24	People feel warm, lethargic and sleepy. Optimal for unclothed people.
72	22	Most comfortable year-round indoor temperature for sedentary people.
70	21	Optimum for performance of mental work.
64	18	Physically inactive people begin to shiver. Active people are comfortable.

Noise - Auditory Effects

What kinds of health effects can be caused by exposure to noise?

The two kinds of health effects of noise are non-auditory effects and auditory effects. Non-auditory effects include stress, related physiological and behavioural effects, and safety concerns. Auditory effects include hearing impairment resulting from excessive noise exposure. Noise-induced permanent hearing loss is the main concern related to occupational noise exposure.

What are examples of auditory health effects?

The main auditory effects include:

Acoustic trauma:

Sudden hearing damage caused by short burst of extremely loud noise such as a gun shot.

Tinnitus:

Ringing or buzzing in the ear.

Temporary hearing loss:

Also known as temporary threshold shift (TTS), which occurs immediately after exposure to a high level of noise. There is gradual recovery when the affected person spends time in a quiet place. Complete recovery may take several hours.

Permanent hearing loss:

Permanent hearing loss, also known as permanent threshold shift (PTS), progresses constantly as noise exposure continues month after month and year after year. The hearing impairment is noticeable only when it is substantial enough to interfere with routine activities. At this stage, a permanent and irreversible hearing damage has occurred. Noise-induced hearing damage cannot be cured by medical treatment and worsens as noise exposure continues.

When noise exposure stops, the person does not regain the lost hearing sensitivity. As the employee ages, hearing may worsen as "age-related hearing loss" adds to the existing noise-induced hearing loss.

What are the characteristics of noise-induced permanent hearing loss?

The main characteristics of noise-induced hearing loss are:

- Noise-induced hearing loss is a cumulative process: both level of noise and exposure time over a worker's work history are important factors.
- At a given level, low-frequency noise (below 100 Hz) is less damaging compared to noise in the mid-frequencies (1000 - 3000 Hz).
- Noise-induced hearing loss occurs randomly in exposed persons.
- Some individuals are more susceptible to noise-induced hearing loss than others.
- In the initial stages, noise-induced hearing loss is most pronounced at 4000 Hz but it spreads over other frequencies as noise level and/or exposure time increases.

Does aging affect hearing?

Hearing sensitivity declines as people become older. This medical condition is called presbycusis. Again, just like noise-induced hearing loss, everyone is not affected equally. Age-related hearing loss adds to noise-induced hearing loss. Hearing ability may continue to worsen even after a person stops work in a noisy environment.

What are some other causes of hearing loss?

Noise affects the hearing organs (cochlea) in the inner ear. That is why noise-induced hearing loss is sensory-neural type of hearing loss. Certain medications and diseases may also cause damage to the inner ear resulting in hearing loss as well. Generally, it is not possible to distinguish sensory-neural hearing loss caused by exposure to noise from sensory-neural hearing loss due to other causes. Medical

judgement, in such cases, is based on the noise exposure history. Workers in noisy environments who are also exposed to vibration (e.g., from a jack hammer) experience greater hearing loss than those exposed to the same level of noise but not to vibration.

Some chemicals are ototoxic; that is, they are toxic to the organs of hearing and balance or the nerves that go to these organs. This means that noise-exposed workers who are also exposed to ototoxic chemicals (e.g., toluene, carbon disulfide) may suffer from more hearing impairment than those who have the same amount of noise exposure without any exposure to ototoxic chemicals.

How is hearing loss measured?

Hearing loss is measured as threshold shift in dB units using an audiometer. The 0 dB threshold shift reading of the audiometer represents the average hearing threshold level of an average young adult with disease-free ears. The PTS (permanent threshold shift), as measured by audiometry, is dB level of sounds of different frequencies that are just barely audible to that individual. A positive threshold shift represents hearing loss and a negative threshold shift means better than average hearing when compared with the standard.

How is the amount of hearing disability measured or expressed?

Several methods of calculating the percentage of hearing disability are in use. The American Medical Association (AMA)/ American Academy of Otolaryngology (AAO) formula is widely accepted in North America. The current method recommended by AMA/AAO is as follows:

1. The average hearing threshold level at 500, 1000, 2000, and 3000 Hz should be calculated for each ear.
2. Multiplying should calculate the percentage of impairment for each ear (the monaural loss) by 1.5 times the amount by which the above average exceeds 25 dB (low fence). Hearing impairment is 100% for 92 dB average hearing threshold level.
3. The hearing disability (binaural assessment) is calculated by multiplying the smaller percentage (better ear) by 5, adding it to the larger percentage (poorer ear), and dividing the total by 6.

What is an example of a hearing disability calculation?

The data in the table below show how audiometric readings are converted into percent hearing impairment.

Table 1
Hearing Disability Calculation Using the American Medical Association Formula

Frequency, Hz	Hearing Threshold Level, dB	
	Left Ear	Right Ear
500	30	15
1000	45	25
2000	60	45
3000	85	55
Sum	220	140
Average	55	35
Low fence	25	25
Exceeds low fence	30	10
%Impairment	45	15
Disability	[45 + (5x15)]/6 = 20%	

The actual dollar value of compensation for a given percentage of hearing loss varies from one jurisdiction to another.

What is the relationship between noise exposure and hearing loss?

From the scientific data accumulated to date, it is possible to determine the risk of hearing loss among a group of noise exposed persons. To do this we need the following data:

- A measure of daily noise exposure level
- Duration of noise exposure (months, years)
- Age of person

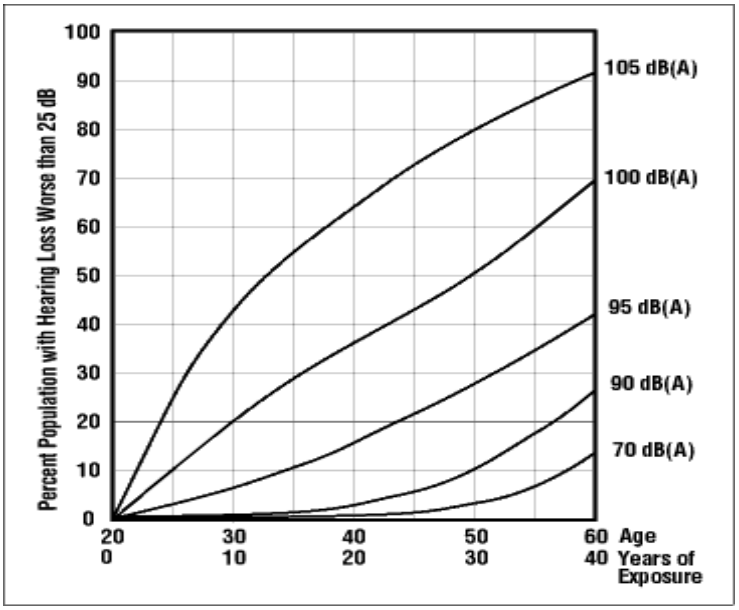


Figure 1. Percent of exposed population with hearing loss greater than 25 dB for various noise levels and years of exposure as given by the ISO 1999-1990 method. Hearing loss is defined as average threshold shift at 500, 1000, 2000 and 3000 Hz.

Noise-induced hearing loss occurs randomly. All exposed persons are not affected equally. Some highly susceptible people lose their hearing ability faster than others. Given a noise-exposed person, it is not possible to determine whether or not his or her hearing loss is due to noise. However, in a group of exposed persons, the percentage of population with hearing loss depends on the level of noise exposure and the duration of exposure. For higher noise exposure levels, and longer durations of exposures, a larger percentage of exposed persons acquire hearing loss. This observation forms the basis for calculating noise-induced hearing loss as outlined in the international standard ISO1999-1990 and American National Standard ANSI S3.44 - 1996.

Noise - Occupational Exposure Limits for Extended Workshifts

Are there guidelines for noise exposure on shifts longer than 8 hours?

Most standards and guidelines concerning noise exposure limits are based on an 8-hour work shift and also provide exposure limits for shorter and longer working days. In real life conditions, longer working days are common. When determining exposure limits for an extended work shift such as a 12-hour shift, one must take into account information on health effects related to noise exposure and those related to a 12-hour shift work. The final answer has to come from a study of actual work places that might have experimented or adapted such work practices.

A change from an 8-hour shift to a 12-hour shift must consider the following issues:

- Eight-hour time-weighted noise exposure level in dB(A).
- Problems related to use of hearing protectors for such a prolonged work shift.
- Combined effect of stress factors related to a 12-hour shift and noise exposure.

How do I calculate the exposure limit?

Equal energy rule

Many regulatory agencies recommend a time-weighted average (TWA) sound level of 85 dB(A) to 90 dB(A) as a noise exposure limit for 8-hour work day.

The International Organization for Standardization standard -- Acoustics -- Determination of occupational noise exposure and estimation of noise-induced hearing impairment recommends the use of the equal energy principle (3 dB exchange rate) in calculating the TWA for a work shift:

$$\text{Limit for a given shift} = 85 - 10 \log (T/8)$$

where T = duration of work shift in hours. Results of such calculation for various extended work shifts are listed in Table 1.

