

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

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DEPARTMENT OF MECHANICAL ENGINEERING

IS3168 INDUSTRIAL SAFETY LABORATORY-I

ACADEMIC YEAR 2026-2027

OBJECTIVES:

1. To provide opportunity to operate the equipment to acquire practical knowledge.
2. To know the various PPEs and standards
3. To carryout experiments to find out the environmental parameters.
4. To know the Fire Extinguisher operations and types.

NOISELEVEL MEASUREMENT AND ANALYSIS 9

Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values.

ILLUMINATIONMEASUREMENT AND ANALYSIS 9

Measurement of intensity of light was measured in LUX, continuous and intermittent sources at various places.

ENVIRONMENTALPARAMETER MEASUREMENT 9

Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, windflow measurement, Particle size Measurement.

TRAININGINUSAGEAND SKILL

DEVELOPMENTPERSONALPROTECTIVEEQUIPMENT 9

Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet, belt, hand gloves ,goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, earmuff, anti static and conducting plastics / rubber materials, apron and leg guard.

FIREEXTINGUISHERS ANDITS OPERATIONS 8

Water, Foam, Carbon dioxide (CO₂), Dry chemical powder and currently amendment fire safety systems

SAFETYMEASURES 1

Lockout tagout, Fire Hydrant, Fire alarm, Sprinklers.

Total: 45 Periods

Equipments Required

1. Noise level meter: 1No
2. Lux meter:1No
3. Sling Physcrometer:1No

4. Anemometer:1No
5. Gyrotory Sieve Shaker: 1 No
6. PPE Set : 1 No
7. Fire extinguisher set: 1No
8. Lockout/Tagout:1No

OUTCOMES:

1. Run the various equipments to bring out the safety environment in the industry.
2. Identify the different illumination test for determination of intensity of light.
3. Analyze the various environmental parameters and measure the particle size.
4. Use personal protective equipment.
5. Operate fire extinguishers in emergency situations.

CO	PO					PSO		
	1	2	3	4	5	1	2	3
1	1							
2				1	1	1		
3		1	1	1				
4			1					
5								

1- low,2-medium,3-high

S.No	List of Experiment	Page No
1	Noise level meter	1
2	Lux meter	3
3	Sling Phycrometer	4
4	Anemometer	5
5	Gyratory Sieve Shaker	6
6	PPE Set	7
7	Fire extinguisher set	15
8	Lockout/Tagout	19

NOISE LEVEL METER

Ex.No :

Date :

Aim:

To determine the sound level in dB for impact, continuous and intermittent sources at various networks, peak and average values.

Apparatus Required:

1. Sound level meter
2. Controls.

Introduction:

A Sound source radiates power and these results in a sound pressure. In this sense, the sound power is the cause and the sound pressure is the effect. The sound pressure is what we hear. Too high a pressure and prolong exposure will cause hearing damage and stress. Noise is any unwanted sound.

In ergonomics study - sound level is to be measured in dB (A). This is due to the fact that the A- filter is adapted to the physiology of the human ear. Table 1. Shows the effect of noise on man.

Table 1. Effect of noise pressure

How Noise Affects Man			
Noise area 1 20-65 dBA	Noise area 2 65-90 dBA	Noise area 3 90-120 dBA	Noise area 4 > 120 dBA
Disturbing and annoying psychological reactions possible	Vegetative disorder, constriction of blood vessel, poor blood circulation of skin	After longer-term noise exposure permanent hearing damage	Clear hearing loss after very short time of exposure

Sound Level Meter:

- Sound level meter SLM consist of a microphone, electric circuit and digital display. Microphone detects and reads minimal air pressure changes and converts them into electric signals.
- These signals are processed by electric circuits and converted into decibels. SLM can read noise level for one location at a time.
- While measuring noise levels it is held in an arm's length at the ear height. It does not matter whether microphone is point towards source. Sound level monitor must be calibrated before and after use.
- Every sound level meter has two modes and those are SLOW and FAST.
- It is the response rate which SLM averages before showing on screen. For workplace noise level monitoring it should be taken as SLOW.

Formula used:

Occupational Safety and Health Administration (OSHA) has established permissible noise exposure which depends on the duration of exposure shown in Table.

The exposure to any sound level above 80dB causes the listener to incur a partial dose. If the total daily exposure consist of several partial exposure to different noise levels, then the several partial dose are added to obtain a combined exposure using the following formula:

$$D = 100 \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \dots + \frac{C_n}{T_n} \right) \leq 100$$

Where:

D = Noise dose

C = Time spent at specific noise level (hrs)

T = Time permitted at specified noise level (hrs)

The noise dose is then converted to an 8 hour weighted average (TWA) sound level using the formula:

$$TWA = 16.61 \log\left(\frac{D}{100}\right) + 90$$

The TWA is the sound level that would produce a given noise dose if a person is exposure to that sound level continuously over an 8 hour work day. Thus a worker may be working in a safe environment based on the permissible noise exposure but the cumulative effect of this exposure based on TWA may proof otherwise.

