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MODULE 4

SAFETY HAZARDS IN MACHINES

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.

SAFETY HAZARDS IN MACHINES

Every day, workers are injured on the job due to machinery hazards. In some cases, these injuries are fatal. It is important for employers to understand the dangers associated with machinery and take steps to protect their workers. Most machinery has the potential to cause injury to people. These injuries may range in severity from a minor cut or bruise, through various degrees of wounding and disabling mutilation, to crushing, decapitation, or other fatal injuries. It is not solely powered machinery that is hazardous, for many manually operated machines (e.g., hand-operated guillotines and fly presses) can still cause injury if not properly safeguarded.

Machinery accidents figure prominently in official accident statistics, and it is important posed by machinery in the workplace. Proper training to take steps to minimize the risks maintenance, and safety procedures can help to reduce the likelihood of an accident occurring, and effective safeguards can help to protect workers from injury if an accident does occur. By taking these precautions, we can workplace safer for everyone.

Moving machinery can cause injuries in many ways:

- People can be struck and injured by moving parts of machinery or ejected material. Parts of the body can also be drawn in or trapped between rollers, belts and pulley drives

- Sharp edges can cause cuts and severing injuries, sharp pointed parts can cause stabbing or puncture the skin, and rough surface parts à cause friction or abrasion
- People can be crushed, both between parts moving together or towards a fixed part of the machine, wall or other object and two parts moving past one another can cause shearing
- Parts of the machine, materials and emissions (such as steam or water) can be hot or cold enough to cause burns or scalds and electricity can cause electrical shock and burns
- Injuries can also occur due to machinery becoming unreliable and developing faults or when machines are used improperly through inexperience or lack of training

Before starting the machine

Before start using any machine, the machine operator need think about what risks may occur and how these can be managed. We should therefore do the following:

- Check that the machine is complete, with all safeguard fitted, and free from defects. The term 'safeguarding includes guards, interlocks, two-hand controls, light guards, pressure-sensitive mats etc. By law, the supplier must provide the right safeguards and inform buyers of any risks that users need to be aware of and manage because they could not be designed out
- Produce a safe system of work for using and maintaining the machine. Maintenance may require the inspection of critical features where deterioration would cause a risk. Also look at the residual risks identified by the manufacturer in the information/ instructions provided with the machine and make sure they are included in the safe system of work
- Ensure every static machine has been installed properly and is stable (usually fixed down)
- Choose the right machine for the job and do not put machines where customers or visitors may be exposed to risk
- Note that new machines should be CE marked and supplied with a Declaration of Conformity and instructions in English.

Make sure the machine is:

- safe for any work that has to be done when setting up, during normal use, when clearing blockages, when carrying out repairs for breakdowns, and during planned maintenance
- properly switched off, isolated or locked-off before taking any action to remove blockages, clean or adjust the machine.

Mechanical Machinery Hazards & Control Measures

There are many potential hazards associated with machinery. Some of these hazards are always present, while others can appear unexpectedly. It is important to be aware of all potential hazards in order to develop a comprehensive risk management plan.

The following are some common hazards associated with machinery:

1. Crushing Hazards

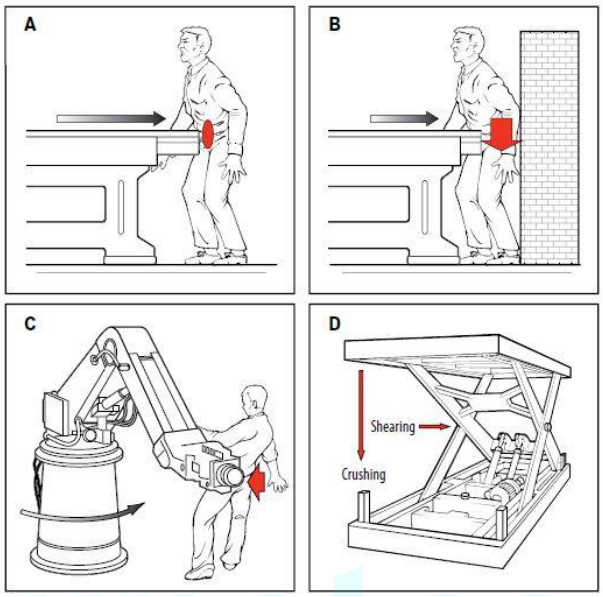
On construction sites, crushing hazards are often caused by excavators and other heavy machinery. If an employee is struck by a piece of machinery, it can result in serious injuries or even death. To prevent crushing hazards, employees should always be aware of their surroundings and stay clear of areas where heavy machinery is operating. If necessary, workers should wear personal protective equipment (PPE) to protect themselves from potential hazards.

Crushing hazards can also occur when workers are performing maintenance on machinery. If a worker is not properly trained in how to safely perform maintenance, they could be seriously injured or killed. To prevent these hazards, it is important for employers to provide employees with proper training and safety procedures.

2. Shear Hazards

Shear hazards are caused by moving parts that can cut or slice through skin and flesh. Shear hazards can occur when workers are using hand-operated tools, such as knives, or when they are

operating machinery with moving parts, such as saws.To prevent shear hazards, employees should always use the proper safety equipment and procedures when working with hand-operated tools or machinery.



3. Cutting/Severing Hazards

There are many types of cutting hazards, but the three most common are contact with a moving sharp-edged part, contact with a rotating part, and contact with a moving part.

The first type of cutting hazard is contact with a moving sharp- edged part. This can happen when the operator is using a machine with a blade, such as a bandsaw. If the blade is not properly guarded, clothing or skin can come into contact with the blade and be cut.

The second type of cutting hazard is contact with a rotating part. This can happen when the operator is using a drill press or lathe. If the chuck or bit is not properly secured, clothing or skin can come into contact with the rotating part and be cut.

The third type of cutting hazard is contact with a moving part. This can happen when the operator is using a power saw or drill. If the blade or bit is not properly secured, clothing or skin

can come into contact with the moving part and be cut.To avoid these hazards, always make sure that the blades our machines are properly guarded and that the chucks and bi on our drill presses and lathes are properly secured. If the operator is using a power saw or drill, make sure that the blade or bit is not worn or damaged. Also, always wear prope protective clothing, such as gloves, when using any type of machinery.

4. Drawing In or Trapping Hazards

This hazard can occur when clothing or body parts become caught in moving parts of a machine. The result can be severe injuries or even death. To prevent this hazard, always make sure that the operator is wearing proper protective clothing such as gloves and long sleeves when working with machinery. Also, keep the hands and feet away from moving parts and make sure that hair is tied back so that it cannot become caught in machinery.

5. Stabbing or Puncture Hazards

Stabbing or puncture hazards can occur when we are using a machine with a pointy or sharp edge, such as a drill press. If the bit is not properly secured, clothing or skin can come to contact with the pointy or sharp edge and be punctured. To prevent this hazard, always make sure that

the bit on our drill press is properly secured. Also, wear proper protective clothing, such as gloves, when using any type of machinery.

7. Friction or Abrasion Hazards

Friction and abrasion hazards are often found in mechanical machinery. When contact is made with a fastmoving surface that may be smooth (e.g. touching a spin dryer) or rough (e.g. touching a belt sander), there is a potential for serious injury.

