

Machine Guard Training

The logo for ODI2, featuring the letters 'ODI2' in a stylized, yellow, outlined font. The letters are bold and have a slight 3D effect with a yellow-to-orange gradient. The background is black, and the entire logo is enclosed in a thick yellow rectangular border.

Safety Through Innovation



Machine Guarding Training

**Module presentation to meet:
Code of Federal Regulations 26 CFR 1910.212
Company's Machine Safeguard Standard**

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COURSE CONTENT



- INTRODUCTION / OBJECTIVES / GOALS
- MECHANICAL HAZARDS
- MACHINE RELATED ACCIDENTS
- RESPONSIBILITIES
- JOB HAZARD ANALYSIS
- SAFETY TIPS



OBJECTIVES



INCREASE the individuals awareness of the proper use and function of machine guards.

ENSURE COMPLIANCE TO:

- COMPANY POLICY
- FEDERAL, STATE, PROVINCIAL

REDUCE machine and equipment related injuries

CREATE A SAFE AND HEALTHY WORKPLACE



GOALS



UNDERSTAND the hazards and risks associated with machinery.

DEVELOP an understanding & knowledge of safeguarding

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Machine Guarding Management System



Procedure Development / Key Elements

- Application and Scope
- Responsibilities (supervisor, operator EHS coordinator)
- General requirements (rules, assessments, inventory, etc.)
- Communications
- Training
- Audits
- Program evaluation



Machine Guarding Mgt. System Cont.



Communications Program

- Training classes
- Department communication boards
- Handouts
- Posters



Machine Guarding Mgt. System Cont.



Training Program

- Awareness training
- Practical application training
- Refresher training
- Auditor training
- Instructor base



Machine Guarding Mgt. System Cont.



Program Evaluation

- Accident investigation trending
- Near misses
- Audit trends
- Employee interviews
- Procedure changes



Note:

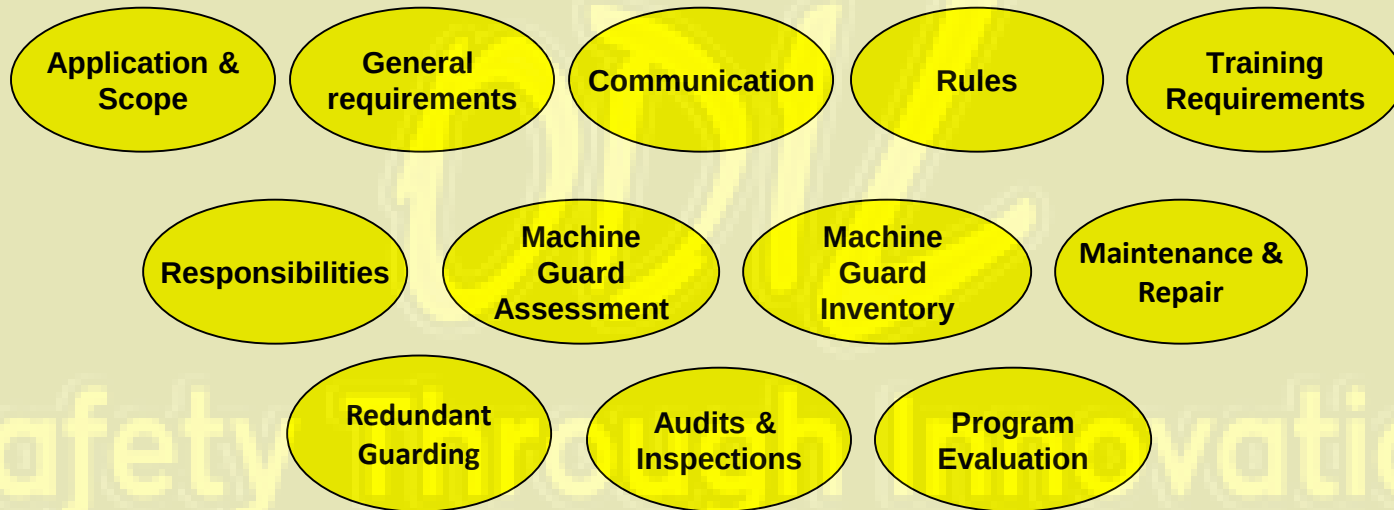
The machine guarding assessment and resulting inventory document are the most important parts of the machine guarding program. The individual assessment of each machine is critical to being able to control the day to day activities.



Machine Guard Management



Working Procedure Key Elements



NOTE: With CHANGE, good or bad, there will always be a cause and effect. Remember as we make changes to machine guarding it will impact other processes and procedures.



OSHA General Requirements



OSHA General Requirements

Crushed hands and arms, severed fingers and limbs, lacerations and abrasions - the list of possible machinery-related injuries is long and horrifying. Many hazards are created by moving machine parts. Safeguards are essential for protecting workers from preventable injuries.



MECHANICAL HAZARDS



Point of Operation

The point of operation is where work is performed on the material, such as cutting, shaping, boring, or forming of stock.

Power Transmission Device

The power transmission apparatus is all components of the mechanical system which transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

Operating Controls

A mechanical or electrical power control shall be provided on each machine to make it possible for the operator to cut off the power from each machine without leaving his position at the point of operation.



