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Module II

(Personal protection in work environment- 7 hrs)
Personal protection in the work environment, Types of PPEs, Personal protective equipment respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

Personal protection in the work environment,

- Personal safety in the workplace depends on your own awareness of potential threats and risks as well as your employer's safety policies and procedures.
- Employers may have different priorities to consider besides your personal safety, such as losses from shoplifting, fraud against the company or the need to control costs.
- By giving some thought to managing the risks, you can make yourself safer on the job.
- **Personal protective equipment** (**PPE**) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection.
- The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter.
- Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities.
- *Protective clothing* is applied to traditional categories of clothing, and *protective gear* applies to items such as pads, guards, shields, or masks, and others.
- PPE suits can be similar in appearance to a cleanroom suit.
- The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering controls and administrative controls are not feasible or effective to reduce these risks to acceptable levels.
- PPE is needed when there are hazards present.
- PPE has the serious limitation that it does not eliminate the hazard at the source and may result in employees being exposed to the hazard if the equipment fails.
- Any item of PPE imposes a barrier between the wearer/user and the working environment.
- This can create additional strains on the wearer, impair their ability to carry out their work and create significant levels of discomfort.
- Any of these can discourage wearers from using PPE correctly, therefore placing them at risk of injury, ill-health or, under extreme circumstances, death.
- Good ergonomic design can help to minimise these barriers and can therefore help to ensure safe and healthy working conditions through the correct use of PPE.

Types of PPEs

- Personal Protective Equipment (PPE) means any device or appliance designed to be worn or held by an individual for protection against one or more health and safety hazards.
- It could include safety glasses, gloves, face shields, protective clothing or footwear.

There are two types of PPE these include **simple** and **complex.**

- **Simple personal protective equipment** – this refers to equipment that has a basic design model, it protects against lower risk hazards. It is reasonable to assume with this type of PPE that the user – is aware of the hazards, can see the risk gradually increasing and is able to make an assessment and safely identify the need for PPE to be worn.
- **Complex personal protective equipment** – this refers to equipment that it more of a technical design and provides protection against fatal or serious risk. With this type of PPE the user cannot identity the hazard in sufficient time and is immediately exposed to hazards that have irreversible effects.

- About 0 to 40% of total accidents can be prevented or controlled by the proper use of personal protective equipment.
- The **PPE** provides good defense against hazards of toxic exposure, oxygen deficiency, dusting, chemical splashes, steam, water and liquids, flying particles, hot substances, radiation, sharp edges, welding, cutting, grinding, striking against and stepping over objects, glare, personal falls and injury due to falling bodies, noise, scarp cleaning, material handling, the opening of pipelines or any hazardous work, electric shocks, burn and firefighting.

The need for PPE exists because:

1. Chances of failure of engineering controls, materials, process, equipment, and safety devices cannot be denied and in those circumstances, the **PPE** can act as a barrier between the man and hazard and save from the injury.
2. There are certain operations or accidental situations where engineering controls are less possible and **PPE** becomes necessary. For repair or maintenance or to enter into a toxic or oxygen-deficient atmosphere, or while working at height or doing jobs like welding, cutting grinding, chipping, **PPE** gives good protection.
3. It effectively avoids the contact of dangerous substances, noise, vibration, and radiation.
4. It protects from atmospheric contaminants.
5. It is a legal as well as moral duty to provide suitable PPE.

Respiratory Protective Equipment (RPE)

- Respiratory Protective Equipment (RPE) is a particular type of Personal Protective Equipment (PPE), used to protect the individual wearer against the inhalation of hazardous substances in the workplace air.
- Employers are required to firstly attempt to eliminate the hazard at source.
- RPE should only be used after all other reasonably practicable control measures have been taken.
- PPE is considered a last resort because it only protects individual workers, is prone to failure or misuse, such as wearing the wrong RPE for the job, and employees wearing RPE may get a false sense of security when using RPE.
- Respiratory Protective Equipment (RPE) not worn or selected appropriately is totally ineffective and may give the user a false sense of protection.

RPE is divided into two main types:

I. **Respirator (filtering device)** – uses filters to remove contaminants in the workplace air , there are two main types:
   a. Non-powered respirators – rely on the wearer's breathing to draw air through the filter
      Eg: Disposable filteing half mask, Half mask, full face mask
   b. Powered respirators – use a motor to pass air through the filter to give a supply of clean air to the wearer
      Eg: Half mask , full face mask, helmets, hoods, visors

II. **Breathing apparatus (BA)** – needs a supply of breathing-quality air from an independent source (eg air cylinder or air compressor)

- Both respirators and BA are available in a range of different styles, which can be put into two main groups:

- Tight-fitting facepieces (often referred to as masks) - rely on having a good seal with the wearer's face. These are available as both non-powered and powered respirators and BA. Examples are filtering facepieces, half and full-face masks.
- Loose-fitting facepieces – rely on enough clean air being provided to the wearer to prevent contaminant leaking in (only available as powered respirators or BA). Examples are hoods helmets, visors, blouses and suits.
- WARNING: Only BA is suitable for use in oxygen deficient atmospheres

Non Respiratory PPEs

- There are many different types of PPE for the body and depending on the job type.
  - Eye protection (e.g. goggles)(RPE)
  - Head protection (e.g. safety helmets)
  - Ear protection (e.g. earplugs)
  - Foot protection (e.g. steel toecap boots)
  - Hand and arm protection (e.g. gloves)
  - Body protection (e.g. high-visibility clothing)
  - Fall protection (e.g. safety harnesses).
  - Skin protection (e.g. protective clothing)

Eye Protection

- These help protect the mucus membranes of the eyes, as well as help to reduce the risk of foreign objects entering the eyes and damaging them.
- Needed when an employee work presents the potential of causing eye injury from physical, chemical, or radiation agents.

