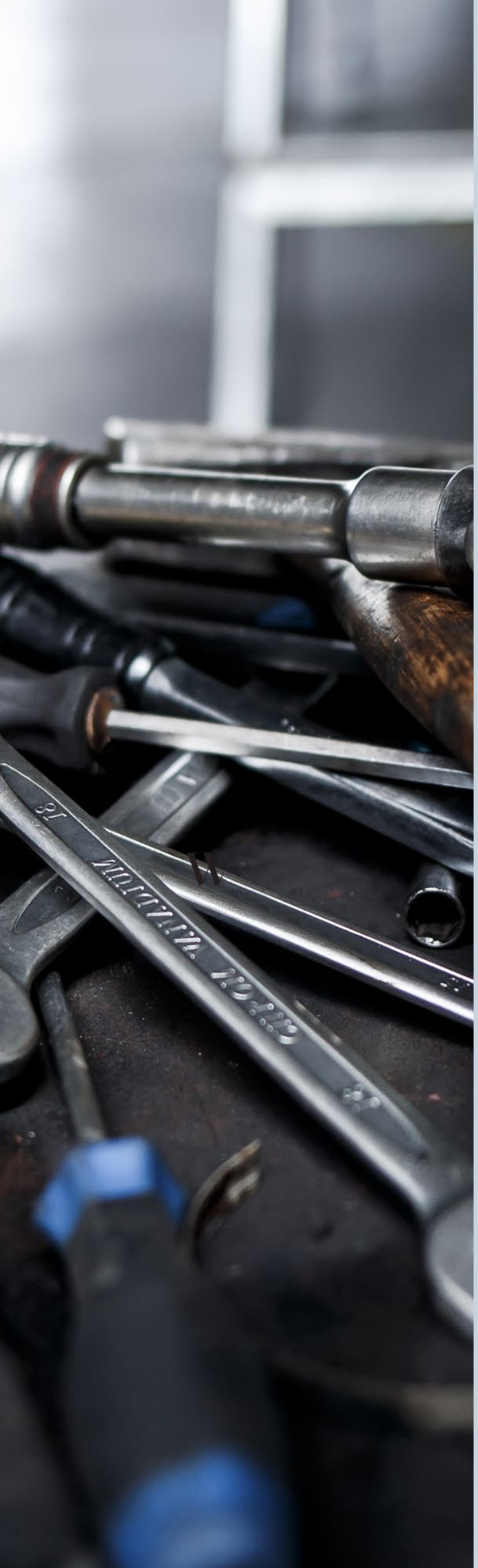


MAINTENANCE AND TROUBLESHOOTING PRINCIPLES AND PROCEDURES

WRITER:

ARMAN BIN MD. SAID
SITI KHALIJAH BINTI SHUIB

MECHANICAL ENGINEERING

MAINTENANCE AND TROUBLESHOOTING PRINCIPLES AND PROCEDURES

WRITER:

ARMAN BIN MD. SAID

SITI KHALIJAH BINTI SHUIB

MECHANICAL ENGINEERING

DECLARATION OF COPYRIGHT

MAINTENANCE AND TROUBLESHOOTING PRINCIPLES AND PROCEDURES

Authors :

ARMAN BIN MD.SAID
SITI KHALIJAH BINTI SHUIB

PUBLISHED EDITION 2023

Published by

POLITEKNIK MELAKA

NO 2, JALAN PPM 10,PLAZA PANDAN MALIM,

BALAI PANJANG,

75250 MELAKA.

Tel: 06-337600

Fax: 06-3376007

Website : https://polimelaka.mypolycc.edu.my/

Content Editor: Nazarudin Bin Mohtaram

Language Editor: Tan Peck Ghee

Cataloguing-in-Publication Data

Perpustakaan Negara Malaysia

A catalogue record for this book is available from the National Library of Malaysia

eISBN 978-967-0838-93-9

ACKNOWLEDGEMENTS

Thank you to the Almighty ALLAH for providing us with the power, fortitude, and health to complete this e-book. We would want to convey profound appreciation to the Mechanical Engineering Department at Polytechnic Melaka for providing us with all of the essential resources. We wish to express our sincere appreciation to everyone who has contributed, directly or indirectly, to this endeavour. Above all, we would like to express our deepest gratitude to our family and friends for their unending encouragement and support in helping us finish this book in such a short period of time.

ABSTRACT

The maintenance and troubleshooting principles and procedures e-book is written for Mechanical Engineering Polytechnic's lecturer and student. This e-book is divided into five sections. The first section introduces the understanding of maintenance and troubleshooting and covers the definition, objectives and the needs and importance of maintenance and troubleshooting. The second section contains the consideration and various types of cost in maintenance. The third section indicate workplace safety and covers the benefits of clean and safe work environment. The forth section is about the important of personal protection equipment and the usage of lockout and tagout. It also contains the classification of power tools and hand tools equipment, demonstrate the proper use and the importance of inspecting hand tools and power tools. The five section of this e-book consists exercise and answer.

.

TABLE OF CONTENTS

LIST OF FIGURE

1 MAINTENANCE AND TROUBLESHOOTING PRINCIPLES AND PROCEDURES

Repair, unplanned or casualty maintenance, often known as MRO, is the process of maintaining, repairing, and operating (MRO) or maintaining, repairing, and overhauling any type of plumbing, electrical component or mechanical. Additionally, it involves performing routine chores to maintain the item in excellent working order known as planned maintenance or prevent problems from arising known as preventative maintenance. Any action that aims to keep or restore a thing in or to a state where it can carry out its intended function is referred to as MRO. All technical, corresponding administrative, management, and supervision actions are included in the actions.

1.1 Understanding the principles of maintenance and troubleshooting

1.1.1 Define the meaning of maintenance and troubleshooting

i) According to the language, maintenance refers to the actions necessary or carried out to preserve an asset or resource as closely and as long as feasible in its original condition while making up for regular wear and tear and troubleshooting refers to trace and correct faults in a mechanical or electronic system.

ii) The term "maintenance" is frequently defined as an action performed on any equipment to assure its dependability to carry out its intended functions.

iii) Maintenance and troubleshooting is the process of identifying the problem, plan a response, test the solution and resolve the problem.

iv) Engineering maintenance refers to the procedures required to maintain or restore of machinery, equipment or a system back to the appropriate operational state in order to extend its usable life. Both preventive and remedial maintenance are part of it.

1.1.2 The objectives of maintenance and troubleshooting

Maintenance seeks to maximise the performance of the equipment by ensuring that it runs consistently and effectively, by attempting to prevent breakdowns or failures, and by minimising the losses brought on by breakdowns or failures. Actually, maintaining or increasing the overall reliability of the operating system is the purpose of the maintenance function. The maintenance function has not been seen as necessary for production in recent years. The earlier approach, in contrast, was to see maintenance as an expensive necessary evil. It was generally believed that the cost of maintenance was excessively great.

According to this definition of maintenance, its sole purpose is to fix and upgrade outdated equipment. This is a typical method of maintenance management. It is not advisable in today's maintenance management to merely focus on breakdown and repair tasks. Modern maintenance management, which attempts to keep the equipment in working order and produce high-quality products, fails every time we have to make an unforeseen repair. In actuality, the priority one goal of the maintenance activity is to pursue expected availability performance, and its priority two goal is to achieve this at the lowest cost. Of course, safety must also be taken into account.

