

HOT WORKING PROCESS

Introduction

SAFETY ENGINEERING: - Safety engineering also is the key component for eliminating hazards that would otherwise be controlled by either administrative controls or use of personal protective equipment as a barrier between a hazard and a worker.

What is the need of safety in engineering industries?

Safety is important in engineering industries because it protects workers and their families from accidents that can cause injuries or loss of life.

Some ways to ensure safety in engineering industries:

- **Design and build safety equipment:** Industrial safety engineers design and construct safety systems to determine the safest ways to do business.
- **Emergency preparedness:** Have a plan for what to do in an emergency, including evacuation routes, fire-fighting equipment, and medical supplies.
- **Hazard identification and risk assessment:** Identify and verify hazards to prevent accidents from reoccurring.
- **Quality assurance and compliance:** Ensure products are safe and compliant with regulatory agencies.
- **Communication:** Have an open-door policy so employees can report issues directly. Post safety rules and remind staff of emergency procedures.
- **Leadership commitment:** Leaders should establish policies and procedures, provide resources, and foster a culture of safety.

What is Hot Work?

- Hot work is any process that can be a source of ignition when flammable material is present or can be a fire hazard regardless of the presence of flammable material in the workplace.
- Common hot work processes are welding, soldering, cutting and brazing. When flammable materials are present processes such as grinding and drilling become hot work processes.

Examples of Hot Working Process:

- Welding

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld.

- Soldering

Soldering is a process in which two or more metal items are joined together by melting and flowing a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal. Soldering differs from welding in that soldering does not involve melting the work pieces.

- Brazing

In brazing, the filler metal melts at a higher temperature, but the work piece metal does not melt. In the past, nearly all solders contained lead, but environmental concerns have increasingly dictated use of lead-free alloys for electronics and plumbing purposes.

- Cutting

- Metal cutting
- Cutting has been at the core of manufacturing throughout history. For metals many methods are used and can be grouped by the physical phenomenon used.
- Chip forming - sawing, drilling, milling, turning etc.
- Shearing - punching, stamping, scissoring.

- Abrading - Grinding, lapping, polishing; water-jet.
- Heat - flame cutting, plasma cutting, laser cutting.
- Electro-Chemical - Etching, Electrical discharge machining (EDM).
- Foundry operation

Foundry is a operation where castings are produced by melting metal, pouring liquid metal into a mold, then allowing it to solidify.

Different Processes of Foundry Operation

- **Melting:** The process of melting metal in a furnace at a high temperature, which can reach up to 2700°F.
- **Degassing:** A technique to reduce the amount of hydrogen in the molten metal.
- **Mold making:** The process of creating a mold for the metal to be poured into. Silica sand is a common mold material, but other materials can be used depending on the metal and method.
- **Pouring:** The process of pouring the molten metal into the mold. This can be done by gravity, or with the help of a vacuum or pressurized gas. Modern foundries often use robots or automatic pouring machines.
- **Cooling:** The metal is allowed to cool in a controlled process.
- **Removal:** Once the metal has solidified, the casted part is removed from the mold.
- **Cleaning and finishing:** The object is cleaned and finished, which can include fettling to remove excess material.
- **Inspection:** The finished casting is inspected by the foundry before being shipped.

Flow sheet for foundry operation including use of different types of furnaces

A foundry operation flow sheet typically includes: raw material preparation, charging into a melting furnace (like cupola, induction, or crucible depending on the metal type), molten metal pouring into molds, cooling and solidification, degating and cleaning, inspection, and finally, finishing operations; with different furnace types selected based on the desired metal quality, production volume, and specific alloy requirements.

➤ **1. Raw Material Preparation:**

Scrap collection: Sorting and segregation of different metal scrap types.

Cleaning: Removal of dirt, rust, and other contaminants through processes like shot blasting or pickling.

Weighing: Accurate measurement of scrap charges for precise alloy composition.

➤ **2. Melting in Furnace:**

Cupola Furnace: Primarily used for large-scale cast iron melting, utilizing a fuel (coke) to heat the charge with hot air blast.

Charging: Pig iron, scrap, and flux are loaded into the cupola.

Melting: Molten iron is tapped from the bottom, often with slag removal.

Induction Furnace: Ideal for high-quality alloys due to precise temperature control and rapid melting.

Charging: Scrap metal is placed in the crucible within the coil.

Melting: Electromagnetic induction heats the metal directly.

Crucible Furnace: Suitable for smaller batches or specialty alloys, often used with a fuel-fired heating system.

Charging: Scrap metal is loaded into the crucible.

Melting: Heated by external flame, then molten metal is poured from the crucible.

➤ **3. Molten Metal Handling and Pouring:**

Ladle Transfer: Molten metal is transferred from the furnace to a ladle for pouring into molds.

Temperature Control: Monitoring and adjusting the temperature of the metal using thermocouples.

Alloying: Addition of alloying elements to achieve desired properties.

➤ **4. Molding Process:**

Pattern Making: Creating a wooden or metal pattern representing the desired casting shape.

Mold Preparation: Making a mold cavity using sand or other materials based on the pattern.

Mold Assembly: Assembling the mold components to form the complete mold cavity.

➤ **5. Pouring and Solidification:**

Pouring: Carefully pouring the molten metal into the mold cavity.

Cooling and Solidification: Allowing the metal to solidify in the mold.

➤ 6. Finishing Operations:

Shakeout: Removing the sand mold from the casting.