Examples of hazards:

- Machines
- Lasers
- Impacts
- Heat
- Tools
- Flying Particles / Dust
- Electrical work
- Chemical handling

There are three main types of eye protection, these are

- Safety glasses – These are effective for flying objects heading straight towards the face, but they are not effective for vapours and dust that can enter the eyes.
- Goggles – They are effective at protecting the eyes from all angles, as the rim is in contact with the face
- Face shields and visors – These can be worn with prescription glasses underneath, and they help to protect the whole face.

Head protection

- Head protection can protect the head from physical hazards, they can also protect other parts of the upper body, such as the neck, hair, nose and ears.

There are two main types of head protection that are used in the workplace, these are:

- Industrial safety helmets – These protect the head from falling objects such as – tree-felling, building and construction and blasting at a quarry.
- Bump caps – These protect the head from being bumped, they are useful for maintenance personnel working under machinery and plumbers working under pipework. However, the do not offer adequate protection from the risk of a falling object.

- Firefighter helmets are similar to industrial safety helmets, however they cover more of the head and give greater protection against impact, heat and flames.
- Head Protection: Care Considerations
    - Remove and replace hard hats if they have:
    - Perforation, cracking, or warping of the brim or shell;
    - Indication of exposure to heat, chemicals or UV light (loss of surface gloss, chalking or flaking)
    - Always replace a hard hat if it sustains an impact
    - Suspension can be changed if excessive wear is noticed
    - Never drill holes, paint or apply labels to headgear
    - Do not store headgear in the rear window shelf of a car: sunlight and extreme heat can damage them

Types of Head Protection

- Hard hats are divided into three industrial classes:
- **Class A hard hats** provide impact and penetration resistance
- along with limited voltage protection (up to 2,200 volts).
- **Class B hard hats** provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying/falling objects.
- **Class C hard hats** provide lightweight comfort and impact protection but offer no protection from electrical hazards.
- **Bump hats** for use in areas with low head clearance
  - These are not designed to protect against falling or flying objects and are not ANSI approved.

Ear protection

- Exposure to noise levels over 85 dB can cause hearing loss
- Hearing protection required at 90 dB
- Implement effective Hearing Conservation Program

There are three main types of ear protection, these include:

- Ear defenders (ear muffs) – The cups are lined with a sound absorbing material, this helps to reduce the level of noise to the ears
- Ear plugs – These fit into the ear canal and form a seal, they also can have a cord on them, that you can put behind the back of the neck, to help prevent them from becoming lost.
- Canal caps – These are similar to ear plugs, however they offer less protection they are suitable for operations where earplugs would be frequently taken out and put back in.

Foot protection

There are two common types of foot protection, they both offer a variety of protection, these are:

- Safety boots and shoes – They come with slip-resistant soles, penetration-resistant midsoles, protective toe caps.
- Wellington boots – These are suitable for people who work in wet conditions, they are normally made from rubber, they also come with slip-resistant soles, penetration-resistant midsoles, protective toe caps.

- Toe and foot injuries account for 5% of all disabling workplace injuries. Workers not wearing safety shoes have 75% of all occupational foot injuries.
- Situations where employees should wear foot / leg protection include:
  - Heavy objects such as barrels or tools might roll or fall in feet
  - Sharp objects such as nails or spikes that can pierce ordinary shoes
  - Exposure to molten metal that might splash on feet or legs
  - Working on or around hot, wet or slippery surfaces
  - Working when electrical hazards are present

- Safety footwear must meet ANSI minimum compression and impact performance standards in ANSI Z41-1991 (American National Standard for Personal Protection-Protective Footwear)

➢ Foot and leg protection choices
  - **Leggings** protect the lower legs and feet from heat hazards such as molten metal or welding sparks. Safety snaps allow leggings to be removed quickly.
  - **Metatarsal guards** protect the instep area from impact and compression. Made of aluminum, steel, fiber or plastic, these guards may be strapped to the outside of shoes.
  - **Toe guards** fit over the toes of regular shoes to protect the toes from impact and compression hazards. They may be made of steel, aluminum or plastic.
  - **Combination foot and shin guards** protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed.
  - **Safety shoes** have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles in some safety shoes protect against puncture wounds.

➢ Special Purpose Shoes
  - **Safety shoes** may also be designed to be electrically conductive to prevent the buildup of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect workers from workplace electrical hazards.
  - **Electrically conductive shoes** provide protection against the buildup of static electricity. Workers in explosive and hazardous locations such as explosives manufacturing facilities or grain elevators must wear conductive shoes to reduce the risk of static electricity buildup.
  - **Electrical hazard, safety-toe shoes** are nonconductive and will prevent the wearers' feet from completing an electrical circuit to the ground. These shoes can protect against open circuits of up to 600 volts in dry conditions.
  - **Foundry Shoes** insulate the feet from extreme heat and keep hot metal from lodging in shoe eyelets, tongues or other shoe parts.

Hand and arm protection

- Hand and finger injuries account for 18% of all disabling injuries and about 25% of all industrial work place accidents
- Some factors that influence selection of protective gloves:
  - Type of chemicals handled.
  - Nature of contact (total immersion, splash, etc.).
  - Duration of contact. •
  - Area requiring protection (hand only, forearm, arm).
  - Grip requirements (dry, wet, oily).
  - Thermal protection.
  - Size and comfort.
  - Abrasion/resistance requirements.
- Gloves materials fall into 4 groups
  - Leather, canvas or metal mesh
  - Fabric and coated fabric gloves
  - Chemical- and liquid-resistant gloves
  - Insulating rubber gloves

There are four main types of hand and arm protection, these include:

- Gloves – These protect the hands, they can prevent blisters from occurring, people from burning themselves or getting splinters in their hands.
- Gloves with cuffs – These protect both the hand and the wrists
- Gauntlets, sleeves and long gloves – These provide protection for the hands, wrists and parts of the forearms.
- Sleeves and arm protection – These can provide protection for the whole forearms and upper arms.