MOTION INJURIES



- ROTATION
- RECIPROCATING
- TRANSVERSE



Rotating

Rotating

Rotating motion can be dangerous; even smooth, slowly rotating shafts can grip hair and clothing, and through minor contact force the hand and arm into a dangerous position. Injuries due to contact with rotating parts can be severe. Collars, couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting are some examples of common rotating mechanisms which may be hazardous. The danger increases when projections such as set screws, bolts, nicks, abrasions, and projecting keys or set screws are exposed on rotating parts.

Examples of Hazardous Projections on Rotating Parts



Rotating coupling with projecting bolt heads



Rotating shaft and pulleys with projecting key and set screw



Reciprocating

Reciprocating

Reciprocating motions may be hazardous because, during the back-and-forth or up-and-down motion, a worker may be struck by or caught between a moving and a stationary part.



Worker Caught Between a Reciprocating Table Piece and a Stationary Part



Transversing

Transversing

Transverse motion (movement in a straight, continuous line) creates a hazard because a worker may be struck or caught in a pinch or shear point by the moving part.



Transverse motion of belt



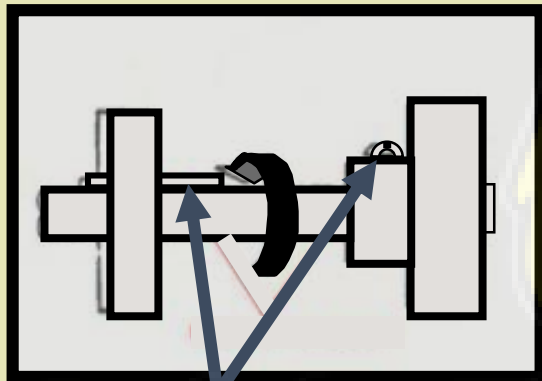
NIP POINTS / IN-RUNNING



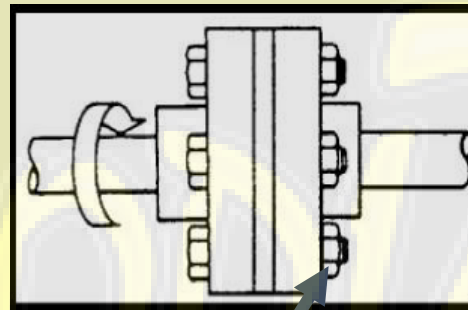
In-running **nip point hazards** are caused by the rotating parts on machinery. There are three main types of in-running nips. Parts can **rotate** in opposite directions while their axes are parallel to each other. These parts may be in contact (producing a nip point) or in close proximity. In the latter case, stock fed between two rolls produces a nip point. As seen here, this danger is common on machines with intermeshing gears, rolling mills, and calenders. Nip points are also created between **rotating and tangentially moving parts**. Some examples would be: the point of contact between a power transmission belt and its pulley, a chain and a sprocket, and a rack and pinion. Nip points can occur between **rotating and fixed parts** which create a shearing, crushing, or abrading action. Examples are: spoked handwheels or flywheels, screw conveyors, or the periphery of an abrasive wheel and an incorrectly adjusted work rest and tongue.



