PERSONAL PROTECTION AT THE WORKPLACE

Preface

Accidents at the workplace can result in varying degrees of harm to people. Some of these injuries may be minor, others serious enough to cause handicaps or disability. Besides affecting employee productivity and morale, such incidents result in considerable pain and suffering to the victim and members of the family. There is thus a need for everyone in the workplace to have a basic knowledge of injury risks and personal protection practices.

Over the years, Loss Prevention Association of India Ltd. (LPA), has been featuring articles on various aspects of Personal Protection in various issues of LPA's safety journal, Loss Prevention News; they were found to be a useful source of information for many We have now edited them, added some more and brought them together at one place for easy reference. This publication is, however, not intended to be a comprehensive book on "Personal Protective Equipment".

Introduction

Before embarking on a publication of this nature, it will be appropriate to keep in mind certain "Ground Rules" for Personal Protective Equipment (PPE) is a second line of defence for employee protection. The first line of defence is to eliminate accident causing situations at the workplace by effective engineering measures.

PPE does not, and cannot, eliminate hazards at work. As a barrier between the hazard and the worker, PPE can help eliminate an injury or reduce its severity.

PPE should be resorted to only if absolute

removal of the hazard in the work environment is impossible or impracticable.

PPE relevant to the hazard should be selected and used.

PPE should conform to applicable National Standards or Codes of Practice and good engineering practices.

PPE's principal requirements are:-

- to safeguard the worker from the identified hazard to which he is exposed
- to afford reasonable comfort
- to permit essential movement of limbs required for efficient job performance
- to be amenable to easy cleaning and maintenance.

Head Protection

The head is for absorbing knowledge — not blows. It houses the command centre of our central nervous system that controls all movements, senses and basic bodily functions. An injury to the head can pose a serious threat to the brain. The complex mechanism of the brain is delicately balanced and extremely susceptible; the slushiest disturbance in its functioning can extremely susceptible; the slightest disturbance in its functioning can have grave consequences for the body. Since the brain is housed in the head, it is of utmost importance to protect it against all injuries and accidents. One single head injury can turn the victim into a veritable vegetable and even rob him of life.

Hazards

The skull with its covering of scalp and hair acts as a natural helmet, cushioning the brain against minor bumps and knocks. However, this is no protection against the serious hazards one encounters at construction sites, mining, factories, in overhead line construction and maintenance work.

The bare head is no proof against a sudden cascade of loose masonry or accidentally dropped tools. A trowel or a hammer falling from a height on an unprotected head can prove fatal. Heavy objects dropping on the head can knock one unconscious, lacerate the scalp, break open the skull, cause concussion or badly damage the brain.

Collapsing cave roofs and walls are the ever-present fears at the back of miners' minds. In the cold dark confines of mines, remote from expert medical aid, head injuries are to be avoided at all cost: chances of a victim's recovery can be extremely thin.

Overhead line construction poses a different kind of hazard — that of electric shock. Severe shock can permanently damage the brain and even kill.

A head injury can induce concussion or a violent shaking up of the brain, damaging it permanently. A blow to the head may result in amnesia or memory lapses. Amnesia can leave huge irrevocable gaps in memory.

Severe brain injury often paralyses and totally incapacitates the victim, robbing him of almost all bodily functions, turning him

into a vegetable.

Protective Measures

Before you tackle a job, find out the hazards involved and the protective measures available. Good head protection on the job depends on safe work habits and proper use of protective headgear.

A safety conscious worker follows all rules and regulations, concentrates totally on the job, does not show off by taking unnecessary risks or fool around on the job, distracting himself and others. Such a person jeopardises not only his own safety but that of others around him also. Don't be in too much of a hurry to finish the job. Work at a steady, comfortable pace. Trying to get too much done in too short a time can overtire one, leading to carelessness, poor performance and even accidents.

Be alert on the job. Expect the unexpected. Keep a sharp look-out for hidden hazards. Report unsafe conditions and equipment promptly to the authorities. Be considerate for other people. Remember, your carelessness can cost others dear. Watch out for other peoples' safety and mistakes as well as yours.

Safety Headgear

The safety helmet is a basic protective device for the head that helps protect it against the impact of falling or flying objects as well as knocking and banging against hard, solid substances. A blow to the head is the most common cause of all head injuries in the workplace.

Sharp, heavy objects can penetrate and break open the skull causing lacerations, deep cuts, fractures or brain damage. Safety helmets act as barriers against such hazards, as well as protecting the head from flame, preventing burn injuries.

No single headgear can offer protection against all hazards. There are different protective headgears suited to the needs of particular jobs with their specific hazards.

Safety Helmet

The hard shell of the safety helmet is designed to protect the head against impact. It deflects objects and distributes the force of the impact over the whole head, diffusing the gravity of the blow.

The peak, a permanent extension of the shell over the eyes, protects the face, and especially the eyes from injury. The brim is a narrow rim surrounding the shell that also helps deflect objects away from the head.

The chin strap holds the helmet securely in place while ventilation holes in the shell allow circulation of air inside the hard hat.

Your safety helmet should be the right size for you, so adjust the fit correctly and comfortably. Straps should be snugly, but not too tightly in place.

Wear the helmet straight, not tilted on your head. The helmet is the protector of your head and not a receptacle for odds and ends. Do not stash away cigarette packs, cards, letters, etc., in the clearance inside your hard

hat and never wear an ordinary cap or hat under it.

Your hard hat is for the safety of your head, so take good care of it. Don't fling it around carelessly or drop it.

Since the helmet is such an important safety tool, it's proper maintenance is imperative. Regular checking of the shell for cracks, dents, signs of wear and for loose or broken straps is vital.

Replace damaged, worn-out helmets, or those that have taken hard knocks. The harness must be changed at least once a year if the helmet is in regular use.

Protect your helmet from exposure to sunlight and extremes of heat and cold, chemicals, etc., as much as possible. PVC helmets are not suitable in very hot locations as they are likely to soften.

Remove dirt and moisture after use. Clean the hard hat at least once a month in warm water and a recommended cleanser and air dry.

Do not leave the helmet lying about. Store it in racks inside vehicles or in lockers or other places meant for it. It is important that your helmet is in perfect condition whenever you use it.

Other Protective Headgear

Apart from safety helmets, there are other protective headgear that provide protection against hazards in the workplace.

Sundry accessories may be used with the helmet where the nature of the job requires them. A chin strap holds the helmet in place where there is a chance of its falling off. Face shield mounts hold face shields in place where there is a danger from flying objects or liquid splashes or heat radiation. Appropriate eye protection should be worn under the face shield.

Ear defenders are use full in noisy environments for protection against noise pollution. Some safety helmets have built-in brackets for attaching ear plugs. A fixture for lamps on the helmet can be of great help to a miner whose hands are engaged while working in the mine. The lamp fixed to the helmet lights up the work area for him.

Emergency Measures

In spite of taking precautions, accidents and injuries cannot always be ruled out. They happen. Head injuries can be extremely serious, and pretty often are. Prompt and competent first aid and medical attention in such cases can spell the difference between life and death. A well equipped emergency first aid station with trained personnel in attendance is of utmost importance in work areas where the job poses serious hazards to the head. Workers trained in the rudiments of basic first aid measures applicable to head injury victims can be of immense help.

Double check for safety before you start a hazardous job. Remember, your head is the most important part of your body. It is in your safekeeping. Use your head to keep it safe.

Eye Protection

Eyes are our windows to the world, the best means of direct and instant communication that the body has with the environment. If eyesight is lost, a curtain of darkness descends between us and the world, isolating us physically, psychologically and emotionally. Eyes are precious, vital parts of our body; we cannot, must not neglect them. Indifference to their care, in many cases, causes irreversible damage.