Skin protection

Types of skin protection

There are three main types of whole-body skin protection

- Separates – these only cover part of the body (e.g. jackets or trousers).
- Aprons – these only cover part of the body.
- Overalls, coveralls, body suits, boiler suits and chemical suits – these cover the whole body, and may be reusable or disposable.

For leg protection (as well as trousers), there is also;

- Knee pads.
- Gaiters – these cover the shins.
- Hard fibre or metal guards, which help to protect against some impact hazards.

For skin protection to be effective;

- Protective clothing must be suitable for the hazard (e.g. chemical resistance and protection against physical hazards can vary widely).
- Manufacturer's instructions must be followed (e.g. do not use chemical resistance for longer than the recommended breakthrough times, and clean as to not damage its effectiveness).
- Worn or contaminated clothing must be stored separately from clean clothing.
- Check for surface damage, which could reduce its effectiveness.
- Do not wear loose clothing near moving machinery, if there is a chance that it could get caught.

High visibility clothing

This is required to protect the body against certain hazards such as moving vehicles, the main types are:

- Jackets
- Tops
- Trousers
- Vests

Fall protection systems

These can be used by individuals when they are working at height, they can wear the harness, there are two main types of fall protection systems, these include:

- Work restraint systems – These prevent the user from reaching zones where the risk of a fall exists, this means they will be protected from falling and hurting themselves
- Work positioning systems – These are similar to work restraint systems and allows the user to have both hands for working. If using this system, you must always have a back up system in place.

Personal Protective Equipment (PPE) Standards

- The existing Occupational Safety and Health Administration (OSHA) personal protective equipment (PPE) standards are found in 29 Code of Federal Regulations (CFR) Part 1910 Subpart I for General Industry, Part 1915 Subpart I for Maritime, Part 1917 Subpart E for Marine Terminals, Part 1918 Subpart J for Longshoring and Part 1926 Subpart E for Construction.
- **29 CFR 1910.133 Eye and Face Protection**: "The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation." Eye and face protection must comply with: ANSI/ISEA Z87.1American National Standard for Eye and Face Protection which was last updated in 2015.
- **29 CFR 1910.134 Respiratory protection:** "The employer shall provide arespirator to each employee when such equipment is necessary to protect the health of such employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program.
- **29 CFR 1910.135 Head protection**: "The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects. The employer shall ensure that a protective helmet designed to reduce electrical shock hazard is worn by each such affected employee when near exposed electrical conductors which could contact the head." Performance criteria for head protection are provided in the American National Standards Institute (ANSI) Z89.1 American National Standard for Industrial Head Protection. This standard is incorporated by reference in 29 CFR 1910.135 and 29 CFR 1910.6. The most recent revision was issued on May 15, 2014.
- **29 CFR 1910.136 Occupational foot protection**: "The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards." Protective footwear must comply with ASTM F-2412-18a: Standard Test Methods for Foot Protection and ASTM F-2413-18 Standard Specification for Performance Requirements for Protective Footwear
- **29 CFR 1910.137 Electrical protective equipment:** details the design requirements for specific types of electrical protective equipment—rubber insulating blankets, rubber insulating matting, rubber insulating covers, rubber insulating line hose, rubber insulating gloves, and rubber insulating sleeves used for the primary insulation of employees from energized circuit parts. It also details the in-service care and use of all electrical protective equipment covered by this standard.
- **29 CFR 1910.138 Hand protection**: "Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes." Employers should select appropriate hand protection relative to the application, present conditions, duration of use and any identified or potential hazards.
- **29 CFR 1910.140 Personal Fall Protection Systems:** "Employers shall ensure that each personal fall protection system used to comply with this part must meet all applicable requirements of this section. This section establishes performance, care, and use criteria for all personal fall protection systems such as personal fall arrest systems and positioning systems."

29 CFR 1910.132: General requirements says that all PPE has to meet these minimum requirements:

- Provide adequate protection against the particular hazards for which they are designed
- Be of safe design and construction for the work to be performed
- Be reasonably comfortable when worn under the designated conditions

- Fit snugly and not unduly interfere with the movements of the wearer
- Be durable
- Be capable of being disinfected
- Be easily cleanable
- Be distinctly marked to facilitate identification only of the manufacturer
-

Monitoring Safety Performance:

Frequency rate

A question 'How often do injuries occur?" is replied by the frequency rate which is defined as the disabling (lost time) injuries per 10^6 man-hours worked.

-
- or
- Number of lost time injuries per million man hours worked.

6.1 Frequency Rate — The frequency rate shall be calculated both for lost time injury and reportable lost time injury as follows:

$$F_A = \frac{\text{Number of lost time injury} \times 1\,000\,000}{\text{Man-hours worked}}$$

$$F_B = \frac{\text{Number of reportable lost time injury} \times 1\,000\,000}{\text{Man-hours worked}}$$

NOTE 1 — If the injury does not cause loss of time in the period in which it occurs but in a subsequent period, the injury should be included in the frequency rate of the period in which the loss of time begins.

NOTE 2 — If an injury causes intermittent loss of time, it should only be included in the frequency rate once, that is, when the first loss of time occurs.

NOTE 3 — Since frequency rate F_B is based on the lost time injuries reportable to the statutory authorities, it may be used for official purposes only. In all other cases, frequency rate F_A should be used for comparison purposes.

- What does 1000000 mean ?
  - No of workers in a year = 500
  - Daily Hour Worked = 8 hrs
  - No. of days worked in a week = 5 days
  - Total hours worked in a week = 8 * 5 = 40 hrs
  - Total week in a year = 50 week
  - So, In a year = 50 week * 40 hrs/week * 500 workers = 10 00 000
- The frequency rate is the number of disabling injuries per one million man-hours worked
- Man-Hours Worked
  - The total number of employee-hours worked by all employees in the industrial premises,
  - It includes managerial, supervisory, professional, technical, clerical and other workers including contractors labour
  - It shall be calculated from the pay roll or time clock recorded including overtime.