A noise dose of 50% (TWA=85dBA) is the action level and 100% (TWA = 90 dBA) is the permissible exposure level.

Procedure:

- set the range selector switch to the appropriate measuring range for the proposed measurement.
- Set the detector response switch as follows;
“Fast” : for relatively steady sound levels
“Slow” : for relatively fluctuating sound levels
- Select “Man” mode.
- Switch the power switch on “ON”.
- Note the displayed value.
- Press the Reset button.
- Measure the same sound source for the second time.
- Turn the power switch “OFF”.
- Go through step (a) to (e) again for 2 other sound sources.

Observation:

Mode of Drilling	Noise Level (dBA)			Average Noise level	Permissible time of exposure	Noise Dose , D	TWA
	1	2	3	dBA	hour	dBA	dBA
Drilling without Load							
Drilling with Load							
Drilling withload and impact							

Calculation :

1. Noise Dose $D = 100\left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \dots + \frac{C_n}{T_n}\right) \leq 100$	2. TWA: $TWA = 16.61 \log\left(\frac{D}{100}\right) + 90$
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Result:

The noise dose from the above experiment _____ is (action / permissible exposure level).

EX.NO
DATE

ILLUMINATION TEST BY LUX METER

AIM

To determine the illumination of various location of lighting source on the floor plan using Lux meter.

Apparatus Required: Lux meter

Introduction:

The sun has been our main source of illumination in many aspects of our daily life. However in certain circumstances artificial illumination is used. When an environment involved artificial illumination it is important to make sure that the illumination is designed to give satisfactory illumination level for the user.

Illumination is important because it deals with visibility level, colour and glare. In measuring illumination level, there are several types of quantities units involved all the quantities

Types of Illumination Index

Candle power, cp - (Measuring the luminous intensity of a light source as expressed in candelas).

Lumen -The light from a point source of one candela falling on an area of 1 square ft at a distance of 1 ft.

Lux - 1 lumen per square meter.

Acceptable Illumination Level for selected activities

- Storage areas, plant rooms, entrance halls = (150 -200)
- Rough machinery and assembling, conference rooms, typing rooms, canteens, control rooms, wood machinery, cool strip mills, weaving and spinning = (300 – 400)
- Routine office work, medium machinery and assembly = 500
- Demanding work such as in drawing offices, inspection of medium machinery = 750
- Fine work requiring colour discrimination, textile processing and fine machinery and assembly = 1000
- Very fine work, for example: hand engraving and inspection of fine machinery and assembly = 1500 and above

PROCEDURE

- Switch ON the power button.
- Ensure 0 reading in Lux meter LCD display.
- Switch ON 25% of lighting and take the reading.
- Switch ON 50% of lighting and take the reading.
- Switch ON 100% of lighting and take the reading.
- All the Reading are Tabulated.

S.NO	PERCENTAGE OF ILLUMINATION	LUX
1.	25% of lighting	
2.	50% of lighting	
3.	100% of lighting	

RESULT

The illuminations of various locations at various conditions are determined.

EX.NO

SLING PSYCHROMETER

DATE

Aim

To find the measure humidity of the air .

Description

A Device for determining air humidity, called a sling psychrometer. It contains two thermometers, one of which is covered with a wick saturated with ambient temperature liquid water. These two thermometers are called dry bulb and wet bulb. When the sling psychrometer is spun rapidly in the air, the evaporation of the water from the wick causes the wet bulb thermometer to read lower than the dry bulb thermometer. After the psychrometer has been spun long enough for the thermometers to reach equilibrium temperatures, the unit is stopped and the two thermometers are quickly read.

Procedure

- 1.To ensure WICK (A) is saturated with water and covers spirit reservoir on WET BULB THERMOMETER (D), remove END CAP (B) and immerse PSYCHROMETER BODY (C) up To the thermometer reservoirs until WICK is thoroughly wetted.
2. Fill END CAP with water and replace; tighten just enough to prevent leakage. Be sure Reservoir on other THERMOMETER (F) is dry.
3. Pull TUBE {E} clear of BODY so BODY can swivel.
4. Holding TUBE, whirl body two to three revolutions per second (120 to 180 RPM).
5. Continue whirling until temperatures stabilize (1-½ minutes is usually ample).
6. Immediately read WET BULB THERMOMETER (D) and then DRY BULB THERMOMETER (F).
7. Set wet and dry bulb temperatures opposite each other on side rule type calculator Scales, sliding BODY into TUBE as required.
8. Read % R.H. (percent relative humidity) indicated by arrowhead on lower scale.