Eye are extremely vulnerable to injury; their vital parts have few natural defences. The cornea and the lens have few blood vessels and heal slowly, if injured. The retina, made up mostly of nerves, does not heal if damaged or destroyed.

Wherever hazardous work is going on, eye protection equipment must be provided. Use them. If the equipment does not offer adequate protection against the particular hazards involved in what you are doing, then it is important that you get the proper protection before going on with the job. Wearing the right type of eye protection on the job is the key to the prevention of eye injury at work. Remember, everyone on the job site needs and must use eye protection — that includes visitors as well.

Direct Hazards

Eyes are vulnerable to various kinds of hazards in the workplace. Broadly speaking, these may be classified into three main categories- 1) **Mechanical hazards 2) Chemical hazards and 3) Thermal & Radiation hazards.**

Mechanical

There are eye protection equipment that offer special protection against particular hazards inherent in particular jobs. In machining, grinding and chipping, cutting and handling molten metals, there is great risk of flying particles, dust, chips, sparks and molten metal splashes getting into the eyes and injuring them. For machining, wear industrial safety spectacles with side shields or goggles. Box or cup goggles would provide protection against fire, dusts and chips. In cutting jobs use face shields with plastic window and safety glasses. Be extremely careful of splashes while handling molten metals. Wear goggles or face shields over tinted spectacles.

Chemical

Handling chemicals in laboratories and factories poses the threat of chemical splashes, fumes, dust and burns. In laboratory work wear box type chemical goggles. In especially risky situations, use a chemical face shield. Use chemical splash hoods for short duration jobs in handling chemicals.

Thermal

Protect your eyes against thermal and radiation hazards such as heat, glare, ultraviolet rays and infrared rays by using the right protective eye wear. These hazards are present in some processes, for example, welding.

Use welding helmet or handshield fitted with welding filter, ideally with tinted spectacles underneath, for electric arc welding jobs. For spot welding wear spectacles or box goggles with tinted lenses that provide mechanical protection. Either cup or box type gas welding goggles with filters are recommended for gas welding. For laser operations, safety spectacles or goggles with the correct filter for the laser wavelength is necessary; for furnace operations wear both tinted safety glasses and goggles or face shields.

In all hazardous operations, make sure you use the right safety eye wear recommended for the particular job; if in doubt, check with your supervisor. Maintain your safety equipment properly. Check it daily and clean dirty lenses and frames.

Replace equipment immediately if the lenses are scratched, cracked, chipped, pitted or faded. Keep the eye wear in a clean container, preferably with your name on it so nobody else uses it inadvertently,

Your safety eye wear must be the right fit for you, neither too tight nor too loose, fitting snugly close to the eyes without touching the eyelashes and without hampering body movement. Never use somebody else's eye equipment.

Safe eye wear is meant for constant use in the workplace, so use it wherever and whenever the job demands it. No amount of safety equipment can guard you against accident and injury if you do not use them.

Associated Hazards.

Apart from the hazards directly associate with the job, conditions in the workplace can affect the well being of the eyes. Lighting needs vary from job to job. Inadequate and improper lighting arrangement can cause eye strain, headache, blurred vision, fatigue, slowed perception, nervousness and frustration eventually leading to accident and injury.

You cannot work efficiently if the light is too dim and insufficient, nor can you work for long if it is too bright, — producing glare directly from lamps or windows facing you, or bounced from shiny walls, desk tops, machines, etc.

Very sharp contrasts like deep shadows surrounding harshly lit work areas make it extremely strenuous for the eyes; adjusting to such sharp contrasts takes time and consequently results in strain, blurred vision, tension, irritability and a multitude of other ills.

IS 6665-1972 give recommended values of illumination and limiting values of glare index for various industrial buildings and processes (See Fig.). In your workplace, if the lighting is inadequate or unsuitable to your job requirements, report immediately to the authorities and have the situation remedied.

Precautions

A thorough medical check-up before you take up a hazardous job is a must. Poor eyesight can increase chances of accident

and injury on the job to yourself and others.

Get regular eye check-up, especially those over 40. Even if you enjoyed good eyesight as a young person, by middle age your eyes may have weakened considerably without you being aware of it. While on the job, if you have any problems like frequent headaches, squinting, twisting your head or bending closer to see better, your eyes may need medical treatment. See your doctor without delay and tell him the kind of work you do. Obey doctor's instructions faithfully; if glasses have been prescribed, use them. Remember, perception glasses and contact lenses are no substitute for eye protection equipment. Safety equipment must be worn over glasses and contact lenses wherever and whenever the job requires them.

Emergency Measures

In spite of using eye protection equipment, accidents can and do occur. Be sure you know how to react to emergencies quickly and calmly. Know where the emergency equipment is kept and how to use them.

Eyes are precious. Take good care of them. You have got only one pair. They cannot be replaced.

Ear Protection

Hearing is one of life's most precious gifts. It is through the process of hearing that a newborn baby learns about the world and to speak. A child with defective hearing may have severe difficulty in learning to speak. Too much noise can damage hearing temporarily or even permanently, create stress that can and does sometimes affect one's physical and mental wellbeing and cause accidents in the workplace when people can't hear instructions and warning signals. Hearing conservation is protecting your ear (hearing) from potentially damaging levels of sound. Impaired hearing prevents us from leading a full, happy participative life in the community. Surely, it's a rare gift worth protecting in all seriousness.

The Hearing Mechanism

Our organ of hearing comprises three distinct compartments or regions with their own particular functions in the mechanism of hearing. These are the outer (external), the middle and the inner (internal) ear. As sound enters the ear, the sound waves pass along the ear canal to the eardrum each wave causes a sympathetic vibration of the eardrum which is carried by the eardrum to three small bones, called Ossicles — the tiniest bones in the body.

The vibrations are carried by the Ossicles to a fluid contained in the Cochlea— a tiny snail-shaped structure containing microscopic nerve endings that respond to the fluid vibrations. The neural impulses created by the nerve endings are transmitted to the brain which interprets them as sound.

The ear changes the energy in sound waves into nerve impulses that the brain interprets. Mechanical disturbances in the air produce

sound waves. Sound is measured by its frequency and intensity. Frequency measured in HERTZ corresponds to the pitch (high or low) of a sound — the number of complete sound cycles in a second (Hz).

Human beings can hear sounds ranging from 20 to 20,000 Hz, but for proper understanding of speech, hearing ability in 500 to 5,000 Hz is important.

Intensity (sound pressure level) is the loudness of a sound, measured in decibels (dB). You run the risk of hearing loss if you are exposed to an average of more than 90 dB over an 8-hour workday.

Hearing Loss

We may define hearing loss in the simplest of terms as any reduction in our ability to hear from that of a person with normal hearing. The loss may be classified as — Temporary and Permanent.

Exposure to loud noise like the din in rifle range, ear-splitting bursts of firecrackers, noisy machinery like concrete mixers, pneumatic drills, chain saws or the sustained loud whine of vacuum cleaners and food processors, or even the high-pitched rock music on a stereo can cause hearing loss. Fortunately, such loss is temporary and hearing is restored after a period of rest away from the noise source.

Permanent hearing loss usually is the result of Presbycusis — the gradual decrease in hearing sensitivity accompanying the aging process; diseases; injury; or exposure to loud noise and vibration over extended periods of time. The loss of hearing from exposure to industrial noise is commonly termed 'noise induced hearing loss'. In all such cases of permanent hearing loss, exposure to loud noise or vibration damages or destroys the tiny very sensitive nerve or hair cells in the hearing organ. The process is not reversible. However, such losses are usually only partial in most cases. Total hearing loss is generally associated with disease or some traumatic injury.

Noise

Noise is an unwelcome, undesired sound that intrudes into and interferes with our hearing the sounds we prefer to hear. The same sound at times may be pleasing, — at others, annoying or even harmful. At any given location there is always some noise coming from ceilings, walls and floors. This composite, all encompassing noise associated with any particular environment is called "ambient noise"

We can call noise useless sound also. Such sound carries no information and tends to interfere with our ability to clearly receive and interpret useful sound.