Maintenance in industry aims to:

i) Obtain the highest level of personal safety and operational dependability at the most reasonable cost.

ii) To maintain desired performance in terms of availability at the lowest cost and within permitted safety constraints. "Planned availability performance" refers to an agreement between the manufacturing manager and the maintenance manager regarding the performance of availability for a period of time in the future. It is essential to underline that establishing the availability performance aim should occur before considering cost considerations.

An alternative way to state this objective is to strive for the highest operational dependability that is affordable, or the highest operational dependability at the lowest cost. To do this, a variety of techniques are used and described below:

i) Work planning increases the chance the completing of right task at the right time. Planning also contains details on where to find supplies and spare components as well as information on estimating personal needs .

ii) A variety of methods for learning through experience can also be used. One method is to keep track of all operational issues. This information can be utilised to make plans.

iii) Design enhancements, stronger lubricants, and improved suspension systems, among other things, might assist with maintenance.

iv) When rationalising maintenance work, it is critical to minimise maintenance requirements.

v) By making better use of knowledge, planning, and design, as well as by employing appropriate techniques for determining the state of machinery and equipment (condition monitoring), it may be possible to lessen the amount of maintenance work required in the majority of places. Maintenance lowers capital expenditure by preserving the value of supplies and machinery.

vi) With good maintenance, the equipment lasts longer. This means that money that would have previously been used to invest in or buy new equipment can now be used for other organizational goals.

vii) The manner in which maintenance is performed in a business has a significant economic impact. Proper maintenance improves dependability and, as a consequence, productivity, which leads to higher revenue.

Most of those actions reduce the amount of time and materials required for maintenance, which lowers costs for the company. There is a case can be made that preventive maintenance increases a company's total profitability. Correctly performed maintenance improves the economy, human safety, stress reduction and working environment. With good maintenance, both energy consumption and capital expenses can be decreased.

1.1.2.1 The needs and importance of maintenance and troubleshooting

i) To maintain equipment and assure product quality and customer satisfaction.

ii) To prolong the useful life of equipment

iii) Prevent safety risks and keep equipment secure.

iv) To decrease the number and impact of disruptions.

v) By using a high facility utilisation rate, you can increase production capacity.

vi) It must be consistent with manufacturing objectives, such as cost, quality, transportation and their safety .

vii) Should be comprehensive with clear obligations.

1.1.2.2 Importance of Implementing maintenance and troubleshooting

i) Reduced operational costs
ii) A quicker, more reliable throughput
iii) Increase productivity
iv) Better quality
v) Constant improvement
vi) Enhanced capability
vii) Inventory reduction

1.1.2.3 Importance of Corrective Maintenance

i) Lowering of immediate costs
ii) As a result of the decreased workload, fewer personnel are needed.

1.1.2.4 Importance of Preventive Maintenance

i) Increased component life.
ii) less failures of assets
iii) Potential energy cost savings.
iv) Cost reduction of 12-18% compared to Corrective Maintenance (CM).

1.1.2.5 Importance of Predictive Maintenance

i) Extended part lifespan
ii) Fewer machine downtime
iii) Cost reductions of 6% to 15% above preventive maintenance (PM) programme

1.2 Cost consideration in maintenance and troubleshooting

1.2.1 Introduction

All companies and organisations desire to spend less on maintenance. As a result, maintenance costs must be managed by experts. Many companies employ cost-controlled maintenance management, which means that the maintenance department is only constrained by the amount of money available in the budget. The effects on production or other operations won't be take into account in this scenario because of the maintenance work.

Actual maintenance expenses will be compared to the maintenance budget as part of the cost control system. The maintenance engineer should request an

additional increase to his budget if an unfavourable variance happens, such as considerable damage to a piece of machinery caused by an ineffective operator. This approach beats the alternative of "delay tactics," which entailed hoping that savings would be realised in other areas, resulting in total actual costs that compared favourably with budget expenses at the end of the year.

This may be a sign that other machinery has not gotten the required level of maintenance, compromising the machinery's capacity to operate efficiently in the future. In such situations, it is essential that all parties involved realize the problems connected to the maintenance function and work together to develop a structure that helps to increase maintenance management's effectiveness. Both the budget planning stage and the budget execution stage must adhere to this rule, especially while analyzing variances and weighing all available options.

It is crucial to effectively communicate the necessary information to the supplier or designer when excessive maintenance happens as a result of inadequate machinery design

1.2.2 Cost controlled maintenance and troubleshooting

Troubleshooting and cost-controlled maintenance are unrelated to ongoing maintenance. According to one of the maintenance goals, "maintain planned availability performance at the lowest cost possible," long-term effects must be taken into account. The predicted availability performance must be balanced against the maintenance cost. Maintenance has always been thought of as a cost-controlled activity since it has been difficult for specialists to quantify maintenance spending in terms of the entire economy. The cost of maintenance can be easily calculated, but it can be challenging to see the consequences.

Maintenance and its consequences can be compared to an iceberg, with the majority of it hidden beneath the water's surface and only a little portion visible above it. The visible component indicates maintenance costs, but the invisible component represents expenditures for many factors that are influenced by maintenance.

Types of Cost in Maintenance and troubleshooting:

i) Repair or replacement expenses

ii) Output losses

iii) Delays in shipping

iv) Rework

1.3 Indicate workplace safety

The location where an employee routinely carries out the responsibilities of his or her position is referred to as the workplace. When referring to an itinerant worker, the workplace is the actual location where they return to set up and submit reports, as well as do other administrative responsibilities associated with their employment.

Establishing a secure environment where people can work without endangering their health depends on workplace safety. Workplace accidents could cause severe injury or even death. To avoid these accidents, the organization's staff must collaborate. There are a variety of workplace dangers, including risks brought on by human error and problems with technology. An business must use both safety legislation and training to prevent as many employee injuries as feasible.

An environment that is safe and healthy at work is advantageous to everyone. When people feel secure and healthy, they are more productive at work. As a result, the company gains. A safe and healthy workplace reduces the amount of time wasted due to illness and injury. Everyone will do more work.

A safe and healthy workplace environment helps to lower the likelihood of avoidable problems. To prevent dealing with employee complaints or lawsuits brought on by workplace injuries, it is in the company's best interests to establish a safe and healthy workplace. Businesses that prioritise a tidy, orderly, and secure workplace help to boost employee and team morale.

This motivates everyone who works there to give their all and take pride in their accomplishments. Workplace safety can be achieved with little expenditure of time, money, or other resources. There is simply a basic structure and set of paths that must be built in order to accomplish the desired goals. Every worker in organization should be aware of responsibilities must adhere to training and local rules sessions with updating periodically should be offered to guarantee that the entire atmosphere is secure and safe.

Employees who regularly practise workplace safety develop a habit of doing so. Near misses should be documented by employees since they are crucial for developing new procedures and safeguards against possible disasters. Workers that are confident and productive are those who work in a safe and healthy atmosphere. Because they recognise the benefit of having healthy and satisfied staff, successful firms take steps to ensure the safety of their workers.

The benefits of working in a sanitary and healthy environment may be felt by your personnel. While they might enjoy their work, a cheerful and organised workspace might make difficult days easier to bear and encourage productivity. Troubles and bad days seem to linger longer at a dirty or dark workspace.

1.3.1 The benefit of clean and safe working environment

A clean workplace increases air quality, which helps everyone reduce sick days and absence. Your employees will be more energetic and inventive. Cleaning alone can enhance performance and increase business.

When people are happier with their surroundings, relationships between them improve. Consider keeping the room cleaner if you're having difficulties with workplace communication and employees seem to be fighting with one another. Perhaps the new change will help everyone feel better and work harder to get along at work.