Table 1 also shows the noise exposure limit for extended shifts when the 5 dB exchange rate is used. The formula used for calculating these exposure limits for extended shifts is:

$$\text{Limit for a given shift (5 dB rule)} = 85 - 16.61 \log (T/8)$$

Table 1 - TWA Method		
Work Shift Duration (Hours)	Noise Exposure Limit, dB(A) [Assuming 8-hour exposure level = 90 dB(A)]	
	Using 3dB exchange rate	Using 5 dB exchange rate
8	90	90
9	89.5	89.2
10	89.0	88.4
11	88.6	87.7
12	88.2	87.1
13	87.9	86.5
14	87.6	86.0
15	87.3	85.5
16	87.0	85.0

NB: time weighted average (TWA)

The noise exposure limit for a 12-hour shift, based on the equal energy rule, is 88.2 dB(A). In other words, if the noise level is kept below 88 dB(A) then, according to equal energy concept, the maximum permissible limit is not exceeded.

Information on hearing protectors is available in the "Personal Protective Equipment" section.

Vibration - Introduction

Why measure or evaluate vibration exposure?

Vibration exposure is possible in many occupations where a worker comes in contact with vibrating machinery or equipment. When a worker operates hand-held equipment such as a chain saw or jackhammer, vibration affects hands and arms and is called **hand-arm vibration exposure**. When a worker sits or stands on a vibrating floor or seat, the exposure affects almost the entire body and is called **whole-body vibration exposure**. The risk of injury depends on the intensity and frequency of the vibration, the duration (years) of exposure and the part of the body which receives the vibration energy.

Hand-arm vibration causes damage to blood vessels and nerves in the fingers. The resulting condition is known as white finger disease, Raynaud's phenomenon or hand-arm vibration syndrome (HAVS). The affected fingers turn white, especially when exposed to cold. Vibration-induced white finger disease also causes a loss of grip force and reduced sensitivity to touch.

The effect of whole-body vibration is poorly understood. Studies of drivers of heavy vehicles have revealed an increased incidence of the disorders of bowel and the circulatory, musculoskeletal and neurological systems.

However, disorders of the nervous, circulatory and digestive systems are not specific to whole-body vibration exposure. These disorders are assumed to be caused by a combination of various working conditions and life style factors rather than by one physical factor alone. More information is available in the document Vibration - Health Effects that describes the effects of hand-arm vibration and whole body vibration.

What is vibration?

If you could watch a vibrating object in slow motion, you can see movements in different directions. How far, and how fast the object moves helps determine its vibrational characteristics. The terms used to describe this movement are frequency, amplitude and acceleration.

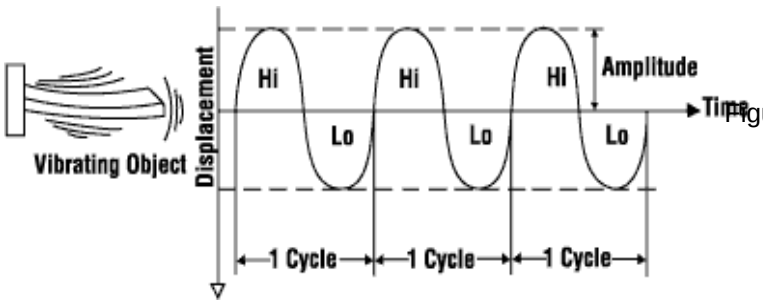


Figure 1 - Representation of Vibration

Frequency

A vibrating object moves back and forth from its normal stationary position. A complete cycle of vibration occurs when the object moves from one extreme position to the other extreme, and back again. The number of cycles that a vibrating object completes in one second is called frequency. The unit of frequency is hertz (Hz). One hertz equals one cycle per second.

Amplitude

A vibrating object moves to a certain maximum distance on either side of its stationary position. Amplitude is the distance from the stationary position to the extreme position on either side and is measured in metres (m). The intensity of vibration depends on amplitude.

Acceleration

The speed of a vibrating object varies from zero to a maximum during each cycle of vibration. It moves fastest as it passes through its stationary position to an extreme position. The vibrating object slows down as it approaches the extreme, where it stops and then moves in the opposite direction through the stationary position toward the other extreme. Speed is expressed in units of metres per second (m/s).

Acceleration is a measure of how quickly speed changes with time and therefore, acceleration is expressed in units of (metres per second) per second or metres per second squared (m/s2). The magnitude of acceleration changes from zero to a maximum during each cycle of vibration. It increases as vibrating object moves further from its normal stationary position.

What is resonance?

Every object tends to vibrate at one particular frequency that depends on the composition of the object, its size, structure, weight and shape. This frequency of natural vibration is called the resonant frequency. A vibrating machine transfers the maximum amount of energy to an object when the machine vibrates at the object's resonant frequency.

How does the vibration exposure occur?

Contact with a vibrating machine transfers vibration energy to a person's body. Depending on how the exposure occurs, vibration may affect a major part of the worker's body or only a particular organ. The effect of vibration exposure also depends on the frequency of vibration. Each organ of the body has its own resonant frequency. If exposure occurs at or near any of these resonant frequencies, the resulting effect is greatly increased.

Segmental vibration exposure affects an organ, part or "segment" of the body. The most widely studied and most common type of segmental vibration exposure is hand-arm vibration exposure which affects the hands and arms. **Hand-arm vibration** affects operators of chain saws, chipping tools, jackhammers, jack leg drills, grinders and many other workers who operate hand-held vibrating tools.

Whole body vibration energy enters the body through a seat or the floor, it affects the entire body or a number of organs in the body. Exposed groups include operators of trucks, buses, tractors and those who work on vibrating floors. Table 1 lists examples of vibration exposure in various industries.

Table 1
Examples of occupational vibration exposure

Industry	Type of Vibration	Common Source of Vibration
Agriculture	Whole body	Tractors
Boiler making	Hand-arm	Pneumatic tools
Construction	Whole body Hand-arm	Heavy equipment vehicles Pneumatic tools, Jackhammers
Diamond cutting	Hand-arm	Vibrating hand tools
Forestry	Whole body Hand-arm	Tractors Chain saws
Foundries	Hand-arm	Vibrating cleavers
Furniture manufacture	Hand-arm	Pneumatic chisels
Garments	Whole body	Sewing Machine Embroidery Machine
Iron and steel	Hand-arm	Vibrating hand tools
Lumber	Hand-arm	Chain saws
Machine tools	Hand-arm	Vibrating hand tools
Mining	Whole body Hand-arm	Vehicle operation Rock drills
Rivetting	Hand-arm	Hand tools
Rubber	Hand-arm	Pneumatic stripping tools
Sheet Metal	Hand-arm	Stamping Equipment
Shipyards	Hand-arm	Pneumatic hand tools
Shoe-making	Hand-arm	Pounding machine
Stone dressing	Hand-arm	Pneumatic hand tools
Textile	Hand-arm	Sewing machines, Looms
Transportation	Whole body	Vehicles

Vibration - Health Effects

What are the health effects of hand-arm vibration?

Vibration-induced white finger (VWF) is the most common condition among the operators of hand-held vibrating tools. Vibration can cause changes in tendons, muscles, bones and joints, and can affect the nervous system. Collectively, these effects are known as Hand-Arm Vibration Syndrome (HAVS). The symptoms of VWF are aggravated when the hands are exposed to cold.

Workers affected by HAVS commonly report:

- attacks of whitening (blanching) of one or more fingers when exposed to cold
- tingling and loss of sensation in the fingers
- loss of light touch
- pain and cold sensations between periodic white finger attacks
- loss of grip strength
- bone cysts in fingers and wrists

The development of HAVS is gradual and increases in severity over time. It may take a few months to several years for the symptoms of HAVS to become noticeable.

What are the symptoms of hand-arm vibration syndrome (HAVS)?

Hand-arm vibration exposure affects the blood flow (vascular effect) and causes loss of touch sensation (neurological effect) in fingers. One of the earliest methods used for identifying the severity of these symptoms was the Taylor-Pelmear classification method. Table 1 shows the Taylor-Pelmear classification of the clinical stages of vibration induced white finger. This classification was widely used in the past.

Table 1
Taylor-Pelmear classification of vibration-induced white finger by stages

Stage	Signs and Symptoms	Interference with Activities
0	None	None
OT	Intermittent tingling	None
ON	Intermittent numbness	None
OTN	Tingling and numbness	None
1	Blanching of one or more fingertips with or without tingling and numbness	None
2	Blanching of one or more fingers with numbness, usually during winter only	Slight interference with home and social activities; no interference with work
3	Extensive blanching with frequent episodes during both summer and winter	Definite interference with work, home and social activities; restricted hobbies
4	Extensive blanching of most fingers; frequent episodes during summer and winter; finger ulceration	Occupation change required to avoid further vibration exposure

In 1986, a new classification, known as Stockholm classification was introduced. In this classification, vascular (blood flow) changes and neural (feeling of touch, heat, cold, etc.) changes are considered separately [see Tables 2(a) and 2(b)].

Table 2(a)
The Stockholm Workshop classification scale for cold-induced vascular (blood flow) symptoms in fingers with hand-arm vibration syndrome

Stage	Grade	Description
0	(none)	No attacks
1	Mild	Occasional attacks affecting only the tips of one or more fingers
2	Moderate	Occasional attacks affecting finger tips and middle of the finger and rarely also the finger parts close to the palm
3	Severe	Frequent attacks affecting most fingers
4	Very Severe	Same symptoms as in stage 3 with degenerate skin changes in the finger tips.

