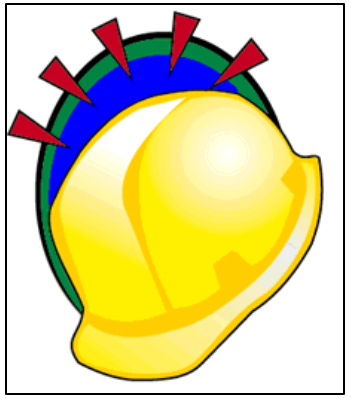
MODULE 2

Types of PPE

Head protection:

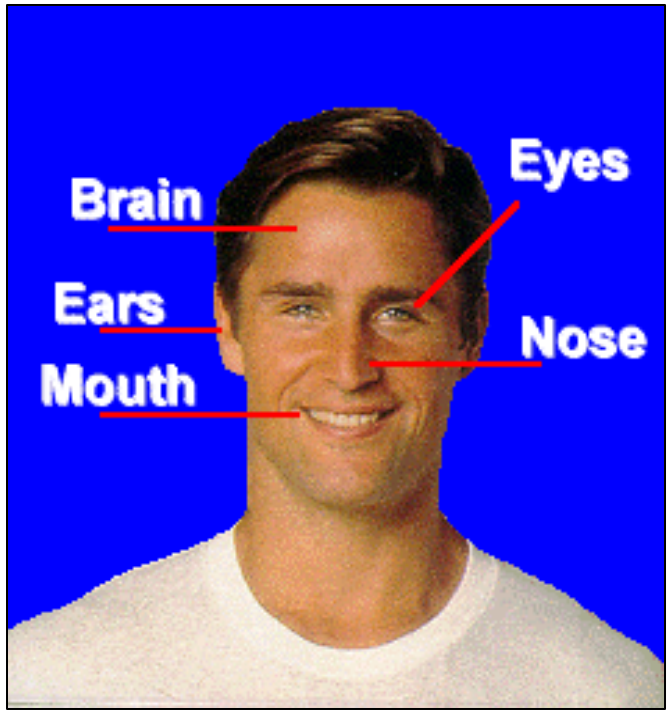
- Frequent causes of head injuries
  - Falling objects from above striking on the head;
  - Bump head against fixed objects, such as exposed pipes or beams; or
  - Accidental head contact with electrical hazards.

Source: OSHA



Types of PPE

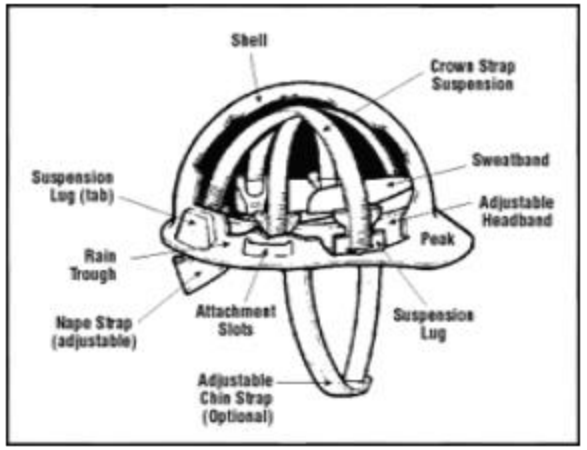
Why head protection is important…



Source: OSHA

Types of PPE

- Classes of hard hats:
  - CLASS G (General)
    - Protect against impact, penetration
    - Low-voltage electrical protection (proof-tested to 2,200 volts)



Source of graphics: OSHA

Types of PPE

- CLASS E (Electrical)
  - Designed for electrical/utility work
  - Protect against falling objects, impact
  - Electrical protection against high-voltage (proof-tested to 20,000 volts)

Source: OSHA

Types of PPE

- CLASS C (Conductive)
  - Designed for comfort; offers limited protection
  - Protects heads that may bump against fixed objects
  - Does not protect against falling objects or electrical hazards

Source: OSHA

Types of PPE

Eye and face protection:

Source of images: OSHA

Types of PPE

- Common causes of eye injuries
  - Chemical splashes
  - Blood or OPIM splashes or sprays
  - Intense light
  - Dust and other flying particles
  - Molten metal splashes