Benefits

a) Healthy employees are efficient and lead to healthy families, making them a vital tool for alleviating poverty.
b) Small businesses and the unorganized sector, which are essential for eradicating poverty and providing opportunities for individuals to escape it, raise more serious issues with workplace safety.
c) Secure work environments contribute to long-term development, which is necessary for reducing poverty.
d) Important shared components like pollution management and exposure reduction are incorporated into the procedures for safeguarding workers, local communities, and the environment for the next generation.

e) Industrial activities produce a lot of pollution and risky environmental exposures to human health, both of which can be significantly reduced by workplace health and safety programmes.

f) The ability of employees to find employment can be increased by workplace redesign, upkeep of a healthy and safe working environment, training and retraining, evaluation of job requirements, medical diagnosis, health screening, and evaluation of functional capacities.

g) It is becoming clear that severe illnesses (including AIDS, heart disease, and cancer) necessitate workplace wellness measures, making occupational health essential to public health.

1.3.1.1 The advantages of encouraging a healthy workplace for the organization

a) an effective approach to health and safety

b) Favourable and considerate impression

c) enhanced worker morale

d) lower staff turnover

e) lower absenteeism

f) higher productivity

g) lower health care/insurance costs

h) lower risk of penalties and lawsuits

1.3.1.2 Benefits of promoting a healthy workplace to the workers

i. a secure and wholesome workplace
ii. a secure and wholesome workplace
iii. less tension
iv. increased morale
v. improvement in satisfaction with work
vi. greater capacity to defend your health
vii. increased well-being

1.4 The important of personal protection equipment

1.4.1 Introduction

Sharp edges, falling items, flying sparks, chemicals, noise, and a variety of other potentially hazardous circumstances are present in every workplace. Employers are required by the Occupational Safety and Health Administration (OSHA) to safeguard their employees against workplace risks that might cause injury.

Eliminating risks at their source is the best way to protect employees. Depending on the hazard or working conditions, OSHA suggests utilizing engineering or work practice controls to manage or eliminate risks to the greatest extent possible. In situations where engineering, work practices, and administrative controls are impractical or insufficiently protective, employers must provide and enforce the use of personal protective equipment (PPE) for their employees. Building a barrier between the danger and the employees is one example of an engineering control. Personal protective equipment, also referred to as "PPE," is gear used to lower risk exposure. PPE includes items like gloves, foot, eye, and hearing protection, as well as hard helmets, respirators, and full body suits.

The following activities, which affect both employers and employees, will be helped by this advice.

a) Recognise the various PPE types
b) Understand the fundamentals of doing a "hazard assessment" of your place of work.
c) Choose proper PPE for a range of situations.
d) Recognise the type of instruction required for the proper use and maintenance of PPE.

1.4.2 PPE Specification

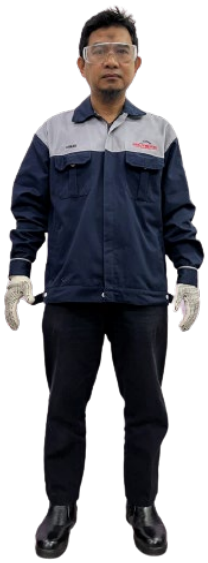


Figure 1-1 : Personal Protective Equipment

In order to build and maintain a safe and healthy working environment, employers and employees must collaborate in order to provide the best protection for employees in the workplace. Employers typically are accountable for:

a) To detect and manage hazards to employees' physical and mental health by conducting a "hazard assessment" of the workplace.

b) Choosing and supplying employees with appropriate personal protective equipment (PPE).

c) Educating staff on the proper use and upkeep of personal protective equipment (PPE).

d) PPE maintenance, including replacement of old or broken PPE.

e) Regularly assessing the success of the PPE programme and making necessary changes.

In general, employees should:

a) Use PPE correctly

b) Participate in PPE training courses

c) Maintain, clean, and care for PPE

d) If PPE needs to be repaired or replaced, notify a supervisor.

1.4.3 The Hazard Assessment

Recognizing the physical and physiological dangers that occur at work is the first and most crucial step in creating an extensive safety and health program. "Hazard assessment" is the term used to describe it. Through a thorough hazard assessment, threats in both categories should be discovered. Potential dangers include those that are physical or health-related.

Physical dangers can include anything that roll or pinch, bright lights, moving objects, shifting temperatures, electrical connections, and sharp edges. Radiation, poisonous dust, and prolonged exposure to pollutants are all health risks.
A walk-through inspection of the plant should be conducted to identify potential risks in the following areas of fundamental hazards: impact, penetration, and compression Risks can be chemical, thermal, biological, caused by light (optical radiation), toxic dust, etc.

Along with noting the facility's general structure and evaluating any earlier cases of occupational diseases or injuries, the walk-through survey should also check for the following things:

1. Electricity sources.
2. Motion sources include any devices or procedures where movement might be present and result in contact between personnel and machinery.
3. High-temperature sources that might cause burns, eye damage, or fire.
4. Chemicals found in the workplace.
5. Potential sources of hazardous dust.
6. Light radiation sources such as welding, brazing, cutting, furnaces, heat treatment, high intensity lighting, and so on.
7. The possibility of items falling or being dropped.
8. Sharp items with the potential to poke, cut, stab, or pierce.
9. Biohazards such as blood or other potentially infectious items.

When the walk-through is over, the employer should organise and analyse the data so that it may be utilised to quickly determine the right forms of PPE necessary at the jobsite. The employer should get familiar with the various types of PPE available and the degrees of protection provided. It is always a good idea to choose PPE that offers more protection than the bare requirement for protecting personnel from threats.

By performing any alterations to the working environment, equipment, or operational processes that may have an impact on occupational risks should be reviewed often. In addition to reviewing accident and sickness data, this quarterly examination should look for any patterns or other concerns so that appropriate corrective action can be taken. Reviewing the adequacy of the existing PPE and assessing its age and quality are both important considerations.

A written certification containing the following information is required to document the hazard assessment:

- Evaluation of the workplace's identification
- The assessment's supervisor's name
- The assessment's date
- Identifying the document that certifies the hazard assessment was completed.

1.4.4 Choosing PPE

Every piece of PPE, including apparel and tools, must be manufactured safely, maintained consistently, and kept clean. When selecting authorized work-related goods, employers should take the fit and comfort of PPE into consideration. The likelihood that employees will use PPE will increase if it fits properly and is comfortable to wear.

It's important to choose the appropriate piece of safety equipment for each user because it comes in a variety of sizes. If you are wearing a variety of PPE, ensure that they are all compatible. Being exposed or being safely protected could depend on how well a piece of PPE fits. It might not fulfill the American National Standards Institute (ANSI) published standards for several types of personal protective equipment (PPE), which are required by OSHA. Since the 1920s, when the first safety standard was put into place to safeguard the heads and eyes of industrial employees, ANSI has been developing safety standards.

Employers who are obligated to supply personal protective equipment (PPE) in the categories below need ensure that new equipment they purchase complies with the necessary ANSI standard. PPE stocks must comply with the ANSI standard that was in force when they were made, or they must offer protection that is at least as effective as PPE that complies with ANSI standards.

Employers must confirm that any employee-owned personal protective equipment (PPE) used in the workplace complies with the employer's requirements, which are based on hazard analysis, OSHA regulations, and ANSI standards. Employers must also inform employees who provide their own PPE about the selection decisions made by the employer. As required by OSHA regulations, personal protective equipment (PPE) must meet the ANSI requirements listed below:

- Eye and Face Protection: ANSI Z87.1-1989 (USA Standard for Occupational and Educational Eye and Face Protection).
- Head Protection: ANSI Z89.1-1986.
- Foot Protection: ANSI Z41.1-1991.