Table 2(b)
The Stockholm Workshop classification scale for sensorineural changes in fingers due to hand-arm vibration syndrome

Stage	Symptoms
OSN	Exposed to vibration but no symptoms
1SN	Intermittent numbness, with or without tingling
2SN	Intermittent or persistent numbness, reduced sensory perception
3SN	Intermittent or persistent numbness, reduced tactile discrimination and/or manipulative dexterity

Source: Gemne, G., et al. Scandinavian Journal of Work, Environment and Health. Vol. 13, no. 4 (1987). p. 275-278.

The severity of hand-arm vibration syndrome depends on several other factors, such as the characteristics of vibration exposure, work practice, personal history and habits. Table 3 summarizes these factors.

Table 3 Factors that influence the effect of vibration on the hand		
Physical Factors	**Biodynamic Factors**	**Individual Factors**
Acceleration of vibration	Grip forces - how hard the worker grasps the vibrating equipment	Operator's control of tool
Frequency of vibration	Surface area, location, and mass of parts of the hand in contact with the source of vibration	Machine work rate
Duration of exposure each workday	Hardness of the material being contacted by the hand-held tools, for example metal in grinding and chipping	Skill and productivity
Years of employment involving vibration exposure	Position of the hand and arm relative to the body	Individual susceptibility to vibration
State of tool maintenance	Texture of handle-soft and compliant versus rigid material	Smoking and use of drugs. Exposure to other physical and chemical agents.
Protective practices and equipment including gloves, boots, work-rest periods.	Medical history of injury to fingers and hands, particularly frostbite	Disease or prior injury to the fingers or hands

What is Raynaud's phenomenon of occupational origin?

Hand-arm vibration syndrome is also known as Raynaud's phenomenon of occupational origin. Vibration is just one cause of Raynaud's phenomenon. Other causes are connective tissue diseases, tissue injury, diseases of the blood vessels in the fingers, exposure to vinyl chloride, and the use of certain drugs. The resulting reduced blood flow can produce white fingers in cold environments. Raynaud's phenomenon is discussed in more detail in another document on this site.

What are the health effects of whole-body vibration?

Whole-body vibration can cause fatigue, insomnia, headache and "shakiness" shortly after or during exposure. The symptoms are similar to those that many people experience after a long car or boat trip. After daily exposure over a number of years, whole-body vibration can affect the entire body and result in a number of health disorders. Sea, air or land vehicles cause motion sickness when the vibration exposure occurs in the 0.1 to 0.6 Hz frequency range. Studies of bus and truck drivers found that occupational exposure to whole-body vibration could have contributed to a number of circulatory, bowel, respiratory, muscular and back disorders. The combined effects of body posture, postural fatigue, dietary habits and whole-body vibration are the possible causes for these disorders.

Studies show that whole-body vibration can increase heart rate, oxygen uptake and respiratory rate, and can produce changes in blood and urine. East European researchers have noted that exposure to whole-body vibration can produce an overall ill feeling which they call "vibration sickness."

Many studies have reported decreased performance in workers exposed to whole-body vibration.

How much vibration exposure has to accumulate before people are affected?

As in all occupational exposures, individual sensitivity to vibration varies from person to person.

Three important factors affect the health effects that can result from exposure to vibration:

- the threshold value or the amount of vibration exposure that results in no adverse health effects
- the dose-response relationship (how the severity of the ill health effects is related to the amount of exposure)
- latent period (time from first exposure to appearance of symptoms

The threshold value of vibration is the level below which there is no risk of vibration syndrome. In other words, it is the maximum intensity of vibration to which workers can be exposed every workday for their entire full-time employment without developing numbness, paleness or chill of fingers. Workers will not develop vibration-related injuries or disease if their exposure to vibration is maintained at sufficiently low levels.

What has been observed is that the number of affected people increases as the intensity and duration of vibration exposure increases. This type of exposure-response relationship indicates a possible link between health effects and the total amount of vibration energy entering the hands or body. Depending on the intensity of exposure, the symptoms may appear months or years after the start of the exposure.

The latent period for VWF is the time from the first occupational exposure to hand-arm vibration until the onset of symptoms. The latent period depends on the intensity of exposure. The higher the intensity, the shorter the latent period. Table 4 shows typical latent periods reported for workers in some occupations.

Table 4
Average latent periods for vibration-induced diseases in different occupations

Occupation	Stage of VWF	Latency (years)
Foundry worker	Tingling Numbness Blanching	1.8 2.2 2.0
Shipyard worker	Tingling Numbness Blanching	9.1 12.0 16.8
Chain saw operator	Numbness	4
Grinder	Blanching	13.7

Why is it not easy to diagnose vibration related diseases?

The acceptance of vibration syndrome as an industrial disease is hindered mainly because:

- Not every physician is trained to diagnose vibration-induced white finger (VWF) or other vibration-related diseases.
- The causes of VWF cannot always be identified.
- There are no objective clinical tests to measure the impairment.
- The disease progresses for years before the symptoms become severe enough to affect a worker's ability to do her or his work.

Are there any studies about the combined effect of noise and vibration?

Since most vibrating machines and tools produce noise, a vibration-exposed worker is likely to be exposed to noise at the same time. Studies of hearing loss among lumberjacks revealed that, for equal noise exposure, those with vibration-induced white finger (VWF) had greater hearing loss than those without VWF. The reason for this effect is not clear.

Studies of the effect of separate and simultaneous exposure to noise and whole-body vibration have concluded that whole-body vibration alone does not cause hearing loss. However, simultaneous exposure to noise and vibration produces greater temporary hearing loss than noise alone.

Vibration - Measurement, Control and Standards

How can you measure vibration?

A complete assessment of exposure to vibration requires the measurement of acceleration in well-defined directions, frequencies and duration of exposure. How hard a person grips a tool affects the amount of vibrational energy entering the hands; Therefore, hand-grip force is another important factor in the exposure assessment.

Most jurisdictions and agencies use acceleration as a measure of vibration exposure for the following reasons:

- Several types of instruments are available for measuring acceleration, the rate of change of velocity in speed or direction per unit time (e.g., per second).
- Measuring acceleration can also give information about velocity and amplitude of vibration.
- The degree of harm is related to the magnitude of acceleration.

A typical vibration measurement system includes a device to sense the vibration (accelerometer), a tape recorder, a frequency analyzer, a frequency-weighting network, and a display such as a meter, printer or recorder.

The accelerometer produces an electrical signal. The size of this signal is proportional to the acceleration applied to it.

The frequency analyzer determines the distribution of acceleration in different frequency bands. The frequency-weighting network mimics the human sensitivity to vibration of different frequencies. The use of weighting networks gives a single number as a measure of vibration exposure and is expressed as the frequency-weighted vibration exposure in metres per second squared (m/s2), units of acceleration. Vibration meters equipped with accelerometers can be used for instantaneous vibration measurement. Some types of sound level meters can measure vibration.

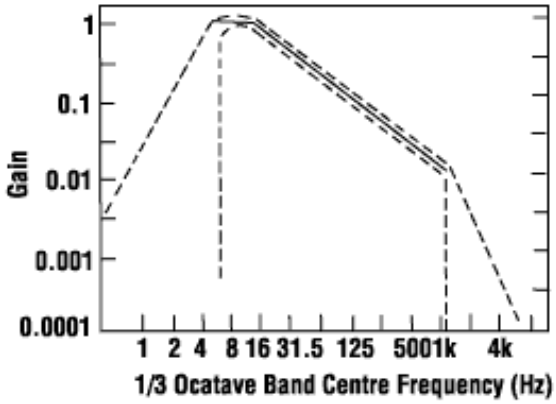


Figure 1

The frequency-weighting network for hand-arm vibration is given in the International Organization for Standardization (ISO) standard ISO 5349. Human hand is not equally sensitive to vibration energy at all frequencies. The sensitivity is the highest around 8-16 Hz (Hertz or cycles per second). Measuring equipment takes this fact into account by using a weighting network. The gain is assigned a value of 1 for vibration frequencies to which the hand-arm system has the highest sensitivity. The dashed lines in Figure 1 represent the filter tolerances in the weighting network.

Are there methods for controlling exposure to vibration?

Protecting workers from the effects of vibration usually requires a combination of appropriate tool selection, the use of appropriate vibration-absorbing materials (in gloves, for example), good work practices, and education programs.

What are some examples of controlling exposure to vibration?

Anti-Vibration Tools

Using anti-vibration chain saws reduces acceleration levels by a factor of about 10. These types of chain saws must be well maintained. Maintenance must include periodic replacement of shock absorbers. A few pneumatic tool companies manufacture anti-vibration tools such as anti-vibration pneumatic chipping hammers, pavement breakers and vibration-damped pneumatic riveting guns.

Anti-Vibration Gloves

Conventional protective gloves (e.g., cotton, leather), commonly used by workers, do not reduce the vibration that is transferred to workers' hands when they are using vibrating tools or equipment. Anti-vibration gloves are made using a layer of viscoelastic material. Actual measurements have shown that such gloves have limited effectiveness in absorbing low-frequency vibration, the major contributor to vibration-related disorders. Therefore, they offer little protection against developing vibration-induced white finger syndrome. However, gloves do provide protection from typical industrial hazards (e.g., cuts, abrasions) and from cold temperatures that, in turn, may reduce the initial sensation of white finger attacks.