However, in many cases it is often difficult to decide whether it is information or mere noise; quite often it is both. To an operator, the sound of his machine conveys information, telling his trained ear if it's running faultlessly. On the other hand, an executive in an adjacent cabin might find the same sound an intrusion into his concentration and performance.

Workplace Hazards

The International Labor Office as part of its activities aimed at improving the work environment of workers adopted a Code of Practice for Noise and Vibration Control in its 192nd session in early '74 and published it in March '75

The Code lays down guidelines for governments, employers, and workers. It emphasises the importance of noise and vibration control, which among others, are two major factors that pollute the work environment with detrimental effects on workers' health. The number and power of noise sources have grown alarmingly over the last few decades with the rapid growth of industry and transport. Noise and vibration, exceeding certain thresholds, impair work capacity — the effects ranging from minor mental and physical inconvenience to severe organic disorders. They cause economic losses by reducing intellectual work capacity and even temporary or permanent elimination from the workforce (sick leave, early retirement) of many workers affected by occupational diseases or accidents.

Elimination of noise and vibration in machinery, equipment and buildings at the design stage is vital to effective noise pollution control

Other methods are isolation of noise and vibration sources; enclosing and soundproofing noisy machinery, equipment and processes; distancing their location from other work areas; use of noise and vibration-reducing methods and materials; good housekeeping; maintenance; and isolation of workers. When such collective measures are not applicable, administrative measures like staggered work schedules, reduction of exposure time of workers and issuing personal protective equipment can be fruitful.

The experts concluded that in the long run, the lack of protective measures and supervision is generally more costly than a suitable safety and supervision program.

For better utilisation of limited financial resources, it is advisable to start with an audiometric screening of all personnel at the recruitment stage and then concentrate on any abnormal and pathological findings needing more detailed medical investigation.

For any noise vibration control and hearing conservation project to succeed, employer co-operation is imperative. The Code details certain duties and obligations of both employers and employees and also the areas of co-operation between the two.

Noise Control

Audiometric testing is a procedure for checking a person's hearing. These tests set a baseline level or threshold of hearing of individuals against which hearing losses (damage) can be assessed. These tests also identify personnel who already have some hearing loss and should avoid additional exposure to noise.

The first step in noise control is to measure sound levels at various locations in the workplace and to analyse the same to determine exactly which areas are hazardous

to hearing. If the findings indicate that the 8-hour noise level is of 85 dB (decibels) or higher, the employer must inform you. The final success of a noise reduction and hearing conservation project usually depends on the ingenuity with which the basic approaches to noise control are used without decreasing the maximum utility and accessibility of the machine or other noise- producing source that is being quietened.

Industrial noise problems are extremely complex, there is no universal panacea for all kinds. A judicious combination of measures such as controlling noise at source by engineering measures, use of acoustic material to absorb noise in its path and use of ear protection would enable many noise problems to be solved.

Ear Protection

Noise control at the ear of the receiver would include administrative control or regulation of exposure time and the use of personal protective aids.

The administration controls exposure time of employees by changing job schedules or rotating personnel to reduce the amount of time they spend in noisy areas. Remote control (TV monitors) and control rooms can be used by worker to monitor a particular process, or perform an operation away from the noise-producing area. Working hours of workers in extra noisy areas can also be interspersed with rest periods away from the noise source.

Hearing Protection Aids

Caps and plugs seal the ear canal and muffs cover the external ear. The choice depends in part on the work situation. Each protective device has its own plus and minus points, so all the circumstances of a particular job have to be considered in the selection of an aid.

A good, comfortable fit is of great importance. You must have your hearing properly tested before getting your hearing protector fitted. Plugs have to be fitted individually for each ear in cases where the ear canals of an individual are not identical in size and shape. Using personal protection aids might be uncomfortable and bothersome at the initial stage because you are not used to it; but it's use is of utmost importance to your good health and hearing. Use it consistently as recommended.

Generally speaking, earplugs give a protection of 3 to 5 dB, whereas earmuffs provide considerably higher attenuation. These protectors when worn continuously and properly will provide adequate protection against most industrial noise exposures.

There are three basic types of ear protectors available on the market: Earplugs, Canal Caps, Earmuffs.

Earplugs

Earplugs are fitted in the outer part of the canal. Fitted properly, they reduce noise quite effectively. There are different types of earplugs.

Disposable plugs are made of waxed cotton or acoustical fibres and are thrown away after a single use. A ball of plain cottonwool stuffed into the ear is of no use at all, and should not be tried. Semidisposable ones are made of sponge or foam material. These are rolled tightly into a ball and inserted inside the ear. The plug expands and fits snugly into the ear canal and can be used more than once if it is clean. These plugs are clean, comfortable and quite inexpensive. Your hands must be absolutely clean when you put them in.

Reusable earplugs made of soft silicone, rubber or plastic, are of two kinds: the universal type which must fit correctly in individual ears to give good protection and the multi-size type that comes in several sizes for a better fit. These are clean and long-lasting but are rather less effective for irregular ear canals and may shrink and harden if there is ear wax (cerumen) in the ear. Incidentally, if you have hardened wax in your ear, do not try taking it out with any rough and ready implements (tooth picks, safety pins, etc.) Go to a qualified doctor for the job. Self-help here might do irreversible damage to your fragile eardrum.

Custom-moulded plugs are moulded to the exact shape of the ear. Silicone, rubber, or plastic moulding is put into each ear and left to set. These themselves might be used as earplugs or serve as moulds for the final plugs. Custom-moulded plugs are clean and comfortable with no fitting problems and last for 3 to 5 years. However, they may not be as effective as the best of the other varieties. Plugs must be the right size and properly positioned to give you a snug fit.

You should have the ear canal medically examined during fitting. Properly fitted earplugs generally reduce noise exposure level by about 5-15 dB (A). Wash reusable earplugs in warm soapy water before and after each use. Keep them clean and store in the carrying cases usually provided with them.

Canal caps

Canal caps close off the ear canals at the opening. Made of a soft rubber-like substance, they are kept in position by a light band under tension. These are useful for people who cannot use earplugs and also those who have to enter and leave high-noise areas frequently. Remember, plugs and caps tend to get dislodged by your jaw movements. You must check from time to time (with clean hands) to see that they are properly in place.

Earmuffs

These fit over the whole ear to seal out noise. A set of earmuffs consists of 3 components:

(a) Cups made of moulded plastic and filled with foam or other material. They vary in size and can be adjusted up or down;

(b) Cushions covered with plastic and filled with foam, liquid or air to ensure comfort and protection, seal out noise;

(c) the spring-loaded headband holds the cups in place against the head. If you wear the band at the back of the head or under the chin, make sure it does not

reduce the protection meant to be given.

Earmuffs can protect you against severe, high frequency noise; they can reduce sound levels by 15-30 dB(A). For people who cannot use earplugs, muffs are ideal. Be sure when you try your muffs for wear. The headband pressure should be neither too tight nor too slack. The cups should not pinch your ear lobes at any point. They should be light enough for you to keep them on comfortably for a number of hours at a stretch. If you wear spectacles, their frames should have temple cushions or thin metal arms that don't break the seal between your head and the muffs.

For cleaning and storage, follow manufacturer's instructions. Have repairs done or replacements made immediately if any part of the equipment is damaged or you have any problem with it. Prevent contact of the equipment with grease and oil and replace hardened and worn cushions as and when needed. Report all malfunctions immediately to the authorities.

Wear your protection on the job. Even a short period without it may damage your hearing. Make your choice of ear protector wisely and well. Remember, noise pollution is a very real hazard. It needs everybody's co-operation to keep it under control and conserve hearing.