OSHA suggests that the selection be made in line with the duties to be done as well as the performance and construction features of the glove material, even if there is no ANSI standard for hand protection gloves. When selecting gloves for chemical protection, chemical exposure, chemical resistance, and glove material qualities must all be taken into account. Instruction of Staff Members on the Safe Use of PPE.

Employers are required to provide PPE training to every employee. The following subjects must be given to employees:

- When PPE is required.
- How to wear personal protective equipment (PPE) properly.
- PPE restrictions.
- Proper maintenance, use, and disposal of personal protective equipment

Before assigning employees to tasks requiring the use of PPE, employers should make sure they demonstrate understanding of the PPE training as well as the ability to appropriately don and use PPE. A previously trained employee needs to be retrained if the employer believes that they are not using PPE with the necessary comprehension and proficiency.

Additional or retraining of employees may be required in cases where previous training was ineffective owing to changes in the workplace or in the type of PPE required.

Employer is necessary to provide a certification including the names of all trained employees, the date of training, and a clear statement of the certification's subject in order to prove that each individual who is required to wear or use PPE has received the necessary training.

1.4.5 Safety for the face and eyes

Employees may be subjected to a variety of risks that endanger their faces and eyes. According to OSHA, employees who are working with flying particles, molten metal, fluid-based chemicals, acids or corrosive liquids, chemical gases or vapours, potentially infected material, or conceivably hazardous light radiation are obligated to be provided with proper eye or facial protection.

Most industrial eye injuries are caused by workers not putting on any eye protection, although others are caused by faulty or improperly fitted eye protection. Employers have to ensure that all workers wear suitable eye and facial protection along with ensuring the type of protection chosen matches the need for the task at hand and properly fits every worker susceptible to the threat.

1.4.6 Eye Protection for Exposed Workers

OSHA recommends that carpenters, electricians, engineers, mechanics, millwrights, plumbers and pipefitters, sheet metal workers and tinsmiths, assemblers, sanders, grinding machine operators, sawyers, welders, labourers, chemical procedure operators and handlers, timber cutting and logging labourers use eye protection on a regular basis. Employers employing workers in other fields should conduct risk assessments to determine whether eye and face PPE is required.

Examples of potential eye or face injuries include:

- Dust, dirt, metal or wood chips enter the eye as a result of operations such as chipping, grinding, sawing, hammering, power tool use, or even high wind pressures.
- Splashes of caustic chemicals, heated liquids, solvents, or other potentially dangerous solutions.

- Objects such as tree branches, chains, tools, or ropes swinging into the eye or face.
- Welding radiation, damaging rays from the employment of lasers or other radiant light (together with heat, glare, sparks, splash, and flying particles).

1.5 Head Protection

Protecting employees from possible head injuries is a critical component of any safety programme. A brain injury can leave an employee disabled for life or be deadly. Wearing a safety helmet or hard hat is one of the simplest methods to safeguard an employee's head from damage. Employees can be protected from impact and penetration dangers, as well as electrical shock and burn hazards, by wearing hard helmets.

Employers must require employees to wear head protection in any of the following circumstances:

- Stuff could fall on them from above and hit them in the head.
- They might bump into fixed objects like exposed beams or pipes
- They may come into touch with electrical risks.

Construction workers, carpenters, electricians, linemen, plumbers and pipefitters, wood and log cutters, and welders are just a few examples of jobs where personnel should be compelled to wear head protection. Head protection must be worn whenever there is a risk of things falling from above, such as while working beneath individuals who are using tools or when working beneath a conveyor belt. To fully safeguard personnel, hard helmets must be worn with the bill forward.

Hard hats and other protective headwear should typically satisfy :

- Object penetration should be avoided.
- Reduce the shock's intensity
- Be water resistant and slow burning.
- The suspension and headband's replacement and adjustment procedures are well documented.

With a headband and straps that hang the shell from 1 to 1 1/4 inches or 2.54 cm to 3.18 cm out from the wearer's head, sturdy hats must have a hard outer shell and a shock-absorbing inner lining. This design of structure enables for ventilation while wearing and shock

absorption after a collision.

Protective headgear must satisfy or give an equal degree of protection to ANSI Standard Z89.1-1986 (Protective Headgear for Industrial Workers). Helmets acquired before to July 5, 1994 must meet the previous ANSI Standard (Z89.1-1969) or provide similar protection.

1.5.1 Hard Hats Types

Nowadays, there are many different types of hard helmets available. Employers should make sure that employees wear hard helmets that offer sufficient protection from potential occupational dangers in addition to selecting protective headgear that complies with ANSI standards. Employers must take into account all possible risks, including electrical concerns, before making this choice. A thorough assessment of the dangers and familiarity with the various types of protective headgear on the market can help achieve this. There are three industrial classes for hard hats:

- Class A hard hats provide impact and penetration resistance as well as limited voltage protection (up to 2,200 volts).
- Class B hard helmets offer the maximum level of electrical safety, including high-voltage shock and burn protection (up to 20,000 volts). They also defend against flying/falling items' impact and penetration dangers.
- Class C hard helmets provide lightweight comfort and impact protection but don’t have electrical security.

Another type of protective headwear on the market is a "bump hat," which is designed to be used in spaces with limited head clearance. In places where head knocks and abrasions must be avoided, they are advised. These are not ANSI-approved and are not designed to guard against falling or flying objects. It is essential to inspect the kind of hard hats the employees is wearing to make sure the tools offer proper protection. A label identifying the maker, the ANSI classification, and the hat class should be placed inside each shell of the hat

1.6 Foot and Leg Protection

Employees who may sustain foot or leg injuries as a result of falling or rolling objects, as well as crushing or piercing materials, should wear protective footwear. Employees who deal with hot chemicals, caustic or dangerous materials, or both must wear protective gear that covers exposed body parts, including the legs and feet. Non-conductive footwear should

be used whenever an employee's feet may be exposed to electrical risks. Static electricity exposure in the workplace, on the other hand, may demand the usage of conductive footwear.

Employees should wear foot and/or leg protection in the following situations:

- Heavy things, such as barrels or tools, may roll onto or fall on the employee's feet
- Working with sharp things that might penetrate the soles or uppers of standard shoes, such as nails or spikes
- Exposure to molten metal, which may splash on the feet or legs
- Participating in work that involves hot, wet, or slippery surfaces
- Work in locations where there are electrical hazards.

The impact performance and compression requirements of ANSI Z41-1991 (American National Standard for Personal Protection-Protective Footwear) must be met or equal protection must be provided by safety footwear. Shoes purchased prior to July 5, 1994, must meet the requirements of the previous ANSI Standard (ANSI Z41.1-1967) or provide an equivalent level of protection. All footwear that has received ANSI approval has a covered toe and offers compression and impact resistanceHowever, the kind and level of protection aren't always the same. Various shoe designs provide varying levels of protection. To ensure that the footwear will shield the wearer from the risks they encounter, check the product packaging or get in touch with the manufacturer.

The following are some options for protecting your legs and feet::

- Leggings provide protection for the feet and lower legs from hot items like welding sparks or molten metal. Using safety snaps allows for quick removal of leggings.
- The instep region is protected from impact and compression by metatarsal guards. They can be fastened to the outside of shoes using straps and are composed of aluminum, steel, fiber, or plastic.
- For impact and compression protection, toe guards are placed over the toes in conventional footwear. Steel, aluminum, or plastic are frequently used to make them.
- In addition to toe guards, combination foot and shin guards provide additional protection for the lower legs and feet.