Cleaning: Removing any remaining sand or slag through processes like tumbling, shot blasting, or grinding.

Inspection: Quality checks for defects using visual inspection, ultrasonic testing, or X-ray.

Heat Treatment: Optional process for improving mechanical properties by heating and controlled cooling.

What is die casting operation?

Die casting is a manufacturing process in which molten metal is poured or forced into steel molds. The molds also known as tools or dies are created using steel and are specially designed for each project. This allows each component to be created with accuracy and repeatability.

Some common health problems in metal casting foundries include:

- Breathing problems
- Burns
- Crush injuries
- Skin problems
- Electric shock
- Eye injuries
- Strains and back injuries

Health hazards and safe methods of operation in Die casting

- **Personal protective equipment:** Wear heat-resistant personal protective equipment to avoid burns from molten metal, hot castings, and hot oil.
- **Inspect and maintain machinery:** Regularly inspect and maintain casting machinery and materials to ensure they are in optimal working condition.
- **Inspect before use:** Regularly inspect castings during the manufacturing process to identify potential problems early.
- **Proper ventilation:** Ensure proper ventilation in the manufacturing area to reduce the risk of exposure to harmful gases.

- **Reduce moisture:** Moisture in the furnace melting crucible, pouring ladle, or sand mold can cause energetic reactions when the metal heats up.
- **Avoid defective equipment:** Do not use any equipment or materials that are defective.
- **Maintain a clean and organized workplace:** Keep the workplace clean and organized to avoid slips and falls.
- **Implement a first aid program:** Have a first aid program in place.
- **Have an emergency response team:** Have an emergency response team in place.

Fettling operations:

Fettling is a metal finishing process that removes excess material from castings to prepare them for use. It's the first step in the finishing process for aluminum sand casting and gravity-die casting.

Fettling involves:

- Removing gates, risers, and cores
- Chipping, cutting, sawing, or abrasive machining
- Chipping off fins and other projections
- Cleaning the casting surface

Fettling can be done using manual cutting, grinding, or automated tools. The type of metal used and the end application determine the level of finishing required for castings.

Shot blasting operations:

Shot blasting is a surface treatment process that uses high-velocity spherical particles to clean, strengthens, or polishes metal:

How it works

A centrifugal wheel or compressed air propels the particles at the surface of the work piece. The force of the particles acts as an abrasive to clean, remove debris, and improve the surface's adhesion quality.

Benefits

Shot blasting is an economical way to prepare metal for processing. It's also efficient and can be used on large surfaces. The process doesn't require harsh chemicals and is easy to clean up.

Uses

Shot blasting is used in many industries that use metal, including aerospace, automotive, construction, foundry, shipbuilding, and rail.

Types of shot blasting

There are two main types of shot blasting: wheel blasting and air blasting. Wheel blasting uses a centrifugal wheel, while air blasting uses compressed air or fluid.

Safety

Shot blasting is performed inside blast cabinets to isolate the equipment and work piece from the environment. It's important to be careful about dust collection and excessive shot blasting.

Sand blasting operations:

Sandblasting, also known as abrasive blasting is a process that uses a high-pressure stream of abrasive material to clean, shape, or remove contaminants from a surface.

Steps for sandblasting:

- Prepare the area: Open the door, place the item inside, and close the door.
- Put on protective equipment: Put on gloves and an N95 mask.
- Turn on the sandblaster: Turn on the power and step on the foot pedal.
- Blast the surface: Use the blast hose or suction gun to blast the surface.
- Blow off the item: Use the blow-off nozzle to remove any remaining material.
- Inspect and repeat: Inspect the surface and repeat the blasting process if necessary.
- Remove the item: Open the door and remove the item.

some safety precautions to take when sandblasting:

- Keep the blasting area free of tripping hazards.
- Don't eat, drink, or smoke in the blasting area.
- Make sure all ventilation, air compressors, power supplies, and wash stations are working properly.

Forging operations:

Forging is a manufacturing process that shapes metal into a desired form by hammering, pressing, or rolling it. The process involves heating the metal to a specific temperature and then deforming it plastically with a hammer or die.

Types of forging processes:

- **Closed die forging**

The heated metal is placed in the bottom die, and the top die is moved towards it to form the part.

- **Open die forging**

The metal is compressed between two flat dies, allowing it to flow laterally. This process is often used to produce larger, simpler parts like bars, rings, and hollows.

- **Seamless rolled ring forging**

A hole is punched in a thick, round piece of metal, then it's rolled and squeezed into a ring. This process uses curved dies instead of flat dies.

- **Roll forging**

Also known as roll forming, this process uses opposing rolls to form the part.

Hazards in forging operation

The most common hazards of forging are burns and smoke/gas poisoning. Working in an industry where smoke or gas are in the surrounding atmosphere all day is damaging, but protective clothing and equipment can reduce this possible damage slightly. It is key to take frequent breaks in the fresh air.

Other possible hazards include:

- Cuts and scrapes
- Crushed fingers
- Sight or hearing damage

- Repetitive strain in the elbow
- Knee strain (due to standing for long hours)

Preventative maintenance of forging machines:

- **Follow manufacturer's specifications:** Use the type and amount of lubricant recommended by the manufacturer.
- **Change lubricants regularly:** Replace lubricants at the recommended intervals to ensure smooth operation.
- **Monitor for contaminants:** Dirt and other foreign particles can decrease the machinery's efficiency.
- **Stock key items:** Stock key items like main gears, eccentric shafts, and rams to avoid long lead times for replacement.
- **Schedule regular inspections:** Schedule and record regular inspections of guards and point of operation protection devices.
- **Train personnel:** Train personnel for the proper inspection and maintenance of forging machinery and equipment.
- **Fasten overhead parts:** Ensure that all overhead parts are fastened or protected so that they won't fall off or fly in the event of failure.