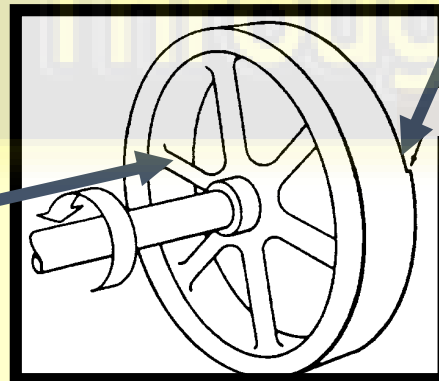
ROTATING MOTIONS



KEY & SET
SCREW



BOLTS &
NUTS

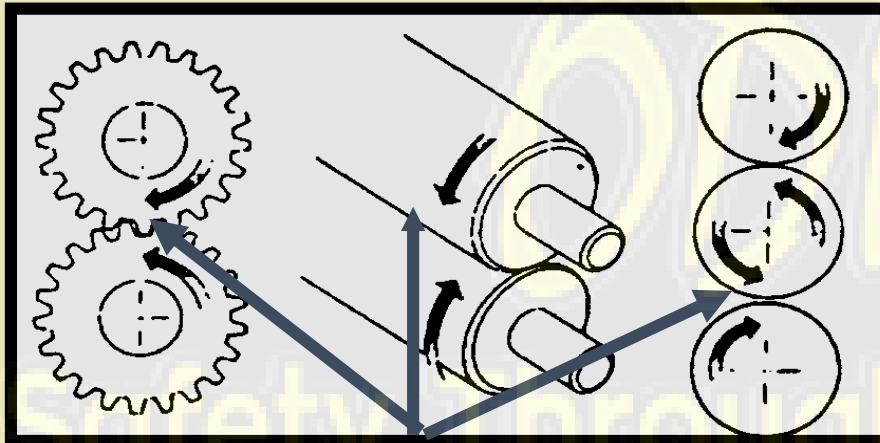


SPOKES

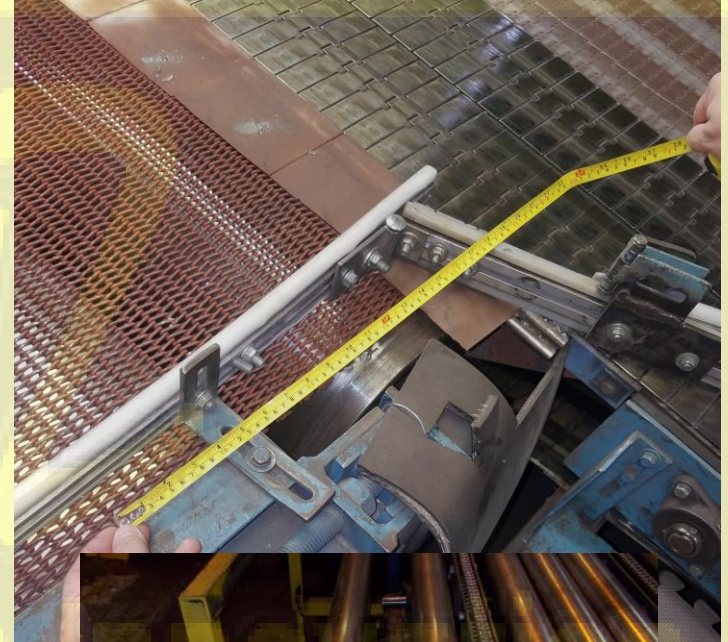
BURR



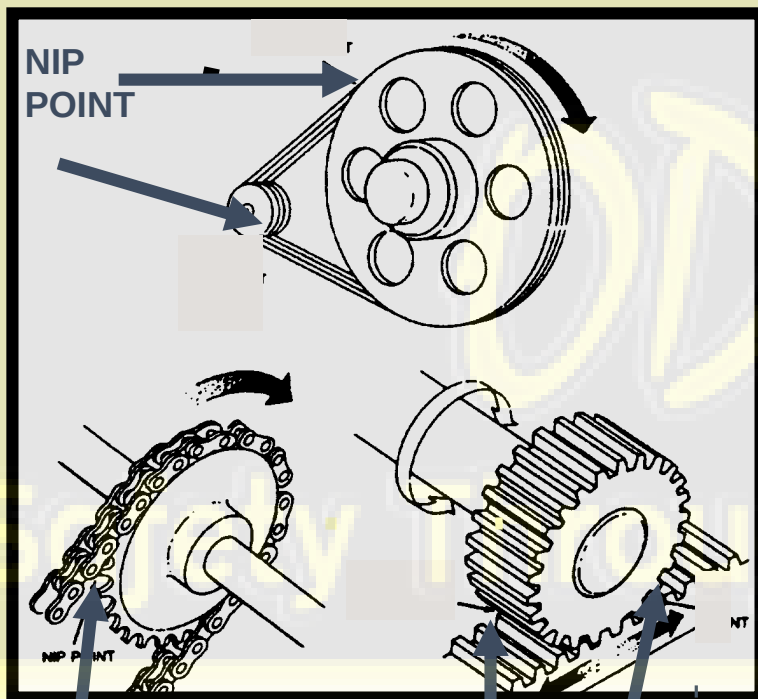
NIP POINTS / IN-RUNNING



NIP POINTS



NIP POINTS TANGENTIAL & ROTATING

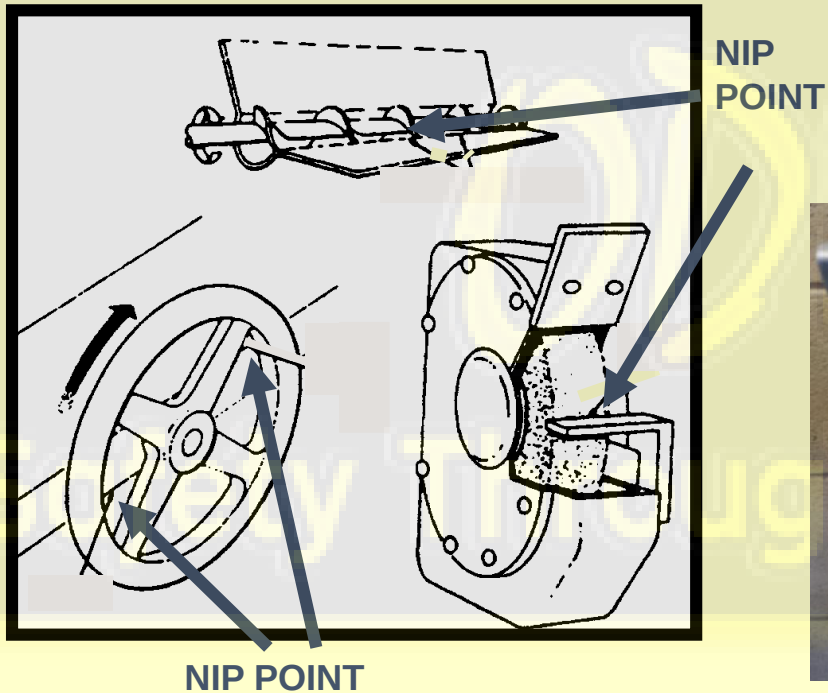


NIP POINT

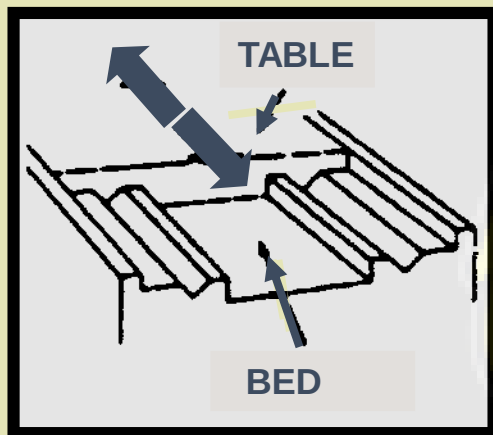
NIP POINT