- The feet are shielded from the hot work surfaces typical of the roofing, paving, and hot metal industries by impact-resistant toes and heat-resistant soles. Some safety shoes include metal insoles that guard against puncture wounds. Safety boot can also be electrically conductive to avoid static electricity accumulation in potentially explosive environments, or nonconductive to safeguard employees from workplace electrical risks.

1.6.1.1 Care of Protective Footwear

Before each use, safety footwear, like other protective gear, should be inspected. Regularly check your shoes and leggings for signs of wear and tear. In order to do this, look for material separation, cracks or holes and worn laces or buckles. Inspect your shoes for any embedded metal or other objects that might be a trip or electrical hazard. Employees should care for their safety footwear as instructed by the maker.

1.6.2 Hand and Arm Protection

Employers must guarantee that employees wear suitable protection whenever a workplace hazard assessment finds that employees face possible damage to their hands and arms that cannot be prevented via engineering and work practice measures. Potential hazards include dangerous material absorption via the skin, chemical or thermal burns, electrical hazards, bruising, abrasions, cuts, punctures, fractures, and amputations. Gloves, finger guards, and arm covers or elbow-length gloves are examples of protective equipment.

Employers ought to examine all engineering and work practice controls to eliminate risks and use PPE to provide additional protection against hazards that are not entirely avoidable through other methods. Machine guards, for instance, can help to eliminate a hazard. Another method is to put up a barrier to keep employees' hands from coming into touch with the table saw blade and the thing being cut.

1.6.2.1 Types of Protective Gloves

Today, several different styles of gloves are available to protect against a wide range of risks. The nature of the hazard and the operation will influence the choice of gloves. The wide range of potential occupational hand injuries makes choosing the correct pair of gloves difficult. Because gloves created for one purpose may not protect against a different function even if they appear to be a suitable protective device, it is critical that personnel utilize gloves

particularly suited for the risks and duties prevalent in their workplace. The following are examples of some factors that may influence the selection of protective gloves for a workplace.

Type of chemicals handled.

- Nature of contact (complete immersion, splash, etc.).
- Duration of the encounter
- Area requiring protection (hand only, forearm, arm).
- Grip conditions (dry, wet, oily).
- Thermal security
- Size and comfort.
- Abrasion and resistance criteria

Gloves constructed from a variety of materials are intended to protect against a wide range of job risks:

- Canvas, leather or metal-mesh gloves
- Gloves made of coated and fabric
- Gloves resistant to liquids and chemicals
- Gloved with rubber insulation

1.6.2.1.1 Leather, Canvas or Metal Mesh Gloves

Durable gloves consisting of metal mesh, leather, or canvas protect against cuts and burns. Leather or canvas gloves also provide protection against prolonged heat.

- Leather gloves provide protection against sparks, mild heat, blows, chips, and harsh items.
- Aluminized gloves provide reflecting and insulating heat protection and require a synthetic insert to defend against heat and cold.
- Aramid fibre gloves are heat and cold resistant, cut and abrasion resistant, and comfortable to wear.
- Synthetic gloves of various materials provide heat and cold protection, are cut and abrasion resistant, and may survive some diluted acids. These materials are not resistant to alkalis and solvents.

1.6.2.1.2 Gloves made of fabric and coating

Cotton or other fibers are used to make fabric and coated fabric gloves, which provide varying levels of protection.

- Gloves of fabric prevent abrasions, chafing, filth, and slivers. When handling hard, pointy, or heavy things, they might not provide sufficient protection. Applying a plastic coating can strengthen some cloth gloves.
- Cotton flannel that has napped on one side is regularly used to make coated fabric gloves. The fabric gloves can be made into all-purpose hand protection with slip-resistant properties by covering the unnapped side with plastic. Uses for these gloves include handling wire, bricks, and containers for chemical laboratories, among others. Always check with the manufacturer or search up the company's product information before purchasing gloves to reduce occupational chemical exposure dangers. Gloves that are Resistant to Chemicals and Liquids

Chemical-resistant gloves are constructed from a variety of rubbers, including natural, butyl, neoprene, nitrile, and fluorocarbon (viton), as well as plastics, including polyvinyl chloride (PVC), polyvinyl alcohol, and polyethylene. For improved performance, these materials can be mixed or laminated. In general, the thicker the glove material, the stronger the chemical resistance; nevertheless, thick gloves may compromise grip and dexterity, compromising safety. Some examples of chemical-resistant gloves include:

- **Butyl gloves** are composed of synthetic rubber and resist a broad range of chemicals, including peroxide, rocket fuels, extremely corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid, and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters, and nitrocompounds. Butyl gloves are also resistant to oxidation, ozone corrosion, and abrasion, and they retain their flexibility at low temperatures. Butyl rubber reacts poorly with aliphatic and aromatic hydrocarbons, as well as halogenated solvents.
- **Natural (latex) rubber** gloves are a common general-purpose glove because they are comfortable to wear. They have exceptional tensile strength, flexibility, and temperature resistance. These gloves protect workers' hands against most aqueous solutions of acids, alkalis, salts, and ketones, as well as abrasions generated by

grinding and polishing. Latex gloves have been linked to allergy responses in certain people and may not be suitable for all personnel. For workers who are sensitive to latex gloves, hypoallergenic gloves, glove liners, and powderless gloves are suitable alternatives.

- **Neoprene gloves** are comprised of synthetic rubber and have excellent pliability, finger dexterity, density, and tear resistance. They resist hydraulic fluids, petrol, alcohol, organic acids, and alkalis. They often outperform natural rubber in terms of chemical and wear resistance.
- **Nitrile gloves** are a copolymer that protects against chlorinated solvents such as trichloroethylene and perchloroethylene. Despite being designed for occupations that need dexterity and sensitivity, nitrile gloves can withstand extensive use and even continuous exposure to toxins that cause other gloves to degrade. They provide protection while dealing with oils, greases, acids, caustics, and alcohols, but they should not be used with strong oxidising agents, aromatic solvents, ketones, or acetate

1.6.2.1.3 Protective Gloves maintenance

Before each usage, safety gloves must be inspected to make sure they are not torn, punctured, or otherwise made useless. A cursory examination can help you find any rips or tears, but a more thorough examination will reveal any pinhole leaks. To do this, fill the gloves with water and tightly roll the cuff over the fingers. Gloves that are discoloured or rigid may also indicate issues brought on by heavy use or chemical deterioration.

It is necessary to toss away and replace any gloves that are no longer protective. When considering the absorptive qualities of the gloves, the reuse of chemical-resistant gloves must be carefully taken into account. When considering whether to reuse chemically exposed gloves, one must take into account the toxicological effects of the chemicals involved as well as factors like time of exposure, storage, and temperature.

1.6.3 Protection of Body

Workers must wear the appropriate body protection while doing their responsibilities if they could sustain bodily injury that cannot be prevented by engineering, work practises, or

administrative controls. The following are examples of workplace hazards that could cause bodily injury aside than cuts and radiation:

- Extremes of heat
- Splashes of boiling liquids and molten metal that are extremely painful
- Potential effects of equipment, machinery, and supplies
- Dangerous chemicals substance

For different dangers, there are numerous forms of protective clothing available. Employers are responsible for ensuring that staff members only utilise personal protective equipment on vulnerable body parts. Body protection can take the form of lab coats, coveralls, vests, jackets, aprons, surgical gowns, and complete body suits.