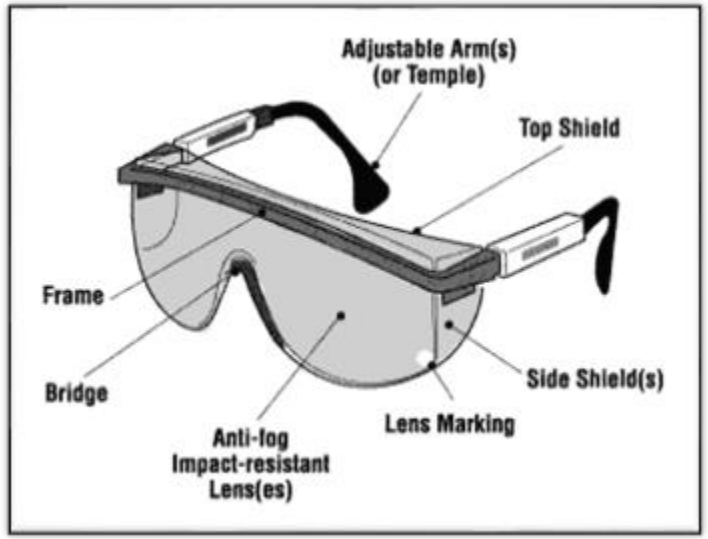
Source: OSHA

Types of PPE

- Selecting eye and face protection – elements to consider:
  - Ability to protect against workplace hazards
  - Should fit properly
  - Should provide unrestricted vision and movement
  - Durable and cleanable
  - Allow unrestricted functioning of other PPE

Types of PPE

- Safety glasses
  - Used to protect against moderate impacts from particles



Source of graphics: OSHA

Types of PPE

- Prescription glasses
  - Employees who use prescription glasses while performing operations with potential eye hazards must use eye protection that:
    - Incorporates the prescription in its design, **or**
    - Can be used over your prescription glasses without interfering with the proper positioning of the prescription glasses or goggles

Source: OSHA

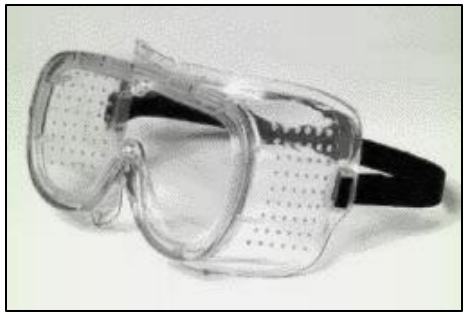
Types of PPE

- Goggles
  - Protect eyes, and the facial area immediately surrounding the eyes from impact, dust, splashes.
  - Some can be used over corrective lenses, if they fit them.

Source: OSHA

Types of PPE

- Goggle types

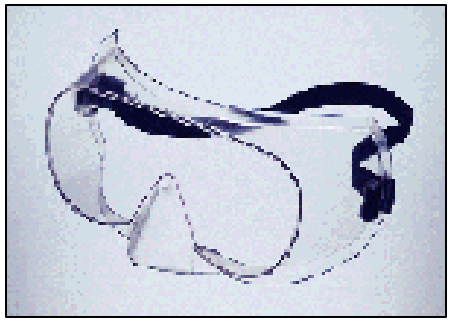


Direct-ventilated

- Resist direct passage of large particles into the goggle
- Prevents fogging by allowing air circulation

Indirect-ventilated

- Prevents fogging by allowing air circulation
- Protects against liquid or chemical splash entry



Non-ventilated

- Does not allow the passage of air into the goggle
- Prevents splash entry
- May fog and require frequent lens cleaning

Source: OSHA.gov

Types of PPE

- Face shields
  - Protect face from nuisance dusts and potential splashes or sprays of hazardous liquids
  - Shields do not protect from impact hazards unless so rated
  - Shields are for face protection, not eye protection. To protect the eyes, wear safety glasses with side shields, or goggles under the face shield.

Source: OSHA

Types of PPE

- Welding shields
  - Protect eyes from burns caused by:
    - Infared light
    - Intense radiant light
  - Protect eyes and face from flying sparks, metal spatter, and slag chips

Source of photos: OSHA

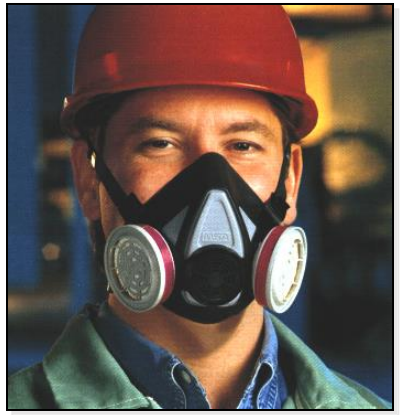
Types of PPE

- Laser safety goggles
  - Provide protection from hazards:
    - physical contact such as flying particles
    - ultraviolet light, laser, and welding

Source: OSHA

Types of PPE

Respiratory protection:



Source of photos: OSHA

Types of PPE

- Elimination/substitution or Engineering controls
  - Eliminate toxic material or substitute a less toxic material
  - Enclose or confine operation
  - General or local exhaust ventilation
- **Only** when engineering controls are not feasible, will respirators be used

Source: OSHA

Types of PPE

- Types of respirators
  - **Air-Purifying (APR)** – remove contaminants from air
    - Particulate respirators
    - Chemical cartridge/ gas mask respirator
    - Powered Air-Purifying Respirator (PAPR)

Source of photos: OSHA

Types of PPE

- **Atmosphere-Supplying** – provide clean, breathable air
  - Self-Contained Breathing Apparatus (SCBA)
  - Supplied-Air Respirator (SAR)

Source of photos: OSHA

Types of PPE

- Medical evaluation
  - Before fit tests are conducted and employee is authorized the use of a respirator, a medical evaluation must be provide to determine the ability of the employee to use a respirator.
  - Identify a physician or other license health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical evaluation with which the same information is obtained.