- When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day
- Total number of man-days is the sum of the number of men at work on each day of the period

- Disabling Injury (Lost Time Injury) - An injury causing disablement extending beyond the day of shift on which the accident occurred.
- Reportable Disabling Injury (Reportable Lost Time Injury) - An injury causing death or disablement to an extent as prescribed by the relevant statute.
- **Example 1.**Using the following data calculate the frequency rate of accident in an industrial plant.
  Number of workers=500
  Number of disabling injuries per year= 5.
  Average number of hours worked by worker per year=2000.
  Sol. Frequency rate=numbers of disabling injuries/number of man-hours worked x 1000,000
  = 5/500×2000 x 1000000=5.

severity rate

Severity Rate:
A question How serious are the injuries? is replied by the severity rate which is defined as the number of days of lost time per 10^6 man-hours worked.

- Or
- Number of man –days lost per million man hours worked.
- The severity rate is the total number of days lost or charged due to accidents per one million man-hours worked

6.2 Severity Rate — The severity rate shall be calculated from man-days lost both of lost time injury and reportable lost time injury as follows:

$$S_A = \frac{\text{Man-days lost due to lost time injury} \times 1\,000\,000}{\text{Man-hours worked}}$$

$$S_B = \frac{\text{Man-days lost due to reportable lost time injury} \times 1\,000\,000}{\text{Man-hours worked}}$$

NOTE — Since severity rate S_B is based on the lost time injuries reportable to the statutory authorities, it should be used for official purposes only. In all other cases severity rate S_A should be used for comparison purposes.

- **Here days lost=** actual days lost due to accidents + standard number of days considered to be lost depending on nature of disabling injury.
- Standard number of days lost is correlated to the nature of injury, as for example, standard number of days lost in 35days, the nature of injury being cutting of the tip of a finger, whereas standard number of days lost in 6000 days for a total disability case.

6.2.1 Calculation of man-days lost under **6.2** shall be based on the following:

a) Man-days lost due to temporary total disability;

b) Man-days lost according to schedule of charges for death and permanent disabilities as given in Appendix A. In case of multiple injury, the sum of schedule charges shall not be taken to exceed 6 000 man-days;

c) Days lost due to injury in previous periods, that is, if any accident which occurred in previous period is still causing loss of time in the period under review, such loss of time is also to be included in the period under review;

d) In the case of intermittent loss of time, each period should be included in the severity rate for the period in which the time is lost; and

e) If any injury is treated as a lost time injury in one statistical period and subsequently turns out to be a permanent disability; the man-days charged to the injury shall be subtracted from the schedule charge for the injury when permanent disability becomes known.

Example 2. Using the following date calculate the severity rate of accident in an industrial plant where only one accident occurred during the year, the type of injury being cutting of the tip of a finger.
Number of workers=2000.
Number of days lost in a year due to accidents=100
Average number of hours worked by worker per year=2000.

Sol. Severity rate=days lost in year due to accidents/number of man-hours worked x 1000,000

Number of man-hours worked in this case=2000 X 2000.

Days lost in year due to accidents=100+35=135.

$$\text{Severity rate} = \frac{135}{2000\times2000} \times 1000{,}1000 = \frac{135}{4} = 33.75 \text{ answer.}$$

Eg : Using the following data calculate the severity rate of accident in an industrial plant where only one accident occurred during the year involving total disability of a worker.
Number of workers=2000.
Number of days lost in a year due to accident=100.
Average number of hours worked by worker per year=2000.

Sol. Severity rate= days lost in year due to accidents/number of man hours worked x 1000000.

Number of hours worked in this case=2000×2000.

Total disability; days lost=100+6000=6100 days.

Severity rate =6100/2000x2000x1000000= 6100/4=1525

incidence rate

Incidence Rate:
General incidence rate is the ratio of the number of injuries to the number of employees during the period under review. It is expressed as the number of accidents or injuries per 1000 persons employed.

- Or -Number of lost time injuries per thousand persons employed

6.3 Incidence Rates

General incidence rate is the ratio of the number of injuries to the number of persons during the period under review. It is expressed as the number of injuries per 1 000 persons employed.

The incidence rate may be calculated both for lost-time injuries and reportable lost-time injuries as follows:

$$\text{Lost-time injury incidence rate} = \frac{\text{Number of lost-time injuries} \times 1\,000}{\text{Average number of persons employed}}$$

$$\text{Reportable lost-time injury incidence rate} = \frac{\text{Number of reportable lost-time injuries} \times 1\,000}{\text{Average number of persons employed}}$$

NOTE – Since reportable lost-time injury incidence rate is based on the lost time injuries reportable to the statutory authorities, it should be used for official purposes only. In all other cases lost-time injury incidence rate should be used.

activity rate

- The safety activity rate is the overall safety promotional & awareness activity which including safety training & safety inspection conducted in a year with respect to total employees present & man hours worked in a year.
- This emphasizes the cost of accident prevention activities against the cost of accident occurrences incidents.
- $$\text{Safety Activity Rate} = \frac{(\text{safety activity number}) \ 5 \times 10^6}{\text{man hours worked} \times \text{total number of employees present in a year}}$$

Housekeeping

- Refers to the management of duties and chores involved in the running of a household, such as cleaning, cooking, home maintenance, shopping, and bill payment.
- These tasks may be performed by members of the household, or by other persons hired for the purpose.
- This is a more broad role than a cleaner, who is focused only on the cleaning aspect.