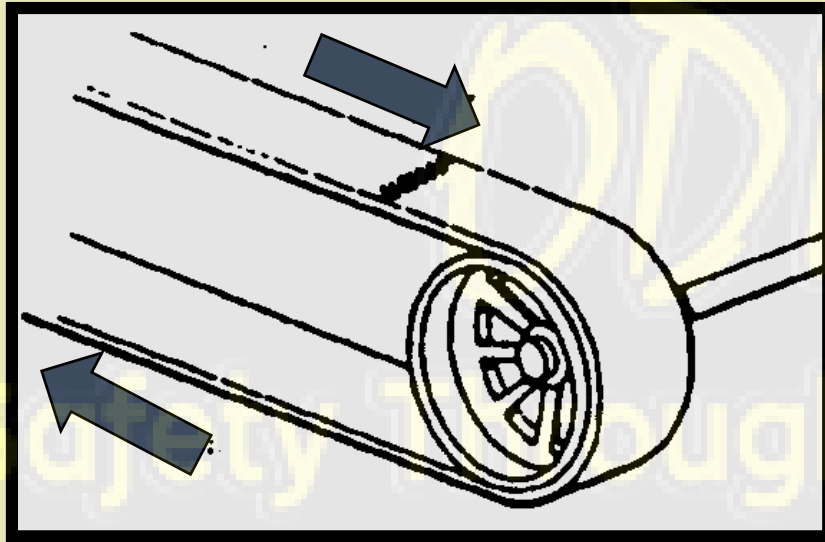
NIP POINTS ROTATING & FIXED PARTS



RECIPROCATING MOTION



TRANSVERSE MOTION

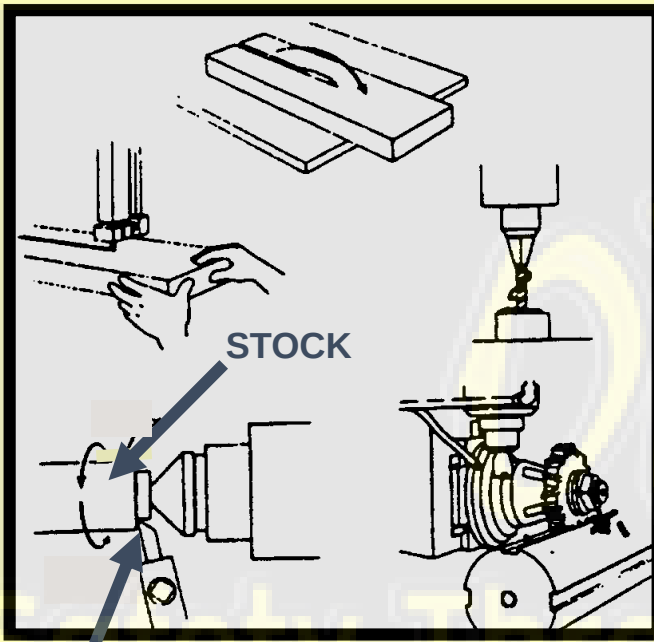


ACTION INJURIES

- CUTTING
- PUNCHING
- SHEARING
- BENDING



CUTTING ACTION



Self-Adjusting Guard

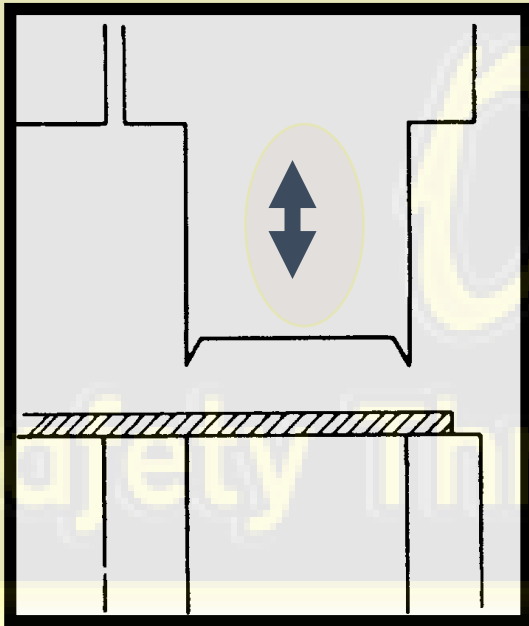
Point of Operation



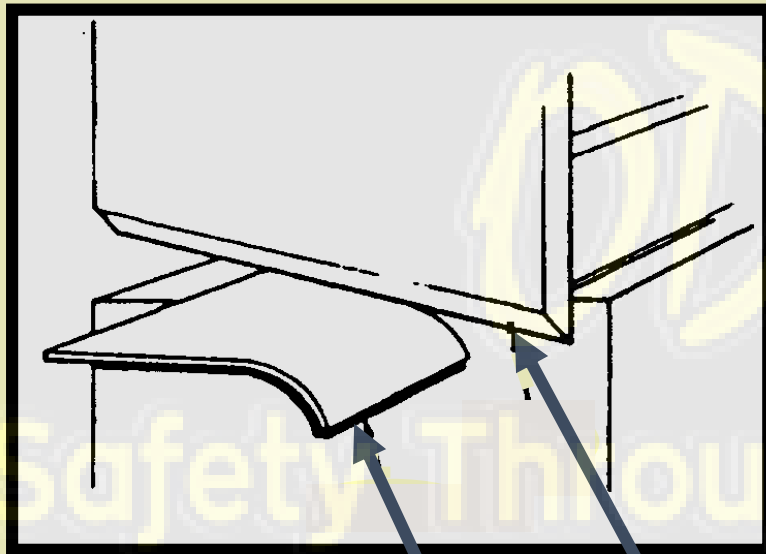
Operator Controls



PUNCHING ACTION



SHEARING ACTION

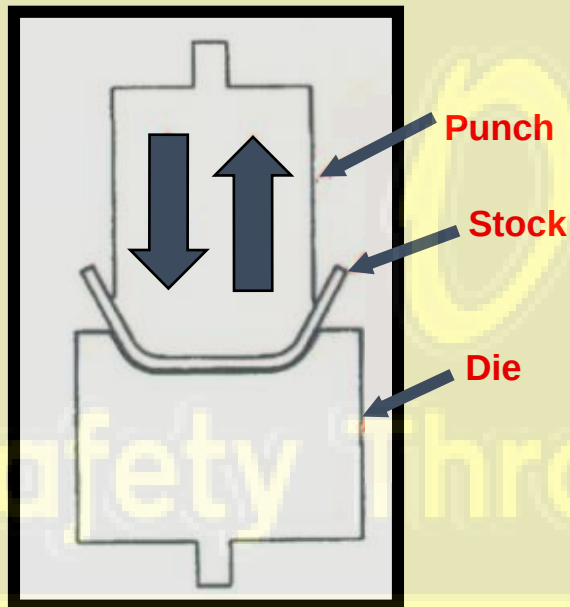