Types of PPE

- Inspecting and cleaning respirators
  - Inspect all respirators for wear and tear before and after each use
  - Wash in a detergent solution; then, disinfect by immersing in a sanitizing solution

Source of photos: Carmen Vazquez

Types of PPE

- Storing respirators
  - Protect against dust, sunlight, heat, extreme cold, excessive moisture, and damaging chemicals
  - Store in position to retain natural configuration

Source of photos: Carmen Vazquez

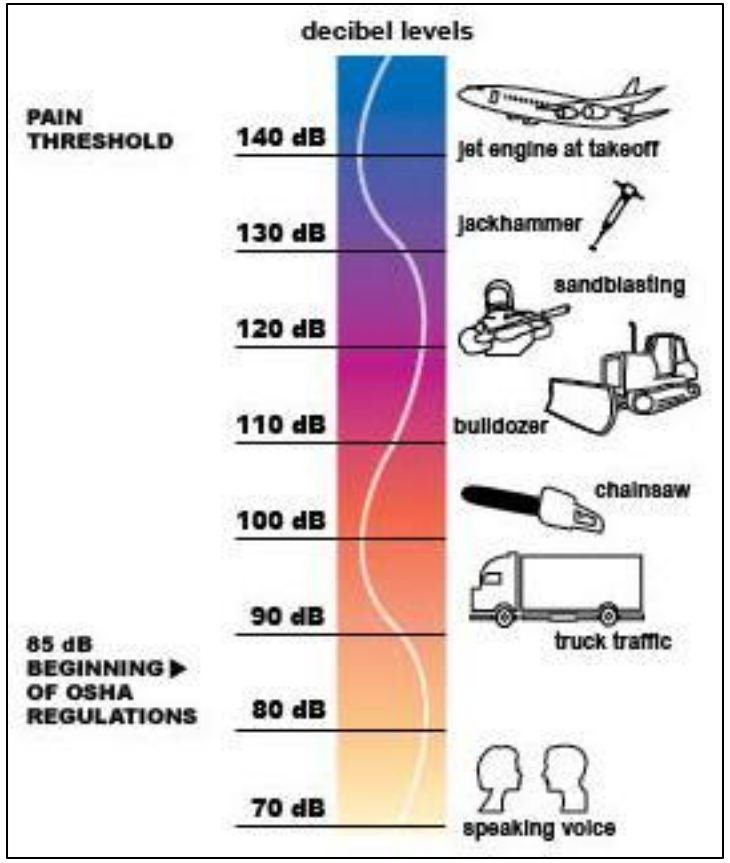
Types of PPE

Hearing protection:

Source of photos: OSHA

Types of PPE

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



Source: OSHA

Types of PPE

- The employer must provide ear protection when the noise level in the work area is greater than indicated in this table.

Source: NIOSH

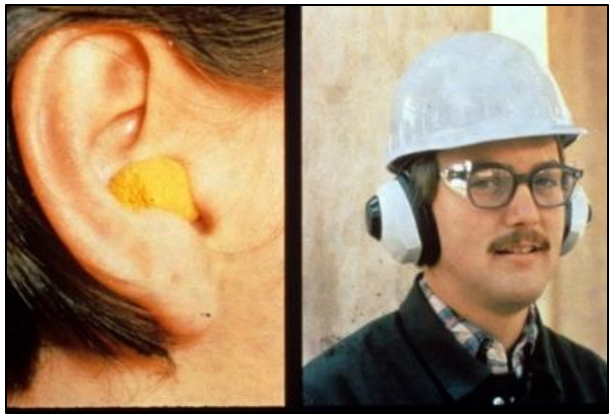
Permissible Noise Exposure 29 CFR 1910.95(b)(1)	
Duration per Day (hours)	Sound Level (dBA)
8	90
6	92
4	95
3	97
2	100
1	105
1/2	110
1/4	115

Impact noise should not exceed 140 dB

Types of PPE

- Examples of hearing protection:
  - Disposable foam plugs
  - Molded ear plugs
  - Noise-cancelling ear plugs
  - Ear muffs
- Consider Noise Reduction Rating (NRR) of devices

Source of photos: OSHA



NIOSH/John Rekus/elcosh.org

Types of PPE

- How to insert ear plugs properly

How To Wear Soft Foam Earplugs

To get the best protection from your soft foam earplugs, remember to **roll**, **pull**, and **hold** when putting them in. Use clean hands to keep from getting dirt and germs into your ears!