If a hazard assessment reveals that full-body protection against hazardous chemicals or harmful physical agents is required, the clothes should be thoroughly examined before each use, fit each worker appropriately, and perform properly and for the purpose intended.

Several materials are used to make protective garments, each of which is effective against a particular risk, including:

- Disposable suits are protected from dust and splashes by filaments like paper
- Treated cotton and wool are cosy, fire-resistant, and resistant to dust, abrasions, and irritating and abrasive surfaces. They also respond well to temperature changes.
- In order to avoid cuts and bruises when handling objects that are heavy, sharp, or abrasive, duck is a tightly woven cotton fabric.
- Flame and dry heat resistance is typically achieved using leather.
- Materials such as rubber, rubberized fabrics, neoprene, and plastics offer protection from particular chemicals and hazards. Consult the clothing manufacturer if there are any chemical or physical issues to be sure the material will offer protection from the specific hazard.

1.6.4 Protection of Hearing

It could be difficult challenging to decide whether or not employees need hearing protection. Several variables, such as the following, affect how much noise is exposed to employees by a variety of factors, including:

- The intensity of the noise in decibels (dB).
- The duration of each employee's noise exposure.
- Whether employees travel between work locations with varying noise levels.
- Whether noise is generated from a single or several sources.

In general, the longer the exposure duration before hearing protection is necessary, the louder the noise. Employees, for example, may be exposed to a noise level of 90 dB for 8 hours a day before hearing protection is required (unless they suffer a Standard Threshold Shift). If the noise level exceeds 115 dB, hearing protection is recommended if the predicted exposure time exceeds 15 minutes.

For a more thorough explanation of the requirements for an extensive hearing conservation programme, OSHA Publication 3074 (2002), "Hearing Conservation," or consult the OSHA regulation in 29 CFR 1910.95, Occupational Noise Exposure, part (c).

If engineering and work practises cannot decrease employee exposure to workplace noise to acceptable levels, then employees must wear appropriate hearing protection. It is important to remember that hearing protection only reduces the amount of noise that gets into the ears. The amount of this reduction, or attenuation, varies according to the type and fit of the hearing protection worn.

1.7 The usage of lockout and tag-out

When an associated device or component of equipment is being maintained, the lockout procedure is utilised to prevent unintentionally starting the equipment and releasing stored energy. The energy-isolating device is secured with a padlock or another suitable mechanical mechanism, which should be in the off or closed position and physically prevents the transfer or release of energy.

Devices that isolate energy include:

- Turn off the switches.
- Breaker switches
- Handle Valves
- Unsightly flanges

The reason the equipment is secured, who locked it, and for how long will all be listed on a tag that will be fastened to the locking mechanism. It is acceptable to employ only tags

without locks as long as other equipment protection measures are put in place. As an example:

- Cutting off the circuit isolating componen
- The valve handle should be removed.
- A regulating device is blocked

The protection of workers' health and safety is the main objective of lockout/tagout procedures. The safeguarding of equipment against harm comes in second.

Lockout Devices Types:

- Turn off the switches.
- Gliding gates
- Valves examples gate and ball

1.7.1 Locks and Tag colours:

1.7.1.1 Locks:

- Blue locks, often known as equipment locks, are used to protect equipment.
- Personal protection is provided by red locks.
- Contractors receive green locks to use on machinery.
- Use orange locks to manage a group lockout.
- Locks out numerous pieces of equipment using a single locking mechanism.

1.7.1.2 Tag :

- Red locks and tags are utilised for employee personal safety..
- Contractor protection is provided via red tags with green locks.
- Equipment protection is provided by yellow tags with blue locks..
- Equipment that is not in use is identified with a yellow tag without a lock. The tag will indicate any issues with the apparatus..

1.7.1.3 The Five Most Common Reasons for Fatal Lockout or Tagout Injuries:

1. Failure to shut off equipment
2. Failure to detach from the power source

3. Failure to disperse (bleed, neutralise) remaining energy
4. Equipment restarting by accident
5. Failure to clean work sites before resuming operations

1.7.1.4 Lockout Procedure:

1. Before tagging or locking any equipment, conduct some study on it and the energy sources it uses. The operators should be informed that the power will be switched off.
2. Equipment shutdown
3. Device Isolation - track down and separate each sort of energy the device uses..
4. Use lockout devices to secure any energy-isolating equipment using locks and/or tags. It is necessary to keep out anything that can restart the energy flow to the work area.
5. Use lockout devices to secure any energy-isolating equipment using locks and/or tags. It is necessary to keep out anything that can restart the energy flow to the work area:
   i. relieving any leftover energy
   ii. waiting until moving parts cease
   iii. relieving trapped pressure
   iv. Blocking or supporting high equipment
   v. Installing ground wires to discharge electrical capacitors

6. Check Equipment Isolation - Before beginning work, double-check that all equipment is locked out/tagged out and clear of stored energy.

1.7.1.5 Removal of Lockout

1. Restore Serviced Equipment:
   - Remove all equipment
   - Make sure that every part of the equipment is firmly in place.
   - All safety guards must be reattached

- Closely maintained equipment

2. Inform personnel that lockout/tagout devices will be removed.

3. Remove lockout/tagout devices - only the person who installed each lockout/tagout device has the authority to remove it.

1.7.1.6 Equipment Reactivation

1. Hold off until the last lockout/tagout device has been taken out.

2. To make sure no one else is operating in the area, assemble all individuals involved in the operation in a secure location.

3. Employees should be made aware that the equipment will be re-energized.

4. Recharge the apparatus

1.7.1.7 Follow Up:

1. Inform your supervisor of any difficulties with the lockout/tagout procedure.

2. Disseminate this information to those who were participating in the operation.

1.8 Classification of the organizations that regulate the safety of hazardous materials.

OSHA adopted a slew of new restrictions in 1994. The emphasis of these legislation has been on building mechanisms to implement occupational safety and health in the workplace. A Safety and Health Policy must be implemented in all workplaces with at least five staff members. In enterprises with 40 or more employees, the Safety and Health Committee Regulations 1996 necessitate the formation of a safety and health committee. The committee is supposed to convene at least once every three months to identify workplace dangers, implement control measures, investigate incidents, and conduct audits.

In terms of committee representation, workplaces with fewer than 100 employees must have at least two representatives for workers and management, respectively. Workplaces with more than 100 employees, on the other hand, must have a minimum of four representatives for workers and management.

A Safety and Health Officer (SHO) is required in certain businesses under the Safety and Health Officer Regulations. A SHO is a person who has completed training from the Department of Safety and Health (DOSH), the National Institute of Occupational Safety and Health (NIOSH), or another recognized training institution, passes the NIOSH test, and is registered.

1.8.1 Accident Investigation

Purpose

• Determine reasons for the incidents;

• To prevent future incidents, develop efficient control measures.

• To record all relevant information about the accident for use in claims and compensation, among other things

According to the Act, who is responsible for conducting an investigation?

• Oversight

• Officer of Safety and Health

• Members of the Safety and Health Committee

• Special Forces

1.8.2 Responsibilities for Safety and Health

A general duty of care is imposed on managers under the Occupational Safety and Health Act of 1994 (Malaysia) to make sure that their employees are protected from risks to the greatest extent practicable. Workers must make sure they don't put themselves or others in danger, according to the same Act. The University is committed to establishing and maintaining a safe and healthy workplace and acknowledges that the Vice Chancellor is ultimately responsible for the safety and health of its staff, students, visitors, contractors, and labour hire agreements.