Hand Protection

Hands are the two busiest, most important, indispensable, invaluable and at the same time vulnerable tools the human body has at its disposal. The versatility of their use sets humans apart from other living creatures. We use them constantly for so many diverse jobs that we tend to take them for granted. Our hands and fingers are a set of amazingly dexterous tools with the strength to grasp, grip, lift, push, pull, squeeze, twist and hold things. They are sensitive to touch, respond to pressure, temperature and pain and have the flexibility and co-ordination to perform highly complicated and intricate jobs.

Injuries

Among the injuries suffered by hands in the workplace, some common ones are amputations, lacerations, burns, fractures, punctures, dermatitis, Carpel tunnel syndrome and Reynaud's syndrome. Amputation is the cutting off of a part or the whole of a hand or any other limb by accident or as the result of surgery necessitated by disease.

Lacerations are cuts, both minor and major. Minor when only the skin is broken, but serious when nerves or tendons are severed. Foreign matter getting into the open wound can infect it, causing serious complications. Fractures are broken bones sustained in hands trying to break a fall, twisting at an awkward angle or getting trapped and crushed by, under and between heavy loads.

Splinters, glass shards, wood chips and sharp, pointed, spiked tools and objects can puncture the skin and go through tendons, ligaments, muscle tissue and even bones at times. Infection of the open wound is an ever-present possibility, so is permanent

damage.

In industries, hands suffer burns and dermatitis when they come in contact with hot objects (steam pipes, etc.) and some chemicals.

Carpel tunnel syndrome is inflamed tendons pressing against nerves in the wrist, numbing and weakening it, often accompanied by excruciating pain in the wrist and even the elbow.

Reynaud's syndrome results from cold temperature, emotional disturbance, vibration and other causes. Blood vessels in the hand constrict, numbing and weakening them and creating other related problems.

Hazards

Broadly speaking, hands are vulnerable to three basic kinds of hazards in the workplace.

Mechanical: Your hands are at risk from mechanical hazards wherever machinery is in use. The most vulnerable area, of course, is the point of operation—where the job is actually getting done. The hazards here are many. Sharp-edged cutting objects like guillotine cutters, shears, cleavers, axes, knives, etc. can cause grave damage. A moment's carelessness in operating such machines can result in lacerations, mangling and even amputation. Take great care in handling sharp, pointed implements like knives, awls, screwdrivers punches, etc. A little inattention can leave you with punctured flesh and bone, possibly leading to serious infection. Rotating shafts of blades can catch, cut or mangle your hands, given half a chance. Rollers, wheels or gears moving inward can grab a finger or a sleeve and injure severely. Rotary saws, flywheels, grinders, sanders, belts, pulleys, etc. can also trap the hands of the unwary, damaging and mutilating them. Be on guard around machines like presses and brakes where two solid, heavy objects come together with force. If your hands get in their way, they can be severely crushed and mutilated.

Environmental: Almost all work environments present some kind of hazard for the hands. You can severely burn yourself by contact with hot objects, liquids or molten metals. Acids, chemicals and corrosives can be equally injurious. They can destroy tissue, remove natural oils and cause severe burns to unprotected hands. A cold work environment can cause frostbite which, in extreme cases, may lead to the loss of fingers and toes.

Contact with irritating substances is a common problem at the workplace. Inflammation of the skin, dermatitis frequently result from the work environment. Dermatitis can be caused both by chemical and biological agents. Chemicals like metallic salts, solvents, acids and alkalies can injure and irritate the skin on direct contact while certain oils and epoxies induce allergic reaction, some temporary, others frequently long term. Biological agents like bacteria and fungi can irritate the skin, infect it and cause sickness. Agricultural workers and those who work in laboratories, and with food and flowers, are especially vulnerable to this.

Prevention of Hand Injuries

Be alert on the job all the time around machinery. Keep your hands well away from moving parts. Use tools properly and only for their intended use. Ensure that machine guards meant for shielding the dangerous parts of the machine are securely in place.

Keep your hands out of danger areas by using aids like push-sticks to feed small pieces into saws. Use brushes to clear away debris like chips, splinters, glass shards, dust, etc. Do not fiddle with safety devices like graders or emergency stop and never remove them. Take off watches, bangles, rings, bracelets, etc. while working with machinery. Do not wear loose flowing clothes, especially long, flapping sleeves that may get entangled in machinery. Avoid accidents by cleaning and tidying up when you finish each job.

Before staring work in a hazardous environment, first identify the hazards you are likely to face and the damage they can do to you. Take protective measures by using personal protection gear every time it is necessary. Take special care in handling chemicals, acids and molten materials to avoid spills, splash and contact. Carry loads through doorways and narrow aisles with hands at top and bottom of the load and not on the sides. Use batons instead of hands as spacers while stacking load so your fingers do not get pinched.

Keep your hands clean and change work clothes regularly. Wash frequently, especially after direct exposure to contaminants, before eating and smoking and also each time before you leave the work area. Do not use industrial solvents, mineral oils, etc. for cleaning hands. Use only the recommended approved cleaners.

Use appropriate personal protection for each hazard you may encounter on the job. Use the recommended glove material for the specific chemical you are going to handle.

Type of Hand Protection

Many kinds of gloves are available for hand protection. For your particular job you may need to combine two or more types.

Apart from gloves, other protective devices are also manufactured for the hands.

Hand pads protect you from splinters and abrasive materials as well as in heavy jobs where dexterity is not the first priority. Forearm cuffs of cloth, aluminised fabric, etc. protect the forearm from heat. Fabric or metal thumb guards and tapes offer protection against pinched fingers. Mittens of a variety of fabrics guard the hands in handling tough or sharp materials and also in cold conditions.

Various barrier creams too offer protection from harm. Coat your skin with dry barrier cream for easier clean-up after the job and against mild acids; wet creams against irritants like acids and alkali dissolved in water and solvent repellent creams against irritating solvents and oils. Barrier creams are used when use of other personal protection is not possible.

Selection

While choosing hand protection equipment you should keep four things in mind.

Type of Job: Your personal protection equipment should not interfere with your job performance.

Specific Hazards: No single protective equipment can be effective against all hazards. Select the particular one for the specific hazard the job in hand involves.

Proper Fit: Gloves must fit comfortably so that you do not lose out in your dexterity of operation. A glove too loose or large will hamper dexterity and chances of accidents are higher; if it is too tight it will constrict the muscles, veins and nerves, inducing fatigue, and wear out quickly. Gloves should not be used while working on machines having revolving or fast moving parts in view of the risk of entanglement of gloves in these parts.

Proper Design: The design of the gloves should fit the job requirements: inner seams and linings should be comfortable and non-irritating.

Use and Care

Cover up exposed skin by using gloves of sufficient length and wear sleeves over gauntlets for extra protection against sparks and hazardous liquids. When and where necessary, use additional protection like barrier creams. Apply barrier cream on cleaned skin always, and re-apply frequently. Rub on lanolin after using a barrier cream. Wash away barrier cream first and then rub on lanolin. Keep spare equipment handy so your hands are protected at all times on the job. Report any problem with protective gear promptly to the authorities and never use defective equipment at all.

Inspect and test gloves and other equipment for leaks, etc. every day before you commence work. Repair or replace damaged, defective equipment. Never work without personal protection. Wash and clean your equipment and air it thoroughly after exposure to contaminants. Clean it regularly and separately. Do not put it in the family laundry. Store as recommended. Shield rubber and plastic protection from heat and sunlight. While operating machinery, especially electrical equipment do not use wet gloves or their protection material. Keep equipment away from harmful substances.

Leg Protection

Our legs keep us mobile. Apart from assisting us in our domestic activities, this pair of slender limbs help us to go out to earn our livelihood. In the process, they are exposed to various hazards and unfortunately, are often injured. Leg accidents account for a large proportion of occupational accidents. And many go unrecorded.