S.NO	LOCATION	DRY BULB	WET BULB
1.	INDOOR		
2.	OUTDOOR		

Result

The wet bulb and dry bulb temperatures are measured by using sling psychrometer.

EX.NO

ANEMOMETER

DATE

AIM:

To measure the wind velocity at various locations.

Description:

Air velocity is commonly measured using anemometers. A vane anemometer is a device used to measure air velocity or wind speed. It typically consists of a set of small vanes or blades that are exposed to the airflow. As the wind blows, the vanes rotate, and the rotation speed is directly related to the air velocity.

Procedure:

1. Turn on : Press "MODE" button for 2 seconds to turn on The unit.
2. Place the sensor in the air stream under test
3. Read the air velocity and temperature measurements directly on the LCD.
4. Take down the readings in indoor and outdoor locations.

S.NO	LOCATION	AIR VELOCITY(m/s)
1. 2.	INDOOR OUTDOOR	

Result

The wind velocity measured at various places by Anemometer.

EX.NO
DATE

GYRATORY SIEVE SHAKER

Aim

To determine the screen effectiveness for a particular screen in a gyratory sieve shaker.

Description

The word gyratory means an object rotating about vertical axis also keeps rotating in its own direction. Same way in the gyratory sieve shaker you will get vertical and rotation motion. The machine is able to be cut off on predetermined time through digital timer cum controller.

Safety precaution

- Before operating the machine proper supply is given to the machine.
- Please also take a note that while machine is in working condition, the stud must be in the adopter only. Never remove this stud from the machine.
- Also take a note that the machine must be placed in a surface which is properly leveled. Check the same with the help of spirit level.
- We recommend to do the foundation of the machine.

Specification

Electric Supply : 230 volt, Ac Supply

Motor: ½ HP single phase.

Capacity : 7 sieves, lid and pan.

Body Construction: Good quality C.I .

Procedure

1. Switch on the machine.
2. Place the sieves between upper and lower adopter and tighten the nut of the adopter.
3. Press reset button to start machine.
4. After the pre-seted time the machine will Automatically stopped.

Result

The quality of raw material is analyzed.

Ex.No

STUDY ON PERSONAL PROTECTIVE EQUIPMENT (PPE)

Date

Objectives:

After studying this comprehension, you will be able to understand

1. The need selection, applicable standard, supply use care and maintenance of Personal Protective Equipment.
2. Types of Personal Protective Equipments, respiratory and Non-respiratory Personal Protective Equipment.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) includes all clothing and work accessories designed to protect employees from workplace hazards. It refers to protective clothing, helmets, goggles, or other gear designed to protect the wearer's body from injury by electrical hazards, heat, chemicals, and infection, for job-related occupational safety and health purposes. PPE can also be used to protect the working environment from pollution or infection from the worker. Examples of PPE include safety goggles, blast shields, hard hats, hearing protectors, gloves, respirators, aprons, and work boots.

PPE is a second line of defense for employee protection. The first line of defense is to eliminate accident causing situations. The primary methods for preventing employee exposure to hazardous materials are engineering and administrative controls. Where these control methods are not appropriate or sufficient to control the hazard, personal protective equipment (PPE) is required. Employees must wear protective equipment as required and when instructed by a supervisor.

Classification:

Personal protective equipment may be classified into two broad categories:

1. Non-respiratory protective equipments
2. Respiratory protective equipments

More importance is given to respiratory protection because even a small failure or violation in the use of respiratory protective equipment will affect the entire body system and will lead to unconsciousness, or fatal injury. The non-respiratory protection equipment can be further classified according to the part of the body to be protected. A general classification is given below:

Non-respiratory protective devices:

- a) Head protectors
- b) Eye protectors
- c) Hand and arm protectors
- d) Foot and leg protectors
- e) Body protectors
- f) Skin protectors

Respiratory protective equipment:

- a) Short distance fresh air breathing apparatus
- b) Compressed air line breathing apparatus
- c) Self contained breathing apparatus
 1. Regenerative oxygen types
 2. Open circuit compressed air type
 3. Open circuit oxygen type

HEAD PROTECTION

An injury to the head can pose serious threat to the brain. Since the brain is housed in the

head it is at most important to protect is against all injuries and accidents. The skull with its covering of scalp and hair acts as a natural helmet, cushioning the brain against minor bumps and knocks. However, this is no protection against the serious hazards one may encounter at construction sites, mines, factories and during maintenance work. Head protection is necessary if you work where there is a risk of injury from moving, falling, or flying objects or if you work near high-voltage equipment.