Safe work practices in forging operations:

- Properly maintain the hammer or press. Make sure all nuts and bolts are tight; Make sure you have proper lubrication.
- On a press, if you have leaks, fix them. Hydraulic oil is flammable.
- Make sure that any operator has proper training prior to using the machine.
- Wear proper eye protection & use ear protection.
- Wear safety shoes and proper clothing & verify the dies are tight before forging.

- Always have a clear path between the forge and the hammer and in the workspace around the hammer.
- Use the proper size tongs for holding hot steel.
- Never allow bystanders to be close to the hammer when operating the hammer.
- Make sure they also have proper safety equipment as hot sparks can fly.
- Keep hands clear of the moving parts.
- Make sure the hammer is properly secured to the foundation.
- Keep belt guard and other safety guards attached to the hammer or press.
- Know where the shut-off switches or valves are.
- Never "cold forge" or hit the dies together without steel at forging temperature between them.
Try to hold the work piece parallel with the die surface. If the work piece is at an angle, it can "kick up" and hurt you.
- Hold the tongs to your side, not pointing into your stomach when forging.
- Make sure your shop is properly ventilated.

Above all else, use common sense. Forging can be dangerous.

Safety in use, handling and storage of dies:

- **Remove blocks:** Always remove die storage blocks when using tooling.
- **Be careful with the handle:** Use caution when operating the handle and releasing it to engage the block.
- **Check placement:** Ensure the blocks are properly seated before setting down tooling.

- **Avoid crushing:** Be mindful of the risk of injury to your hands or feet when moving or setting down dies.
- **Clean:** Clean with a non-abrasive detergent.
- **Apply lithium grease:** Use lithium grease on the handle and sliding pins.

Safety on die changing:

When performing a die change on a press machine, safety measures include:

- locking out the machine power
- use appropriate personal protective equipment (PPE)
- Utilizing die safety blocks to support the heavy die during removal and installation.
- Carefully managing pinch points.
- Ensuring proper machine guarding

And following established lockout/ tagout procedures to prevent accidental activation while working in the die area; always prioritize proper training and awareness of potential hazards during the die change process.

Hot Rolling Mills Operation:

- The hot rolling process involves passing heated steel through a rolling mill to shape and reduce its thickness.
- The hot rolling process can:
 - ✓ Increase the strength, toughness, ductility, formability, and weld ability of the metal.
 - ✓ Produce new raw materials for other rolling or metal forming processes.
 - ✓ Create uniform grain structures and volume in the final product.

Hazards in hot rolling operations:

Hot rolling mills are part of the steelmaking process and present several hazards to workers, including:

- **Burns:** The high temperatures of the rolling process can cause burns to workers who touch hot metal or surfaces.
- **Heat stroke:** The high temperatures of the furnace and working shed can cause heat stroke to workers.
- **Eye irritation:** The high temperatures of the furnace and working shed can cause eye irritation to workers.
- **Noise:** The machinery and equipment in steel production can generate high levels of noise, which can lead to hearing loss.
- **Exposure to dust:** Workers can be exposed to dust.
- **Slip and fall:** Workers can slip and fall.
- **Entanglement:** Workers can get entangled with moving stock.

Control measures for the hazards include in hot rolling:

- **Fire safety measures**

Fire suppression systems, fire extinguishers, and smoke detectors can help with fire safety. Employees should also be trained on fire safety protocols.

- **Hearing protection**

ESTD. 2024

Earplugs or earmuffs can help reduce the impact of high noise levels on workers' hearing.

- **Noise assessments**

Regular noise assessments can help prevent noise-induced hearing loss.

- **Noise-reducing barriers**

Engineering controls like noise-reducing barriers can help prevent noise-induced hearing loss.

Safety in hot rolling mills:

- **Machine guarding**-Protect workers from moving parts, belts, pulleys, and other machinery with guards. Regularly inspect guards to ensure they are in good condition.
- **Personal protective equipment (PPE)**-Wear appropriate PPE, such as safety glasses, hard hats, gloves, and safety shoes.
- **Training**-Ensure workers are trained on how to safely operate and maintain the mill, including how to use PPE and emergency procedures.
- **Ventilation**-Ensure there is adequate ventilation to remove toxic fumes, dust, and gases produced by metal processing.
- **Fire safety**-Have fire suppression systems, fire extinguishers, and smoke detectors in place. Train employees on fire safety protocols.
- **Lockout procedures**-Ensure the mill is turned off and de-energized before maintenance, repair, or cleaning.
- **Material handling and storage**-Have clear procedures for material handling, lifting, and storage. Secure heavy loads properly during transportation.
- **Control settings**-Learn how to use the controls for temperature, speed, and pressure.
- **Check the material**-Look for irregularities in the material being rolled, such as cracks or surface defects.
- **Prevent slippage**-Use clamps or other securing mechanisms to keep the material in place.