A leg accident causes lots of pain and suffering and if severe, may lead to temporary or permanent disablement resulting in absence from work, loss of income and medical expenses.

Hazards

In the prevailing industrial scenario various types of hazards pose danger to our legs. They can be classified into:
"Direct Hazards,
"Indirect Hazards

Direct Hazards

Direct hazards have the potential to cause injury directly to the feet or leg. These are further classified into four major types such as:

Mechanical Hazards: e.g. Struck by falling/rolling or flying objects.

Chemical Hazards: e.g. Coming in contact with acids, alkalies, bleaches, cutting oils, etc.

Heat Hazards: e.g. Exposure to hot surfaces, sparks, molten metal splashes, direct flame, etc.

Fungal Infection: e.g. From prolonged exposure to water.

Indierect Hazards

Indirect hazards may have their origins in inappropriate footwear and/or result from environmental factors. They can be broadly classified into 4 categories:

Fire/Explosion Hazards: These include flammable gases, liquids or explosives ignited by sparks from metallic parts of the shoe; accumulated static electricity in the body igniting volatile material.

Slipping Hazards: on wet or only surfaces

Electrical Hazards: Electrocution due to inadequate foot protection.

Sanitation Hazards: Contamination and infection from insanitary conditions.

Protective Measures

The various hazards can be eliminated or at least minimised by use of suitable footwear. One should be aware of particulars of footwear appropriate/suitable for different hazards.

For adequate protection, the footwear chosen should be appropriate for the job, comfortable to wear and should have some visual appeal. The correct choice of the footwear, therefore assumes they importance.

Legging and Legguards

Leggings of varied sizes, from waist length to those that reach only part way up to the knees, protect legs against numerous hazards. Given below are some hazards and the legging material for protection.

Hazard	Legging Material
Impact from falling or flying objects	- Hard fibre or Metal
Molten Metal, sparks, heat	- Asbestos or leather
Acid alkalies, hot water	- Natural or synthetic rubber
Light spatter	- Fire-resisting duck or wool.

Knee leggings are held in place by metal spring clips or may be wrapped round the leg and fastened with snap buttons or similar quick release devices. Hip leggings are suspended by straps from a waist belt.

The leg guards which encircle the legs may also have a flap at the bottom to protect the instep. The front part may be reinforced to

take the impact. Such guards are useful for persons exposed to flying objects from jack hammer operations or being struck or striking against falling objects.

Knee pads of asbestos, fibre, felt or reinforced leather are used as protection against heat and sharp edges encountered in steel mills, glass plant operations, sheet metal plants, mines and similar industries. Rubber knee pads are preferable for workers who have to be on their knees for long hours in operations like tile setting and cement finishing. Ballistic Nylon pads are recommended for protection of thighs and upper legs against injury from chainsaw operations.

Safety Shoes

The basic, universal form of foot protection is the safety shoe. Special protective features such as steel toe cap, steel inner sole, special sole, reinforced instep, etc. are incorporated into the safety shoe depending on the nature of hazard it is to protect against.

Material of the uppers, soles, etc. vary to a great extent and their choice is influenced by the hazard. It is imperative that careful and judicious selection is made while ordering for shoes, vis-a-vis the situation in which it would be used. For example, in areas where there is likelihood of flammable gases /vapors being present in the air in sufficient quantities to produce explosive or ignitable mixtures either under normal operating conditions or process upsets/ breakdowns, conductive shoes or overshoes should be used which permit static electricity build-up in the users body to drain off harmlessly into a conductive grounded floor. Safety footwear, to be used by welders or moulders in foundries where there are chances of hot metal splashes or flying sparks from welding torches, should be designed so that thery can be speedily removed. Zip fasteners, rather than laces, facilitate quick removal in such cases. Matching footwear to the job is of utmost importance. Inappropriate and unsuitable footwear is easily damaged and offer no protection against hazards.

There are safety shoes available for protection against corrosive chemicals and cutting oils and for use on hot surfaces. There are over-shoes for extreme heat and against direct flames, wet surfaces and against electrical hazards, etc. Often, a pair of safety shoes of proper design and the right material can be used in several different hazardous situations and working environments.

Maintenance/Care

Safety shoes should be kept as dry as possible. This is extremely important when they are used for protection from electrical hazard lest their insulating property gets affected. Protection is diminished when they are wet from perspiration and rain.

Shoes and over-shoes used in an explosive or flammable environment should not be used outdoors because any accumulation of dirt impairs conductance of the shoes. Electrical resistance of the shoes should be tested periodically while they are in use.

Wash feet and change socks daily. Perspi-

ration harms the leather and causes the lining to wear out and become rough. Wear heavy cotton or woolen socks that absorb perspiration better.

Inspect regularly for dampness or damage by embedded metal pieces which might impair electrical protection; cuts, cracks, etc. might expose feet to danger.

Repair or replace worn-out or defective shoes. Make sure repairs are made without lessening protection. Repair of antispark and shock-resistant type shoes and conductive shoe soles should be entrusted to people thoroughly familiar with their manufacture and properly trained for this job. The advice of manufacturers may be sought in this respect. Further, repair of any damaged or worn-out component should be undertaken immediately in order to obtain the maximum amount of service from the footwear because the longer they are neglected, the more difficult it becomes to repair them properly.

Clean and condition the footwear as a matter of routine (e.g. after every shift) for better protection.

In case of doubt, safety shoes with toe-caps may be subjected to an impact test. This test may also be carried out on finished toe-caps prior to their incorporation in safety boots.

It is the responsibility of the management to provide suitable leg protection to all employees who may need one depending on the nature of their work. In addition to protection and safety, it does have a morale boosting effect on the work force and may indirectly contribute to productivity and improved industrial relations. Providing leg protective equipment is not enough. Workers need to wear them regularly and not treat it as a cumbersome appendage. Only then will a comprehensive leg protection programme show results in terms of fewer accidents.

Skin Protection

The skin is the body's first line of defence: its role is that of a foot soldier in military strategy. Like the infantry, it almost always faces and absorbs the brunt of the enemy attack. A good general does not send his soldiers into battle without planning to safeguard their survival. In hazardous work environments, the skin is the most vulnerable to accident and infection from exposure. So, for your own body's well-being, protect your skin against all hazards, both at home and at work.

The skin has two layers. The epidermis or the outer layer, constantly sheds dead cells and replaces them with new ones. The dermis, the inner layer, contains sweat glands, nerve endings, oils, etc. The skin acts as a barrier against harm from sunlight, bacteria and physical injury. However, the human body with its protective skin covering that has evolved through time, cannot withstand the grievous, insidious penetration of harmful chemicals and solvents. A number of chemicals and solvents injurious to the body, like those in pesticides, are absorbed through the skin without one being aware of it. The harmful effects may not

immediately be apparent but once these substances get into the system they cause severe, long term and often irreversible damage.

A very high percentage of job-related injuries are skin injuries that lead to prolonged illness, anguish and suffering, impaired ability for work, loss of production, loss of income and many other related problems. It is in your own interest to identify and understand the hazards in the workplace and take all precautions to protect yourself against them.

Causes

The causes of job-related skin disease and injury may be classified under four headings:

1. **Physical Hazards** (environmental and mechanical) — pressure, abrasion, moisture, drying up (desiccation), heat, cold, light, X-rays and other rays.
2. **Chemical Substances** — inorganic acids and salts, hydrocarbons, oils, tars, pitch, anthracene or coal tar and dyes.

3. **Plant Products** — leaves, stems, sap, roots, bulbs, flowers, fruits, vegetables, wood dust, resins and lacquers.

4. **Living Agents** — bacteria, viruses, fungi, parasites, insects and mites.