There are several ways to protect ourself from these hazards:

•Wear appropriate Personal Protective Equipment (PPE), such as gloves, safety glasses, and ear protection.
• Be aware of our surroundings and stay clear of movingparts.
• Follow the manufacturer's instructions for operating the machinery safely.

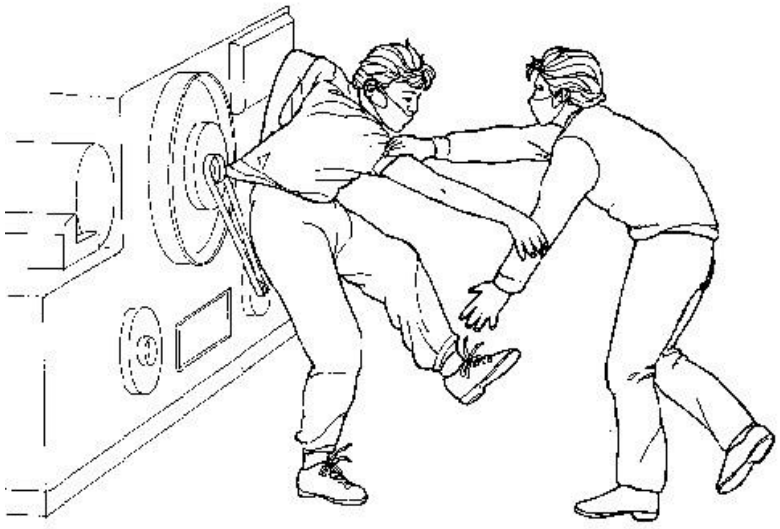
8. Entanglement Hazards

Entanglement hazards can occur when clothing or body parts become caught in moving parts of a machine. The result can be severe injuries or even death.

There are several ways to prevent this from happening:

- Keep the hair pulled back and away from rotating machine parts.
- Wear close-fitting clothes that won't get caught on anything.
- Be aware of our surroundings and what we're doing at all times.

If we see someone else caught in a machine, don't try to help used by mac them ourselves. Turn off the machine and get help from someone who knows how to safely release them.



9. Impact Hazard

The most common type of impact hazard is when the body is struck by a powered part of a machine. This is similar to crushing, but there is no fixed structure to trap the person. The speed and weight of the object do the damage.

Impact hazards can also occur when two parts of a machine collide with each other. This can happen when two parts of a machine are not properly aligned, or when one part of amachine breaks and hits another part. Impact hazards can also occur when a person is hit by a flying object that has been thrown or ejected from a machine.

Impact hazards can be prevented by proper maintenance of machines, training of workers, and using safety devices. Impact hazards can also be minimized by the use of guards and barriers. When working with machines, it is important to be aware of the potential for impact hazards and to take precautions to avoid them.

MACHINERY SAFEGUARD

Machine guards are the first line of defense against injuries caused by machine operation. Each machine must have adequate safeguards to protect operators and other employees in the immediate work area from hazards created by ingoing nip points, rotating parts, sparks and flying debris.

Principle of machine guarding

Prevent contact: The safeguard must prevent hands, arms, and any other part of a worker's body from making contact with dangerous moving parts. A good safeguarding system eliminates the possibility of the operator or another worker placing parts of their bodies near hazardous moving parts.

Secure: Workers should not be able to easily remove or tamper with the safeguard, because a safeguard that can easily be made ineffective is no safeguard at all. Guards and safety devices should be made of durable material that will withstand the conditions of normal use. They must be firmly secured to the machine.

Protect from falling objects: The safeguard should ensure that no objects can fall into moving parts. A small tool which is dropped into a cycling machine could easily become a projectile that could strike and injure someone.

Create no new hazards : A safeguard defeats it's own purpose if it creates a hazard of its own such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration. The edges of guards, for instance, should be rolled or bolted in s a way that they eliminate sharp edges.

Create no interference: Any safeguard which impedes worker from performing the job quickly and comfortably mig soon be overridden or disregarded. Proper safeguarding actually enhance efficiency since it can relieve the worke apprehensions about injury.

Allow safe lubrication: If possible, one should be able lubricate the machine without removing the safeguards. Locating oil reservoirs outside the guard, with a line leading t the lubrication point, will reduce the need for the operator maintenance worker to enter the hazardous area.

Machine Guarding at the Point of Operation

All machines consist of three fundamental areas: the point of operation, the power transmission device, and the operating controls.

- The point of operation is where work is performed on the material, such as cutting, shaping, boring, or forming of stock.
- The power transmission apparatus is all components of the mechanical system which transmit energy to the par of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods couplings, cams, spindles, chains, cranks, and gears
- A mechanical or electrical power control shall be provided on each machine to make it possible for the operator to off the power from each machine without leaving his position at the point of operation.

Machine operators often need to come into close proximity to points of operation in the course of their work. In those cases, machine guards can be installed to prevent hands or other body parts from accidentally getting caught in those moving parts.

When a solid guard would impede the operator's productivity or cannot be installed, optical sensing technologies such as safety light curtains can act as a safeguard at the point of operation.

Methods of Safeguarding

There are five (5) general types of machine safeguards that can be used to protect workers and personnel in the immediate vicinity of machinery. They are:

Guards - Guards are barriers that prevent access to dangerous areas of machines. Guards can be made of various materials, such as metal, plastic, or wood, and are typically attached to the machine using screws, brackets or clamps. Common guard types include door guards, gate guards, and fence guards.
Guards must be properly installed and maintained to be effective. Improperly installed or maintained guards can create hazards themselves or may fail to protect workers from hazards.

Devices : A safety device may perform one of several functions. It may stop the machine if a hand or any part of the body is inadvertently placed in the danger area; restrain or withdraw the operator's hands from the danger area during operation; require the operator to use both hands on machine controls, thus keeping both hands and body out of danger, or provide a barrier which is synchronized with the operating cycle of the machine to prevent entry to the danger area during the hazardous part of the cycle.

Automated Feeding and Ejection Mechanisms: Feeding and ejection methods generally do not require the operator to place his or her hands in the danger area. In some cases, no operator involvement is necessary after the machine is set up. In other situations, operators can manually feed the stock with the assistance of a feeding mechanism. Properly designed ejection methods do not require operator involvement after the machine starts functioning.

Machine Location or Distance : To consider a part of a machine to be machine guarded by location, the dangerous moving part of a machine must be positioned so that those areas are not accessible or do not present a hazard to a worker during the normal operation of the machine. This may be accomplished by locating a machine so that the hazardous parts of the machine are located away from operator work stations or other areas where employees walk or work.