Safety hats

On construction sites different hard hat colors can signify different roles. For instance: white for supervisors, blue for technical advisors, red for safety inspectors and yellow for workmen. Hard hats should be water resistant, flame resistant, and adjustable. Wear one of the following hard hats as appropriate for your work situation:

Class A - General service, limited voltage protection

Class B - Utility service, high-voltage protection

Class C - Special service, no voltage protection

Follow these guidelines for head safety:

- Check the shell and suspension of your headware for damage before each use. Look for cracks, dents, gouges, chalky appearance, and torn or broken suspension threads. Discard damaged hats or replace broken parts with replacements from the original manufacturer.
- Discard any hat that has been struck or dropped from a great height, even if there is no apparent damage.
- Do not wear a hard hat backwards, unless this is necessary to accommodate other protective equipment (e.g., welder's face shield).

Do not paint the plastic shell of a hard hat or alter it in any way.

Care and maintenance

- Clean the shell with a mild detergent and rinse with clear water. Inspect for signs of cracks, penetration, or other damage caused by rough treatment or wear. It's a good idea to inspect the helmet daily, or prior to each use. If the helmet is damaged, it should not be worn.
- Consult the manufacturer before painting a helmet shell or using a solvent to clean it. Some paints and solvents may damage the shell and reduce its protective level.
- Holes should never be drilled or punched in a helmet shell for ventilation. This reduces the helmet's ability to sustain impact. Class E helmets must never have holes drilled in the shell or any accessory that contains metal.

EAR PROTECTION

High noise levels, a common problem in most industrial settings, carry a very serious health hazard, permanent irreversible hearing loss. Hearing loss has an impact on a person's quality of life. A worker who doesn't hear well has a difficult time communicating with others and may feel isolated. Hearing loss can also affect job safety when a worker doesn't hear a shouted warning or a back-up alarm signal. Because of the hazards associated with high noise levels, all workers who are exposed to 85 decibels or more for an eight-hour period must be placed in a hearing conservation program and provided with hearing protection. People working in a high noise area, must wear hearing protection. Most hearing protection devices have an assigned rating that indicates the amount of protection provided. An earplug is a device that is meant to be inserted in the ear canal to protect the wearer's hearing from loud noises or the intrusion of water, foreign bodies, dust or excessive wind. Ear plugs or muffs should be issued when noise may be a problem, such as around heavy machinery and impact tools. Most earplugs are made of foam that is typically rolled into a tightly compressed cylinder by the wearer's fingers and then inserted in the ear canal. Once released, the earplug expands until it seals the canal, blocking the sound vibrations that reach the eardrum. Other plugs simply push into the ear canal without being rolled first.

Depending on the level of exposure, we may choose from:

1. Disposable earplugs
2. Reusable earplugs

3. Headband plugs

4. Sealed earmuffs

To avoid contamination, we should follow these guidelines:

- Wash your hands before inserting earplugs.
- Replace disposable earplugs after each use.
- Clean reusable earplugs after each use.

Disposable ear plugs are designed for one-time use. They are made of formable material and designed to insert into a person's ear canal. Once inside the ear canal, they will expand and conform to the shape of the ear canal. Ear plugs must fit snugly inside the ear canal to reduce the noise level. This type of hearing protection may need to be shaped before use

- Wash hands and inspect plugs before insertion.
- Wash reusable plugs daily and store them in a clean case.
- Replace plugs that are hard or discolored.
- If ear plugs are working properly, the wearer's voice will sound louder to him/her.



Fig.Ear Safety Devices

Headband plugs

Headband plugs can be worn comfortably with safety glasses or protective helmets. These plugs are on a flexible plastic band that is worn under the chin while the protectors are in the ears. Headband plugs should be kept clean by wiping with a clean damp cloth and care must be taken not to bend or twist the band.

Ear muffs

Ear muffs have cups and cushions that fit securely around the ears, covering them completely, and are held in place by a headband. Long hair, sideburns, or facial movements such as chewing gum can interfere with a proper fit and reduce the protection level. In extremely loud situations, wear ear plugs and ear muffs.

EYE PROTECTION

(Welding, glassblowing, gas welding, oxygen cutting, torch brazing, laser use, etc.)

The radiation produced by welding covers a broad range of the spectrum of light. Exposure to ultraviolet light (UV-B) from welding operations can cause "welders flash", a painful inflammation of the outer layer of the cornea. Arc welding or arc cutting operations, including submerged arc welding, require the use of welding helmets with an appropriate filter lens. Goggles with filter plates or tinted glass are available for glassblowing and other operations where intense light sources are encountered, including but not limited to, gas welding or oxygen cutting operations.. Spectacles with suitable filter lenses may be appropriate for light gas welding operations, torch brazing, or inspection.. Users and visitors to Laser use areas (the laser nominal hazard zone) must be protected with suitable laser protection eye wear. Workers shall wear the appropriate eye and face protection when involved in activities where there is the potential for eye and face injury from:

- Handling of hot solids, liquids, or molten metals
- Flying particles from chiseling, milling, sawing, turning, shaping, cutting, etc.
- Heat treatment, tempering, or kiln firing of any metal or other materials

- Intense light radiation from gas or electric arc welding, glassblowing, torch brazing, oxygen cutting, laser use, etc.
- Repair or servicing of any vehicle
- Handling of chemicals and gases

Eye protection choices include the following: (1) Safety glasses, (2) goggles and (3) face shields



Fig. Eye Safety Glasses

Safety Glasses

Safety glasses are the most commonly used form of eye protection. They are designed primarily to provide protection from flying particles that may strike the eyes from the front. Side shields, either built into the frame or detachable, and full (cup) shields provide additional protection. A professional who can adjust the glasses should fit prescription safety glasses.