Physical Hazards

Environmental: Heat, cold, wind, radiation and overexposure to sunlight, all have their reactions on the skin. They burn, chafe, and dry the skin, induce heat rash, frost bite and cause other types of skin damage.

Outdoor workers, people who work in extremely cold environments like those in cold storages, ice factories, freezers in the meat-packing industry and those who work on furnaces, with hot metals, welding tools, lasers, etc. are especially prone to these agents and should be aware of the hazards related to their jobs.

Mechanical: The tools of trade of industrial workers pose grave problems for their skin. Blows from friction with and pressure by machines and tools cause cuts, lacerations, punctures, and bruises with risk of infection and other ills. Pneumatic and high-frequency tools may cause injury and pain to the operator's hands and feet. Skin subjected to repeated stress often forms heavy callouses. After prolonged exposure to vibration, white finger disease develops.

Chemical Substances

Chemicals are the most common causes of skin disease and injury in the workplace. Contact with them may, and very often does, cause burns, dermatitis, ulcers, etc. Chemical agents like solvents, metallic salts, photosensitisers and carcinogens affect the skin causing grievous harm. While spirit, kerosene and such other solvents soak up body oils and moisture from the skin, making it more vulnerable to injury and infection, metallic salts (chromium, mercury, zinc) may induce severe dermatitis Photosensitisers like pitch and creosote make the skin so sensitive that it overreacts to light. Some petroleum and coal tar based

substances are carcinogens; exposure to them can cause skin cancer.

Inorganic arsenic compounds cause dermatitis ulcers, hyperkeratosis and cancer. In factories where arsenic is handled, the fine powder of arsenical compounds settling on the skin of the industrial worker may give rise to warts on the nostrils, eyelids, ears, lips and in the wrinkles in the folds of the neck: the compounds being carcinogenic, the warts can become malignant.

Other metallic compounds cause mercury dermatitis mercury fulminate dermatitis, fulminate itch, beryllium dermatitis, nickel eczema, metal plater's dramatics, suspender dermatitis, spectacle dermatitis, chrome dermatitis, chrome ulcer and chrome hole.

TNT dermatitis chloronaphthalene acne, chlor halowax acne, cable rash, blackhead itch, tar warts, tar cancer, pitch cancer, anthracene cancer, chimney-sweep's cancer, shale oil cancer and mule spinner's cancer are some of the skin dermatitis diseases caused by organic chemical substances. Asbestos causes asbestos warts, and X-rays are responsible for X-ray dermatitis and X-ray cancer.

Plant Products

Plants, vegetables, fruits, flowers, wood dusts and resins, producing substances harmful to the skin, make a very long list. Horticulturists, florists, nurserymen, gardeners, market gardeners, field laborers, pharmacists, perfumers, confectioners, fruit-pickers and packers, canning factory workers and those handling certain insecticides and lacquers are all vulnerable to these. The sap, stems. bulbs, leaves, flower heads, roots, etc. can cause irritation, lesions, itching and even dermatitis,

Living Agents

Mites, viruses, bacteria, fungi, etc. all cause disease transmitted through the skin. Grain itch, copra itch and grocer's itch are various kinds of occupational dramatics caused by mites. Grain handlers loading and unloading grain in ships, farmers, bakers, etc. are subject to this type of dramatics.

Farmers, shepherds, cattlemen, butchers, animal handlers petshop salespeople and such others are prone to diseases transmitted by animals, contracted through the skin.

Preventive Measures

Follow some practical, common sense, safety guidelines and prevent skin disease and injury to yourself and others at the workplace.

Wash frequently using proper cleansers:

Use plenty of fresh clean water and soap or other approved cleaner that has been recommended by the authorities. Do not use petrol, white spirit or other solvents to clean skin. Many cases of trade dermatitis are caused not by the substances handled on the job, but by their removal by degreasing agents and other substances harmful to the skin. Washing soda, soda ash, chloride of lime, paraffin, petrol, naphtha, turpentine, methylated spirit and trichloroethylene are the worst offenders. A mixture of bleach-

ing powder and soda ash (known as Chemic) is commonly used to remove dye stains from the skin; unless all traces of this mixture are removed from the skin, preferably in warm running water, alkali dermatitis may occur.

Change clothes often: Do not keep work-soiled clothes on for long. Keep fresh, laundered clothes handy and change into them frequently. Do not reuse unwashed work clothes at all. Clean clothes will keep solvents and other harmful substances away from your skin.

Remove irritants: Do not allow irritating matter to remain on your skin; wash it off right away.

Take showers: Take a thorough shower if possible, before you leave contaminated area. Shower immediately if you have been splashed by chemicals accidentally.

Separate soiled clothing: Your work clothes should not be mixed with the family wash, especially if your work involves handling hazardous chemicals. Do not take heavily contaminated clothing home. Get them washed at your workplace.

Protective Equipment

Eye Protection

Chemicals can get under contact lenses and damage the eyes, so do not wear them without additional protection. Use cuptype goggles and glasses with side-shields and a face shield or mask where the job demands it.

Gloves

Use the right kind of gloves for the job to protect your hands. For abrasives, use cotton or leather; for solvents, coated cotton; for corrosives, rubber and for hot objects, lined or leather ones. The gloves should fit properly, be clean and in perfect repair.

Footwear

Use boots and shoes that are designed specially to suit your job requirements and protect your feet from related hazards.

Body Protection

Wear heavy aprons and coveralls to prevent irritants from soaking into your clothing and thereby damaging your skin. Immediately change aprons that have become soiled or soaked. Holes or tears must be mended promptly. Do not use damaged or defective protective gear; replace with clean, new, undamaged ones without delay. Be careful of loose strings, belts, ties, around machinery. Use heavy, closely woven fabrics to provide extra protection for your skin at work against many types of gases and liquids that can be absorbed even through the intact skin. Appreciable skin absorption occurs with some liquids of low volatility. Aprons and suits of appropriate material afford body protection in such cases.

Protective Creams

Protective creams or 'barrier' creams, though not as effective as protective clothing, should be used where wearing protec-

tive clothing is not possible, and also as a supplement to protective clothing. You must always clean the skin thoroughly before applying barrier creams. Wash off with recommended cleansers and reapply frequently.

Do not use solvents for cleaning up. Use proper cleansers like soap, liquid or dry cleansers as recommended for the job. If you have skin allergies, use the special cleansers that your doctor prescribes.

Housekeeping

Machine Guards

For protection against splashes, injury and abrasions on face, hands and fingers, special guards on machinery are provided. Be sure to have them securely in place before you operate the machines. Do not risk your safety by removing them while you work.

Ventilation

Exhaust systems, windows, fans, etc. are provided in factories to help protect the skin and lungs of workers. Dust and particulate matter in the workplace settle on the skin, clogging sweat pores and hair follicles, causing irritation and disease. See that the ventilation system works properly.

Storage and Transport

Flammables and corrosives must be properly stored, well away from the work area. Store corrosives in containers that won't cause a chemical reaction. Bring small amounts for the job to the site in approved, sealed containers only when needed. If possible, use closed transportation systems, like pumping chemicals through pipes, to further minimise hazards.

Identification Labels

All containers of hazardous chemicals, solvents, etc. used at work must bear clear, legible labels identifying the contents and their potential hazards. Labels should be kept clean and read before the hazardous substances in them are used.

Before you start work, identify and acquaint yourself thoroughly with the hazards involved in the job and learn the precautionary and protective measures against them. Follow all recommended safety procedures. Use the correct protective equipment always on the job, and practise good personal hygiene and proper housekeeping procedures.

Keep your work area clean, clear and uncluttered. Put tools and materials away in their proper places after use. Keep cleaning material like hot water, towels, non-irritating skin cleansers, etc. handy and in sufficient supply. Washrooms and cleaning areas and equipment must always be kept clean. Do not depend on others to do it, but leave the area as spotless as you found it.