STOCK

BLADE



BENDING ACTION



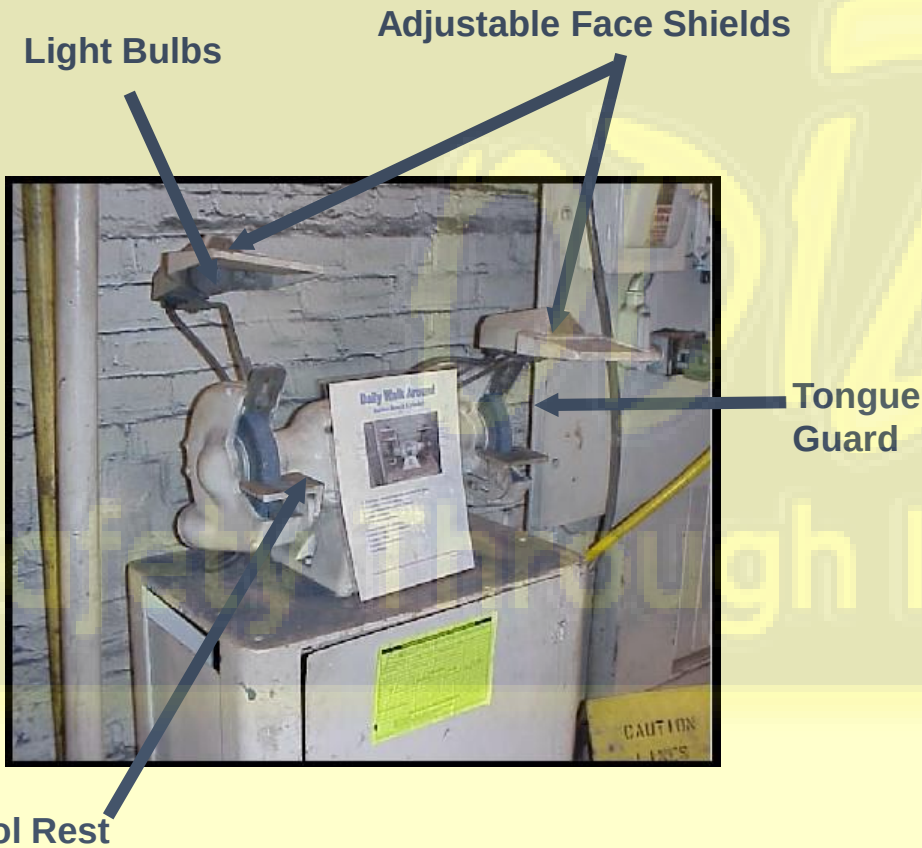
GENERAL REQUIREMENTS FOR SAFEGUARDS



- **PREVENT CONTACT**
- **SECURE**
- **PROTECT FROM FALLING OBJECTS**
- **CREATE NO NEW HAZARD**
- **CREATE NO INTERFERENCE**
- **ALLOW SAFE LUBRICATION**



ABRASIVE WHEEL



LOCATION / DISTANCE



- A THOROUGH **JOB HAZARD ANALYSIS (JHA)** MUST BE PERFORMED BEFORE ATTEMPTING THIS SAFEGUARDING TECHNIQUE.