Ordinary prescription glasses do not provide adequate protection. Eye protection must conform to the standard. Prescription safety glasses are recommended for employees who must routinely wear safety glasses in lieu of fitting safety glasses over their personal glasses. All safety glasses should have side shields.

Goggles

Goggles and safety glasses are forms of protection wears that usually enclose or protect the eye area in order to prevent particulates or chemicals from striking the eyes.

Whenever protection against splashing is a concern, "Chemical Splash Goggles" must be worn. Goggles and other eye protectors are made of heat treated or chemically treated glass, plastic, light-filtering glass or wire screens. Goggles with soft vinyl or rubber frames protect against corrosive chemicals. Goggles must be fitted close to the eyes to achieve the widest field of vision and a tight facial seal, but the eyelashes should not touch the lenses

FACE PROTECTION:

Full-face shields provide the face and throat and partial protection from flying particles and liquid splash. For maximum protection against chemical splash, a full face shield should be used in combination with chemical splash goggles. Face shields are appropriate as secondary protection when implosion (e.g vacuum applications) or explosion hazards are present. Face shields which are contoured to protect the sides of the neck as well as frontal protection are preferred.

Faceshields that attach to hardhats provide added protection. A combination that leaves no gap between the shield and the brim of the cap is best because it prevents overhead splashes from running down inside the face shield. The face shield must meet specifications.



Fig. Face Protection Shields

Precautions

1. Solvents such as petrol, thinners etc. should not be used for cleaning
2. Avoid very high temperature of water.
3. Manufacturer's instructions should be followed.
4. Cleaned goggles should be placed in plastic bags with a tag indicating the date of cleaning and disinfecting.

The eye protectors should be standard safety gear when the respiratory protection is a half-face mask with no face shield. Both safety glasses/goggles and a face shield are advisable as long as they do not impair visibility.

Important points to be considered

- Do not wear contact lenses in the laboratory or other areas where hazardous atmospheres may be present. Contact lenses do not provide eye protection and may reduce the effectiveness of an emergency eyewash.
- If you wear prescription glasses, wear goggles or other safety protection over the glasses.
- Safety glasses with side shields provide primary protection to eyes and are four times as resistant as prescription glasses to impact injuries.
- Goggles protect against impacts, sparks, chemical splashes, dust, and irritating mist. Wear full goggles, not just safety glasses, when working with chemicals.

BODY PROTECTION

To protect the body from hazards like falling of hot chips, slag, heat radiation, ionizing radiation, splashing of chemicals and others, the body must be protected by protective suits or aprons.

Protective suit is an umbrella term for any suit or clothing which protects the wearer. Any specific design of suit may offer protection against biological and chemical agents, particle radiation (alpha) and/or radiation (delta and gamma), and may offer flash protection in the case of bomb disposal suits. Most forms of industrial clothing are protective clothing. Personal protective equipment includes:-

A variety of protective clothing, including laboratory coats, long pants, rubber aprons, coveralls, and disposable body suits are available for specific work conditions.

- Rubber, neoprene, and plastic clothing protect employees from most acids and chemical splashes.
- Laboratory coats, coveralls, and disposable body suits protect employees and everyday

clothing from contamination.

- Welding aprons provide protection from sparks.

Vinyl or rubber aprons and sleeves should be used when dispensing corrosive liquids (e.g. hydrofluoric acid, phenol, etc). Where metal organic liquids or other materials which may self ignite on contact with air are used, Nomex lab coats are recommended, along with face shields. Where contact with hazardous materials with your protective clothing is likely, such as during spill cleanup or pesticide application, polyethylene- coated Tyvek or similar clothing should be used to provide additional protection. The limitations of the protective clothing must always be understood, particularly in situations where contact with the material is likely.

Clothing to protect the body against hazardous liquids, gases, or vapors is available in a variety of styles and materials.

GLOVES:

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; chemicals; burns; thermal burns; and harmful temperature extremes.