In spite of taking all precautions, accidents would happen. A well-equipped first aid station conveniently located near the work area is the hall mark of good industrial management. Avail of its services immediately whenever the need arises.

Your work environment has been designed to give you maximum protection against the hazards of the workplace. The safety rules and guidelines have been formulated for your own safety. Follow them faithfully. Remember : Your health and earning power are at stake if you flout them.

Respiratory Protection

The respiratory system, consisting of some vital organs of the body, is the very core of a human being. If it collapses, life itself is extinguished. One, naturally, must give it the best protection against the hazards of the workplace that threaten it.

The Respiratory System

Respiration is the act of inhaling fresh air into the lungs and exhaling stale air from them. When we breathe in and out, our chest cavity, housing the lungs, expands and contracts. The entire rib cage, curving round the chest, is flexible and expands readily by special muscles.

The nose, mount, upper throat, larynx, trachea, bronchi (all air passages) and the lungs where oxygen is passed into the blood and carbon dioxide expelled, are the respiratory organs that form the respiratory system. The diaphragm and chest muscles perform the movements of inspiration and expiration. The diaphragmatic chest muscles perform the movements of inspiration and expiration. The system is an intricate one with built-in safeguards against normal, everyday hazards. The nostrils filter dust particles from inhaled air; the specially structured nasal passage monitors the air temperature; the mucous secreted by the membrane in the nasal passage continually drips into the throat, heating and moistening the inspired air and trapping bacteria and dust. There are many other such barriers but they are obviously no match against sustained onslaughts of unusual and ruinous hazards posed by contaminated or toxic chemicals, dusts, mists, gases and sprays.

Hazards

Broadly speaking, oxygen-deficient air and harmful toxic contaminants in the atmosphere are the major respiratory hazards.

Oxygen deficiency

Every living body-cell needs a constant supply of oxygen: some are, more dependent than others on a regular supply. Cells in the brain and the nervous system, if starved of oxygen for more than 4 to 6 minutes, can be severely damaged and even die. Since these cells, once destroyed, cannot be replaced or regenerated, permanent brain damage may follow. Oxygen-deficient atmosphere is a major hazard in industry. Workers in mines, tanks, ships' holds, vats, silos, etc., are especially vulnerable to it. In the confined spaces of such areas, the air may be diluted or displaced by choking, poisonous gases or vapors, or the available oxygen totally used up by chemical or biological reactions. In operations like fruit preservation, oxygen is deliberately drained from the atmosphere and replaced by another gas to prevent spoilage in fruit storage areas. In some operations,

heavier gases or vapors may displace the oxygen.

Labored, tortured breathing, disorientation, lack of bodily coordination, dizziness, sluggish movements and a semiconscious unconcern about the imminence of death are some sighs of oxygen deficiency (16% or less) in an individual. A person entering a confined area drained of oxygen, would have no warning of danger to his system; he is likely to lose consciousness immediately, without any recollection of the incident if rescued and revived in time. Our sensory organs cannot be relied upon to warn us of atmospheres deficient in oxygen.

Maintenance and repair jobs of systems for storage and transportation of fluids or cleaning or repairing of tanks and tunnels are usually controlled by the immediate supervisor who must necessarily be particularly conversant with all the safety rules and regulations. He must not only know them but see that his workforce observes and follows them faithfully.

Harmful Contaminants

The workplace is replete with harmful contaminants in various forms against which workers must be protected.

Smoke and Fumes

Welding, smelting, burning, etc., requiring the heating of solids, sometimes produce harmful toxic smoke and fumes; these fumes, mostly invisible, have no distinct smell that may warn workers. Their inhalation can damage the respiratory system, particularly the lungs.

Sprays and Mists

Acids, paints, pesticides that need mixing or spraying (construction work, farming), when liquids with taxi chemical content are vaporised or distilled (in paints, pesticides) or when there are chemical reactions, toxic mists and sprays are formed whose inhalation can damage the throat and lungs, leading to lung cancer and blood poisoning. Diseases can spread through the blood to other parts of the body.

Gases and Vapors

The air may be contaminated by dangerous but invisible gases and vapos like hydrogen chloride, ammonia, propane, etc. Use of high temperatures (i.e. welding) may entail reactions that change harmless elements into toxic gases. Nitrogen and Oxygen might become toxic nitrogen oxides; such toxic gases and vapos are extremely harmful to the respiratory system.

Dusts

Dust is hazardous to health, especially if it contains asbestos, toxic chemicals, silica, lead, vegetable fibres, etc.; such harmful dusts are common in jobs like grinding, milling, crushing, drilling, sanding, blasting etc,.

Protective Equipment

There are 3 basic types of protective respiratory equipment.

Air Purifying Respirators

These clean the contaminated air before it is breathed in.

The particle filtering type that filters out dangerous dust particles, mists, sprays, are available as models used for protection against coarse dust particles. In some models, the dislodged filter can be replaced by a clean one. In others, the dust-clogged filters can be cleaned and reused. These models are no protection against oxygen deficiency and toxic gases or vapors; breathing can be difficult as they all get clogged with dust particles.

Vapor and gas removing respirators absorb or chemically remove gases and vapors. These are cartridge respirators, using one or two cartridges, usually attached to the face piece. Canister respirator, generally used in emergencies, comprises a large canister held against the body with a breathing tube attached to the face piece. These respirators are ineffectual against oxygen deficiency or hazardous dusts, mists or fumes. Each type of cartridge protects against only one specific kind and generally low concentration of gas or vapour

Fresh Air Breathing apparatus

Fresh Air Hose and Compressed Air Line Breathing Apparatus supply fresh breathable air from an outside source and protects against all respiratory hazards. In some models, compressed air passes through a pressurised line and air flows into the face piece only when inhaled; in others if flows continuously, preventing foul, contaminated air from leaking in. In hosemask models, a motor or a hand-operated blower supplies non-compressed air through a large hose to the face piece.

These apparatus may not give total protection in some highly toxic atmospheres; proper face sealing (no gap between face and face piece anywhere) is difficult if user wears spectacles, sideburns or beards. The inconvenient length of the hose may restrict movement. Contaminated air may leak into the face piece of the types that lack a continuous air flow.

In Air Hose mask, in order that the wearer draws air by suction without difficulty, the air hose should be of large diameter and should not be more than 15m in length. Pressure hose masks operated by hand or motor operated blowers can have lengths limited to 100 m.

In all cases, it is of paramount importance that the air drawn into the breathing apparatus is clean, respirable and free from contamination such as toxic gases/vapors of work environment; objectionable odour; oil/mist/dust from supply lines; and exhaust gases of compressors.

S.C.B.A.

In Self-Contained Breathing Apparatus (S.C.B.A.s), air is supplied from a source carried by the user; these protect against all respiratory hazards.

Some of these are closed-circuit devices that purify air by removing carbon dioxide and restoring oxygen (compressed oxygen cyl-

inder) or combine chemicals with carbon dioxide and moisture from breath to make oxygen (oxygen generating type).

Open circuit devices supply clean, compressed air from a backpack cylinder and expel stale inhaled air. Air may flow continuously or only when the wearer breathes. An extended supply hose supplies air from cylinders in open circuit devices.

S.C.B.A.s, having limited air supply, cannot be used for extended periods at a stretch. The bulky, heavy apparatus can be awkward and tiring to work with. If air flow is not continuous, both closed and open circuit devices may allow contaminated air into the face piece. Compressed air and oxygen cylinders, and oxygen making canisters need frequent replacements. Increased fire risk compels banning of smoking and open flames while using S.C.B.A.s.

Selection

In selecting respirators, consider carefully before hand the nature of work, type and concentration of the hazards involved, distance from work site to a safe area and the length of time the device is to be used at a stretch.