ESTD. 2024

Selection and use of PPE for hot work:

- **Eye and face protection**-Goggles, face shields, or helmets protect from sparks, molten particles, and intense light.
- **Hand protection**-Insulated gauntlet gloves protect from burns, sparks, heat, cuts, scratches, and electric shock.
- **Foot protection**-High-top boots or leggings protect feet from heat, burns, and electric shock.
- **Clothing**-Flame-resistant clothing and aprons protect exposed skin from heat, fires, and burns. Heavier materials like wool or heavy cotton are harder to ignite and resist wear and damage.
- **Ear protection**-Ear plugs protect ears from noise.



Chapter – 2 Cold Working Process

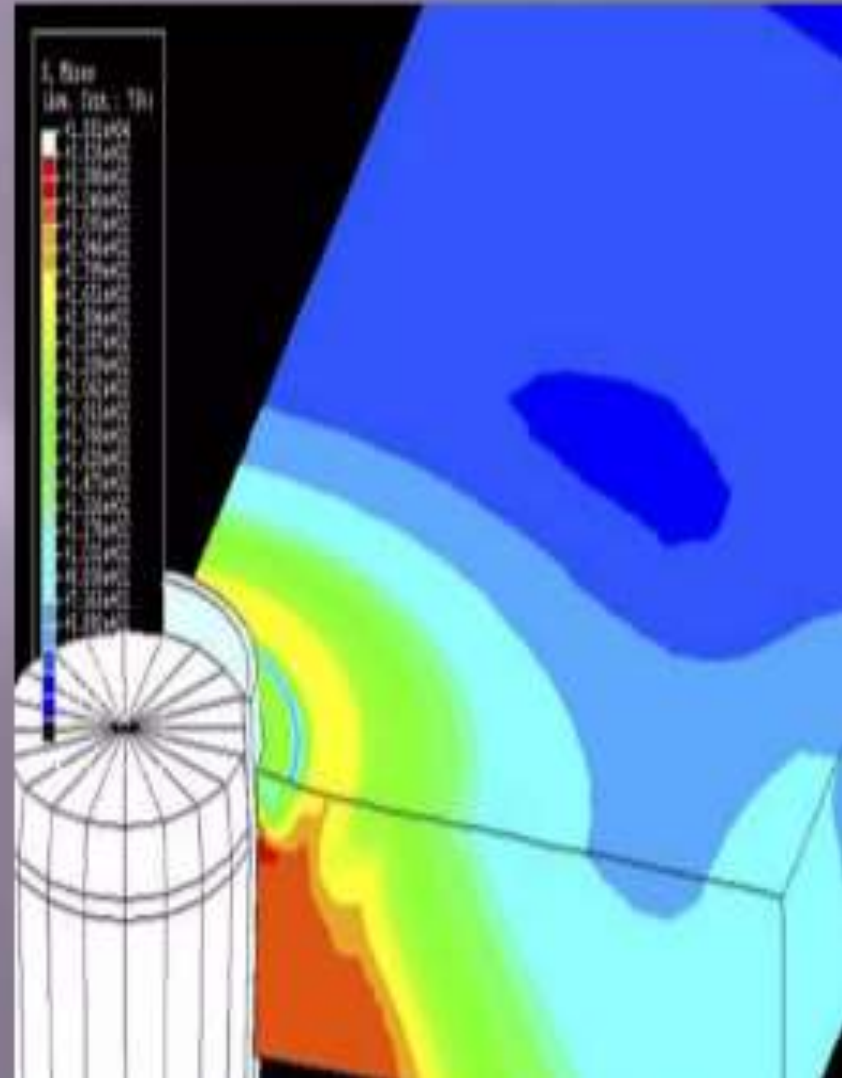
- Safety in the use of

- | | |
|----------------------|--------------------------|
| 1) power press | 2) shearing |
| 3) Bending | 4) rolling |
| 5) Drawing | 6) Turning |
| 7) Drilling | 8) Boring |
| 9) milling / shaping | 10) planning / broaching |
| 11) Grinding | 12) CNC Systems. |

- Need for selection and care of cutting tools.
- Preventive maintenance, periodic checks for safe operation.
- Associated hazards and their prevention.
- Safety in use of the machine tools.

WHAT IS COLD WORKING?

- Cold working of metal means the mechanical working at temperature below the re-crystallization temperatures
- Normally, it is taken to be working of metals at room temperature.



Safety in the use of power press

During Operation

Focus: Stay focused on the task and avoid distractions like mobile phones or talking.

Hands Off: Keep hands and other body parts a safe distance from moving machine parts, work pieces, and the die area.

No Interference: Do not disable or bypass safety devices, such as light curtains or interlocking guards.

Emergency Stop: Know the location and use of the emergency stop button to halt the machine in case of an incident.