Gloves are available to protect against:-

- Chemicals, contamination and infection (e.g. disposable latex/vinyl/nitrile gloves)
- Extremes of temperature (e.g. oven gloves, welder's gloves)
- Mechanical hazards (e.g. rigger gloves, chainmail gloves)
- Lacerations and other wounds from sharp objects

The hands are as susceptible to contamination as the feet. Gloves must resist puncturing and tearing as well as provide the necessary chemical resistance. Heavy leather gloves may be worn over chemical protective gloves when doing heavy work. If they become contaminated, they should be discarded because leather is difficult to decontaminate.

Two pair of gloves should also be considered for extra protection of the hands if the outer glove is torn or permeated. A pair of inner gloves also adds an extra layer of protection for the hands during the removal of outer gloves and other chemically protective items.

Always wear the appropriate hand and arm protection. Double your hand protection by wearing multiple gloves when necessary (e.g., two pairs of disposable gloves for work involving biological hazards). For arm protection, wear a long-sleeved shirt, a laboratory coat, chemical-resistant sleeves, or gauntlet-length gloves.

Follow these guidelines to ensure arm and hand safety:

- Inspect and test new gloves for defects.
- Always wash your hands before and after using gloves. Wash chemical-protective gloves with soap and water before removing them.
- Do not wear gloves near moving machinery; the gloves may become caught.
- Do not wear gloves with metal parts near electrical equipment



Fig. Safety Gloves

FOOT PROTECTION

The toes, ankles, and feet are exposed to a wide range of on-the-job injuries. Safety shoes and boots provide impact and compression protection for workers who handle heavy materials or work in areas where materials could fall or roll onto their feet. To protect feet and legs from falling objects, moving machinery, sharp objects, hot materials, chemicals, or slippery surfaces, employees should wear closed-toed shoes, boots, footguards, leggings, or safety shoes as appropriate. Safety shoes are designed to protect people from the most common causes of foot injuries — impact, compression, and puncture.

Puncture-resistant footwear incorporates a steel insole to provide protection where sharp objects are present that could be stepped on. Conductive footwear minimizes electrical hazards by preventing the accumulation of static electricity, and electrical hazard footwear reduces the hazards from contact with electrically energized equipment.



Fig. Foot Protection Shoe

AIR PURIFYING RESPIRATOR:

Air-Purifying Respirator is a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element before it reaches the user. Cartridge respirators purify the air – they do not supply air and may not be used in an oxygen deficient atmosphere.

Cartridge respirators are designed to filter dangerous gases, vapors or particles from the air before inhalation. It is imperative to have the correct cartridge for protection against a given type of hazard. The cartridges attach directly to the face piece of a respirator. Half-mask face pieces protect against substances that will not irritate the eyes and cannot be absorbed through the skin. Full face piece masks include protection for the eyes.

TRAINING

It is very important for workers who need protection to practice wearing the equipment that will shield them from job hazards. Merely showing the equipment is no guarantee that, when they need the protection, they will know how to determine its adequacy and be able to wear and remove it properly. Training must be provided to employees who are required to use personal protective equipments. The training must be comprehensive, understandable, and recur annually, and more often if necessary. Employees must receive training which includes the proper PPE for their job, when this PPE must be worn, how to wear, adjust, maintain, and discard this equipment, and the limitations of the PPE. All training must be documented.

PPE training must include demonstrations and practical exercises in the following:

- When PPE is necessary.
- What PPE is necessary.
- Limitations and capabilities of the PPE
- How to properly put on, remove, and wear PPE.
- How to correctly adjust the equipment to get the best fit and afford the greatest protection

- Effective use in emergency situations
- The proper care, maintenance, useful life and disposal of the PPE.
- How improper fit, use, or maintenance can compromise its protective effect
- How to inspect, put on and remove, use and check the seals
- How to check for wear or damaged parts that could compromise the protective qualities of the equipment.
- Recognition of medical signs and symptoms that may limit or prevent effective use
- General requirements of PPE standards.

Conclusion:

When PPE training covers all the angles, workers will have a better understanding of their protective equipment and the important role it plays in keeping them safe, both on the job and off. It really is their personal shield of protection.

Ex.No

STUDY ON FIRE EXTINGUISHERS

Date :

Objectives:

After studying this unit, you will be able to understand

- Fire, factors contributing towards fire, Fire-chemistry, type of fire.
- Fire extinguisher types and its operations.

Introduction:

Fire is one of the simplest forms of energy known to man. Invaluable lives are lost every year due to fire. Property is destroyed by uncontrolled fire incidents. A number of industrial units suffer huge losses due to it. It is the most common serious hazard that one faces in process industries. Hence it is necessary to understand the mechanism of fire and methods of prevention of loss from it for the safe working of any industry.