1. Roll the earplug up into a small, thin "snake" with your fingers. You can use one or both hands.

2. Pull the top of your ear up and back with your opposite hand to straighten out your ear canal. The rolled-up earplug should slide right in.

3. Hold the earplug in with your finger. Count to 20 or 30 out loud while waiting for the plug to expand and fill the ear canal. Your voice will sound muffled when the plug has made a good seal.

Check the fit when you're all done. Most of the foam body of the earplug should be within the ear canal. Try cupping your hands tightly over your ears. If sounds are much more muffled with your hands in place, the earplug may not be sealing properly. Take the earplug out and try again.

Source: NIOSH

Types of PPE

Hand protection:

- Potential hazards for hands
  - Skin absorption of hazardous substances
  - Lacerations or severe cuts
  - Punctures
  - Chemical burns
  - Thermal burns
  - Extreme temperatures

Source of photos: OSHA

Types of PPE

- Types of gloves

Anti-vibration

Chemical-resistant

Leather Palm

Permeation-resistant

Heat-resistant

Cut-resistant

Source of photos: OSHA

Types of PPE

Foot and leg protection:

- Causes of foot injuries:
  - Falling or rolling of heavy objects
  - Crushing or penetrating materials
  - Sharp objects that can penetrate the sole
  - Exposure to molten metal
  - Working on, or around, hot, wet, or slippery surfaces
  - Working when electrical hazards are present.

Source: OSHA

Types of PPE

- Conditions requiring foot protection
  - Impacts
  - Compressions
  - Cuts/punctures
  - Chemicals
  - Temperatures

Source: OSHA

Types of PPE

- Examples of foot and leg protection
  - Impact-resistant toe and/or instep
    - Steel
    - Composite
  - Heat-resistant soles
  - Metal shanks
  - Specialty footwear may be needed
    - Metatarsal guards
    - Liquid- or chemical-resistant
    - Conductive or nonconductive

Source of photos: OSHA

Types of PPE

- Protection from hazards
  - Shoes with metal toe-cap protects against knocks, falling objects
  - Rubber shoes protect against chemical materials, as directed by the SDS

Source of photos: OSHA

Types of PPE

Body protection – protective clothing:

Source of photos: OSHA

Types of PPE

- Provide protective clothing for those parts of the body exposed to possible injuries
- Types of body protection
  - Laboratory coats
  - Coveralls
  - Vests
  - Jackets
  - Aprons
  - Surgical gowns
  - Full-body suits

Source of photos: OSHA

Types of PPE

- Selection of body protection – variety of materials effective against particular hazard
  - Paper-like fiber – dust and splashes
  - Treated wool and cotton – fire-resistant; dust, abrasions, rough/irritating surfaces
  - Duck – cuts, bruises
  - Leather – dry heat, flames
  - Rubber, rubberized fabrics, neoprene, and plastics – certain chemicals and physical hazards

Source of photos: OSHA

Types of PPE

- Protective clothing is required for HAZWOPER activities
- EPA's levels of PPE
  - **Level A**
    - Provides highest level of protection
    - Required when greatest potential for exposure exists and greatest level of skin, respiratory, and eye protection is required
    - Examples
      - Positive pressure, full facepiece SCBA, or positive pressure supplied air respirator with escape SCBA
      - Totally encapsulated chemical- and vapor-protective suit
      - Inner and outer chemical-resistant gloves
      - Disposable protective suit, gloves, and boots

Types of PPE

- **Level B**
  - Required for highest level of respiratory protection and lesser level of skin protection
  - Examples
    - Positive pressure, full facepiece SCBA, or positive pressure supplied air respirator with escape SCBA
    - Inner and outer chemical-resistant gloves
    - Face shield
    - Hooded chemical-resistant clothing
    - Coveralls
    - Outer chemical-resistant boots

Types of PPE

- **Level C**
  - Required when concentration and type of airborne substances are known and criteria for using APR is met
  - Examples
    - Full-face air-purifying respirators
    - Inner and outer chemical-resistant gloves
    - Hard hat
    - Escape mask
    - Disposable chemical-resistant outer boots

Types of PPE

- **Level D**
  - Required when minimum protection is needed
  - Sufficient when no contaminants are present or work operations preclude splashes, immersion, or potential for unexpected inhalation or contact
  - Examples
    - Gloves
    - Coveralls
    - Safety glasses
    - Face shield
    - Chemical-resistant, steel-toe boots or shoes

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.