Miscellaneous Aids - these methods can be used to protect both operators and people in the immediate vicinity of operating machinery. Examples include shields to contain chips, sparks, sprays or other forms of flying debris; holding tools that an operator can use to handle materials going into the point of operation; and awareness barriers to warn about hazards in the area. people

MACHINE SAFEGUARD DEVICES

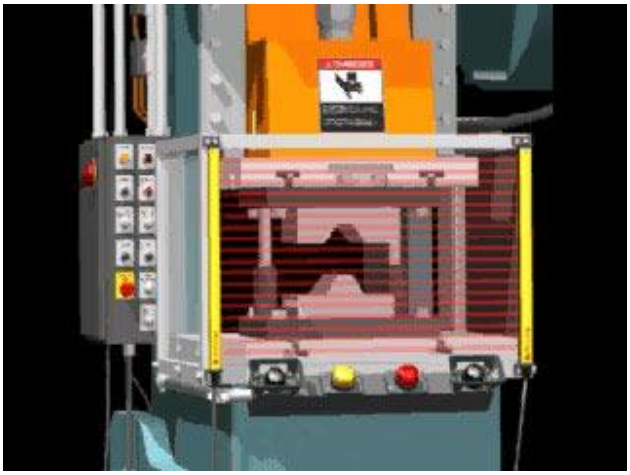
A safety device may perform one of several functions. It may stop the machine if a hand or any part of the body is inadvertently placed in the danger area; restrain or withdraw the operator's hands from the danger area during operation require the operator to use both hands on machine controls thus keeping both hands and body out of danger, or provide a barrier which is synchronized with the operating cycle of the machine in order to prevent entry to the danger area during the hazardous part of the cycle.

Presence-Sensing Devices

Presence-sensing devices use a system of light or radiofrequency sources and controls which can interrupt the machine's operating cycle; if the light or electric field is broken, the machine stops and will not cycle.

Photoelectric presence-sensing device: When the light beam is broken, either the ram will not start to cycle, or, if the cycle has begun, the stopping mechanism will be activated so that the press stops before the operator's hand can enter the danger zone.

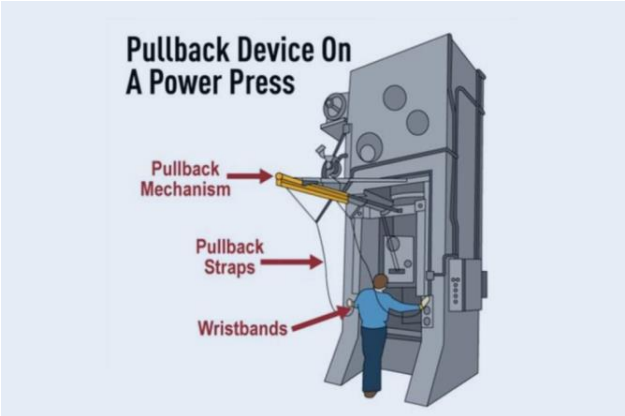
Electromechanical sensing device: This device has a probe or contact bar which descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full predetermined distance, the control circuit does not actuate the machine cycle.



Pullback devices:

Pullback devices use a series of cables attached to the operator's hands, wrists, and/or arms. This type of device is primarily used on machines with stroking action.

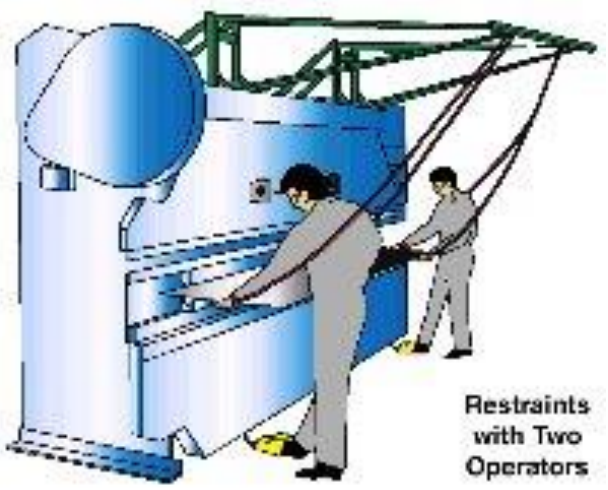
When the slide/ram is up between cycles, the operator is allowed access to the point of operation. When the slide/ram begins to cycle by starting its descent, a mechanical linkage automatically assures withdrawal of the hands from the point of operation.



Restraint Devices

The restraint (holdout) device in the figure to the right uses cables or straps that are attached to the operator's hands at a fixed point. The cables or straps must be adjusted to let the operator's hands travel only within a predetermined safe area. There is no extending or retracting action required because the hands are never allowed to extend into the danger area. Consequently,

hand-feeding tools are often necessary if the operation involves placing material into a dangerous area.



Safety Trip Controls

Safety trip controls provide a quick means for deactivating the machine in an emergency situation. A pressure-sensitive body bar, when depressed, will deactivate the machine. If theoperator or anyone trips, loses balance or is drawn toward the machine, applying pressure to the bar will stop the operation. The positioning of the bar, therefore, is critical. It must stop the machine before a part of the employee's body reaches the dangerous area.

Unfortunately, it may be easy to defeat the body bar by going under it into the danger zone. The figure here shows a pressure- sensitive body bar located on the front of a rubber mill.

Two-Hand Control Devices

The two-hand control device requires constant, concurrent pressure by the operator to activate the machine. This kind of control requires a part- revolution clutch, brake, and a brake monitor if used on a power press. With this type of device, the operator's hands are required to be at a safe location (on control buttons) and at a safe distance from the danger area while the machine completes its closing cycle.

Two-Hand Trip Devices

The two-hand trip device requires concurrent application of both the operator's control buttons to activate the machine cycle, after which the hands are free. This device requires the joint operation of two trigger buttons located away from the "danger zone" of the press. To be effective, both two-hand controls and trips must be located so that the operator cannot use two hands or one hand and another part of his/her body to trip the machine.

TYPES OF GUARDS

Guards are barriers which prevent access to danger areas. There are four general types of guards:

- **Fixed**

Fixed guards are permanently attached to the machine or tool, don't have any moving parts, and can't be moved while the machine is in use. They're most often used to enclose the point of operation, or other hazards that the operator doesn't need to interact with, like fan blades or flywheels. Because fixed guards are permanent features of the machine, they must be disassembled and removed to perform any kind of adjustment or maintenance. It may be constructed of sheet metal, screen, wire cloth, bars, plastic, or any other material that is substantial enough to withstand whatever impact it may receive and to endure prolonged use. This guard is usually preferable to all other types because of its relative simplicity and permanence.

Safeguarding Action: Provides a barrier

Advantages:

- Can be constructed to suit many specific applications.
- In-plant construction is often possible.
- Can provide maximum protection.
- Usually requires minimum maintenance.
- Can be suitable to high production, repetitive operations.

Disadvantages:

- May interfere with visibility.
- Can be limited to specific operations.

- Machine adjustment and repaired often require its removal, thereby necessitating other means of protection for maintenance personnel.

- **Interlocked**

Interlocking guards, also known as automatically shut off or disengage the power source when the guard is open or removed. These are barrier situations where operators need to be able to open the guard or access the guarded parts of the machine, such as when clearing guards particularly useful in jams. These guards allow safe access to interior parts of the machine without requiring a total disassembly. However, the can be easy to open on accident and require careful adjustment and maintenance.

Safeguarding Action: Shuts off or disengages power and prevents starting of machine when guard is open; should require the machine to be stopped before the worker can reach into the danger area

Advantages:

- Can provide maximum protection.
- Allows access to machine for removing jams without time consuming removal of fixed guards.