Safe Work Practices

Along with using anti-vibration tools and gloves, workers can reduce the risk of hand-arm vibration syndrome (HAVS) by following work practices:

- Employ a minimum hand grip consistent with safe operation of the tool or process.
- Wear sufficient clothing, including gloves, to keep warm.
- Avoid continuous exposure by taking rest periods.
- Rest the tool on the work piece whenever practical.
- Refrain from using faulty tools.
- Maintain properly sharpened cutting tools.
- Consult a doctor at the first sign of vibration disease and ask about the possibility of changing to a job with less exposure.

Employee Education

Training programs are an effective means of heightening the awareness of HAVS in the workplace. Training should include proper use and maintain vibrating tools to avoid unnecessary exposure to vibration. Vibrating machines and equipment often produce loud noise as well. Therefore, training and education in controlling vibration should also address concerns about noise control.

Whole-Body Vibration

The following precautions help to reduce whole-body vibration exposure:

- Limit the time spent by workers on a vibrating surface.
- Mechanically isolate the vibrating source or surface to reduce exposure.
- Ensure that equipment is well maintained to avoid excessive vibration.
- Install vibration damping seats.

The vibration control design is an intricate engineering problem and must be set up by qualified professionals. Many factors specific to the individual work station govern the choice of the vibration isolation material and the machine mounting methods.

What are the standards or guidelines for exposure to hand-arm vibration?

The American Conference of Governmental Industrial Hygienists (ACGIH) has developed Threshold Limit Values (TLVs) for vibration exposure from hand-held tools. The exposure limits are given as frequency-weighted acceleration that represents a single number measure of the vibration exposure level. The frequency-weighting is based on a scheme recommended in the international standard ISO 5349. Vibration-measuring instruments have a frequency-weighting network as an option for vibration measurement. Table 1 lists acceleration levels and exposure durations to which, ACGIH has determined, most workers may be exposed repeatedly without severe damage to fingers. ACGIH advises that these guidelines be applied in conjunction with other protective measures including vibration control.

Table 1
The ACGIH Threshold Limit Values (TLVs) for exposure of the hand to vibration in X, Y, or Z direction*

Total Daily Exposure Duration (hours)	Maximum value of frequency weighted acceleration (m/s^2) in any direction*
4 to less than 8 hours	4
2 to less than 4 hours	6
1 to less than 2 hours	8
less than 1hour	12

* Directions of axes in the three-dimensional system

The International Organization for Standardization (ISO) has published a method for measuring vibration and interpreting the resulting data. This 1986 standard (ISO 5349) also gives the set of curves shown in Figure 2 that can determine exposure levels likely to cause the first signs of white finger in workers.

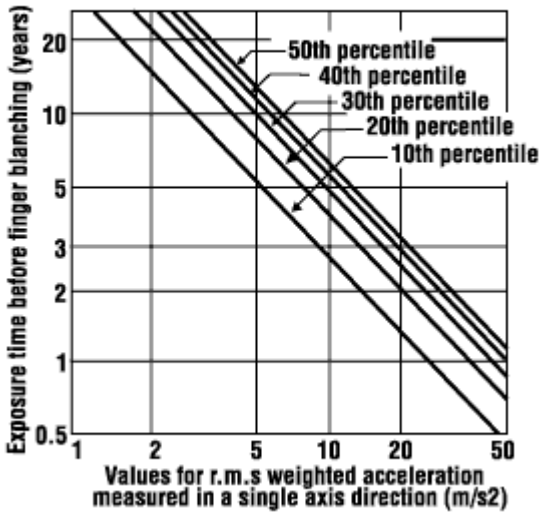


Figure 2 - Curves for exposure times of percentiles of population groups (ISO 5349.2) to suffer mild effects on tip of finger (see Stage 1, Table 2)

The horizontal axis in Figure 2 represents vibration acceleration. This is measured as RMS (Root Mean Square) weighted acceleration in m/s^2. RMS is a method of determining average for quantities that fluctuate with time about a central value. Weighting accounts for variation in human sensitivity to vibration of different frequencies. The measured value of acceleration at different frequencies is passed through a weighting filter (see Figure 1 - Representation of Vibration) to obtain a single number as an overall measure of vibration exposure. According to this frequency-weighting filter people are most sensitive to hand arm vibration in the frequency range of 1/3 octave bands with centre frequency 6.3 to 16 Hz. As frequency increases above this range the sensitivity decreases. The standard provides methods for calculating weighted RMS accelerations and equivalent acceleration values where the level of daily exposure varies with time.

Figure 2 can be used to assess the long-term effect of 4-hour per day exposures to hand-arm vibration. For example, the standard predicts that exposure to 50 m/s^2 vibration acceleration will cause 50 percent of exposed workers to reach stage 1 of Raynaud's phenomenon of occupational origin in about 1.2 years. At a vibration acceleration of 5 m/s^2, the standard predicts that it would take about 14 years for the same percentage of workers to reach stage 1. The data for which the curves were generated are limited, so they should not be used if exposure is greater than 50 m/s^2 or if the exposure duration exceeds 25 years.

What are the standards or guidelines for exposure to whole-body vibration?

The standards and guidelines concerning whole-body vibration are designed to reduce vibration to a level where most workers can perform job tasks without discomfort.

The most widely used document on this topic is Guide for the Evaluation of Human Exposure to Whole Body Vibration (ISO 2631). These exposure guidelines have been adopted as ACGIH TLVs. The ISO standard gives three different types of exposure limits:

- a reduced-comfort boundary
- the fatigue-decreased proficiency boundary
- an exposure limit

The reduced-comfort boundary is for the comfort of people travelling in airplanes, boats, and trains. Exceeding these exposure limits makes it difficult for passengers to eat, read or write when travelling.

The fatigue-decreased proficiency boundary is a limit for time-dependent effects that impair performance. For example, fatigue impairs performance in flying, driving and operating heavy vehicles.

The exposure limit is used to assess the maximum possible exposure allowed for whole-body vibration.

A separate set of "severe discomfort boundaries" is given for 8-hour, 2-hour and 30-minute exposures to whole body vibration in the 0.1 Hz to 0.63 Hz range. As with all standards, it is important to read and understand all the information before applying it in the workplace.

These exposure limits are given as acceleration for one third octave band frequencies and three directions of exposure - longitudinal (head <-> toe) and transverse (back <-> chest and side <-> side). The exposure limit is the lowest for frequencies between 4-8 Hz as the human body is most sensitive to whole-body vibrations at these frequencies.

It is important to remember that people vary in their susceptibility to effects of exposure to vibration so the "exposure limits" should be considered as guides in controlling exposure: they should not be considered as an upper "safe" limit of exposure or a boundary between safe and harmful levels.

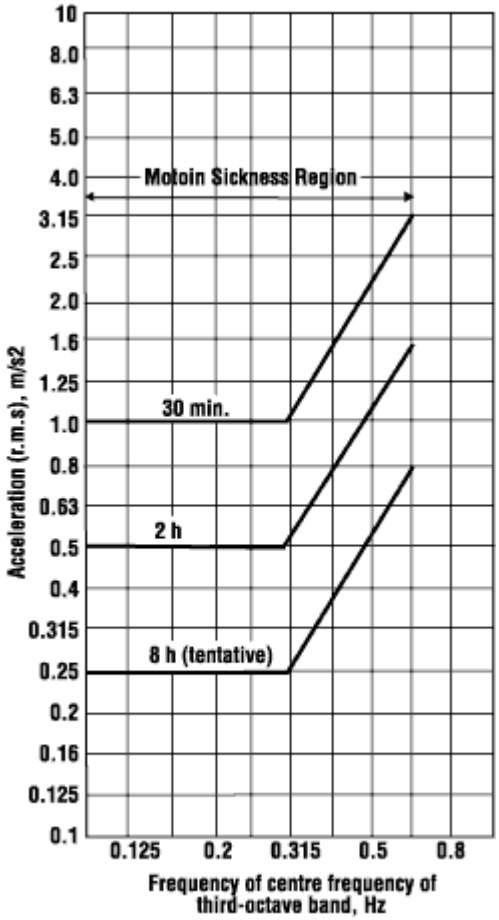


Figure 3 - ISO 2631 "severe discomfort boundaries"

Table 1: Gaps identified in work environment

Areas	Gaps identified	Supportive findings
Furniture		
Cutting table	Work height too high	Complaints of postural discomfort and pain in shoulders, neck and hands
Sorting table	Work height too high	
Inspection table	Work height too low	
Ironing table	Work height too low	
Sewing machine operators stool	Too high	
Workspace/environment		
Inadequate lighting	Low level of lighting	Complaints of visual strain and blurred vision
Excessive noise	Noise level exceeds 90dB(A)	Worker's complaints
Dust	Increased level in cutting section	Complaints of respiratory problems
Hot and humid work place	Humidity 23 to 57%	Workers complaints
Heat	Heat exposure	Identified as risk factor by hazard identification and risk assessment

Table 2: Gaps identified in equipment and tools

Areas	Gaps identified	Supportive findings
Equipment and tools		
Blade guard of the cutting machine	Defects in design of blade guard, non use of blade guards	Fifty per cent of workers reported accidental cuts
Shears used for fabric cutting	Handles heavy and strenuous to use for long	Swollen fingers and cornifications
108.9 cm	Absence of task lighting	Postural discomfort
Safety at work site		
General safety measure	Absence of general safety measures	Observed gaps
Personal protective equipment (PPE)	Absence of personal protective devices	Observation and reported incidences

Table 3: Recommendations for tables in readymade garment units

Parameters	Cutting table	Sorting table	Checking table	Ironing
Length	Variable depending upon the size of the room and the length of the lay	180 cm (6ft)	180 cm (6ft)	120 cm (4ft)
Width	120 cm (4ft) The maximum width of fabric	120 cm (4ft)	120 cm (4ft)	90 cm (3ft) The maximum reach of a worker
Height for men	117.3 cm	112.3 cm	117.3 cm	102.3 cm
Height for women	108.9 cm	103.9 cm	108.9 cm	93 cm

FIRST AID

Introduction

PURPOSE:

This instruction establishes guidelines for the implementation of a first aid kit program to enable first aid treatment and follow-up of minor injuries. The goal is to provide supplies for appropriate care for minor injuries.