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JOB HAZARD ANALYSIS



- **WHAT SHOULD YOU LOOK AT:**
 - **PROCEDURES & WORK INSTRUCTIONS**
 - **BODY POSITION**
 - **TOOLS & EQUIPMENT**
 - **PPE**
 - **CHEMICALS & MATERIALS**
 - **WORK AREAS & CONDITIONS**
 - ***INSPECT SAFEGUARDS***



RESPONSIBILITIES



- **SENIOR OPERATIONS MANAGER**
- **SUPERVISOR**
- **OPERATOR**

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SAFETY TIPS



- PROTECT VISITORS
- BE ALERT AT ALL TIMES
- DON'T WEAR LOOSE CLOTHING/GLOVES/JEWELRY
- PROTECT LONG HAIR (TIE BACK / HAIR NET)
- GOOD HOUSEKEEPING
- REMEMBER GUARDS ALONE WILL NOT PREVENT INJURIES
- DON'T EVER REMOVE, BYPASS OR CIRCUMVENT A SAFEGUARD



ANNUAL TRAINING



- Each year, all employees who have been identified and categorized as machine operators must attend or take part in an annual practical refresher session.
- **Identify audience**
- **Locate specific machinery**
- **Perform the training**
- **Document the training**



ANNUAL TRAINING



- Review the following key elements:
 - **Point of operation**
 - **Company Policy**
 - **Power transmission equipment**
 - **Various hazards (specific to each machine)**
 - **Guard Types (specific to each machine)**
 - **Cleaning and maintenance issues**
 - **Operator feedback**
 - **Document and file**



Machine Guard Training

The logo for ODIZ, featuring the letters 'ODIZ' in a stylized, yellow, outlined font. The letters are bold and have a slight 3D effect with a darker yellow shadow. The logo is centered within a black rectangular area that has a thick yellow border.

Safety Through Innovation



Six Sigma Risk Assessment

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Six Sigma Risk Assessment

- What is a PFMEA?
- PFMEA = Process Failure Mode and Effects Analysis
- Every product or process has modes of failure. The effects represent the impact of the failures. An FMEA is a tool to:
 - Identify the relative risks designed into a product or process.
 - Initiate action to reduce those risks with the highest potential impact.
 - Track the results of the action plan in terms of risk reduction.
- FMEAs help us focus on and understand the impact of potential process or product risks.

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Six Sigma Risk Assessment

- **A systematic methodology is used to rate the risks relative to each other.**
 - An RPN or Risk Priority Number is calculated for each failure mode and its resulting effect(s).
 - The RPN is a function of three factors: The Severity of the effect, the frequency of Occurrence of the cause of the failure, and the ability to detect (or prevent) the failure or effect.
 - $RPN = \text{Severity rating} \times \text{Occurrence rating} \times \text{Detection rating}$
 - The RPN can range from a low of 1 to a high of 1,000
 - Once the RPNs are determined, you need to develop an Action Plan to reduce the risks of failure modes of unacceptably high RPNs.
- **Use the FMEA as the basis for developing a Control Plan. Control Plans are a summary of defect prevention and reactive detection techniques.**



Six Sigma Risk Assessment

- When would a PFMEA be Conducted?
- A PFMEA is a “before the event” action (**Proactive**), not an “after the event exercise” (**Reactive**).
- Three cases in which a PFMEA should be conducted
 - Case 1: A new design, technology or process (This would include any design or process that has never had a PFMEA conducted – even if has been in existence for years.)
 - Case 2: Modification to the existing design, technology or process.
 - Case 3: Existing design or process in a new location, environment or application.