- The term is also used to refer to the money allocated for such use.
- By extension, it may also refer to an office or organization, as well as the maintenance of computer storage systems.
- A housekeeper is a person employed to manage a household and the domestic staff.
- Effective housekeeping can help control or eliminate workplace hazards.
- Poor housekeeping practices frequently contribute to incidents. If the sight of paper, debris, clutter and spills is accepted as normal, then other more serious hazards may be taken for granted.
- Housekeeping is not just cleanliness. It includes keeping work areas neat and orderly, maintaining halls and floors free of slip and trip hazards, and removing of waste materials (e.g., paper, cardboard) and other fire hazards from work areas.
- It also requires paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance.
- Good housekeeping is also a basic part of incident and fire prevention.
- Effective housekeeping is an ongoing operation: it is not a one-time or hit-and-miss cleanup done occasionally.
- Periodic "panic" cleanups are costly and ineffective in reducing incidents
- Although this effort requires a great deal of management and planning, the benefits are many.

Responsibility of management and employees.

- Managers must train employees to recognize potentially hazardous conditions and take corrective actions before they cause injuries like sprains, strains, falls;

  - Wet floors and slippery walkways

  - Messy floors

  - Equipment left out in the way

  - Improper lifting techniques

- Best practices for handling chemicals, proper personal protective equipment selection, material handling, and slip, trip, and fall prevention are discussed.
- Housekeepers are exposed to a variety of hazards while on the job and perform a variety of tasks throughout their work shift.
- Proper training to identify hazards and risks associated with these tasks will help prevent employee injury
- Prepare a safety manual that is read and understood at the time of induction of new employees.
- Paste safety rules on walls at strategic points in the work area.
- Reinforce safety rules in daily briefings.
- Organize continuous safety training. Involve experts like the equipment manufacturers, Engineering to take classes on fire safety etc.
- Have a Preventive maintenance programmed for all equipment.
- Include safety inspection in the supervisor's checklist.
- Ensure that toxic chemicals are stored in closed cupboards and properly labeled.

- Ensure that all waste disposal containers are leak proof and maintained in sanitary conditions. Waste disposal external to the building must be in designated municipal area and with concern for public health. The recycled items are put in their appropriate containers.
- Make sure that locker rooms have proper washing and shower facilities. Locker rooms must be kept clean and dry at all times. Water closets must be sanitized frequently.
- Ensure that housekeeping employees consume food and beverage in the staff canteens and not in public areas.
- Ensure rest breaks for employees during their shift vigil.
- Keep appropriate signs like "Wet Floor"; "Engineering at Work", labels for detergents and toxic material, safety instructions on equipment, "
- Not to stack anything in the corridors.
- Fire exit staircase should always be clear, not to stack items which will obstruct the movement.
- Ensure hot and cold indicators on the tap faucets.
- In the rooms and corridor's few lights should be connected to UPS.
- Swimming pool pH and chlorine levels to be maintained.
- Pool area no diving signage to be painted.
- Bed corner to be covered.
- Non - smoking zone signage.
- Safety shoes for Engineering and Kitchen and Gum boots for Kitchen Stewarding.
- Smoke detectors indicator light to blink at all the times.

Advantages of good housekeeping.

Effective housekeeping results in:

- reduced handling to ease the flow of materials
- fewer tripping and slipping incidents in clutter-free and spill-free work areas
- decreased fire hazards
- lower worker exposures to hazardous products (e.g. dusts, vapours)
- better control of tools and materials, including inventory and supplies
- more efficient equipment cleanup and maintenance
- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work
- improved morale
- improved productivity (tools and materials will be easy to find)

- Good housekeeping and cleanliness normally results into

1. a workplace which is cleaner, safer, well organized and more pleasant for work,
2. improved utilization of floor space,
3. smoother and systematic workflow with substantial reduction in non-value added activities,
4. better inventory control of tools and materials,
5. reduced handling to ease the flow of materials,
6. reduction in wastages of materials,
7. more efficient equipment clean-up and maintenance leading to lower break-downs,
8. minimization of errors leading to better products,
9. safe environment for work and lower exposures of employees to hazardous substances (such as dusts, and vapours etc.),
10. more hygienic workplace conditions which lead to improved health of the employees,
11. improved overall look and feel of the work environment, and
12. improved morale of the employees.

- Poor housekeeping can be a cause of incidents, such as:

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

- Poor housekeeping and cleanliness, on the contrary, creates workplace hazards which lead to various accident such as

    1. slips, trips and falls,
    2. caught in-between objects,
    3. struck by falling objects,
    4. struck by moving objects,
    5. cut/stabbed by objects, and
    6. struck against objects.
    7. Furthermore, poor housekeeping and cleanliness also create fire hazards which inevitably lead to increased fire risk.

- To avoid these hazards, a workplace must "maintain" order throughout a workday.

Elements of housekeeping and cleanliness at workplace

- **Dust and dirt removal –** Working in a dusty and dirty area is unhygienic as well unhealthy for the employees since there can be respiratory type irritations. Also, if dust and dirt are allowed to accumulate on surfaces, there is a potential for a slip hazard. Hence, regular sweeping the workplace for the removal of dust and dirt is an essential housekeeping and cleanliness practice. Further, compressed air is not to be used for removing dust or dirt off employees or equipment. Compressed air can cause dirt and dust particles to be embedded under the skin or in the eye.
- **Employee facilities** – Adequate employees' facilities such as drinking water, wash rooms, toilet blocks, and rest rooms etc. are to be provided for the employees at the workplace so that employees can use them when there is a need. Cleanliness at the place of these facilities is an important aspect of the facilities.
- **Flooring** – Floors are to be cleaned regularly and immediately if liquids or other materials are spilled. Poor floor conditions are a leading cause of accidents in the workplace. Areas such as entranceways which cannot be cleaned continuously are to have mats or some type of anti-slip flooring. It is also important to replace worn, ripped or damaged flooring that poses a trip hazard.
- **Lighting** – Adequate lighting reduces the potential for accidents. It is to be ensured that inoperative light fixtures are repaired and dirty light fixtures are cleaned regularly so that the light intensity levels are maintained at the workplace.
- **Aisles and stairways** – Aisles and stairways are to be kept clear and not to be used for storage. Warning signs and mirrors can improve sight lines in blind corners and help prevent accidents. It is also important to maintain adequate lighting in stairways. Further stairways need to have railings preferably round railings for adequate grip.
- **Spill control** – The best method to control spills is to prevent them from happening. Regular cleaning and maintenance on machines and equipment is an essential practice. Also, the use of drip pans where spills might occur is a good preventative measure. When

spills do occur, it is important to clean them up immediately. When cleaning a spill, it is required to use the proper cleaning agents or absorbent materials. It is also to be ensured that the waste products are disposed of properly.