1.Number of workers=500

2.Number of disabling injuries per year= 5.

3.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.**

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.

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

- **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 figure.
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.

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

Q: 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

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.

- 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 persons per 1000 persons employed

Housekeeping

- It is the process of keeping premises clean, neat and in a pleasing order
- A lot of care, alertness and time consciousness are required in carrying out industrial housekeeping

Advantages

- 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.

Disadvantages

- 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.

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 in 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.

- The term 5S comes from five Japanese words:
- Seiri
- Seiton
- Seiso
- Seiketsu
- Shitsuke

- In English, these words are often translated to:
- Sort
- Set in Order
- Shine
- Standardize
- Sustain
- Each S represents one part of a five-step process that can improve the overall function of a business.

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.
- Some questions to ask during this phase include:
- **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

- What is the purpose of this item?
- When was this item last used?
- How frequently is it used?
- Who uses it?
- Does it need to be here?

Set in Order

- Once the extra clutter is gone, it's easier to see what's what. Now work groups can come up with their strategies for sorting through the remaining items. Things to consider:
- Which people (or workstations) use which items?
- When are items used?
- Which items are used most frequently?
- Should items be grouped by type?
- Where would it be most logical to place items?
    - Would some placements be more ergonomic for workers than others?
    - Would some placements cut down on unnecessary motion?
- Are more storage containers necessary to keep things organized?
- During this phase, everyone should determine what arrangements are most logical. That will require thinking through tasks, the frequency of those tasks, the paths people take through the space, etc.

Shine

- The Shine stage of 5S focuses on cleaning up the work area, which means sweeping, mopping, dusting, wiping down surfaces, putting tools and materials away, etc.
- In addition to basic cleaning, Shine also involves performing regular maintenance on equipment and machinery. Planning for maintenance ahead of time means businesses can catch problems and prevent breakdowns. That means less wasted time and no loss of profits related to work stoppages.
- Shining the workplace might not sound exciting, but it's important. And it shouldn't just be left up to the janitorial staff. In 5S, everyone takes responsibility for cleaning up their workspace, ideally daily. Doing so makes people take ownership of the space, which in the long run means people will be more invested in their work and the company.

Standardize

- Once the first three steps of 5S are completed, things should look pretty good. All the extra stuff is gone, everything is organized, spaces are cleaned, and equipment is in good working order.
- The problem is, when 5S is new at a company, it's easy to clean and get organized...and then slowly let things slide back to the way they were. Standardize makes 5S different from the typical spring-cleaning project. Standardize systematizes everything that just happened and turns one-time efforts into habits. Standardize assigns regular tasks, creates schedules, and posts instructions so these activities become routines. It makes standard operating procedures for 5S so that orderliness doesn't fall by the wayside.

Sustain

- Once standard procedures for 5S are in place, businesses must perform the ongoing work of maintaining those procedures and updating them as necessary. Sustain refers to the process of keeping 5S running smoothly, but also of keeping everyone in the organization involved. Managers need to participate, as do employees out on the manufacturing floor, in the warehouse, or in the office. Sustain is about making 5S a long-term program, not just an event or short-term project. Ideally, 5S becomes a part of an organization's culture. And when 5S is sustained over time, that's when businesses will start to notice continuous positive results.

Work Permit System

- A work permit system spell out:
  1. Nature of job
  2. Equipment involved
  3. Time limitations
  4. Location
  5. Personnel involved
- It is technical measured document to prevent hazards and accidents

Work Permit System

- Permit to work is a written record document raised by shift incharge/ area incharge and authorised by safety personnel, permitting the work in a specified time in define area
- It ensures the responsibility of individuals for performing the work
- These work permits will identify the hazards full to personnel, equipment and property

General Principles

Following aspects should be considered w.r.t. permit to work systems:

- Human factors
- Management of WPS
- Poor skilled manpower
- Lack of Knowledge
- Incompetence
- Objectives of WPS
- Types of Work permit required
- Contents of work permit

Contributory Factors to consider WPS

- Whether staff have been sufficiently informed, instructed, trained and supervised to minimise a human failing operation of WPS
- Whether the work permit contains sufficient information about the type of work
- Whether there is sufficient provision available to fulfill the requirements of WPS
- Whether the employees responsible for control of maintenance work are identified within the WPS and that the work is properly authorised by responsible person
- Whether the WPS is managed, regularly inspected and received and reviewed

Contributory Factors to consider WPS

- Whether all the permits are kept in file for future analysis
- Whether sufficient precautions are taken prior to initiating a work permit (draining, flushing, environmental monitoring, risk assessments)
- Whether staff are aware of the environment they are working induring the operation of work permit (flammable, corrosive, explosive)
- Whether the person responsible for operating the plant is aware of the type of maintenance involved and how long it is likely to take

Major Hazards

- Wrong type of work permit used
- Wrong information about the work required on the work permit
- Failure to recognise the hazards where work is carried out
- Introduction of ignition source is controlled flame proof area (e.g. welding, non-spark proof tools)
- Instruction of work permit not adhered (e.g. failure to isolate plant, drain lines of hazardous substances)

Major Hazards

- Failure to have over plant in safe condition on completion of work/ cancelling of work permit
- Unauthorised staff performing work permit functions
- Poor management of permit to work system
- Insufficient monitoring of WPS

Types of Work Permit

There are Seven main types of Work Permit.