PFMEA Pitfalls and Limitations



Pitfall 1: Prioritizes, Doesn't Correct

Pitfall 2: Only as Good as the Team

Pitfall 3: Time Consuming

Pitfall 4: Unknown Unknowns

Pitfall 5: Not Customizing Rating Scales

Pitfall 6: Not Starting in the Design Stage

Pitfall 7: Taking on Too Large a Scope



FMEA Pitfalls and Limitations



Pitfall 8: Not Including Operators

Pitfall 9: Not Including Customers

Pitfall 10: Not Including Suppliers

Pitfall 11: Becoming a Full-Time Job

Pitfall 12: Not Using Concept of a Process

Pitfall 13: Not Getting into the Details

Pitfall 14: Forgetting there are Internal- and External-Related Failure Modes



FMEA Pitfalls and Limitations



Pitfall 15: Confusing Root Cause and Failure Mode

Pitfall 16: Assuming Detection Controls Are Better Than They Are

Pitfall 17: Not Looking at Each Product

Pitfall 18: Assuming Detection Controls Apply When They Don't

Pitfall 19: Not Linking with Mistake-Proofing

Pitfall 20: Not Tying into Control Plans

Pitfall 21: Failing to Update the FMEA



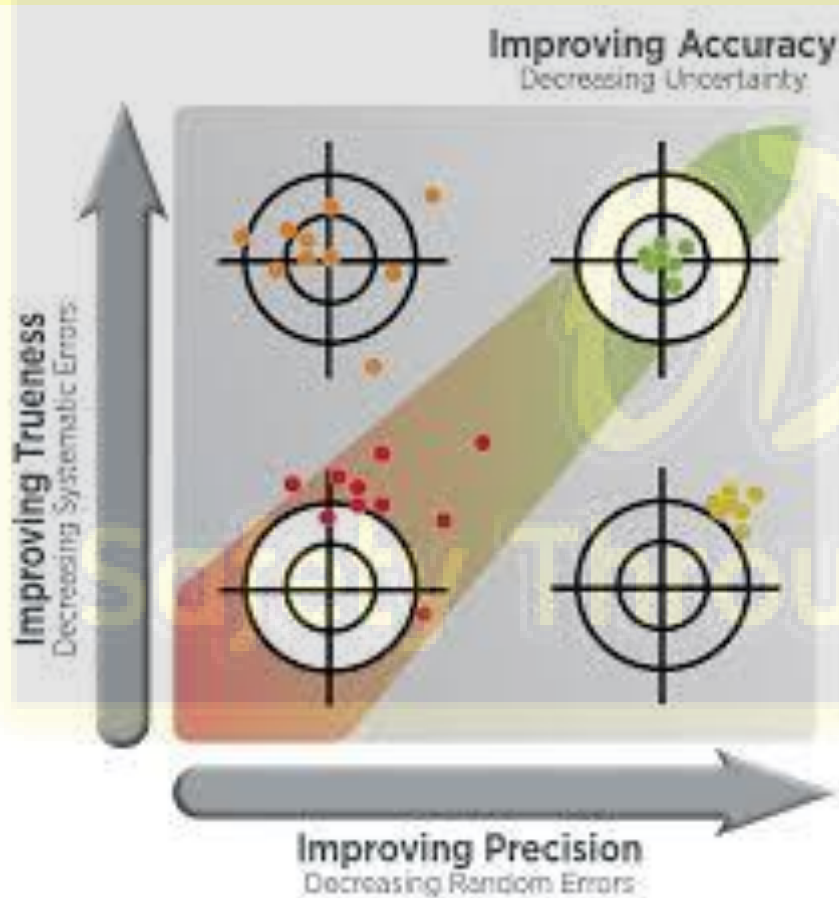
Safety & Lean Six Sigma

An ODIZ Safety Risk Assessment Approach

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Six Sigma Vs Lean



LEAN is the endless pursuit to eliminate WASTE.

8-Wastes Are:

Downtime

Over Producing

Waiting

Not Utilizing People

Travel

Inventory

Motion

Excess Processes

95% of a Business is WASTE





ODIZ Safety Risk Assessment & Project Tracker

Combining Safety & Lean Six Sigma

Name: _____ Date: _____

Area Reviewed: _____

Safety - JHA							6σ - PFMEA					Lean - Autonomation										
Current State												Future State										
Process		Potential Failure Modes		Engineering	Administration	PPE	Potential Effect of Failure	Severity	Potential Cause of Failure		Occurrence	Hazard Controls	Controls	Risk Priority #	Actions Recommended		Actions Taken		Severity	Occurrence	Controls	Risk Priority #
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						





Severity

Effect	Criteria: Severity of Effect Defined	Ranking
Catostrophic	May be catostrophic leading to 3 or more fatalities	10
Fatal	May lead to a fatality	9
Very High	May lead to a hospitilazation	8
High	May lead to a lost time injury	7
Moderate	May lead to a recordable injury	6
Low	May lead to a first aid incident	5
Very Low	May lead to an injury	4
Minor	May lead to a near miss	3
Very Minor	May have at risk behaviors but no risks	2
None	ZERO incidents could EVER occur	1



Occurrence

Probability of Failure	Possible Incident Rates	Ranking
<u>Very High:</u>	≥ 1 in 2	10
Failure is almost inevitable	1 in 3	9
<u>High:</u> Generally associated with incidents similar to previous	1 in 8	8
Incidents that have often failed	1 in 20	7
<u>Moderate:</u> Generally associated with incidents similar to	1 in 80	6
previous incidents which have	1 in 400	5
experienced occasional failures, but not in major proportions	1 in 2,000	4
<u>Low:</u> Isolated failures associated with similar incidents	1 in 15,000	3
<u>Very Low:</u> Only isolated failures associated with almost identical incidents	1 in 150,000	2
<u>Remote:</u> Failure is unlikely. No failures ever associated with almost identical incidents	≤ 1 in 1,500,000	1