***For medical EMERGENCIES, contact Local Police/hospital/clinic for emergency medical assistance.

Process

The process begins with

- individual Department evaluation of potential first aid injury risks and need for first aid kit supplies;
- continues with the use of the first aid supplies to treat first aid injuries;
- followed by the reporting of the injuries immediately to supervisor, and ……..; and
- with the restocking and maintaining of needed supplies within the first aid kit.

Recognize that an Emergency Exists

Emergencies can happen to anyone, anywhere. Before you can give help, however, you must be able to recognize an emergency. You may realize that an emergency has occurred only if you become aware of unusual noises, sights, odors and appearances or behaviors.

Decide to Act

Once you recognize that an emergency has occurred, you must decide how to help and what to do. There are many ways you can help in an emergency, but in order to help, you must act.

Being faced with an emergency may bring out mixed feelings. While wanting to help, you also may feel hesitant or may want to back away from the situation. These feelings are personal and real. Sometimes, even though people recognize that an emergency has occurred, they fail to act.

Activate the EMS System

Activating the EMS system by calling 9-1-1 or the local emergency number is the most important step you can take in an emergency. Remember, some facilities, such as hotels, office and university buildings, and some stores, require you to dial a 9 or some other number to get an outside line before you dial hospital/clinic.

Also, a few areas still are without access to a hospital/clinic system and use a local emergency number instead. Becoming familiar with your local system is important because the rapid arrival of emergency medical help greatly increases a person's chance of surviving a life-threatening emergency.

When your call is answered, an emergency call taker (or dispatcher) will ask for your phone number, address, location of the emergency and questions to determine whether you need police, fire or medical assistance. You should not hang up before the call taker does so. Once EMS personnel are on the way, the call taker may stay on the line and continue to talk with you. Many call takers also are trained to give first aid instructions so they can assist you with life-saving techniques until EMS personnel take over.

Give Care Until Help Takes Over

In general, you should give the appropriate care to an ill or injured person until:

■ You see an obvious sign of life, such as breathing.
■ Another trained responder or EMS personnel take over.
■ You are too exhausted to continue.
■ The scene becomes unsafe.

First Aid Kit

Keep a first aid kit in your workplace area. A well-stocked first aid kit is a handy thing to have. Carry a first aid kit with you or know where you can find one. Find out the location of first aid kits where you work or for any place where you spend a lot of time. Check the kit regularly. Make sure that flashlight batteries work. Check expiration dates and replace any used or out-of-date contents.

FIRST AID STEPS

- For Injured employees- seek care and report their injury:
  Initiate self-care from local first aid supplies, and report their injuries to their supervisor as soon as possible.
  If injury requires Medical Treatment, report to Supervisor and arrange for proper medical treatment.
- For coworkers of injured workers:
  It is permissible on a voluntary basis to provide care for injured co-workers from local first aid supplies.
  If not trained or comfortable in providing first aid, help locate assistance for the injured employee. Consider assisting the injured employee in getting transportation, seeking help, notifying management, etc.
- supervisors/managers of injured employee(s)
  Assist injured employee(s) in getting appropriate care. If uncertain, seek someone with training to evaluate the injury.

Initiate an accident report and submit to LSU E.H.S. and Risk Management before the close of business on the day of the injury.
Ensure medical treatment follow-up (if necessary).
Purchase, restock and maintain first aid kits, as needed.

The steps a rescuer takes during the first few minutes of a medical emergency are critical, they can mean the difference between temporary or permanent disability or between life and death. That's why first-aid knowledge and training are so important. They prepare a man to intervene calmly and effectively in an emergency.

This first-aid information allows a person to find easy-to-follow instructions on how to help in a medical emergency. This information is no substitute for formal instruction and practice. Please contact nearest hospital/clinic for emergency help.

The first step in a medical emergency must be to look around and ask self "Is the scene safe for me?", before attempting a rescue. Too often well-intentioned rescuers become victims themselves when they risk their safety to help others. Don't think that rushing in will make you a hero. If the area is unsafe, go for help or put on the personal protective equipment that will permit you to assist safely.

After you've determined that it is safe for you to enter the accident area, approach the victim. As you do, look for signs of life. Determine if the victim is breathing. If spine or neck injury is suspected, don't move the victim unless there's a threat of fire, explosion, or other life-threatening danger. Tap the victim on the shoulder and ask, "Are you OK?" Anyone involved in the care of an ill or injured person can be at risk of acquiring an infectious disease, such as hepatitis, tuberculosis, acquired immune deficiency syndrome (AIDS), or meningitis. Identifying a person as having a communicable disease can be difficult or impossible; therefore, rescuers must take protective measures to avoid coming in contact with any of the victim's body fluids (blood, urine, sputum, secretions). Protective measures should also be taken during cleanup and disposal of materials used to treat the victim.

If the victim responds, identify yourself as willing to assist. Find out what is wrong and take steps to help he victim. (Treat the more serious injuries first, check the silent ones first.) It's important to stay calm and assure the victim while you're performing first-aid measures.

How you're going to summon help should be another consideration. In most cases, the victim will need some type of emergency medical assistance, be it from emergency medical technicians, the company nurse, or a physician at the hospital. If you're not alone, tell someone else to go for medical assistance while you help the victim.

If you are alone, in certain circumstances intervention is your priority. However, it may be best to call Emergency Medical Services (EMS) first before you intervene, especially if you witness a collapse or come across an unresponsive adult victim. When you do call EMS, remember that there are certain things a dispatcher will need to know in order to get help to you quickly:

_ The address and location of the accident (including specific directions to the exact location).
_ Your name, phone number, and the number of a nearby phone.
_ A description of what happened and how many people need help. (It's also a good idea to check the victim's wrist and neck for a medical alert tag and to report what it says to the dispatcher.)
_ Stay on the phone until the dispatcher tells you it's okay to hang up. Remain calm and listen carefully—the dispatcher may give you valuable first-aid instructions for aiding the victim until help arrives.

TREATMENT FOR ELECTRIC SHOCK

The intent of this document is to identify the minimum requirement and responsibilities for a safety meeting structure and Protocol that meets the needs of Transmission Field Service.

The following methods should be learnt from a qualified Instructor and practiced regularly.

Immediate and Speedy Action is necessary Free from Contact

Switch off current immediately or send someone to do so. Do not attempt to remove a person from contact with high voltage unless suitable articles insulated for the system voltage are used for this purpose. When attempting to free a person form contact with low voltage use rubber gloves, boots, or mat, or insulated stick, but if these are not available use a loop of rope, cap or coat to drag the person free. Whatever is used should be dry and non-conducting.

After Release

Do not waste time moving him. Lay the patient down on something dry, if possible, and if no sign of breathing can be observed. IMMEDIATELY proceed to promote artificial respiration and someone else for a doctor and ambulance. Do not give up efforts to restore natural breathing until told to do so by a doctor.

Artificial Respiration: Mouth-to-Mouth Method

1) Remove any foreign material- false teeth, vomit, etc. which may cause blockage of the air passages.

li) To open the air passage tilt the patient's head backwards as far as possible. Use one hand to push the patient's head backwards and the other to pull the jaw forwards. At the same time slightly opening the patient's mouths

!I!) Take a deep breath, place your mouth over the patient's mouth and blow, Seal the patient's nose either by passing your cheek against it or by grasping it with the fingers

iv) Give 6 to 8 quick blows and then continue to inflate the Chest about 10 times per minute. Watch the chest during inflation. It should rise. No movement indicates a blocked airway. If so, check mouth and throat are clear and tilt the head further backwards.

Artificial Respiration: Holger Nielsen Method

l) Lay the patient face down, the arms above the head, the elbows flexed so that one hand rests on the other. Turn the patient's head to one side so that the cheek rests on his uppermost hand. If the hands are injured rest the cheek on a firm pad

I!) See that the air passages are clear of foreign matter.

iii) Kneel on one knee at the patient's head with the other foot near his elbow.

iv) Place your hands on the patient's shoulder blades and rock forward with your elbows straight until your arms are vertical, pressing downwards but not too heavily. This movement should take two seconds.

v) Grasp the patient arms just above the elbows and rock your self backwards lifting the elbows above the patient's head (two seconds)

vi) Lower arms and transfer your hands to his shoulder blades

vii) Repeat total movement at the rate of ten times per minute.

Artificial Respiration: Silvester's Method

i) Remove any foreign matter blocking the airway.

ii) Place casualty on his back with a pad of some kind under his shoulder so that the head falls back fully extended.

iii) Kneel at his head-grasp the patient's arms at the wrist - cross them over the lower chest and press to squeeze the air out of the chest (two second)

iv) Pull arms upwards and outwards to above the head, stretching the chest (three seconds)

v) Repeat the whole movement approximately ten times per minute.