Disadvantages:

- Requires careful adjustment and maintenance.
- May be easy to disengage jams.

- **Adjustable guards:**

Adjustable guards, like fixed guards, are permanent, but they can be adjusted to allow the machine to handle different sizes of material. They must be manually adjusted and locked into place, so all employees who will operate adjustable guards must be trained on their use. If improperly adjusted or locked, adjustable guards can fail to prevent contact with moving parts, causing serious or even fatal injury.

Safeguarding Action: Provides a barrier that may be adjusted to facilitate a variety of production operations.

Advantages :

- Can be constructed to suit many specific applications.

- Can be adjusted to admit varying sizes of stock.

Disadvantages:

- Hands may enter danger area - protection may not be complete at all times.
- May require frequent maintenance and/or adjustment.
- The guard may be made ineffective by the operator.
- May interfere with visibility.

- **Self-Adjusting**

Self-adjusting guards serve the same purpose as adjustable guards, but automatically adapt to the size of the material. When the machine is at rest, these guards sit all the way down. When the machine is in use, the operator feeds material into the machine, which opens the guard just enough to let the material in. These guards are commonly found on table saws and woodworking tools.

Safeguarding Action: Provides a barrier that moves according to the size of the stock entering the danger area.

Advantages:

- Off-the-shelf guards are often commercially available.

Disadvantages:

- Does not always provide maximum protection.
- May interfere with visibility.
- May require frequent maintenance and adjustment.

SAFETY IN TURNING

Metal turning lathes, particularly centre or engine lathes, are commonly used for machining metal parts. A workpiece secured in a chuck is turned against a tool which cuts metal from the workpiece. Parts are created by turning the workpiece in one or both ends of the lathe, and changing its shape using tools with specific cutting edges.

General Lathe Safety:

- All stock must be properly secured in the lathe chuck or mounted prior to the machining process taking place. Use the correct sized clamp or vise for the stock being machined.

- Turn the chuck or faceplate by hand to ensure there is no binding or danger of the work striking any part of the lathe.
- Check to ensure the cutting tool will not run into the chuck or lathe dog. If possible, feed away from the chuck or dogs.
- When using wood, do not mount a split workpiece or one containing knots.

Before Starting the Lathe:

- Before starting the lathe, ensure the spindle work has the cup center imbedded; tail, stock and tool rests are securely clamped; and there is proper clearance for the rotating stock.
- Prior to starting the lathe, ensure that small diameter stock does not project too far from the chuck without support from the tail stock center.

While in Operation:

- When roughing stock, do not force the tool in the work piece or take too big a cut.
- The operator must always be aware of the direction and speed of the carriage or cross-feed prior to engaging the automatic feed.
- When an operator has finished working on the lathe, and before leaving the lathe for any reason, the power must be shut off and the machine must come to a complete stop.
- Stop the machine immediately if odd noise or excessive vibration occurs.

The Chuck

- Never leave the key in the chuck. Do not let go of the key until it is free of the chuck and secured in its proper holding place.
- Never attempt to run the chuck on or off the spindle head by engaging the power.
- Do not stop the rotation of the chuck by reversing the power to the lathe unless tapping holes.

Turning Speed

- Select turning speed carefully. Large diameter stock must be turned at a very low speed. Always use the lowest speed to rough out the stock prior to final machining.
- The correct speed and feed for the specific material and cutting tool must be used. Stop the machine before making adjustments or measurements.

SAFETY IN GRINDING

All types of grinding machines, whether pedestal, bench mounted, free-standing or portable, can be potentially hazardous if they are not well maintained and used correctly. In addition to the common hazards of flying particles, dust and sparks, shattering abrasive wheel while in Motion can cause severe injury to both the user and others.

Safety measures:

- Guards must be provided and adjusted properly as per the manufacturers manual. Replace damaged guards because if an abrasive wheel breaks while rotating, it can cause a serious injury.
- Before use, check the manufacturer's stated running speeds, or markings on the grinder, and grinder wheel for the maximum speed that it can be used.
- Clean and service grinders according to manufacturers recommendations. Record all maintenance for grinders.
- Ensure that a machine will not operate when unattended.
- Wear safety glasses or goggles, or a face shield (with safety glasses or goggles) to protect against flying particles. Gloves, aprons, metatarsal safety boots, hearing protection, and respiratory protection may be required, depending on the work.
- Ensure the floor around the work area is clean.
- Do not use wheels that are cracked or those that excessively vibrate.
- Do not operate grinder on wet surface.
- Keep the power cord away from the grinding wheel and the material being ground.
- Make sure the work area is clear of flammable materials and that combustible dust is not allowed to accumulate.
- Never adjust the workpiece or work mounting devices whenthe machine is operating
- Do not exceed recommended depth of cut for thewheel or machine.
- Remove workpiecefrom grinding wheel before turning machine off.
- Use proper wheel guards on all grinding machines

SAFETY IN GAS-WELDING (CUTTING)

Since gas welding process uses gases like acetylene and oxygen to produce flames. Acetylene is flammable and hazardous. It has the ability to ignite and condense. Whilst, oxygen helps other substances to burn faster. It does not catch fire but can explode if exposed to fire.

Personal protective equipment:

Eye goggles or safety glasses should use to protect the eye from infrared radiation. Protecting clothing such as flameproof apron, gloves, cap or helmet, and booth should be wear before welding.

The apron should be well fitted to avoid fraying. The shirt should be long sleeves and trousers should be long enough tocover the top of the booth. Protective clothing should be free from oil or grease. All these clothing should be in good condition before operators or students use them.

Storage and Handling Safety:

Cylinders should not be exposed to heat and should be securely chained to prevent from falling. They should be kept away from flammable and combustible materials, same as in upright (vertical) position. They should be store in a well-ventilated area, Acetylene and oxygen cylinders should be store separately. It should not be a drag, but rolling on a slow movement on bottom edges.

Valves on cylinders should be close before moving. Regulators and protective caps should be kept in place. Keep hands off grease or oil when opening or closing valves and regulators

Environmental safety:

Industries or shops where gas welding is used should have proper ventilation, lighting, walkways, store, escape route, safety poster, etc. The floor should be kept clean, free from water grease, and oil. Fire extinguishers should be easily accessible and welded jobs should be properly stored.

Operation and equipment safety:

Flame arrestors must be fitted in acetylene and oxygen cylinder lines. One of them should be fitted beside the low-pressure regulator and the other near the touch. Higher pressure should release on oxygen than acetylene to avoid acetylene flame from going back. However, acetylene should not be used when welding at a pressure exceeding 1bar of atmosphere gauge to avoid explosion.

Whenever a backfire occurs, the oxygen valve should be close first and acetylene should follow immediately. It should be rectified before operations continue. In case of flashback(explosion in gas hose), the first thing to do is to set bot cylinder valve apart. Whenever a flashback occurs, all hoses should be replaced with new ones.

SAFETY IN ARC-WELDING (CUTTING)

Arc welding is a type of welding process using an electric arc to create heat to melt and join metals. A power supply creates an electric arc between a consumable or non-consumable electrode and the base material using either direct (DC) of alternating (AC) currents.