1.8.3 Responsibilities of Managers and Supervisors

Making sure that workers are not in danger at work ultimately falls to managers and supervisors. The Act requires managers to fulfill a number of unique obligations. Establish and maintain workspaces, equipment, and work systems that do not expose personnel to dangers. A management must do this to achieve this :

- Establish safe working practices and make sure that personnel carry out their responsibilities in a secure way
- Create and uphold safety regulations and standards for safe work practices
- Make sure that the current working environment, tools, procedures, and methods don't expose people to risks.

- Determine the risks related to any proposed alterations to employee roles and work practises, and implement workable improvements to improve employee health and safety at work.
- Consider products carefully before leasing or purchasing to prevent exposing workers to risks.
- Identify hazards in the workplace, conduct risk assessments, and implement viable control measures
- Examine incidents to determine how to avoid them in the future
- Set aside money for the supply and upkeep of a safe working environment and the essential tools.

1. Give staff members the information, direction, training, and oversight they need to perform their duties safely.

   To accomplish this, a manager must:

   • establish and maintain information on managing known hazards in the workplace, including:

   (i) rules and safe work practices

   (ii) Codes of practice, Guidance Notes and Malaysian Standards.

   (iii) Material Safety Data Sheets (MSDS) on hazardous substances

   - Make sure that workers are supported and observed while they securely carry out their jobs.
   - Provide appropriate training on workplace safety and health to the personnel, and retain records of what instruction was given, when it was given, and to whom.
   - Make sure that workers are supported and watched over as they safely perform their duties.
   - Encourage safe work practices, as well as workplace safety and health.

2. Consult Work collaboratively while consulting with employees and Safety and Health Representatives (SHRs).

   To do this, a manager must:

- Recognize and support SHR for their workplace

- SHRs and workers should be consulted regarding any prospective changes to the workplace.
- Decide how to manage safety and health issues after consulting others
- Inform SHR of any risks or mishaps in their working environment.
- Work together with SHR to identify hazards and incidents, conduct investigations, and create suitable control measures..

3. Where risks cannot be avoided, provide proper protective clothes and equipment.

To do this, a manager must:

• understand what protective apparel and equipment is necessary for the dangers in their workplace; and

• ensure that the necessary cleaning, maintenance, and storage facilities are available, together with the appropriate safety clothing and equipment

• Instruct and train participants on how to use and care for safety gear and clothing

• Make ensuring that the personnel, students, and guests under their care are wearing the proper protective attire and gear.

1.9 Tools

1.9.1 Classify types of hand tools and power tools equipment

Hand Tools that are operated manually and propelled by human force include cutting shears, pliers, wrenches, and screwdrivers

Portable Power Tools include hand-held, manually operated power tools such as circular saws, sanders, drills, reciprocating saws, air wrenches, air grinders, air fasteners, chainsaws, "Ramset guns," and so forth that are powered by electricity, air, gasoline, diesel, or explosion.

Different types of power tools source:

- Electric
- Pneumatic
- Liquid fuel
- Hydraulic
- Powder-actuated

Tools and equipment used by employees, including tools and equipment provided by employees, must be safe for use by all employers. Dangerous hand tools cannot be provided by employers or permitted to be used. No wrench, whether an adjustable, pipe, end, or socket wrench, should be used when the jaws are sprung to the point of slipping.For instance, mushroomed heads need to be maintained away from drift pins, wedges, and chisels. Tools' hardwood handles need to be kept tight in the tool and free of splinters and cracks.

The proper personal protective equipment must be worn by workers who use hand and power tools and are at risk from flying objects, falling objects, abrasive and splashing materials, or toxic dusts, fumes, mists, vapours, or gases. Both companies and employees have a responsibility to work together to guarantee safe working conditions. A potentially hazardous circumstance should be brought to the notice of the appropriate person as soon as it occurs. Wearing the proper personal protection equipment is necessary due to the risks that could arise from using portable power tools and hand tools. To prevent slips while using or close to potentially dangerous hand devices, floors should be kept as dry and spotless as possible.

1.9.2 Demonstrate the proper use of various types hand tools and power tools

General Hazards:

• Misuse and incorrect maintenance are the two most prevalent dangers linked with the use of hand tools.

• Misuse happens when a hand tool is utilized for a purpose other than that for which it was designed. (A screwdriver, for example, may be used as a chisel. As a result, the tip may shatter and strike someone).

• Poor maintenance causes hand tools to degrade and become dangerous. (Examples include broken hardwood handles that allow the tool head to fly off or mushroomed heads that can shatter on impact).

• Tools that have been specially developed may be needed in dangerous areas. (Always use non-sparking machinery while handling flammable vapours or dusts. Insulated instruments with the appropriate ratings must be used for electrical operations.

Personal Protective Equipment:

- The sort of personal protection equipment (PPE) needed when working with hand tools depends on the job.
- To avoid cuts, abrasion, and repetitive impact, it is usually advisable to wear eye protection, and it may also be required to wear hand protection.

1.9.2.1 Indicate the importance of inspecting hand tools and power tools

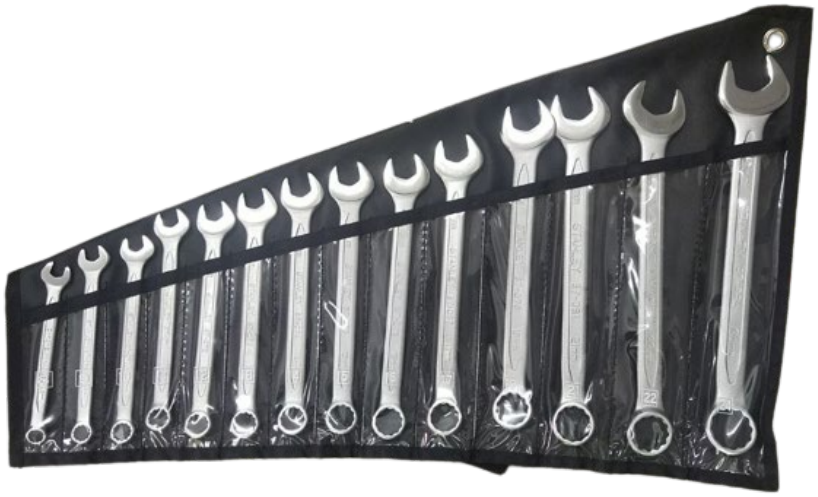


Figure 1-2 : Wrenches

1.9.2.2 Wrenches:

- Select the proper size wrench for the fastener to be twisted. Choosing the right size reduces the likelihood of the wrench slipping.
- Refrain from utilizing a pipe or other extension to boost the wrench's leverage. Wrenches are made by manufacturers such that applying leverage with the handle is as safe as is practical.
- For difficult-to-reach regions, use socket wrenches.
- If a fastener loosens unexpectedly, always attempt to pull (rather than push) on a wrench.

- Regularly check wrenches for defects including cracks, severe wear, or deformation

Figure 1-3 : Plier

Figure 1-4 : Long Nose Plier

Pliers:

- Avoid extending the pliers' handles to increase leverage. It is best to use larger pliers or bolt cutters.
- When twisting nuts and bolts, never use pliers instead of a wrench. Pliers cannot effectively hold these things and will slide.
- Never bang on the handles of pliers or use them as a hammer. Cracks or breakage are probable as a result of such mistreatment.
- Only use pliers intended for cutting tough wire.
- Always cut with the precise angles. Never jiggle the wire against the cutting blades by moving it back and forth.