Other injuries

After breathing, priority should be given to controlling bleeding. This is achieved by firm pressure on the wound.

1) Cover with a clean dressing and bandage firmly in place.

11) If bleeding continues and further dressings on top of the first and increase the pressure by bandaging firmly in place.

Burns should be covered with a clean, sterile dressing to exclude air. This dressing should have the bandaged lightly in position. Unless it is dangerous to leave the casualty at the site of the accident expert assistance should be sought before other injuries are treated. if it is necessary to move the casualty, do so with the utmost gentleness carefully supporting any injured parts.

First aid appliances

The first aid appliances provided shall be used only for the purpose intended. A person shall be appointed to be responsible for ensuring that supplies are always available.

SHOCK

Shock is state of collapse or prostration that interferes with normal action or the heart, respiration and circulation. This condition is probably due to derangement or lack or proper balance within the sympathetic nervous system that controls these vital functions. Shock is a serious condition and requires immediate action on the part of the first aider. Shock follows an injuries or emotional disturbances. Symptoms may develop immediately, or in some cases considerable time may elapse before they are noted. The more serious the injury or emotional disturbance, the more severe is the shock.

a) Symptoms. The symptoms of shock are:

1. The face is pale.
2. The skin is cool and clammy with perspiration around the nose, mouth, and forehead.
3. The pulse will be fast and weak.
4. The eyes will lack luster and the pupils may be dilated.
5. Breathing may be shallow and irregular.
6. Dizziness, nausea and vomiting may develop.

b) Dangers or Shock.

1. Shock may cause death.
2. Shock pre-disposes the body to infection, such as pneumonia or wound infection.
3. Shock may lead to amputation of parts of the body due to lack of circulation in the extremities.

c. Prevention and Treatment. First aid attention is the same for the prevention and treatment of shock.

1. Keep the patient lying down flat until you have determined whether or not a head injury is present. If no head injury is present and no fractures of lower extremities exist, elevate the feet or lower the head, whichever is more convenient. If a serious head injury is suspected, keep the patient laying flat

2. Keep the patient warm; conserve body temperature. This can be accomplished by placing a blanket underneath the patient and covering him, according to weather conditions, to maintain normal body heat. Do not cause the patient to be over heated. In cold weather it may be necessary to use artificial heat.

d) Factors which Contributor to Shock. Anything's which causes pain, such as rough handling, improper transportation, continuation of bleeding, exposure to cold or excessive heat, or fatigue, contributors to shock and should be avoided.

Artificial Respiration

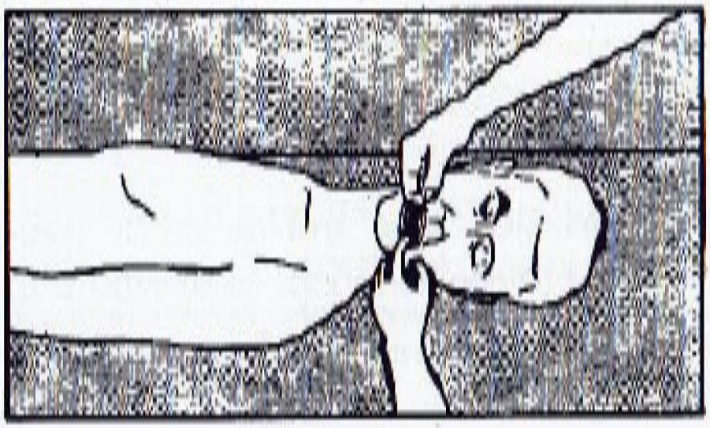


Figure-1

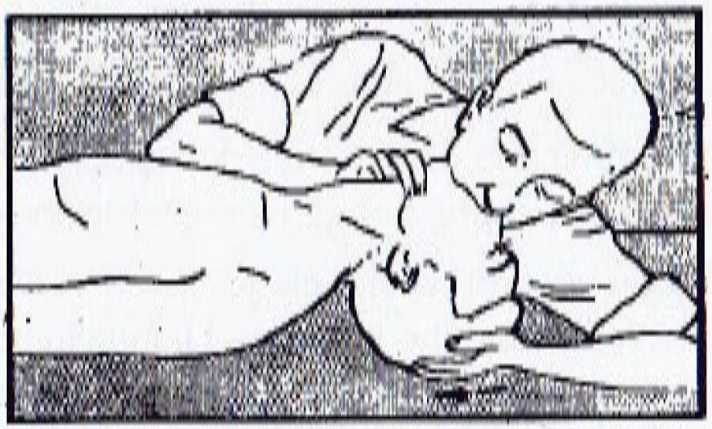


Figure-2

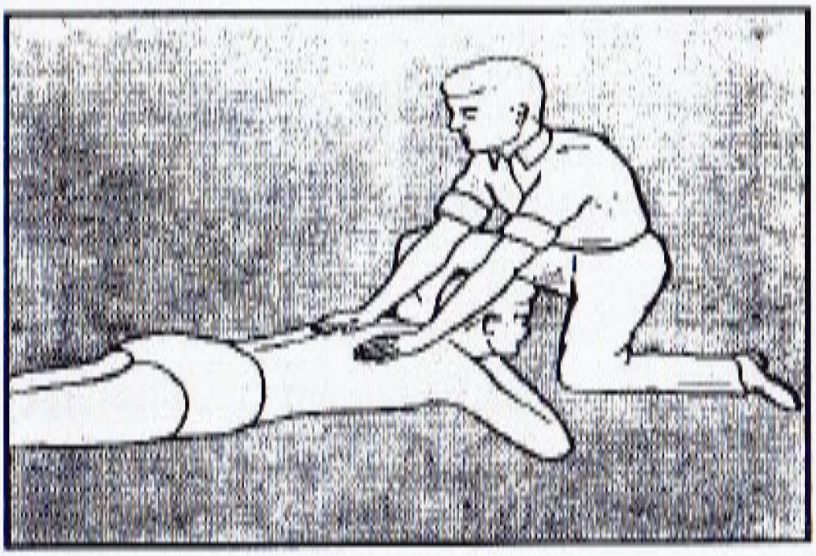


Figure-3

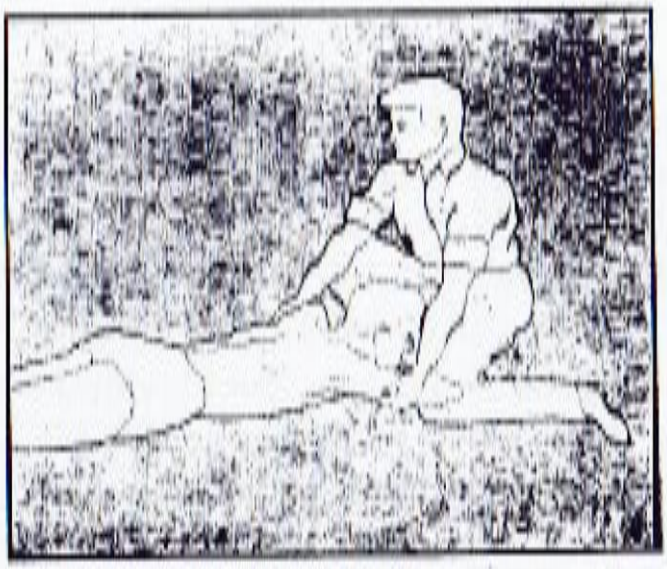


Figure-4

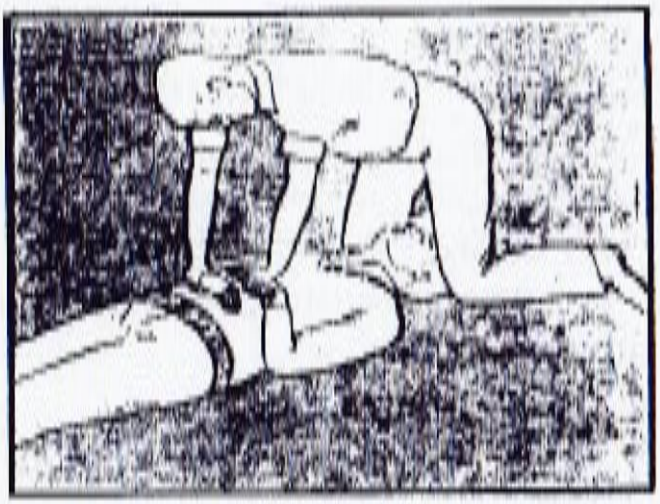


Figure-5

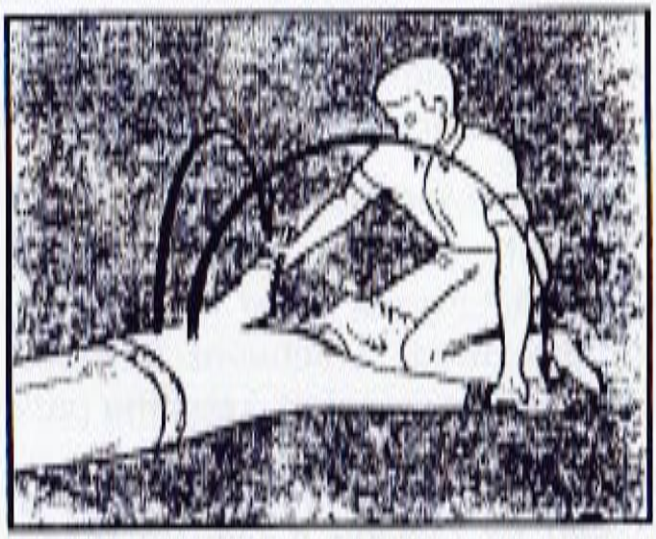


Figure-6

SAFETY INSTRUCTIONS:

Warning for public entry into the Substation

Caution:
1. No entrance without permission/ Public Entry is restricted without permission
2. All except the employees of the substation need to have permission with guide from the appropriate authority before their entry into the substation.
3. Smoking is strictly prohibited inside the substation
4. Entry to the substation with metal rod, conductor etc, is prohibited.
5. No unauthorized person shall operate or handle/touch button, transformer or any part of the electrical equipment.