Welding tools & Equipment Safety

- All welding machine should be properly ground/earthed connection must need.
- Welding machine switch board and fuse should be proper
- Do not over load and heat welding machine.
- If any abnormal sound, then call the expert and get itrectified
- Electrode holder insulation is must.

Personal Safety

- Welder has to protect eyes from - welding infra-red rays, ultra violet light, flying sparks, spatter, hot slag partial, and hot electrode stub.
- In helmet and head screen special filter glass must befitted.
- Welder must wear lather apron, Hand glove, Leg guards,Safety boots.
- Welder must protect from welding fumes, Gases, dusts.
- All welder must aware about Health protection andventilation.

List of Recommended Welding Safety Gear:

- Earplug or muffs when the noise is high
- Leather safety boots
- Leather gloves.
- Safety glasses or a welding helmet with a cover plate: the cover plate's opaqueness is important and dependent on the kind of materials being welded.
- Respirators for protection from the toxic perfumes
- Do not operate the welder if any of the clothing is wet.
- A person who uses a pacemaker is advised not to do thewelding.

SAFETY IN POWER PRESS

"Power press machine" means a machine on which metallic or non-metallic substances are subjected to the operations like blanking, coining, curling, drawing, embossing, forming, piercing, punching, perforating, reaming, trimming, bending, pressing, stamping, raising, mould-making and similar purpose. The press is a metal forming machine tool designed to shape or cut metal by applying mechanical force or pressure.

Safety Devices for power presses

(a) **Two Hand Control Devices** - The following provisions are required to the power press machine which must be equipped with two hand control devices, namely:-

(i) A two hand operating device needs to be so designed as to require the simultaneous use of both hands to actuate the stroke of the press. It shall be so designed, located and d arranged as to prevent tying, wedging or otherwise securing one handle or button and operating the press with other hand only.

(ii) Where two or more workers are engaged in operation of a single press, separate two hand control devices need to be provided for each worker and individual hand controls needs to be operated concurrently for actuation of stroke;

(b) **Presence Sensing Safety Devices** - The following provisions needs to be provided where power press machine is equipped with presence sensing safety devices, namely;-

(i) The Presence Sensing Safety Devices needs to be located and adjusted so that it will respond to any instruction at or before the safe distance and clutch of the press will get deactivated.

(ii) The effective sensing field of the device needs to be located at a distance from the nearest point of operation hazard soany part of the body of an individual cannot reach to the danger zone before motion of the ram stops.

SAFETY IN MILLING MACHINE

Milling refers to the process of removing material from a workpiece with the help of rotary cutters. The process of milling helps in flattening, tapering, curving or carving the workpiece with irregular patterns at various angles by using a rotating cutter that has different types of abrasive edges. A typical milling machine comprises of a milling machine spindle that is powered by a motor and that causes the milling cutter to revolve; the other important component

of a milling machine is its worktable which can be adjusted to feed the workpiece to the cutter as required.

Safety precautions for Milling Machine :

1) Never operating unaccompanied

Operating intentional safety slip. We must always have at least one personaround at the work-site to rush one another to medical assistance if the need arises.

2) Pre-inspecting the machine

Prior to commencing the milling operation, the milling machine should be inspected thoroughly for the presence of any damaged parts or malfunctioning components. If any such components are found, they should be replaced by experienced personnel. Moreover, the machine must never be tended to or serviced, when power is connected.

3) Wearing adequate safety gear

The operator must wear adequate safety gear before beginning operation. Must-have safety essentials around milling machines include safety glasses to protect the eyes from any stray particles that might accidentally fly into them, damaging the vision partially or completely and ear protection to protect any hearing loss from surreptitiously settling in.

4) Keeping away from revolving cutter

Obvious as it may sound, while operating a milling machine, the adequate distance must be maintained from the revolving cutter. Extra care must be taken when dismantling or setting the milling cutter up; it must be held using a spare cloth to prevent its sharp edges from cutting through the skin.

5) Removing chips

Always use a brush and a rake to remove chips from the work- piece to avoid being cut or scraped in the hands.

6) Using cutting oil with care

Many times, the use of cutting oil is required to facilitate the milling action. The cutting oil may splash back at the operator to prevent this, use splash guards. If the cutting oil scatters on the floor, we might slip and accidentally strike the milling machine; this must be avoided at all times and the floor must be kept clean.

MATERIAL HANDLING

Material handling is the movement, protection, storage and control of materials and products throughout manufacturing, warehousing, distribution, consumption and disposal. As a process, material handling incorporates a wide range of manual, semi-automated and automated equipment and systems that support logistics and make the supply chain work.

Material handling involves movements of material mechanically or manually in batches or one by one within the plant. Movement may be horizontal, vertical or a combination of the two. Design and operation of an efficient production plant requires a good and effective material handling system for moving the materials from one stage of production to another.

Safety in material handling:

The National Safety Council suggests employers relay the following information to employees to help reduce workplace incidents when handling and moving materials:

- Avoid lifting materials from the floor or while seated.
- Make use of available handling aids.
- Refrain from using sudden or jerky movements
- Never lift a load over an obstacle.
- Perform lifts in areas with adequate footing, space and lighting
- Modify objects and redesign jobs to make moving easier.
- Seek assistance from co-workers.
- Stay in good physical shape.
- Begin lifts close to the body.
- Use containers made of lighter materials.
- Reduce load sizes when possible.
- Do not twist or bend while lifting objects.
- Ensure repetitive, heavy and bulky lifts are not performed.
- Keep lifts between shoulder and knuckle height.
- Use conveyors, slides or chutes to eliminate pushing or pulling.

TYPES OF MATERIAL HANDLING EQUIPMENTS

Material handling equipment are divided into the following four categories. Each tool assists with the operations process and is used to handle large volumes of material.

Transporting

Transport equipment is used to move materials from one location to another. This could be moving a material between workspaces or from a loading dock to a storage facility.

This saves workers from having to lift and transport heavy materials which is time consuming, and potentially dangerous.

Types of transporting equipment includes:

Conveyors - These are used when material is frequently moved between specific points over a fixed pathway when there is a sufficient flow volume.

Cranes - These are used to transport materials over horizontal and vertical paths. Cranes are more flexible than conveyors as they can handle a variety of shapes and weights. This increases productivity and makes best use of floor space.

Industrial trucks - These are used to move materials over variable paths. These transportation devices can include small hand-operated trucks, pallet jacks, and various kinds of forklifts. Trucks can also be manual or powered operation can either be walk or ride. This requires a user to manually push them or to ride along on the truck.

Manual handling equipment - These are often used to move smaller pieces of equipment where larger tools would struggle. They include pallet trucks, trolleys, and sack trucks.

Storage

Storage equipment is used to store materials in a factory or warehouse before they are transported elsewhere. They could be stored for a period of time due to temporary pauses during transportation or for long-term storage to allow the buildup of stock.

These types of equipment aim to make material easily accessible, and maximize the use of space. If materials are stacked directly on the floor, then storage equipment is not necessary. However, it makes sense to stack products at different heights to make the most out of space. Factories and warehouses usually have rows of shelves, each packed with different materials.