Figure 1-5 : Hammer

Hammers:

- If the handle of the hammer is damaged or loose, do not use it.
- A hammerhead should never be welded, heated, or regrind.
- Any hammer that displays signs of excessive wear, such as cracks, chips, or a mushroomed head, should be put away.
- Choose the right kind of hammer for the job at hand
- Avoid making angled contact with the surface. The striking surface should come into direct contact with the hammer's face. Injury is frequently the result of hammer blows done at an angle.

Figure 1-6 : Flat Tip Screwdriver

Figure 1-7 : Philip Tip Screwdriver

Screwdrivers:

- Always use a screwdriver tip that fits the screw slot properly and avoid using a screwdriver as a pry bar, chisel, punch, stirrer, or scraper..
- Discard screwdrivers with cracked or damaged handles.
- Start fasteners in confined spaces with magnetic or screw-holding screwdrivers.
- Never use pliers to increase the leverage on a screwdriver. Only use a wrench on screwdrivers that have been particularly built to accommodate it.

Utility Knives/Blades:

- Always use a razor-sharp blade. Dull blades demand more power and are thus more prone to slipping. Replace the blade when it begins to "tear" rather than cut.
- Never leave a knife with the blade exposed unattended. Consider utilizing a spring-loaded self-retracting knife. (When you let go of the knife, the blade will retract).
- Avoid placing your free hand near the cut line.
- Do not bend or apply side loads to blades while opening cans or prying loose things. Blades are fragile and quickly shatter.

1.9.2.3 Risks of Power Tools

Five basic safety guidelines can help you avoid any risks that come with using power tools:

i. Maintain all tools on a regular basis to keep them in good working order.

ii. Use the appropriate tool for the job.

iii. Before using any tools, inspect them for damage.

iv. Always follow the manufacturer's recommendations.

v. Provide and utilize appropriate safety equipment.

Figure 1-8 : Grinding Machine

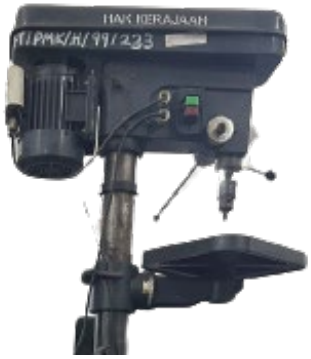


Figure 1-9 : Drilling Machine

1.9.2.4 General Safety Guidelines for Power Tools

I. Be familiar with the power tool.

II. Operators must read and comprehend the operator's handbook.

III. All labels on or in the shipping container must be read and understood.

IV. Ground all tools unless they are double-insulated.

V. Avoid hazardous situations. Power tools should not be used in a moist, wet, or explosive environment with fumes, dust, or combustible materials.

VI. Keep an eye out for any power lines, electrical circuits, water pipelines, and other mechanical hazards in your workspace, especially any that might be found beneath the work surface or hidden from the operator's view.

VII. Dress appropriately. Wear no slacks, hanging things, or jewellery. Long hair should be tied back. When using some power tools, gloves should not be worn. Examine the tool manuals.

QUESTION AND ANSWER

Question 1

Define the meaning of maintenance & Identify three (3) types of maintenance cost

Answer

Maintenance is a set of organize activities to carry out in order to keep an items in it best operational condition with minimum cost required. Three maintenance cost are cost of repair & replace, Cost of losses output & Cost of delayed shipment.

Question 2

Explain FIVE (5) main causes of fatal Lockout/Tagout Injuries

Answer

1. Failure to stop equipment 2. Failure to disconnect from power source 3. Failure to dissipate (bleed, neutralize) residual energy 4. Accidental restarting of equipment 5. Failure to clear work areas before restarting

Question 3

Explain FIVE (5) General Safety Guidelines for Power Tool

Answer

i. Know the power tool.
ii. Operators must read and understand the owner's manual.
iii. Labels affixed or included in the shipping container must be read and understood.
iv. Ground all tools unless double insulated.
v. Avoid dangerous environments. Do not use power tools in a damp, wet and/or explosive atmosphere -- fumes, dust or flammable materials. (select three)

Question 4

Explain FIVE (5) benefit clean and safe working Environment

Answer

The benefit clean and safe working environment.

1. healthy workers are productive and raise healthy families; thus healthy workers are a key strategy in overcoming poverty.
2. workplace health risks are higher in the informal sector and small industries which are key arenas of action on poverty alleviation, where people can work their way out of poverty.
3. safe workplaces contribute to sustainable development, which is the key to poverty reduction.
4. the processes of protecting workers, surrounding communities and the environment for future generations have important common elements, such as pollution control and exposure reduction.
5. much pollution and many environmental exposures that are hazardous to health arise from industrial processes, that can be beneficially influenced by occupational health and safety programmes and retraining, assessment of work demands, medical diagnosis, health screening and assessment of functional capacities.

Question 5

Describe FIVE (5) basic safety rules to prevent hazards involved in the use of power tools.

Answer

All hazards involved in the use of power tools can be prevented by following five basic safety rules:

1.Keep all tools in good condition with regular maintenance.
2.Use the right tool for the job.

3.Examine each tool for damage before use.

4.Operate according to the manufacturer's instructions.

5.Provide and use the proper protective equipment.

Question 6

List FIVE (5) common types each of Hand Tools, Power Tools & Personal Protective Equipment.

Answer

Hand Tools - Tools that are manually operated and powered by human force such as screw

drivers, pliers, wrenches, file, scriber, Vernier calliper, chisel, centre punch, G clamp, cutting shears,

Power Tools - Power tools that are hand held, manually operated, and powered by

electricity, air, gasoline, diesel, or explosion, such as circular saws, sanders, drilling machine, reciprocating saws, air wrenches, air grinders, air fasteners, chainsaws, “Ramset guns” etc.

Personal Protective Equipment - Safety spectacles, Goggles, Welding shields, Face shields. Foot and Leg Protection Leather, Canvas or Metal Mesh Gloves, Body Protection

REFERENCES

Mobley R.K (2014). *Maintenance Engineering Handbook 8th Edition*. McGraw-Hill Professional Publication, USA.

D. R. Kiran (2017) *Maintenance Engineering and Management.* Precepts and Practices CRC Press LLC

Manzini R., Alberto Regattieri A. (2010). *Maintenance For Industrial Systems* Springer Dordrecht Heidelberg London New York

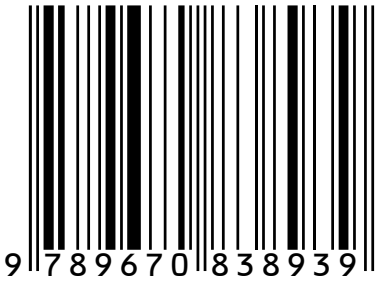
Larry Chastain (2004). Industrial Mechanics and Maintenance, Pearson Prentice Hall New Jersey. ISBN 0-13-047469-x.

Michael E. Brumbach (2003). Industrial Maintenance. Thomson , Delmar Learning , USA.
R.Keith Mobley (2008). Maintenance Engineering Handbook (7 th) McGraw-Hill , USA. ISBN 978-0-07-154646-1.

S.Chand (2009). Maintenance Engineering and Management, Rajendra Ravinda Printeds(Pvt.Ltd), New Delhi , India.

MAINTENANCE AND TROUBLESHOOTING PRINCIPLES AND PROCEDURES

e ISBN 978-967-0838-93-9



POLITEKNIK MELAKA

(online)