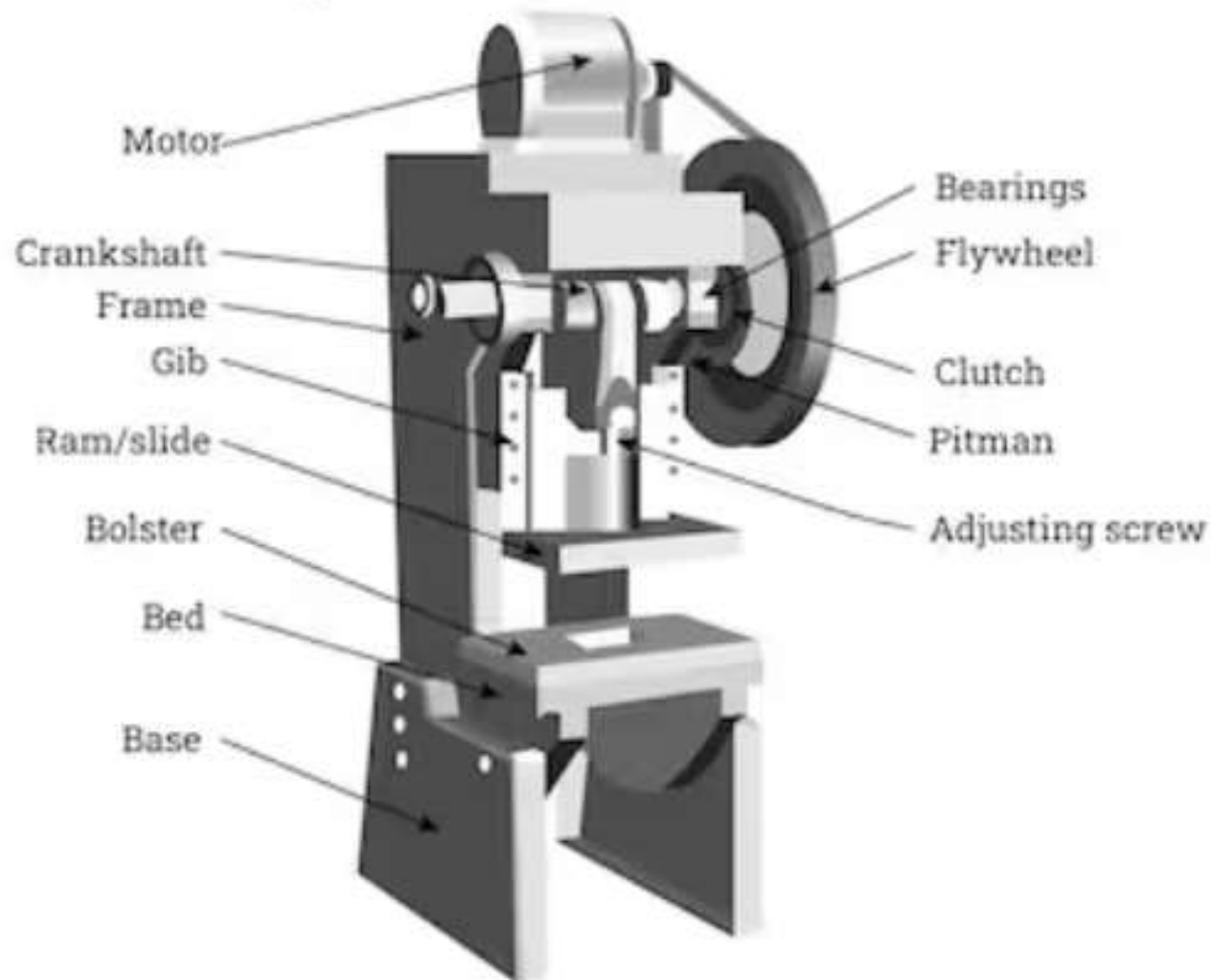
General Safety

Report Defects: Immediately report any defects, missing guards, or other safety hazards to a supervisor.

Understand Risks: Never operate a machine you are not trained and authorized to use.

Regular Maintenance: Implement a schedule for regular maintenance to ensure the machine remains in good working condition.

Components of a Power Press



Safety in the use of shearing

To ensure safety during shearing

- always use proper Personal Protective Equipment (PPE) like safety glasses and gloves.
- never place hands near the blade.
- keep the area clean and free of distractions.
- ensure all safety guards are in place and follow a specific training protocol for your machine.
- Regularly inspect equipment use lockout/tagout procedures for maintenance.
- maintain good posture, and be aware of environmental factors like dust or wet conditions.



Safety in the use of bending

During operation:

Wear PPE: Always wear appropriate personal protective equipment, including safety glasses or a face shield, gloves, and steel-toed boots.

Maintain proper posture: Use correct posture and lifting methods when handling heavy components to avoid injuries.

Mind your hands and clothing: Keep loose hair, clothing, and jewelry away from moving parts. Pay close attention to your hand placement during the operation to avoid getting caught in the machine.

Alertness: Remain alert and focused on the task.

General safety practices:

Machine guarding: Ensure that all necessary guards and barriers are in place to prevent access to moving parts.

Regular maintenance: Implement a scheduled maintenance routine for the machine, including lubrication and inspection, to ensure optimal performance and safety.

Handle wet materials carefully: Be cautious when handling wet metal sheets, as moisture and oil can make the surface slippery and difficult to grip.

Safety in the use of Rolling

Personal Protective Equipment (PPE)

Eye Protection: Wear safety glasses or goggles to protect against flying debris and sparks.

Hearing Protection: Use earplugs or earmuffs to protect against high noise levels from machinery.

Hand Protection: Wear heat-resistant gloves to protect hands from hot metal and equipment.

Foot Protection: Use steel-toed boots to protect feet from heavy objects and sharp debris.

Emergency Stops: Provide easily accessible emergency stop buttons on all machines.

Lockout/Tag out (LOTO): Implement LOTO procedures to ensure machinery is properly shut down and de-energized before maintenance or repair.

Clear Communication: Establish clear communication protocols, especially when coordinating tasks and handling heavy materials.