- **Waste disposal** – The regular collection of the waste materials contribute to good housekeeping and cleanliness practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities. Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing containers for wastes near the place where the waste is produced encourages orderly waste disposal and makes collection easier. All recyclable wastes after their collection are to be transferred to their designated places so that the waste materials can be dispatched to the point of use or sold.
- **Tools and equipment** – Tools and equipment are required to be inspected prior to their use. Damaged or worn tools are to be taken out of service immediately. Tools are to be cleaned and returned to their storage place after use.
- **Maintenance** – One of the most important elements of good housekeeping and cleanliness practices is the maintenance of the equipment and the buildings housing them. This means keeping buildings, equipment and machinery in safe and efficient working condition. When a workplace looks neglected then there are broken windows, defective plumbing, broken floor surfaces and dirty walls etc. These conditions can cause accidents and affect work practices. It is important to have a replacement program for replacing or fixing broken and damaged items as quickly as possible.
- **Storage** – Proper storage of materials is essential in a good housekeeping and cleanliness practice. All storage areas need to be clearly marked. Flammable, combustible, toxic and other hazardous materials are to be stored in approved containers in designated areas which are appropriate for the different hazards that they pose. The stored materials are not to obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations. Also it is important that all containers be labeled properly. If materials are being stored correctly, then the incidents of strain injuries, chemical exposures and fires get reduced drastically.
- **Clutter control** – Cluttered workplaces typically happen because of poor housekeeping practices. This type of workplace can lead to a number of issues which include ergonomic as well as injuries. It is important to develop practices where items like tools, chemicals, cords, and containers are returned to their appropriate storage location when not in use. Clutter is not only unattractive but, in a work area, it is also a serious threat to safety. Danger to the employees increases if the established exit routes and doors are blocked. For this reason, as well as to prevent slips and trips, assorted waste materials need to be disposed of promptly in the appropriate waste containers. Aisles are to be kept clear of obstructions for obvious reasons.
- **Individual workspace** – Individual workspace need to be kept neat, cleared of everything not needed for work. Many workplace injuries occur right in the employee's workspace. This space is often overlooked when conducting general housekeeping and cleanliness inspections. It is necessary to make a checklistwhich is to be used by the employees to evaluate their workspace.

5 s of housekeeping.

- 5S is a system for organizing spaces so work can be performed efficiently, effectively, and safely. This system focuses on putting everything where it belongs and keeping the workplace clean, which makes it easier for people to do their jobs without wasting time or risking injury.

- 5S is a systematic approach to good housekeeping. .

1.Sort

- The first step of 5S, Sort, involves going through all the tools, furniture, materials, equipment, etc. in a work area to determine what needs to be present and what can be removed.
- go through everything; throw away rubbish, archive old stuff you may need, decide what you need in that area on a daily and weekly basis.
- Everything else must be removed. Sentiment can not play a part here – this is a manufacturing environment
- When a group has determined that some items aren't necessary, consider the following options:
    - Give the items to a different department
    - Recycle/throw away/sell the items
    - Put items into storage
-

2. Set in Order – take the items you need in that area on a daily or weekly basis and find the best homes for them; label, mark locations, colour code – make it clear to anyone entering the area what should be where

3. Shine & Clean – as you are setting a location for each item, give it a wipe and check it is is good working order. Any broken item needs to be fixed. If your working area is particularly dirty, more time needs to be set aside so a thorough clean can be completed.

- These first three steps will get you well on your way to visually improving your factory. When our factories look better, our people feel better about working in them – suddenly there is more space to move and those little annoying things are easier to find.

- The Challenge is to Maintain this New Level of Organisation
- This is where the "Standardisation" and "Sustaining" come into play, which we will delve into below.
- The first part of 5S is the easy part, once you get going – we understand how to sort and tidy, as we do it all this time – at home, in our cars, in our garages, for our tax returns (although some people are better at it than others), The challenge is to maintain the new level of cleanliness and improve on it as time progresses; not to let it naturally let is slip back. This is where the last two "S"'s come into the process.

4. Standardisation – the new arrangement and level of cleanliness is our new standard for each area. Take photos and display in the area; talk about the 5S activities in your toolbox talks and daily meetings; share ideas across the factory. This helps to create your new 5S standards and brings consistency across the factory.

5. Sustain – if the first 4 S's have been done well, sustaining the cleanliness and origination becomes simpler as it is clear where everything goes and each person working in an area knows where to return things at the and of the job or end f the shift. Using simple audits, we can track how we are going to maintaining our 5S baseline on a weekly basis and to also note the areas of improvement we need to make in the week ahead.

Where ever you are in your Lean Manufacturing implementation, using 5S as your housekeeping tool ensures you are keeping on track and involving every person in your factory. If you are a little lost or

have fallen behind, then start the process again; get back to Sorting and Setting in order. This is the foundation of your Lean production system and you can make it work.

Work permit system

- The work permit specifies the conditions and procedures for safe execution of the work and allows the work to be carried out under controlled risk conditions.