Risks
1. Electric shock due to high voltage
2. Fire in the electrical equipment due to spark or explosion
3. Electrocution due to lightning.
4. Falling, tripping or striking against stone/ object or structure due carelessness.

Consequences
1. Physical losses like senselessness, paralysis or even death due to electric shock.
2. Burn due to electric short circuit or explosion.
3. Physical injury due to tripping.

Things to be done
1. Control Room must be informed before entering the substation. Please collect necessary mobile phone numbers from the control room to contact in case of any immediate necessity/ emergency.
2. All the employees and visitors shall have to wear personal safety equipment such as safety shoes, helmet etc. before their entrance into the substation.
3. No part of the electrical equipment can be touched if they are not properly earthed and safety is not ensured.
4. First Aid is necessary for any physical injury. An expert's advice is essential soon after.
5. Safe distance shall be maintained when carrying metal rod, conductor, umbrella or ladder to the substation.
6. If any emergency situation arises during inspection (such as electrical short circuit, electric spark, fire, thunder, earthquake etc.) no metal parts can be touched. Take help of the guide or stay inside the in the guard room/ assembly point.

Safety Instructions For SF6 Gas Filling

1. SAFETY FIRST.
2. If you feel that you are not physical fit for the job, DO NOT carry out the work. Ask the person in charge.
3. Use required personal protective equipment (PPE).
4. Do not work alone.
5. If any sort of abnormalities found, stop working. Check everything very carefully. Inform your work in charge if required.
6. Unscrew the protective cover from the SF6 gas bottle.
7. Remove the protective nut from the orifice of the gas output.
8. Fit the seal in position, and turn the screw on the pressure reducing valve.
9. Open the bottle.
10. Adjust the value of the filling pressure by using the lower screw. Maintain the pressure at 7.0 bar.
11. Open the far end valve.
12. As soon as the dial on the pressure reducing valve indicates the desired pressure (6.2 bar) close the bottle.
13. The manometer's needle must be positioned between the 2 small black lines.

14. Ensure that the leak tight seal is clean and coated with grease. If not, clean it and then apply a fine film of grease.
15. No cable or tool should come in contact with any live parts.
16. Maintain a minimum distance during inspection.
17. Do not eat, drink or smoke during gas filling.
18. During gas filling, avoid wiping the nose, eyes or face other than with clean paper tissues.
19. Follow “tools box talk” while performing scheduled or emergency Maintenance work.

Safety Instructions For Lightning Arrestor

1. SAFETY FIRST.
2. If you feel that you are not physical fit for the job, DO NOT carry out the work. Ask the person in charge.
3. Use required personal protective equipment (PPE).
4. Do not work alone.
5. If any sort of abnormalities found, stop working. Check everything very carefully. Inform your work in charge if required.
6. Do not stay or stand in front of the blow-out orifice of the burst protection.
7. Do not store any combustible material near of the blow-out orifice of the burst protection.
8. Regularly check leakage current (at normal condition: indicator is at green marking) and counter reading to see if the lightening arrestor is working properly.
9. Make sure all power is disconnected and properly grounded before attempting shutdown.
10. No cable or tool should come in contact with any live parts.
11. Maintain a minimum distance during inspection.
12. Follow “tools box talk” while performing scheduled or emergency Maintenance work.

Safety Instructions For Power Transformer

1. SAFETY FIRST.
2. If you feel that you are not physical fit for the job, DO NOT carry out the work. Ask the person in charge.
3. Use required personal protective equipment (PPE).
4. Do not work alone
5. Follow “tool box talk” when performing scheduled or emergency Maintenance work.
6. If any sort of abnormalities found, stop working. Check everything very carefully. Inform your Work in charge if required.
7. Don't wear jewelry, other accessories or clothes to avoid electrocution and injury.
8. Fire extinguishers for electrical fires should be kept near and at accessible locations.
9. Refer to nameplate for ratings and voltages.
10. Make sure all power is disconnected and all windings are grounded before attempting any work on the transformer or inside the enclosure.
11. Do not attempt to change any primary or secondary connections or taps while the transformer is energized.
12. Do not tamper with control panels, alarms, interlocks, or control circuits.
13. Do not adjust or remove any accessories or cover plates while the transformer is energized.
14. No cable should come in contact with the core or coil or any live parts except the terminal that it is intended for. Always maintain a minimum distance.
15. If there is any chance of foreign objects falling inside the core of coil assembly while work is being performed around the transformer, then the core and coil should be covered with a suitable protective drop cloth after de-energizing the transformer. The drop should be removed and the transformer should be visually inspected for any objects before re-energizing.
16. Modification of any kind to the equipment is not permitted. Besides breaching the warranty such actions may result in accidents.
17. Regularly check junction temperature by thermo vision camera of temperature gun to avoid red hot.

Safety Instructions For Current Transformer

1. SAFETY FIRST.
2. If you feel that you are not physical fit for the job, DO NOT carry out the work. Ask the person in charge.
3. Use required personal protective equipment (PPE).
4. Do not work alone.
5. If any sort of abnormality is found, stop working. Check everything very carefully. Inform your work in charge if required.
6. Do not stay or stand in front of the blow-out orifice of the burst protection.
7. Do not store any combustible material near the blow-out orifice of the burst protection
8. Regularly check oil level (for future action).
9. Make sure all power is disconnected and properly grounded before attempting any shutdown.
10. No cable or tool should come in contact with any live parts.
11. Maintain a minimum distance during inspection.
12. Regularly check junction temperature by thermo vision camera of temperature gun to avoid red hot.
13. Follow “tools box talk” while performing scheduled or emergency Maintenance work.

Safety Instructions For Circuit Breaker

1. SAFETY FIRST.
2. If you feel that you are not physical fit for the job, DO NOT carry out the work. Ask the person in charge.
3. Use required personal protective equipment (PPE).
4. Do not work alone.
5. If any sort of abnormality is found, stop working. Check everything very carefully. Inform your work in charge if required.
6. Do not stay or stand in front of the blow-out orifice of the burst protection
7. Do not store any combustible material near the blow-out orifice of the burst protection
8. Regularly check hydraulic oil level (take actions if indicator indicates red marking) and SF6 gas pressure for future action.
9. Regularly check junction temperature by thermo vision camera of temperature gun to avoid “red hot”.
10. Make sure all power is disconnected and properly grounded before attempting any shutdown work.
11. No cable or tool should come in contact with any live parts.
12. Maintain a minimum distance during inspection.

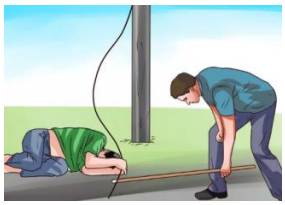
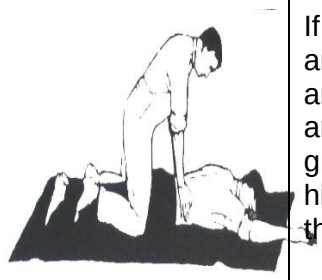
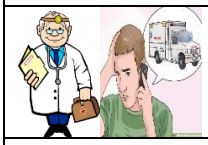
Checklist for Tools for Line Maintenance

Before leaving for line maintenance by vehicle, please check the fitness of the vehicle. Ensure at least of the followings at good working condition at the vehicle

1. Vehicle related legal documents like driving license, insurance, tax token, bluebook, fitness certificate etc.
2. Everyone will have to maintain dress code and keep ID card.
3. First Aid box consist at least of the followings
    a. 6 (six) sterilized bandage of small size;
    b. 3 (three) packets of cotton (0.5 ounce);
    c. 3 (three) sterilized bandage of medium-size;
    d. 3 (three) sterilized bandage of large size;
    e. 3 (three) sterilized bandage of large size usable for burn;
    f. 1 (one) bottle (1 ounce) of Hibisol or Hexasol;
    g. 1 (one) bottle (1 ounce) of rectified spirit;
    h. 1 (one) pair of scissors;
    i. Painkiller and antacid tablet, burn cream, eye drop, antiseptic solutions for surgery;
    j. 3 (three) packets of oral saline.

4. Rope (minimum length 25 m)
5. Safety belt (minimum 04 pcs)
6. Helmet (minimum 06 pcs)
7. Safety shoes (minimum 06 pcs)
8. Ladder & hanging ladder.
9. Grounding Led 3 pcs.
10. Tool Box (Ratchet, Ring & open range set, WD-40/CRC, Emery paper, Wire brush, Jute, Nut-bolt, Washer.)
11. Hand gloves, Goggles.
12. Special tools for specific work.