Maintenance and Preparedness

Regular Inspections: Conduct regular visual inspections of the machinery for damage and ensure equipment is performing as expected.

Preventive Maintenance: Perform scheduled cleaning, lubrication, and maintenance to prevent malfunctions.

Emergency Procedures: Develop and clearly communicate emergency procedures for accidents, including first aid and evacuation plans.

Risk Assessment: Conduct thorough risk assessments to identify potential hazards and implement appropriate control measures.

Safety in the use of Drawing

Mechanical safety

Mechanical hazards pose the greatest risk for entanglement, crushing, and other injuries.

Machine guards: Install and maintain physical guards around all moving parts, including dies, rollers, and conveyors, to prevent accidental contact.

Safety interlocks: Ensure machinery cannot operate when safety guards are open or removed. These systems are crucial for operator protection.

Emergency stops: Equip all drawing machines with clearly marked, easily accessible emergency stop buttons to quickly halt operations in a crisis.

Lockout/tagout (LOTO): Implement and strictly enforce LOTO procedures to prevent machines from being restarted during maintenance or repair.

Material and work piece handling

Improper handling of materials is a common source of injuries.

Safe handling procedures: Train all workers on the correct techniques for handling heavy and sharp materials to prevent cuts and crushing injuries.

Proper equipment: Use mechanical aids, such as conveyors and lifts, to move heavy materials and reduce the risk of musculoskeletal injuries from manual lifting.

Clear access: Keep pathways around the machinery clear and well-lit to prevent trips and collisions.

Proper work positioning: Always be aware of the material's discharge path. Never stand directly in front of the exit, and ensure workpieces are properly palletized to prevent them from flying out.

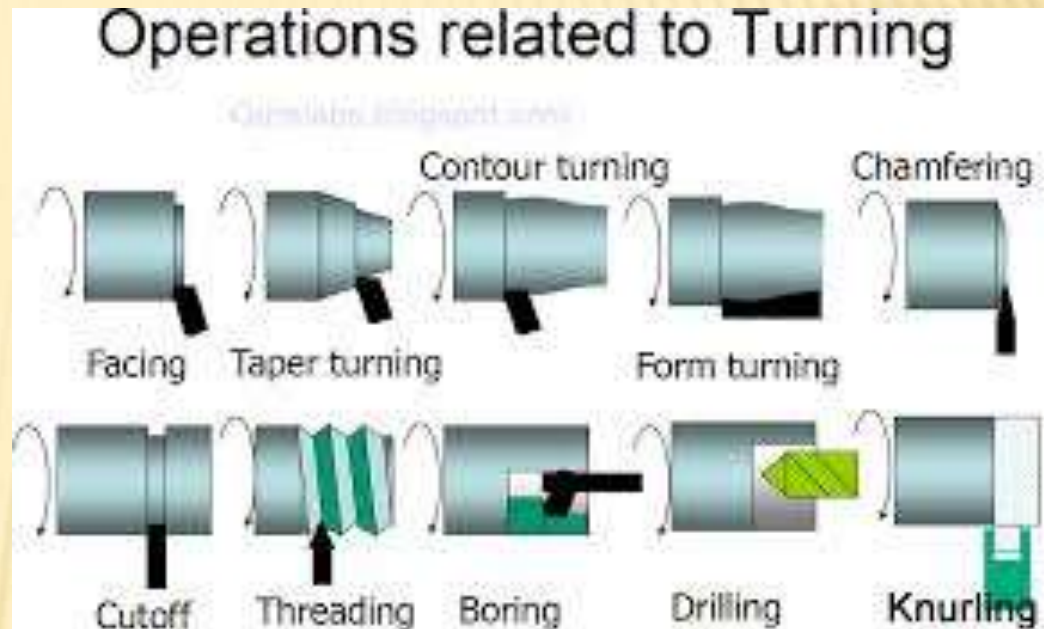
Safety in the use of Turning

Before you start

Inspect your setup
Check the work piece
Use appropriate speeds
Use the right tools

During the operation

Wear PPE
Secure your clothing
Keep hands away
Stop for adjustments
Be ready to stop



Safety in the use of Drilling

Personal Protective Equipment (PPE)

Eye Protection

Clothing

Gloves

Hearing Protection

Machine and Equipment Safety

Guards

Tool Inspection

Power Cord

Safe Operation Practices

Secure the Work piece: Clamp the work piece securely to the table to prevent it from moving during operation.

Avoid Excessive Pressure: Apply steady, moderate pressure; don't press down too hard, and adjust speed and pressure according to the material being drilled.

Clear Debris: Use a brush to clean away chips and debris, never your hands.



Safety in the use of Boring

Personal Protective Equipment (PPE)

Eye Protection

Clothing

Gloves

Hearing Protection

Work piece & Tooling Security

Secure the work piece: Ensure the work piece is held tightly in the chuck or between centers to prevent it from moving or slipping during the operation.

Remove chuck key: Always remove the chuck key from the chuck before starting the machine to prevent serious accidents.

General Safety Procedures

Clear debris: Use a brush to remove chips and sawdust; never use your hand or a cloth, as chips are sharp and can cause cuts.

Keep clear of moving parts: Keep loose clothing, hands, and hair away from rotating tools, chucks, and other moving parts to avoid being drawn into the machine.

Stop the machine before adjustments: Always stop the machine and cut off the power supply before making any adjustments, cleaning, or replacing tools.