Aim:
The purpose of the work permit system is to ensure that:

1. Only authorized persons are allowed to work in hazardous area which is clearly notified.
2. The person permitted for work are being aware of the various safety issues involved and knows that necessary safety precautions have been taken.
3. Work permit is legal documents between issuer and executor for commencement of job inside refinery.
4. Client has implemented the work permit system to distribute the equal responsibilities of job being performed.

So don't do anything without proper work permit.

Purpose & Objective :

The purpose of this standard "Work Permit System" is to describe procedures and guidelines on work permit system to carry out jobs of inspection, testing, maintenance, alternation, repair, upkeepment and construction in safest possible manner. The implementation of this system will help in bring down the risks at work sites to acceptable level, thereby reducing possibility of any accident, fire, explosion, property damage and adverse effect on environment.

The objectives of the Work Permit System are to exercise control over the maintenance, repair and construction activities by assigning responsibilities, ensuring clear cut communication between interested functions & safety considerations to the job, its hazards & the precautions required. It ensures that the work is properly defined, authorised, operating personnel are aware what is going on, precautions to be taken are specified and the persons executing the job understand the nature and extent of hazards involved.

Work Permit System is an important element of **safety management system** and implementation of this in true spirit shall help in ensuring a safe working environment, thereby reducing possibility of injury to personnel, protect property, avoid fire, explosion & adverse affect on environment.

A hot work and cold work permits.

- Hot work and cold work permits are work permits that authorize controlled work in nonstandard, potentially hazardous conditions.
- They consist of specific instructions regarding the nature of the job, time and place, and communicate information regarding safety procedures.

Cold work permit (Green color)

- is required for any job which does not involve or use of any source of ignitions, spark, and fire.
- Cold work permits are green colored permids issued for hazardous maintenance work that does not involve the ignition hazards found in hot work.

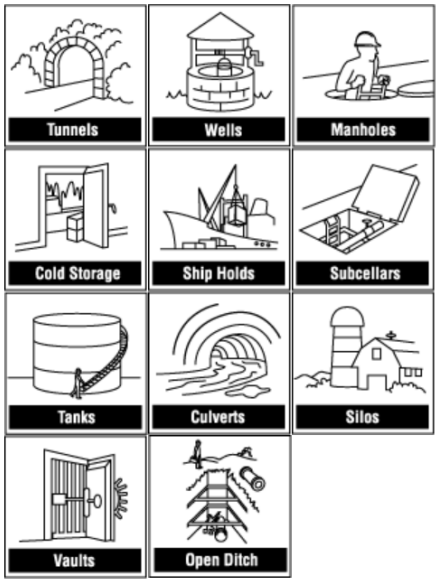
- Cold work situations are determined by conducint a risk assessment for the task and the working environment. If no flammable or explosive risks are identified, a cold work permit is sufficient for carrying out the the work.

Hot work permit (Red color)

- is required for any job which involves or use of source of ignition, spark, and fire.
- Hot work permits are red-colored permits used to authorize work that will generate heat or sparks, such as:
    - Welding
    - Drilling
    - Grinding
    - Riveting
    - Cutting
    - Use of internal combustion engines
- Hot work involves working with a source of ignition in an environment with a potentially flammable or explosive atmosphere.
- Hot works takes into account the presence of flammable and combustible materials as well as combustible gas in the vicinity of the work.

Entry into confined spaces.

- Generally speaking, a confined space is a fully or partially enclosed space that:
    - ✓ is not primarily designed or intended for continuous human occupancy
    - ✓ has limited or restricted entrance or exit, or a configuration that can complicate first aid, rescue, evacuation, or other emergency response activities
    - ✓ Can represent a risk for the for the health and safety of anyone who enters, due to one or more of the following factors:
        - its design, construction, location or atmosphere
        - the materials or substances in it
        - work activities being carried out in it, or the
        - mechanical, process and safety hazards present
- Confined spaces can be below or above ground.
- Confined spaces can be found in almost any workplace.
- A confined space, despite its name, is not necessarily small.
- Examples of confined spaces include silos, vats, hoppers, utility vaults, tanks, water supply towers, sewers, pipes, access shafts, truck or rail tank cars, aircraft wings, boilers, manholes, pump stations, digesters, manure pits and storage bins.
- Ditches, wells, and trenches may also be a confined space when access or egress is limited (but they still have “blue sky” above).
- Barges, shipping containers and fish holds are also considered as possible confined spaces.

- 

What are the hazards in a confined space?

- All hazards found in a regular workspace can also be found in a confined space.
- However, they can be even more hazardous in a confined space than in a regular worksite.

Hazards in confined spaces can include:

- Poor air quality:
    - insufficient amount of oxygen for the worker to breathe.
    - toxic gases that could make the worker ill or cause the worker to lose consciousness.
    - asphyxiants – simple asphyxiants are gases which can displace oxygen in the air (normally about 21 percent). Low oxygen levels (19.5 percent or less) can cause symptoms such as rapid breathing, rapid heart rate, clumsiness, emotional upset, and fatigue. As less oxygen becomes available, nausea and vomiting, collapse, convulsions, coma and death can occur. Unconsciousness or death could result within minutes following exposure to a simple asphyxiant. Asphyxiants include argon, nitrogen, or carbon monoxide.

- Chemical exposures due to skin contact or ingestion (as well as inhalation of toxic gases).
- Fire hazard - An explosive or flammable atmosphere due to flammable liquids and gases and combustible dusts which, if ignited, would lead to fire or explosion.
- Process-related hazards - such as residual chemicals, or release of contents of a supply line.
- Physical hazards – noise, heat/cold, radiation, vibration, electrical, and inadequate lighting.
- Safety hazards - such as moving parts of equipment, structural hazards, engulfment, entanglement, slips, or falls.
- Vehicular and pedestrian traffic.
- Shifting or collapse of bulk material (engulfment).
- Barrier failure that results in a flood or release of free-flowing solid or liquid.
- Visibility - such as smoke particles in air.
- Biological hazards – viruses, bacteria from fecal matter and sludge, fungi, or moulds.