FIRE FIGHTING SYSTEMS

Methods of extinguishing fire

Starvation : Limitation of combusting material

Smothering : Limitation on of oxygen

Cooling : Limitation of temperature

Fixed systems

- a) Water hose reels
- b) Hydrant systems
- c) Sprinkler systems
- d) Carbon dioxide extinguishing systems
- e) Dry chemical powder systems
- f) Foam systems
- g) Steam installation

Fire Extinguishing agents Water

Effectiveness of water as a good extinguishing agent lies in its cooling power and its applicability in a variety of ways, as solid, steam, and atomized fogs. Use of different types of nozzles cut down the quantity of water used and minimizes the wastage of water. It takes away a lot of heat by vaporizing. The enormous increase in volume of steam generated smothers the fire. More the water is broken down, the more successful is the absorption of heat. This is achieved by low pressure fog from hose reels.

APW (air pressurized water) cools burning material by absorbing heat from burning material. Able to work on the least variety of fires, but has the advantage of being cheap, harmless, and relatively easy to clean up.

Water Mist uses a misting nozzle to break up a stream of distilled water to the point of not conducting electricity back to the operator. Class A and C rated.

Dry chemical powder

It is a powder mixture. The principal base chemicals used are sodium bicarbonate, potassium bicarbonate and potassium chloride. Various additives are mixed with the base chemical to improve their storage and flow. Commonly used additives are metallic stearates, tricalcium phosphates or silicones which coat the particles of dry chemical to make them free flowing and to

Ammonium phosphate, used on class A, B, and C fires. It receives its class A rating from the agent's ability to melt and flow at 350 degrees to smother the fire. More corrosive than other dry chemical agents.

- Sodium bicarbonate, used on class B and C fires. Interrupts the fire's chemical reaction.

- Potassium bicarbonate, used on class B and C fires. About two times as effective on class B fires as sodium bicarbonate. The preferred dry chemical agent of the oil and gas industry. The only dry chemical agent certified for use in AR-FF by the NFPA.

Halon system

Halons are halogenated hydrocarbons in which one or more hydrogen atoms have been replaced by atoms from the halogen series like fluorine, bromine, chlorine or iodine. They are recently developed as fire extinguishers on the basis of superb extinguishing properties and relatively low toxicity. These compounds are represented as halons followed by a figure code consisting of four or five numbers. These figures indicate the number of various halogen atoms in the compound molecule.

The extinguishing effect due to cooling, or dilution of oxygen or fuel vapor is minor. Areas where Halon can be effectively used are:

- a) Gaseous and liquid flammable materials
- b) Electrical hazards such as transformer oil switches and circuit breakers and rotating equipment.
- c) Engines utilizing gasoline and other flammable materials.
- d) Hazardous solids
- e) Electrical computers like data processing equipment and control rooms.
- f) Ordinary materials such as paper, wood and textiles.

Halon 1301 is referred to as a chain-breaking agent meaning that it reacts to break the chain reaction of the combustion process.

Inergen system

Inergen is a mixture of three gases namely

- a) Argon 40%
- b) Nitrogen 52%
- c) Carbon dioxide 8%

When released to protected area , it extinguishes fire by diluting the oxygen present.

Foam systems

Foam is an aggregate of air filled bubbles formed from aqueous solutions. It is lower in density than the lightest inflammable liquids and covers horizontal surfaces very well.

The foam concentrates are:

- a) Protein foam concentrate
- b) Fluor protein concentrate
- c) Synthetic foam concentrates
- d) Chemical foam (mixing solutions of sodium bi carbonate and aluminium sulphate containing a foam stabilizing agent)

Foam was first used to extinguish flammable liquid fires in the early 1900 and when foam was generated by mixing solutions of sodium bi carbonate and aluminium sulphate containing a foam stabilizing agent. This was known as chemical foam. It is still frequently used in fire extinguishers.

The general use of foam began to grow rapidly in the early 1930 with the development of foaming agents and foam generating systems, which could produce foam in relatively simple equipment by entering air. The foam so produced is known as mechanical foam.

Foams

1. AFFF (aqueous film forming foam), used on A and B fires and for vapor suppression.
2. AR-AFFF (Alcohol-resistant aqueous film forming foams), used on fuel fires containing alcohol. Forms a membrane between the fuel and the foam preventing the alcohol from breaking down the foam blanket.
3. FFFP (film forming fluoroprotein) contains naturally occurring proteins to create a foam blanket that is more heat resistant than the synthetic AFFF foams.
4. CAFS (compressed air foam system) Any APW style extinguisher that is charged with a foam solution and pressurized with compressed air. Generally used to extend a water supply in wildland operations. Used on class A fires and with very dry foam on class B for vapor suppression.
5. Arctic Fire is a liquid fire extinguishing agent that emulsifies and cools heated materials quicker than water or ordinary foam. It is used extensively in the steel industry. Effective on classes A, B, and D.
6. FireAde, a foaming agent that emulsifies burning liquids and renders them non-flammable. It is able to cool heated material and surfaces similar to CAFS. Used on A and B (said to be effective on some class D hazards).
7. Wet Chemical (potassium acetate) extinguishes the fire by forming a crust over the burning oil. Generally class A and K only.