Safety in the use of milling / shaping

Before you start

- PPE
- Clothing
- Workspace
- Machine Inspection
- Work piece Security

During the operation

- Stay Alert
- Do Not Adjust While Running
- Use Correct Tools
- Monitor for Hazards
- Emergency Stops

After Operation

- Clean Up
- Secure Tools
- Report Issues



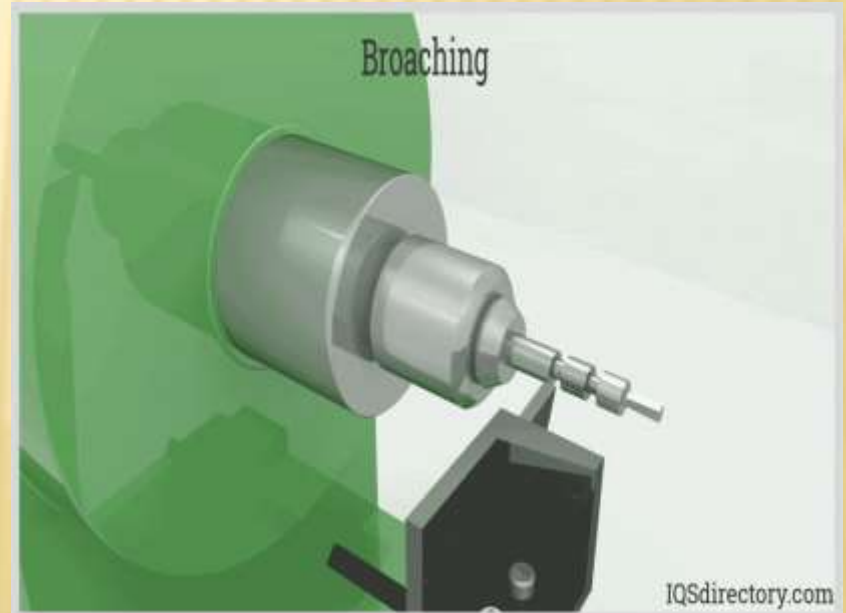
Safety in the use of Planning / Broaching

Planning (shaper) operation safety

Planning, often performed on a metalworking shaper, involves a single-point cutting tool moving in a straight-line motion. Woodworking planers are also common, with their own specific safety rules.

Broaching operation safety

Broaching involves pushing or pulling a multi-tooth tool through a work piece to create a specific shape, such as a keyway or spline.



Safety in the use of CNC

- Safe use of CNC systems requires proper training and the use of Personal Protective Equipment (PPE) such as safety glasses, hearing protection, and steel-toed boots.
- Key practices include regular machine maintenance, inspecting safety shields and sensors, using secure work holding for work pieces, and ensuring the area is clean and free of debris.
- Operators must stay alert, avoid wearing loose clothing or jewelry, and never disable safety features or leave the machine unattended during operation.

Need for selection and care of cutting tools

- Proper selection and care of cutting tools is necessary to achieve desired work piece accuracy, ensure operator safety, maximize productivity, and extend tool life, as the wrong tool can lead to poor results, damage, and increased costs.
- Key factors in tool selection include the work piece material, operation type, machine capabilities, and desired cut quality. Regular maintenance, including cleaning, sharpening, and proper storage, is crucial for optimal tool performance and longevity.

Need for Tool Selection

Accuracy and Quality:

Selecting the right tool ensures precise cuts and a high-quality surface finish, matching the tool's geometry and material to the work piece and operation requirements.

Efficiency and Productivity:

The correct tool minimizes cutting forces and heat generation, leading to faster material removal rates and increased operational efficiency.

Safety:

Using the wrong tool can create dangerous conditions, such as increased chatter or tool breakage, potentially harming the operator.

Cost-Effectiveness:

Choosing the right tool prevents premature wear and damage, reducing the need for frequent replacements and lowering overall production costs.

Factors for Tool Selection

Work piece Material: Harder materials require more durable tools, such as carbide or high-speed steel.

Type of Operation: Different operations, like roughing or finishing, require specific tools with varying characteristics for optimal material removal and surface finish.

Machine Capabilities: The machine's limitations, such as spindle speed and rigidity, directly influence the choice of tool, affecting its performance and lifespan.

Desired Cut Quality: For intricate designs, finer tools like kiss cutters are necessary, while rougher cuts can be handled with simpler tools.

Need for Tool Care

Optimal Performance: Dull or worn tools reduce cutting performance, resulting in poor surface finish and increased cutting forces.

Extended Tool Life: Proper cleaning, sharpening, and lubrication prevent wear and corrosion, significantly extending the tool's operational life.

Reduced Downtime: Well-maintained tools are less prone to failure, minimizing unexpected machine downtime and interruptions in production.

Safety: Regular maintenance ensures the tool remains in good working condition, reducing the risk of breakage and accidents.

Key Maintenance Practices

Cleaning:

Thoroughly clean the tool after each use to remove any debris, coolant residues, or built-up material.

Sharpening:

Regularly sharpen the cutting edge to maintain its sharpness and effectiveness, using appropriate tools like honing stones or grinders.

Lubrication:

Lubricate any moving parts on mechanical tools to prevent rust and corrosion.

Storage:

Store tools properly in dry, temperature-controlled environments, using well-organized tool holders or protective sleeves to prevent damage.