First Aid For Electric Shock

	Do not touch the victim if he/she is still in contact with the conductor.
	Free the victim by switching off or cutting off the lines by tools with insulated handles.
	Alternatively, Free the victim by dragging his clothes (if dry) or use dry bamboo, wood, paper, blanket, hessian, rubber gloves etc. Wear rubber shoes for freeing the victim.
	If the victim is unable to take normal breath, try the following method for artificial respiration. Lay the patient on his belly, keep one of his/her arms straight and bent the other arm and put his/her head on the bent arm. Kneel so as to keep his/her body in-between your knees and grasp two sides of his/her lower ribs with your hands and gently press his/her body with your weight. Relax pressure and your weight. Repeat the procedure fifteen times in a minute.
	In the meantime, either call in a doctor or transfer the victim to a nearby hospital.
	Never give a drink to the unconscious patient.
	Accident report shall have be submitted to the concerned authority.

SAFETY SYMBOLS

সকল দর্শনার্থীর জন্য পরিবেশ, স্বাস্থ্য ও নিরাপত্তা বিষয়ে আবশ্যকীয় জ্ঞাতব্য বিষয়

Important instruction on Environment, Health & Safety issues for all visitors and vendors.

সাবস্টেশন পরিদর্শনের পূর্বে অবশ্যই কর্তৃপক্ষকে অবহিত করুন, প্রয়োজনে গাইড নিন।
Before entering the substaion, please inform the authority and take the help of guide if necessary.

সাবস্টেশন পরিদর্শনের সময় প্রয়োজনীয় ব্যক্তিগত নিরাপত্তা সামগ্রী ব্যবহার করুন।
Please wear required PPE during the visit to the substation.

সাবস্টেশনের অভ্যন্তরে ধূমপান সম্পূর্ণ নিষেধ।
Smoking is strickly prohibited inside the substation.

পরিদর্শনের সময় সুইচইয়ার্ডে অবস্থানকালে মোবাইল ফোন ব্যবহার থেকে বিরত থাকুন। খুব বেশী প্রয়োজন হলে অফিস রুমে প্রবেশ করে ফোন ব্যবহার করুন।
Please abstain from using mobile phone at the switchyard, if it is urgent, use it inside the office room.

যথাযথ অনুমতি ব্যতীত সাবস্টেশনের অভ্যন্তরে ছবি তোলা থেকে বিরত থাকুন।
Photographs must not be taken unless authorised by your host.

নিরাপত্তার স্বার্থে যথাযথ কর্তৃপক্ষের অনুমতি ব্যতীত শিশুদেরকে (বয়স ১-১৪) সাবস্টেশনে প্রবেশের ক্ষেত্রে বিরত থাকুন।
Children (Age 1-14) are not allowed to enter the substation unless authorised

যে কোন প্রকার মেরামত কাজের জন্য 'Safe Work Permit' এর প্রয়োজন আছে কিনা দেখে নিন এবং থাকলে তা সংগ্রহ করুন। (ঠিকাদারদের জন্য প্রযোজ্য)
Obtain safe work permit for maintenance work, if required (for contractors only).

কলেজ ও বিশ্ববিদ্যালয়ের ছাত্র-ছাত্রীদের শিক্ষাসফর সহ যে কোন গ্রুপ পরিদর্শনের ক্ষেত্রে অবশ্যই যথাযথ পূর্ব অনুমতি পত্র সংগ্রহ করতে হবে এবং সাবস্টেশন পরিদর্শনের সময় সেইফটি বিষয়ে বিশেষ সতর্কতা অবলম্বন করতে হবে।
Obtain prior approval for group visits like study tour of different colleges, universities etc. and take extra care regarding safety during the visit.

পরিদর্শনের সময় কোন প্রকার জরুরী পরিস্থিতির সম্মূখীন হলে (যেমন অগ্নিকান্ড) 'Exit Route' ব্যবহার করুন অথবা গাইডের সাহায্য নিন।
In case of any emergency situation (like Fire) please follow 'Exit Route' or take help from your guide.

সাবস্টেশনে যেকোন গাড়ীর গতি সর্বোচ্চ ১০ কি:মি:/ ঘন্টা বজায় রাখুন।
Limit your automobile's speed maximum 10 KMH at the substation

নিরাপত্তার স্বার্থে অনুমতি ব্যতীত কোনো মেশিন, যন্ত্রাংশ বা অন্যান্য মালামালে হাত দেওয়া এবং অননুমোদিত স্থানে প্রবেশ করা থেকে বিরত থাকুন।
For safety purpose, don't touch any machineries or equipment, don't enter any restricted area unless authorized.

সাবস্টেশনের পরিষ্কার পরিচ্ছন্নতা নিশ্চিত করুন, ময়লা আবর্জনা নির্দিষ্ট বিনে ফেলুন।
To keep the premises neat and clean, please dump all wastes in the specific bin.

সাবস্টেশনে ফিটনেস বিহীন যানবাহন প্রবেশ নিষেধ।
Vehicles without fitness are restricted to enter the premises.

মালামাল সরবরাহ/ স্থানান্তর করার ক্ষেত্রে (বিশেষ করে এসিড ও রাসায়নিক পদার্থ) যেন কোনভাবেই পরিবেশ দূষিত না হয় এবং স্বাস্থ্যহানি না ঘটে সে বিষয়ে বিশেষ সতর্কতা অবলম্বন করুন।
In case of material handling materials (especially acid and chemicals), make sure to avoid any pollution to environment and health hazard.

সাবস্টেশনে অবস্থানকালে প্রদর্শিত সকল নির্দেশনা মেনে চলুন।
Please abide by all signs/ instructions displayed in the premises.


SAFETY INSTRUCTIONS
নিরাপত্তা নির্দেশিকা
থামুন
UNAUTHORIZED PERSONS KEEP OUT.
বিনা অনুমতিতে প্রবেশ নিষেধ।
HARD HAT AREA.
হেলমেট পরিধান করুন।
FEET PROTECTION MANDATORY.
নিরাপদ জুতা পরিধান করুন।
NO SMOKING OR NAKED FLAMES.
ধুমপান বা আগুন জ্বালানো থেকে বিরত থাকুন।
USE FIRE EXTINGUISHER. IN CASE OF FIRE
আগুন নিভাতে অগ্নি-নির্বাপনী ব্যবহার করুন।
GROUNDING MUST BE DONE BEFORE WORKING WITH ANY EQUEIPMENT.
যে কোনো যন্ত্রে কাজের পূর্বে তা গ্রাউন্ডিং নিশ্চিত করুন।


FIRE EXTINGUISHER INSTRUCTION
অগ্নি নির্বাপক যন্ত্র ব্যবহার বিধি
রাবারের সিলটি ছিঁড়ুন
এবং লকটি টান দিয়ে
বের করুন
হোস পাইপ আগুনের দিকে
তাক করে ধরুন
উপরের হাতল
নিচের দিকে চাপ দিন
বাতাসের অনুকূলে থেকে অগ্নি নির্বাপক যন্ত্রটি ব্যবহার করুন।


সর্বাগ্রে
নিরাপত্তা
নিরাপত্তার জন্য প্রয়োজনীয় নিরাপত্তা সামগ্রী ব্যবহার করুন
Safety First
Use personal protective equipment as required


CAUTION
সাবধান
MEN WORKING
কাজ চলিতেছে


Danger / সাবধান


Danger
electric shock risk
তড়িতাহতের ঝুঁকি হতে সাবধান


সমাবেশস্থল
Assembly Point


সাবধান !
পিছলে পড়ার ঝুঁকি আছে
Slip Hazard


CAUTION
Tripping Hazard
সাবধান!
হোঁচট এর ঝুঁকি আছে


প্রবেশ নিয়ন্ত্রিত এলাকা
Entry Restricted

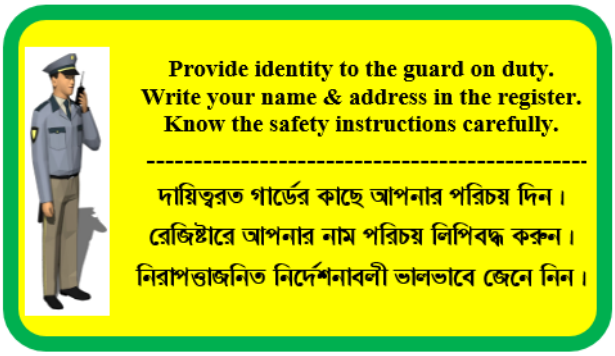

নোটিশ
এই দরজাটি
বন্ধ রাখুন
Keep the
door closed


ধূমপান নিষেধ
Smoking is
Strictly Prohibited


CAUTION !
সর্বোচ্চ
গতিবেগ ১০ কিঃ/ঘঃ
Maximum
Speed 10
km/hr


Safety First
সর্বাগ্রে নিরাপত্তা


Please keep your shoes out.
Use sandals kept inside.
দয়া করে জুতা খুলে প্রবেশ করুন।
ভিতরে রাখা স্যান্ডেল ব্যবহার করুন।


Provide identity to the guard on duty.
Write your name & address in the register.
Know the safety instructions carefully.
দায়িত্বরত গার্ডের কাছে আপনার পরিচয় দিন।
রেজিষ্টারে আপনার নাম পরিচয় লিপিবদ্ধ করুন।
নিরাপত্তাজনিত নির্দেশনাবলী ভালভাবে জেনে নিন।