Fire Extinguisher

A fire extinguisher is an active fire protection device used to extinguish or control small fires, often in emergency situations. Typically, a fire extinguisher consists of a handheld cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.



Fig. Fire Extinguisher

Classification

There are various types of extinguishers, which are used for different types of fires; using the wrong type can worsen the fire hazard, but using the right one can better the situation.

Internationally there are several accepted classification methods for hand-held fire extinguishers. Each classification is useful in fighting fires with a particular group of fuel.

Fire extinguishers are divided into four categories, based on different types of fires. Each fire extinguisher also has a numerical rating that serves as a guide for the amount of fire the extinguisher can handle. The higher the number, the more fire-fighting power. The following is a quick guide to help choose the right type of extinguisher.

- **Class A extinguishers** are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish.
- **Class B** fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish.

- **Class C** fires involve electrical equipment, such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive.
- **Class D fire extinguishers** are commonly found in a chemical laboratory. They are for fires that involve combustible metals, such as magnesium, titanium, potassium and sodium. These types of extinguishers also have no numerical rating, nor are they given a multi-purpose rating - they are designed for class D fires only.

Using fire extinguishers

Attempt to use an extinguisher only if ALL of the following apply:

- The building is being evacuated (fire alarm is pulled)
- The fire department is being called.
- The fire is small, contained and not spreading beyond its starting point.
- The exit is clear, there is no imminent peril and you can fight the fire with your back to the exit.
- You can stay low and avoid smoke.
- The proper extinguisher is immediately at hand.

1. If any of these conditions have not been met, don't fight the fire yourself. Call for help, pull the fire alarm and leave the area.

2. Whenever possible, use the "Buddy System" to have someone back you up when using a fire extinguisher. If you have any doubt about your personal safety, or if you can not extinguish a fire, leave immediately and close off the area (close the doors, but DO NOT lock them). Leave the building but contact a firefighter to relay whatever information you have about the fire.

3. Pull the pin on the fire extinguisher.

4. Stand several feet from the fire, depress the handle and sweep back and forth towards the fire. Note: Do not walk on an area that you have "extinguished" in case the fire reignites or the extinguisher runs out! Remember: you usually can't expect more than 10 full seconds of extinguishing power on a typical unit and this could be significantly less if the extinguisher was not properly maintained or partially discharged.

5. The metal parts of CO₂ extinguishers tend to get dangerously cold -- practice using one beforehand or have someone show you the proper way to hold one.

6. Direct the extinguisher at the base of the flames until the fire is completely out.

7. Recharge any discharged extinguisher immediately after use. If you discharge an extinguisher (even just a tiny bit) or pull the pin for any reason, call your campus or corporate Fire Marshal's office to arrange a replacement.

Conclusions:

Fire, factors contributing towards fire, Fire-chemistry, type of fire, Fire extinguisher types and its operations were studied in a well defined manner.

Ex.no
date

LOCKOUT/TAGOUT

Lockout-Tagout refers to the safety procedure used in industry and research settings to insure that dangerous machines have been properly shut-down and are incapable of being started up again prior to the completion of maintenance or servicing work. Lockout/Tagout (LOTO) is a necessary part of working in industrial settings. These practices are required to protect everyone who works with and around potentially dangerous equipment. The purpose of a lockout/tag out program is to control hazardous energy. A lockout program should: Identify the types of: Hazardous energy in the workplace.

Procedures :

- Lock out, tag out (LOTO) is a safety procedure used to ensure that dangerous equipment is properly shut off and not able to be started up again prior to the completion of maintenance or repair work.
- The four main types are gate valves, ball valves, plug valves and butterfly valves.

Steps of lockout tagout:

- Prepare for shutdown.
- Notify all affected employees of the activities and equipment involved. Shut down the equipment.
- Isolate the equipment from the hazardous energy source.
- Apply applicable lockout or tagout devices.



Lockout / Tagout survey has been conducted to locate and identify all energy sources to verify which switches or valves supply energy to machinery and equipment. Dual or redundant controls have been identified. A Tagout Schedule has been developed for each major piece of equipment and machinery. This schedule describes the energy sources, location of disconnects, type of disconnect, special hazards and special safety procedures. The schedule will be reviewed each time to ensure employees properly lock and tag out equipment and machinery. If a Tagout Schedule does not exist for a particular piece of equipment, machinery and process, one must be developed prior to conducting a Lockout – Tagout. As repairs and/or renovations of existing electrical systems are made, standardized controls will be used.

Conclusion:

Thus the lockout and tag out and its usages were studied well defined manner.