Periodic checks for safe operation

A comprehensive periodic check involves examining various areas of a workplace:

Equipment & Machinery:

Inspect tools, machinery guards, and elevating devices for damage and proper function.

Electrical Systems:

Ensure electrical panels are unobstructed, wiring is secure, and outlet overload protection is in place.

Fire Safety:

Verify that fire alarms, extinguishers, and exit signs are visible, accessible, and in good working condition.

Work Environment:

Assess general housekeeping, the availability of lighting, and the condition of floor and wall openings.

Materials & Storage:

Check for the proper storage of chemicals, materials, and proper use of warehouse and loading racks.

PPE:

Ensure that appropriate and properly fitted personal protective equipment is provided and used correctly.

Emergency Systems:

Confirm that safety showers, eyewash stations, and other emergency facilities are functional and in the correct locations.

Associated hazards and their prevention

Physical Hazards

Hazards: Slips, trips, falls, working at heights, electrical hazards, and hazards from machinery.

Prevention:

Maintain clear, dry, and orderly work surfaces.

Ensure proper equipment maintenance and safe handling of electrical wires.

Use appropriate PPE and fall protection for working at heights.

Chemical Hazards

Hazards: Exposure to toxic, corrosive, flammable, or explosive chemicals.

Prevention:

Consult Safety Data Sheets (SDS) for proper handling information.

Properly store and label chemicals.

Use appropriate PPE, such as gloves and masks.

Ensure adequate ventilation.

Biological Hazards

Hazards: Exposure to bacteria, viruses, fungi, or other pathogens that cause illness.

Prevention:

Implement strict hand hygiene protocols and provide hand washing stations.

Use PPE like gloves, masks, and gowns.

Ensure proper disposal of biological waste.

Maintain good ventilation.

Ergonomic Hazards

Hazards: Physical stress from poor posture, repetitive motions, or heavy lifting, leading to musculoskeletal injuries.

Prevention:

Use ergonomic equipment and encourage breaks and stretching.

Rotate tasks to reduce repetitive strain.

Safety in use of the machine

1. Operate machinery only when safeguards are properly installed and adjusted.
2. Never remove machine safeguards or try to get round them.
3. Do not use a machine with safeguards that are unauthorized or damaged.
4. If you discover a machine safeguard problem, report it immediately to your supervisor.
5. Lubricate machine parts wherever possible without removing the safeguard.
6. Remove machine safeguards only after equipment lock-out/tag-out.
7. Avoid creating safety hazards, e.g. new pinch points, or letting objects fall into a machine's moving parts.
8. Always wear the proper protective clothing, and don't let jewellery, loose clothing or long hair dangle anywhere near machines.
9. Never walk away from a machine until all its parts have stopped moving.
10. Always refer any questions or concerns about machine safety or working with safeguards to your supervisor.

Safety in use of the machine tools

- Gears, pulleys, belts, couplings, ends of shafts having keyways, and other revolving or reciprocating parts should be guarded to a height of 6 feet above the floor. The guards should be removed only for repairing or adjusting the machine and must be replaced before operating it.
- Safety setscrews should be used in collars and on all revolving or reciprocating members of the machine tool or its equipment.
- Do not operate any machine tool without proper lighting.
- Never attempt to operate any machine tool until you fully understand how it works and know how to stop it quickly.
- Never wear loose or torn clothing and secure long hair, since these items can become caught in revolving machine parts. Ties should be removed and shirt sleeves should be rolled up above the elbow.
- Never make any adjustments while the machine is operating.
- Never remove metal chips, turnings, or shavings with your hands; they may cause a serious cut.
- Always wear safety glasses or goggles while operating machine tools. Also, wear respiratory protection if operation creates hazardous dust.
- Know where fire extinguishers are located in the shop area and how to use them.
- Do not operate any machine tool while under the influence of drugs, alcohol, or any medication that could cause drowsiness.

Other Operations: Safety Precautions and Practices

1. Key Operations Covered

- . Welding
- . Cutting
- . Brazing
- . Soldering
- . Metallising
- . Chiseling
- . Blasting Operations

2. Safety Precautions in Each Operation

Welding

- . Use proper PPE (helmet, gloves, flame-resistant clothing)
- . Ensure proper ventilation
- . Inspect equipment regularly

Cutting

- . Use correct tools and cutting techniques
- . Secure the material properly

- . Keep cutting area clean and dry

Brazing

- . Use eye and hand protection
- . Ensure proper heat control
- . Handle flux and chemicals safely

Soldering

- . Ventilate area to avoid inhalation of fumes
- . Avoid contact with hot tools
- . Use lead-free solder when possible

Metallising

- . Shield from spray and fine particles
- . Use respirators and eye protection
- . Control static electricity risks

Chiseling

- . Use tools with secure handles
- . Wear safety goggles
- . Direct chiseling away from the body

Blasting Operations

- . Use hearing protection
- . Maintain safe distances

- Follow standard operating procedures strictly

3. Equipment Safety

- Select appropriate equipment for each task
- Regular maintenance and inspection
- Proper training for use and handling

4. Finishing Operations Safety

- **a) Cleaning**
 - Use non-toxic solvents
 - Wear gloves and eye protection
- **b) Polishing**
 - Secure items properly
 - Avoid loose clothing
- **c) Buffing**
 - Use guards on machines
 - Stay clear of rotating parts

5. General Maintenance Safety

- Disconnect machines before servicing
- Use lockout/tagout procedures
- Replace worn-out parts with approved components