This increases space utilization, as storage racks can be used to allow multiple stacks of different items to occupy the same floor space at varying levels. Storage handling equipment includes pallet racking, stacking frames, shelving, and mezzanine flooring.

Positioning Equipment

This equipment is used to handle materials at a specific location and move into the correct position for subsequent, handling, transporting, or storage.

This enhances productivity as the machine can handle large volumes of material, rather than relying on an employee to move everything into position by hand. Moreover, this reducesthe chance of damage to materials due to human error or a lack of attention.

It can also help to reduce fatigue and hazards when handling materials which are heavy and awkward to manoeuver. Examples of positioning equipment include material lifts, electric chain hoists, glass suction lift, and barrow chains.

MANUAL MATERIAL HANDLING

Manual material handling (MMH) means manually moving or handling things by lifting, lowering, pushing, pulling, carrying, holding or restraining. MMH is also the most common cause of occupational fatigue, low back pain and lower back injuries.

Potential Manual Material Handling Hazards for Workers

Workers frequently cite the weight and bulkiness of objects that they lift as major contributing factors to their injuries. Bending, followed by twisting and turning, were the more commonly cited movements that caused back injuries. Other hazards include falling objects, improperly stacked materials and various types of equipment. The employer should make their employees aware of potential injuries that can occur when manually moving materials including the following:-

- Strains and sprains from lifting loads improperly or from carrying loads that are either too large or too heavy;
- Fractures and bruises caused by being struck by materials or by being caught in pinch points, and
- Cuts and bruises caused by falling materials that have been improperly stored or by incorrectly cutting ties of other securing devices

Precautions to Be Taken During MMH:

When moving materials manually, workers should attach handles or holders to loads. In addition, workers should always wear appropriate personal protective equipment and use proper lifting

techniques to prevent injury from oversize loads. Workers should seek help during the following:-

- When a load is so bulky that employees cannot properly grasp or lift it;
- When employees cannot see around or over a load or;
- When employees cannot safely handle a load.

Using the following personal protective equipment prevents needless injuries when manually moving materials:-

- Hand and forearm protection such as gloves for loads with sharp or rough edges
- Eye protection
- Steel toed safety shoes or boots
- Metal fiber or plastic metatarsal guards to protect the in-step area from impact or compression

Steps for Manual Lifting

- Keep feet apart to give a balanced and stable base for lifting
- Bend the knees so that the hands are as near to the waist as possible
- Keep the back straight, chin tucked-in, lean over the load if necessary [Shoulders in same direction as hips]
- Try to keep the arms within the boundary formed of the legs
- Carry out lifting smoothly without jerk
- Then adjust if precise positioning is necessary
- Give a command to gain group efforts in synchronized ways

Additional Safety Practices in Manual Handling

- Restrict the load to 55 Kg (as per Indian Statute)
- Trial lift before actual lifting
- Ascertain, intended path of movement is clear

The above mentioned procedure shall help the people to safely handle the material manually. Proper manual material handling training should always be considered to avoid manual material handling hazards and thereby safe work performance.

MECHANICAL MATERIAL HANDLING

Heavy materials which are not safe to handle manually must be handled by mechanical means and this includes lifting, transporting, stacking, loading and unloading by means of palletizer, chain pulley block, forklifts, conveyors or cranes and hoists. Mechanical material handling avoids a high risk of musculoskeletal disorders resulting from manual material handling.

Mechanical material handling helps increase levels of productivity in the workplace. Machines can do many tasks more quickly and efficiently in less time which human cannot do.

To operate these machines and tools, great skill is required, otherwise there is a potential risk of harming the personnel. Inspection, preventive maintenance and testing are very necessary to maintain these machines and tools. All lifting machines must have a valid OSHA inspection certificate by a competent person. The validity of most tools is six months, while lifting machines, including the forklift, have a certificate validity of one year.

Before using any tools or machines, personnel should be aware of the hazards associated with each job and should know the safety measures to avoid unwanted incidents.

Hazards in Mechanical Material Handling .

- Use of equipment and machinery without valid inspection certificates.
- Inadequate and wrong selection of handling tools and machines.
- Mechanical damage and faulty equipment.
- Congested space for operation.
- Overloading of machines, tools and equipment.
- Incompetent operator.
- Loading and transporting unbalanced materials.
- Poor rigging and lifting.
- Over speeding and unauthorized operation
- Use of machines without machine guard.

Risk in Mechanical material handling

- Poorly maintained tools, equipment and machines are prone to accidents due to failure of electrical, mechanical, and hydraulic systems that can cause serious injury to personnel and property damage.
- Risk of load failure due to inadequate and incorrect selection of handling tools and machinery.
- There is a risk of collision with property or personnel due to congested operating space.
- An untrained and unauthorized machine operator can cause serious accidents and injure other personnel.
- Risk of material failure during handling due to overloading of machines, tools and equipment.
- Equipment can fall due to improper loading & transportation, poor rigging and lifting, and over can fall due to improper loading and over speeding by unauthorized operation
- The use of machines without guards presents a high risk of serious injury.

Safe Mechanical Material Handling Do's and Don'ts

Following Do's and Don'ts of mechanical material handling can help to educate workers to prevent the injury and property damage.

Dos

- Use lifting tools and hoists of adequate capacity.
- Only authorized persons should use the equipment and machines.
- The identification number and the safe working load must be marked on all tools and hoists.
- Check the functioning of emergency switch, limit switches and over load alarm before actually starting the operation of lifting machines.
- Estimate the weight, distance, and hazards before lifting the load.
- Store lifting tools and hoists in a designated location.
- Use appropriate personal protective equipment
- Keep the speed slow while approaching at destinated location.
- Stay alert and maintain eye contact on load and nearby man movement.

- Special care should be taken when using the forklift and other portable hydraulic equipment.
- When lifting the load with slings, make sure that all sharp corners are padded with soft material.
- Barricade the area where the lifting operation is performed.
- Use appropriate plate clamps to lift metal plates.
- Use beam clamps for lifting beams.
- Use an appropriate guide rope while lifting and shifting the material.
- Apply an appropriate protective coating to keep tools in good condition.

Don'ts

- Don't use faulty tools and tackles.
- Don't stand under a suspended load.
- Don't lift the metal plates by using web slings only.
- Don't use the equipment for any other purpose than intended
- Don't allow personnel to move underneath lifted load.
- Don't load the machines and equipment above its safe working load.
- Don't use makeshift arrangement for lifting the material.
- Don't use equipment, tools, hoist and tackles with a missing label or tag.
- Don't drag chains, ropes or cables on the floor.
- Don't use chemical contaminated web slings, wire sling or belt without re-inspection.
- Don't use a hoist, slings, chains and other lifting tools and tackles that have lost more than 10% of its breaking strength.

MANUAL HANDLING RISK ASSESSMENTS

A manual handling risk assessment is carried out to identify hazardous manual handling tasks and come up with measures to eliminate manual handling or put in place controls to prevent injuries. The assessment must consider the task being carried out, the people who are doing it, the type of load being handled and the environment the task is taking place in. Steps must then be taken to reduce the risks identified.