1) Hot Work Permits,

2) Cold Work Permits,

3) Height Work Permit,

4) Confined Spaces Work Permits,

5) Excavation Permit,

6) Electrical Isolation Permit,

7) Chemical Work Permits,

Hot Work Permit

During process of work where ignition comes out or heat generates its own is considered as hot work.

The permit is required for following jobs:

1. Welding
2. Flame cutting
3. While using pneumatic/ hydraulic power tools

Hot Work Permit

Precautions

1. Equipment of the area should be tested to determine the explosive range (through explosive meter/ by taking air samples). Cleaning or ventilating can clear explosive content
2. Cover all pits, sumps, opening etc. with fireproof material to prevent spark entering and causing explosion or fire. Area and surrounding are sufficiently wetted to facilitate extinguishments of sparks, hot slag etc.
3. Adequate fire fighting equipment should be kept ready along with the person who know the operation of the euipment.

Cold Work Permit

Authorization to operate machinery or other functions that do not generate any form of heat in the manufacturing process.

Example :- Mechanically induced bending, shearing, squeezing and drawing etc.

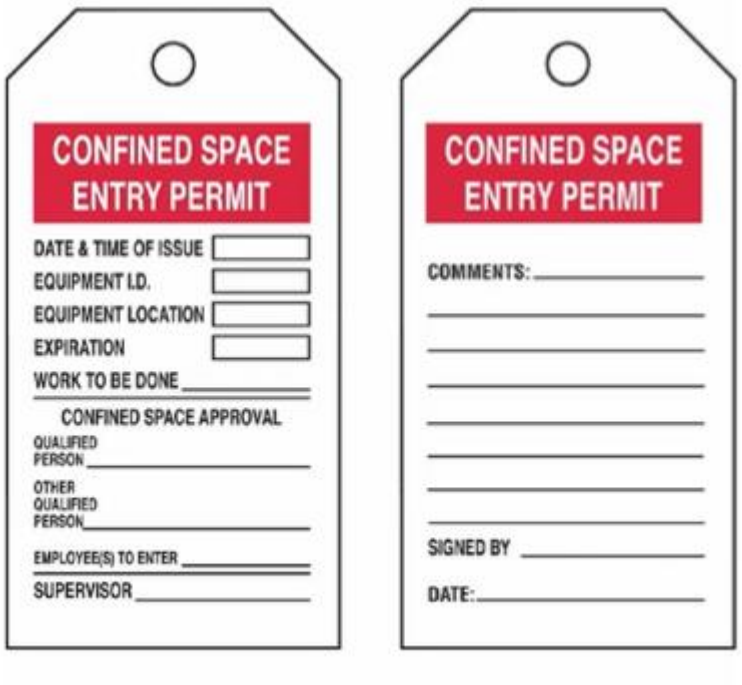
Height Work Permit

Authorization to work on elevated spaces (2m from the ground) be it ladders, scaffolds, Mobile Elevated Work Platforms (MEWP) and other spaces that are off the ground.

Confined Spaces Work Permit

Authorization to perform tasks in a narrow space which is prone to hazards like asphyxiation, a substance that has the ability to engulf, toxic atmosphere, etc.

Confined spaces refer to Vents, Shafts, Sewages, Tanks and much more.



HSE STUDY GUIDE

Excavation Permit

Authorization for personnel to mine or dig land in order to build infrastructure, extract resources or unearth hidden artifacts. The risk involved in excavation includes falling, being trapped, explosions, airborne contaminants, etc.

Excavation Permit

Hazards in excavation are breaking of pipe likely carrying hazardous substances, breaking of electrical / telephone cables etc.

It results into:

1. Accidents
2. Disruption/ delay in production
3. Loss of life
4. Loss of property
5. Disruption in communication

Excavation Permit

Precaution

- Permits can be prepared with the help of factory plan and sent to the engineer / plant in charge for counter signing
- Plant incharge/ Engineer would suggest special precaution to avoid accident, damage etc. before counter signing
- After counter signing permit can be used to executer/ receiver.
- Suitable PPE are to be used

Electrical Permit

Authorization to work in high voltage zones that are prone to uncontrolled dispersion of electricity. Common electrical isolation work is to manage and maintain Lock-out systems and site maintenance by electrical engineers.