What should be done when preparing to enter the confined space?

- The important thing to remember is that each time a worker plans to enter any work space, the worker should determine if that work space is considered a confined space.
- Be sure the confined space hazard assessment and control program has been followed.
- Before entering any confined space, a trained and experienced person should identify and evaluate all the existing and potential hazards within the confined space.
- Evaluate activities both inside and outside the confined space.
- **Air quality testing:** The air within the confined space should be tested from outside of the confined space before entry into the confined space. Care should be taken to ensure that air is tested throughout the confined space - side-to-side and top to bottom. Continuous monitoring should be considered in situations where a worker is in a space where atmospheric conditions have the potential to change (e.g., broken or leaking pipes or vessels, work activities create a hazardous environment, isolation of a substance is not possible). A trained worker using detection equipment which has remote probes and sampling lines should do the air quality testing. Always ensure the testing equipment is properly calibrated and maintained. The sampling should show that:
    - The oxygen content is within safe limits - not too little and not too much.
    - A hazardous atmosphere (toxic gases, flammable atmosphere) is not present.
    - Ventilation equipment is operating properly.
    - The results of the tests for these hazards are to be recorded on the Entry Permit along with the equipment or method(s) that were used in performing the tests.
- Air testing is often ongoing, depending on the nature of the potential hazards and the nature of the work.
- Conditions can change while workers are inside the confined space and sometimes a hazardous atmosphere is created by the work activities in the confined space.

How are hazards controlled in confined spaces?

The traditional hazard control methods found in regular worksites can be effective in a confined space. These include engineering controls, administrative controls and personal protective equipment. Engineering controls are designed to remove the hazard while administrative controls and personal protective equipment try to minimize the contact with the hazard.

However, often because of the nature of the confined space and depending on the hazard, special precautions not normally required in a regular worksite may also need to be taken. The engineering control commonly used in confined spaces is mechanical ventilation. The entry permit system is an example of an administrative control used in confined spaces. Personal protective equipment (such as respirators, gloves, hearing protection, etc.) is commonly used in confined spaces as well. However, wearing of PPE sometimes may increase heat and loss of mobility. Those situations should be carefully evaluated. When using PPE, always use as part of a PPE program and be sure to evaluate all possible hazards and risks associated with PPE use.

How is air quality maintained?

Natural ventilation (natural air currents) is usually not reliable and not sufficient to maintain the air quality. Mechanical ventilation (e.g., blowers, fans) is usually necessary to maintain air quality.

- If mechanical ventilation is provided, there should be a warning system in place to immediately notify the worker in the event of a hazard or a failure in the ventilation equipment.

- Care should be taken to make sure the air being provided by the ventilation system to the confined space is 'clean' throughout the entire space.
- Ease of air movement throughout the confined space should be considered because of the danger of pockets of toxic gases still remaining even with the use of mechanical ventilation.
- Do not substitute oxygen for fresh air. Increasing the oxygen content will significantly increase the risk of fire and explosion.
- The use of mechanical ventilation should be noted on the entry permit.
- Ensure air being removed from the confined space is exhausted away from workers on the outside.

How are fire and explosion prevented?

Work where a flame is used or a source of ignition may be produced (hot work) should not normally be performed in a confined space unless:

- All flammable gases, liquids and vapors are removed before the start of any hot work. Mechanical ventilation is usually used to
    1. Keep the concentration of any explosive or flammable hazardous substance less than 10% of its Lower Explosive Limit AND
    2. Make sure that the oxygen content in the confined space is not enriched. Oxygen content should be less than 23% but maintained at levels greater than 19.5%. (These numbers can vary slightly from jurisdiction to jurisdiction.)

- Surfaces coated with combustible material should be cleaned or shielded to prevent ignition.
- Do not bring fuel or fuel containers into the confined space (e.g., gasoline, propane), if possible. Ensure welding equipment is in good condition.
- Where appropriate, use spark-resistant tools, and make sure all equipment is bonded or grounded properly.

While doing the hot work, the concentrations of oxygen and combustible materials must be monitored to make surecertain that the oxygen levels remain in the proper range and the levels of the flammable productscombustible materials do not get higher than 10% of the Lower Explosive Limit. In special cases it may not be possible, and additional precautions must be taken to ensure the safety of the worker prior to entering the confined space.

If potential flammable atmosphere hazards are identified during the initial testing, the air in the confined space should be cleaned or purged, ventilated and then tested again before entry to the confined space is allowed. Only after the air testing is within allowable limits should entry occur as the gases used for purging can also be extremely hazardous.

How are energy sources controlled?

All potentially hazardous energy sources such as electrical, mechanical, hydraulic, pneumatic, chemical, or thermal must be de-energized (or isolated) and locked out prior to entry to the confined space so that equipment cannot be turned on unintentionallyaccidentally. If lock out or tag out is not possible, the hazardous energy must be controlled in a way that eliminates or minimizes worker exposure to the hazards before workers are allowed to enter the confined space. It is important that any method of control other than isolation and lockout must be evaluated and the effectiveness for controlling the hazardous energy must be demonstrated.

What are other safety precautions?

Many other situations or hazards may be present in a confined space. Be sure that all hazards are controlled, for example:

- Any liquids or free-flowing solids should be removed from the confined space to eliminate the risk of drowning or suffocation.
- All pipes should be physically disconnected or isolation blanks bolted in place. Closing valves is not sufficient.
- Use two blocking valves, with an open vent or bleed valve between the blocking valves when isolating pipelines or similar conveyances to prevent entry of materials and hazardous contaminants.
- A barrier is present to prevent any liquids or free-flowing solids from entering the confined space.