If an organisation employs five or more people, the results of the risk assessment must be recorded or if it is difficult explain or recall then the assessment and findings should also be written down and used for reference or training.

As for when a manual handling risk, assessment should be performed, the Health and Safety Executive (HSE) says it should be carried out "every time there are new machines, substances and procedures, which could lead to new hazards". Assessments should also be reviewed periodically and in particular if there is evidence from inspections or accident reports.

In order to be 'suitable and sufficient the manual handling risk

- Consider the four risk factors: Load, Individual, Task, and Environment.
- Identify people at risk
- Identify what is provided to control the risk.
- Identify further action and who needs to carry it out.
- Documented

The four risk factors are:

- **Load** e.g. heavy, bulky, unwieldy, unstable, sharp or difficult to grasp
- **Individual capability** e.g. strength of person, male or female, age, existing health issues
- **Task** e.g. pushing, pulling or carrying, posture, distance, repetition, number of people
- **Environment** e.g. space around the operation, type of flooring, temperature, lighting, requirement for bulky PPE

Once we have identified the hazards and completed the risk analysis, taking into account any existing control measures, identify and record the actions required to reduce the risk to as low as reasonably practicable.Once we have identified the required actions, outline these in a workable action plan, identifying specific individuals or groups who will need to implement those actions, and the timeframe within which they are to be completed.

Once this has been completed, obtain a signature of approval for the risk assessment. This should be a relevant supervisor (i.e. person with overall control over the activity). This is especially important where risks identified as Medium or High cannot be reduced to 'Low'.

Assign a frequency of review. For those activities where the risk factors can regularly change or where the risks have not been reduced to 'Low', then this should be annually.

Identify Manual Handling Operations

Many manual handling or lifting operations can be undertaken without any significant risk of injury. Therefore, the first stage to any assessment is to identify those manual handling and lifting operations that are likely to involve such a risk.

Use the below figure to make a quick and easy assessment. Each box contains a guideline weight for lifting and lowering in that zone. As can be seen, the guideline weights are reduced if handling is done with arms extended, or at high or low levels, as that is where injuries are most likely to occur.

Observe the work activity and compare it to the diagram. Decide which box or boxes the lifter's hands pass through when moving the load. Assess the maximum weight being handled. If it is less than the figure given in the box, the operation is within the guidelines. If the lifter's hand enter more than one box during the operation, use the smallest weight. Use an in- between weight if the hands are close to a boundary between boxes.

The guideline weights assume that the load is readily grasped with both hands and that the operation takes place in reasonable working conditions, with the lifter in a stable body position.

Frequent Lifting & Lowering

The guideline weights are for infrequent operations - about 30 operations per hour - where the pace of work is not forced, adequate pauses to rest or use different muscles are possible, and the load is not supported by the handler for any up to length of time. Reduce the weights if the operation is repeated more often. As a rough guide, reduce the weights by 30% if the operation is repeated once or twice per minute, by 50% if the operation is repeated five to eight times a minute, and by 80% where the operation is repeated more than 12 times a minute.

Pushing & Pulling

The task is within the guidelines if the following figures are not exceeded:

Activity	**Men**	**Women**
Force to stop or start the load	20Kg	15 Kg
Sustained force to keep the load in motion	10Kg	7Kg

The filters should be used as guides. If there is any uncertainty a full assessment should be completed. The HSE indicate that an assessment will always be required when:

- Lifting or lowering takes place with very large forward reaches, lifting below floor level, or lifting above head height.
- The handling is more frequent than one lift every two minutes.
- The handling involves torso twisting.
- Team handling occurs.
- The activities are complex.
- The load is difficult to grasp or handle.
- Aspects of the working conditions are not favourable.
- The load is not held against the body when carried.

If the filters do not indicate a need for a detailed assessment, it is sufficient to record the outcome of this initial assessment within general risk assessments, rather than detailing specific assessments.

MAINTENANCE OF MATERIAL HANDLING EQUIPMENTS

The proper maintenance of material handling equipment is extremely essential for preventing the occurrence of bottlenecks or points of congestions. Production line flow can be maintained only if the material handling equipment is in the proper working order.

Preventive maintenance is by far one of the best maintenance techniques suggested for material handling equipment. By preventive maintenance, the equipment can be kept running thereby minimizing costly interruptions in the production schedule. A little periodic inspection and minor adjustments may be enough to prevent equipment breakdown.

Preventive maintenance consists of frequent inspections and examination of the material handling equipment, with special attention to the components requiring it. The aim is to uncover conditions leading to breakdown or harmful depreciation. Preventive maintenance also includes lubrication, adjustment, or repair while the equipment is still in a minor stage of defect. Three stages of preventive maintenance are:

(a) Inspection,

(b) Repair,

(c) Overhaul.

The maintenance system for a few material handling equipment like cranes, hoists, and conveyors has been discussed below:

Hoists and Cranes:

(a) Inspection:

All parts, open or covered are inspected for wear and tear. Worn out or unworkable components like wire ropes, wheels,bearings, bolts, etc., are removed. Brakes are adjusted and lubrica-tion is provided wherever necessary.

(b) Repair:

The repairable parts of the system, after inspection are corrected for small repairs and minor defects are rectified. Systems like open gear transmission, couplings, riveted, and bolted joints, trolley, brakes, guards, etc., may be repaired.

(c) Overhaul:

Overhauling involves dismantling the complete-mechanism and replacing all dam-aged components. Crane structure, buffers, rails, open gear transmission, pulley blocks, etc., may be replaced and various sub-mechanisms may be aligned and adjusted.

Conveyors:

(a) Inspection:

Belts or rollers are inspected for tensions and wear and tear. Gear box is properly lubricated, various fasteners are tightened and safety guards are checked.

(b) Repairs:

Rollers and belts are checked, adjusted^ repaired. Couplings, packings, safety guards, steel structures, gear transmission, bearings, fastener joints, threaded components, etc., are adjusted or repaired as per their conditions.

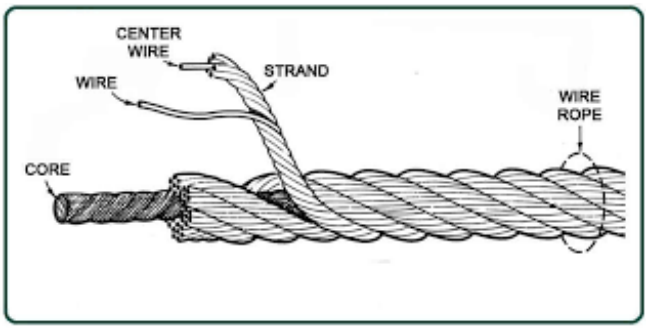
(c) Overhaul:

The conveyor system is completely dismantled. Components, worn out and beyond repair like belts, bearings, packings, oil seals, rollers, drums, fasteners, and couplings are replaced. Structures, safety guards, etc., may be repaired as per their conditions.

MAINTENANCE OF HANDLING EQUIPMENT COMMON ELEMENTS

(i) Wire Rope

Wire rope is several strands of metal wire twisted into a helix forming a composite rope, in a pattern known as laid rope. Larger diameter wire rope consists of multiple strands of such laid rope in a pattern known as cable laid.