Chemical Work Permit

Authorization to work with harmful chemical substances or in a chemically induced atmosphere that is either toxic or corrosive by nature. Chemical engineers that mostly work in chemical plants and labs.

1. CONFINED SPACE:

- Is large enough to enter into and work
- Has a limited means of entry/exit
- Is NOT designed for continuous periods of occupancy

CLASSES OF CONFINED SPACE

- **Class A** – ***IDLH*** atmosphere. May contain oxygen deficiency, explosive or flammable atmospheres, and /or concentrations of toxic substances.

Immediately Dangerous To Life or Health (IDLH)

CLASSES OF CONFINED SPACES cont'd

- **Class B** – space has potential for causing injury if proper safety steps are not followed

CLASSES OF CONFINED SPACES cont'd

- **Class C** – space has potential hazards, but would not require any special modification of the work procedures.

TYPES OF CONFINED SPACE…

- Non-Permitted
  - … does NOT contain physical, chemical or atmospheric hazards capable of causing death or serious physical harm
- Permitted
  - … DOES contain physical, chemical or atmospheric hazards capable of causing death or serious physical harm

PERMITTED CONFINED SPACE ENTRY PROCEDURE

GENERAL CS ENTRY PROCEDURE

- 1. Conduct an assessment
- 2. Post signage; Barricade
- 3. Write the ***Permit***
- 4. Perform pre-entry tests
- 5. Follow all other safety procedures
  - PPE
  - LO/TO
  - Ventilation

GENERAL CS ENTRY PROCEDURE, cont'd

- 6. Pre-entry briefing
- 7. Perform entry & work
- 8. Perform continuous atmospheric tests
- 9. Exit the confined space
- 10. Debrief employees/contractors
- 11. Verify completion

1. CONFINED SPACE ASSESSMENT

ASSESSMENTS MUST INCLUDE:

1. Pre-entry testing and monitoring of/for:
   - Atmospheric conditions
   - Potential hazards in and around the area

POTENTIAL HAZARDS

- Deficient or enriched oxygen
  - Safe level: 19.5% - 23.5%
- Combustible, flammable, and explosive atmospheres
- Toxic gases and vapors
- Corrosive chemicals or biological agents

POTENTIAL HAZARDS cont'd

- Physical hazards–
  - Falling,tripping,moving parts,engulfment,heat extremes,etc…
- Electrical hazards—
  - Shock hazard, static electricity, sparks, etc…
- Rodents,snakes, and insects

ASSESSMENTS MUST ALSO INCLUDE:

2. Written procedures to remove or control hazards including ventilation, LOTO, PPE and communication
3. Written emergency response

2. POST SIGNAGE AND BARRICADE

POSTED SIGNAGE

- MUST be in the immediate area
- MUST identify the Confined Space
- Restricts **unauthorized** personnel
  - E.G.: ***"DANGER—PERMIT REQUIRED CONFINED SPACE, DO NOT ENTER"***

BARRICADES

- MUST prevent unwanted access to the work area
- MUST ensure clear workspace for attendant and emergency rescue (if needed)

3. WRITE THE PERMIT

PERMITS

- Are written authorization and approval specifying the location and type of work
- Certify that all existing hazards have been assessed
- Ensure the safety of each worker
- Specify the date & length of time it applies

Confined Space Permit

NOTE:
PERMITS ARE ALWAYS POSTED IN THE WORKPLACE DURING ENTRY

4. PERFORM PRE-ENTRY TESTS

TESTING STANDARDS

- Duration—Recommend continuous
- Sample priority—Oxygen; Flammable/combustible chemicals; Toxic chemicals