Check the instructions and information on canister and filter labels to see which hazards they protect against and to what extent, and select the one that suits your needs best. Choose only the standard equipment or those recommended by experts of your company.

Use and Fit

Use your respiratory protection whenever you might be exposed to oxygen deficient atmosphere or concentrations of dusts, mists, fumes, sprays and vapors above the accepted safe levels. Engineering controls, safety rules or work practices in some situations cannot neutralise hazards; in routine maintenance or repair work where spills are likely, or in emergencies, your protective respiratory equipment is your safeguard.

Before using the respirator, inspect it and check each part carefully for perfect operating conditions. The face piece should be clean and without cracks or holes in the mask or lenses. The filter should be the right kind for your respirator; check it for holes and ensure that the gaskets are in place and the threads in the filter container tight and secure. The hose must be clean and unbroken with clamps tightened and in place.

Check for cracked or broken connectors and tighten all connections. Check for worn areas and broken or missing buckles in headstrap and harness. The headstraps should be sufficiently elastic to hold the respirator snugly in place. See that the valve covers and seats in correct position.

A correct fit is of utmost importance. A badly fitted respirator would leak, allowing you to breathe contaminated air and endangering your life. Be sure your respirator fits you perfectly. Select one your size and comfortable to use. Pay careful attention during fitting tests and follow instructions to ensure total protection.

The device should be snug enough to prevent leaks but not so tight that it's uncomfortable and restricting in the smooth performance of your job. Carry out negative and/or positive tests (of any others recommended) before entering the work area. Beards, side-burns, facial scars, etc. may hamper a snug fit. No facial hair should project under the facepiece's sealing surface.

There are specially designed respirators for use with spectacles and eye protection. Contact lenses tend to get dislodged by pressure changes or cause irritation if contaminants get in the eyes. They should not be worn with respirators. There may be some slight discomfort initially with a respirator. A feeling of tightness because of pressure around the face; somewhat restricted vision and hearing; cumbersome equipment hampering movement and work; laboured breating because of decreased airflow; fatigue from wearing the respirator — all these can be minimised by a judicial selection of your equipment. If you have problems, report to the authorities immediately. Your safety is at stake, so be alert all the time.

Maintenance and Storage

Never use a damaged respirator; have it repaired or replaced immediately; all maintenance and repair should be done by qualified, trained personnel.

Replace valves, hoses, etc. periodically only with approved, new parts. Parts of different models and makes should not be mixed in one respirator. Clean and scrub it thoroughly in warm water with recommended cleanser after each use. Do not use solvents on rubber or plastic parts. If necessary, soak in disinfectant and rinse after two minutes and dry according to instructions given.

Store the respirator carefully away from chemicals, sunlight, temperature variations, dust and moisture in a sealed plastic bag in such a way that masks, hoses and headstraps are not creased, bent or stretched out of shape. Put your name tag on it, so nobody else uses it by mistake.

Emergency Care

Be smart and get out of a hazardous area instantly if you feel sick, dizzy or find it difficult to breathe. Help shift anybody in trouble to a safe area. Be sure to don your respiratory protection equipment before you go in to help. Give artificial respiration and get medical help quickly.

Knowledge of giving first aid in emergencies in hazardous workplaces can be an advantage. For your own protection and that of others, a course in emergency first aid would be wise. Use your protection whenever and wherever recommended. Be alert and act quickly. A few minutes lack of oxygen can cause brain damage and even death.

Various precautionary measures are taken in hazardous industries as safeguards. Workers in their own interest must know the hazards of the job, how to avoid them and what safety measures to take for protection. Some respiratory hazards are obvious, but most are invisible and almost impossible to detect by odor, taste or irritation. Moreover,

while some are immediately life-threatening from acute exposure, in others, like asbestos dust, health problems surface only after very longterm chronic exposure. Proper respiratory protection can keep such deadly hazards at bay.

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LPA — A Profile

Loss Prevention Association of India Ltd. (LPA) is a non-profit organisation engaged in promoting safety and loss control through education, training and constancy.

LPA uses the mass media to create an awareness of safety among different target segments such as industry, homes, schools, etc.

LPA has developed training programmes on safety to cater for personnel at various levels in an organisation. It also organises workshop, conferences and seminars on different aspects of safety and loss prevention.

LPA provides constancy and advisory services for diverse types of industries. The

constancy services include appraisal of all potential hazards, analysing and evaluating risks, suggesting loss control measures and monitoring their implementation.

LPA has a library of safety films and books procured from many countries, as also a collection of video cassettes available for sale. LPA also produces safety films (16 mm/video). It publishes the safety journals, Loss Prevention News and Road Safety Digest besides booklets, leaflets and posters on accident prevention and safety.

LPA's services can be availed by Associate Members. Associate Membership is open to all organisations/individuals in India and abroad.

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Protection of Feet and Legs

IS 583 : 1981	Ankle boots for general purposes
IS 1989	Leather safety boots and shoes
Part 1 : 1986	For miners (fourth revision)

Part 2 : 1986	For heavy metal industries (fourth revision)
IS 5852 : 1977	Protective steel toe caps for footwear
IS 2472 : 1969	Protective gaiters
IS 3738 : 1975	Rubber knee boots (first revision)
IS 3976 : 1982	Safety rubber-canvas boots (second revision)
IS 4128 : 1980	Fireman's leather boots (first revision)
IS 5557 : 1969	Industrial and safety rubber knee boots
IS 6519 : 1971	Code of practice for selection, care and repair of safety footwear
IS 9885	Protective boots for oil field workmen
Part 1 : 1981	Leather upper boots
Part 2 : 1982	Rubber upper boots
IS 10348 : 1982	Safety footwear for steel plants
IS 10665 : 1982	Safety rubber ankle boots for miners
IS 10667 : 1983	Guide for selection of industrial safety equipment for protection of foot and leg
IS 11225 : 1985	Leather safety shoes for women workers in mines and steel plants
IS 11226 : 1985	Leather safety footwear having direct moulding sole

Protection of Ears

IS 6229 : 1980	Method of measurement of real-ear protection of hearing protectors and physical attenuation of earmuffs (first revision)
IS 8520 : 1977	Guide for selection of industrial safety equipment for eye, face and ear protection
IS 9167 : 1979	Ear protectors

Protection of Hands

IS 2573 : 1986	Leather gauntlets and mittens (second revision)
IS 4770 : 1968	Rubber gloves for electrical purposes
IS 6994 : 1973 (Part 1)	Industrial safety gloves: Part 1 Leather And cotton gloves
IS 8807 : 1978	Guide for selection of industrial safety equipment for protection of arms and hands

IS 4148 : 1967 Surgical rubber gloves

Protection of Head

IS 2745 : 1983 Non-metal helmet for firemen and civil defence personnel (second revision)

IS 2925 : 1984 Industrial safety helmets (second revision)

IS 4151 : 1982 Protective helmets for scooter and motorcycle riders (second revision)

IS 5679 : 1986 Miner's cap lamps assemblies (incorporating lead acid type batteries) (First revision)

IS 9562 : 1980 Non-metal helmet for police force

IS 8318 : 1977 Colour identification marking for air purifying canisters and cartridges

IS 8347 : 1977 Glossary to terms relating to respiratory protective devices

IS 8522 : 1977 Respirators, chemical cartridge

IS 8523 : 1977 Respirators, Canister type (gas masks)

IS 9473 : 1980 Filter-type particulate matter respirators

IS 9563 : 1980 Carbon monoxide filter self-rescuers

IS 9623 : 1980 Recommendation-for the selection, use and maintenance of respiratory protective devices

IS 10245 Breathing apparatus

Part 1 : 1982 Closed-circuit breathing apparatus (compressed oxygen cylinder)

Part 2 : 1982 Open-circuit breathing apparatus

Part 3 : 1982 Fresh air hose and compressed air line breating apparatus