- Put on gloves before handling and checking the condition of the wire ropes.
- Wire ropes should be cleaned at intervals using a brush to remove hardened deposits of grease, which prevent the penetration of lubricants.
- Do not use solvents for cleaning. They may destroy the textile or synthetic components which make up the wire rope.
- The wire rope must be checked over its entire length.
- Check the level of wear and the proper functioning of the sheaves: One defective sheave in a circuit may result in premature wear to the wire rope.
- Apply grease using the product recommended by the manufacturer. The lubrication intervals must take the specific conditions of usage into account: proximity tocoast, metallurgical or chemical environment, harsh climatic conditions, etc.
- All wire ropes showing a broken strand, a collection of visible broken wires, deformation, corrosion, kinks, pleats, crushing, etc. should be scrapped.
- A worn or damaged wire rope should only be replaced with a rope manufacturer. recommended by the equipment
- When replacing the wire rope, it must be possible to brake the drum (coil) to prevent the rope from unwinding too fast or dragging when winding up.

- The length of the new wire rope should match the crane configuration and should cover all drum winding layers.

(ii) **Chains Slings**

Lifting slings are an essential facet of the lifting equipment. Slings come in many different types, including chain slings, wire rope slings, polyester webbing and round slings, etc. Each sling will have its own individual purpose, for example, polyester webbing slings are ideal for maneuvering objects which could be damaged by a chain or wire rope sling.

Maintenance of Chain slings

- A thorough examination must be carried out by a competent person at least every 12 months or more frequently according to statutory regulations, type and frequency of use.
- Chains with bent links or with cracks or gouges in the link should be replaced, as should deformed components such as bent master links, deformed hooks and any fittings showing signs of damage.
- Chain and components wear should never exceed 10% of the original dimensions.
- Once a chain sling has been overloaded it must be taken out of service
- Store chain sling on a properly designed rack. Never leave chain slings on the floor where they may suffer mechanical or corrosion damage.
- Alloy chain slings should not be used in acid or caustic nor solutions in heavily acidic or caustic laden atmospheres. The heat treated alloy material used for alloy steel chains and components is susceptible to hydrogen embrittlement when exposed to acids.

- Chain slings must not be heat-treated, galvanized, plated, coated or subject to any process involving heating of pickling. These processes can have dangerous effects and will invalidate the manufacturer's certification.
- Alloy chain slings may be used at temperatures between (-)40°C to 200°C with no reduction in the Working Load Limit. The use of chain slings within the permissible temperature range in the table does not require any permanent reduction in Working Load Limit when the chain sling is returned to normal temperatures. A sling accidentally exposed to temperature in excess of the maximum permissible should be withdrawn from service immediately and returned for thorough examination.

(iii) **Hooks**

A lifting hook is a device for grabbing and lifting loads by means of a device such as a hoist or crane. A lifting hook is usually equipped with a safety latch to prevent the disengagement of the lifting wire rope sling, chain or rope to which the load is attached.

Maintenance of Hooks

- Before use, hooks must be inspected by an experienced rigger.
- Remove a hook from service if any of the following are in evidence:

a. Cracks, nicks or gouges

b. Twist exceeding 10 degrees from plane

c. Damage or malfunction to the latch

d. Throat opening exceeding 15 percent

e. Wear exceeding 10 percent of original dimension

f. Damage from heat

g. Unauthorized repairs

- Cracks, nicks and gouges should be removed by a qualified person. Grind lengthwise, following the contour of the hook.
- If removing the damaged area results in a loss of more than 10 percent of the original dimension, the hook must be replaced.
- Never repair, alter or reshape a hook by welding, heating, burning or bending, unless approved by the hook manufacturer.
- When lifting, ensure the hook, not the latch, supports the load. The sling or lifting device must always be seated properly in the bowl of the hook.
- Never side load, back load or point load a hook. All reduce hook strength and create an unsafe condition. Point loading can reduce hook capacity as much as 60 percent.

(iv) **Clamps**

A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. There are many types of clamps available for many different purposes. Some are temporary, as used to position components while fixing them together, others are intended to be permanent.

Maintenance:

- To make sure the clamp works efficiently, it is important to keep all the parts clean. Any dirt may damage the ability of the tool and stain the surface of the workpiece during clamping.
- After every use wipe the clamp with a dry cloth to clear any dust or debris that may have built up.
- Regularly oil all the moving parts to keep them in tip-top condition and prevent rust from developing .
- Store the clamp in a safe and dry place, such as on a shelf in a garage or work shed.

HEARING CONSERVATION PROGRAM IN PRODUCTION INDUSTRIES

Hearing conservation programs are designed to prevent hearing loss due to noise. Hearing conservation programs require knowledge about risk factors such as noise and ototoxicity, hearing, hearing loss, protective measures to prevent hearing loss at home, in school, at work, in the military and, and at social/recreational events, and legislative requirements.

Regarding occupational exposures to noise, a hearing conservation program is required by the Occupational Safety and Health Administration (OSHA) "whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels (dB) measured on the A scale (slow response) or, equivalently, a dose of fifty percent." This 8-hour time- weighted average is known as an exposure action value.

Benefits of Hearing Conservation

Prevention of occupational hearing loss benefits the employee by preserving hearing abilities which are critical to good quality of life: interpersonal communication, enjoyment of music, detection of warning sounds, and many more. The HCP provides a health screening benefit, since non-occupational hearing losses and potentially treatable ear diseases are often detected through annual audiograms. Lowering noise exposure also reduces potential stress and fatigue related to noise.

The employer benefits directly by implementing an effective HCP which maintains employees' good hearing, since workers will remain more productive and more versatile if their communication abilities are not impaired. HCPs can reduce accident rates and promote work efficiency.

The key elements of a hearing conservation program:

1. **Noise monitoring** - this is measuring the noise levels in the workplace, the intensity, or loudness, and the duration. We can use either:

   Area monitoring :- measure the average levels in the workplace using a sound level meter. OR

   Personal noise (dosimetry) :- the worker wears a microphone clipped on the shoulder, near the ear, and exactly what they're exposed to all day is measured, which gives a more accurate measurement of unprotected noise exposure.

2. Audiometric testing - the annual hearing test for all employees that are enrolled in the hearing conservation program. It has to be done in an appropriate test environment, like an audio booth or a very quiet room.

3. Hearing protection selection and fit testing - the employer must provide hearing protection in a variety of types with suitable attenuation characteristics. Earplug fit-testing determines if employees are receiving optimal protection for their noise environment, require additional training, or need a different model of hearing protector.

4. Employee training and education - training should include information on the effects of noise, information on hearing protectors, an explanation of a hearing test, and information on the hearing conservation program itself and what is expected of the employee for the program.

5. Record keeping - employers should document the workers' hearing history. When they first start the job, they should have a baseline hearing test, then an annual audiogram after that to look for any changes. All these, along with any evidence of training and education should be kept as a record, as well as any fit-testing results or other relevant documents.

6. Program evaluation constantly evaluate the performance of the program, by asking for employee feedback and reviewing responsibilities and records.