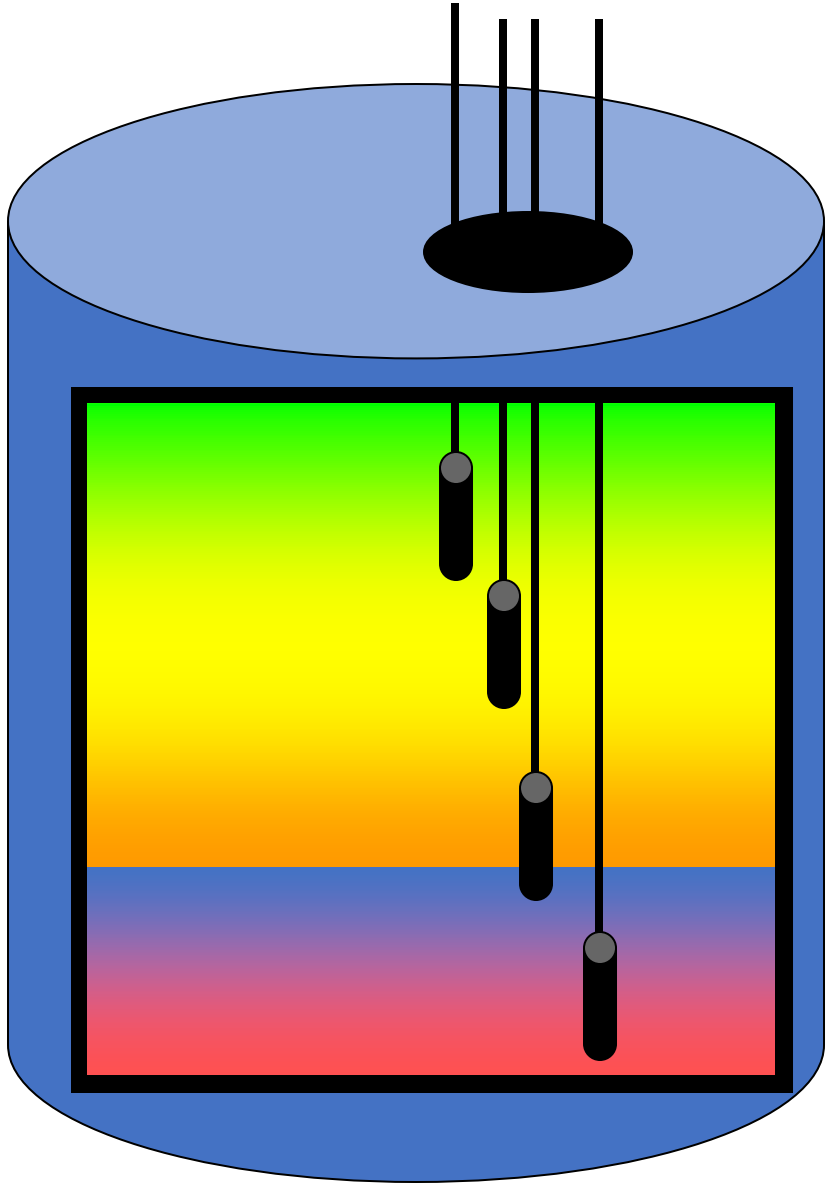
TESTING METHODS

- Sample in layers
  - Every four feet in direction of travel
  - Different chemicals stratify
  - Do not get equipment wet!!

CHEMICAL STRATIFICATION

***Chemicals will stratify according to their vapor density**

***Strata changes with environmental conditions (ex. Temperature and pressure)**



REMEMBER TO DOCUMENT ALL ATMOSPHERIC TESTING RESULTS!!

5. TAKE OTHER SAFETY PRECAUTIONS

OTHER SAFETY PRECAUTIONS

- PPE
- Lockout/Tag out
- Verify emergency response
- Remove sources of hazardous materials outside of confined space
- Ventilation

VENTILATION

- Exhaust
  - Negative pressure
    - Local - for specific sources
    - General - for non-specific sources
- Purging
  - Positive pressure
    - Using inert gases in flammable/combustible environment
    - Causes need for additional PPE

6. PRE-ENTRY BRIEFING

PRE-ENTRY BRIEFING

- Conduct meeting
- Include all affected persons
- Document topics discussed at the briefing.

7. PERFORM ENTRY AND WORK

Entry documentation

- Each entrant should sign an entry log
  - Posted in immediate area

Follow work procedures and safety rules for job task!!!

8. PERFORM CONTINUOUS MONITORING

CONTINUOUS MONITORING

- REMEMBER the mentioned sampling methods!

9. EXIT THE CONFINED SPACE

EXITING THE CONFINED SPACE

- When work is complete, when replacement arrives, or if an alarm sounds
- In the event of an emergency, utilize emergency rescue
- Remember to update the entry log!!

ON-SITE RESCUE

- **Employer determined if on/off-site rescue will be used**
- **On-site, usually comprised of in-house personnel—**
  - **Motivated team**
  - **Extensive training**
  - **Practical exercises (min. once/12 months)**
  - **Regular reinforcement of training**

OFF-SITE RESCUE

- **Assessment necessary**
  - **Determine the practicality of off-site rescue**
- **If used:**
  - **Close proximity**
  - **Extensive pre-coordination**
  - **Must understand the hazards to be faced**
  - **Must have access to all spaces for pre-planning**

10. CONDUCT DEBRIEFING

DEBRIEFING

- Discuss the success of the work
- Identify concerns that occurred
- Verify completion of all documentation
- Document meeting, if possible

11. VERIFYING COMPLETION

VERIFY COMPLETION

- The entry supervisor should remain for at least 30 minutes after the entry to ensure the security of the site and that no hazards remain (ex. Fires)