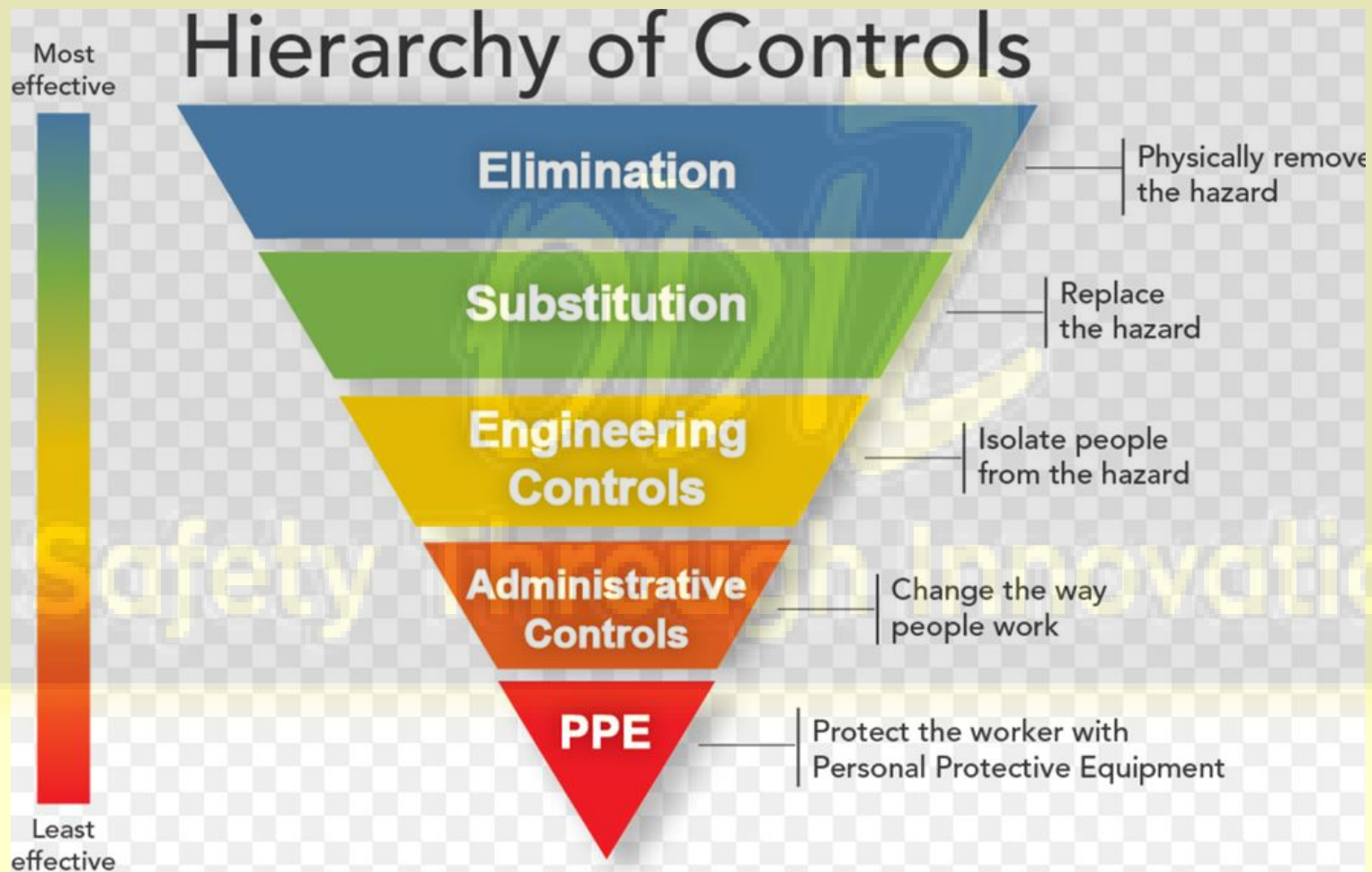


Controls

Detection	JHA	PPE	Administrative Controls	Engineering Controls	Substitution	Elimination	Criteria: Likelihood the existence of a INCIDENT will be detected by test content before product advances to next or subsequent process	Ranking
Almost Impossible							No JHA Performed for Task, ZERO Controls	10
Very Remote	Y						JHA Performed, Risks Identified but No Actions	9
Remote	Y	Y					PPE Identified but not enforced	8
Very Low	Y	Y					PPE Identified and utilized	7
Low	Y	Y					PPE Identified, utilized, but not effective	6
Moderate	Y	Y	Y				PPE Utilized, operators trained but not practiced	5
Moderately High	Y	Y	Y				JHA, PPE, & Training in place but still at risk	4
High	Y	Y	Y	Y			Engineering controls to eliminated hazard	3
Very High	Y	Y	Y	Y	Y		Task has been Substituted	2
Almost Certain	Y	Y	Y	Y	Y	Y	Task has been Eliminated	1



OSHA Hierarchy of Controls



LEAN - Poka-Yoke

Poka-yoke is a Japanese term that means "**mistake-proofing**" or "**inadvertent error prevention**". The key word in the second translation, often omitted, is "**inadvertent**". There is no poka-yoke solution that protects against an operator's sabotage, but sabotage is a rare behavior among people. A poka-yoke is any mechanism in a lean manufacturing process that helps an equipment operator avoid (yokeru) mistakes (poka). Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur. The concept was formalized, and the term adopted, by Shigeo Shingo as part of the Toyota Production System. It was originally described as baka-yoke, but as this means "**fool-proofing**" (or "**idiot-proofing**") the name was changed to the milder poka-yoke.



Examples of Poka-Yoke



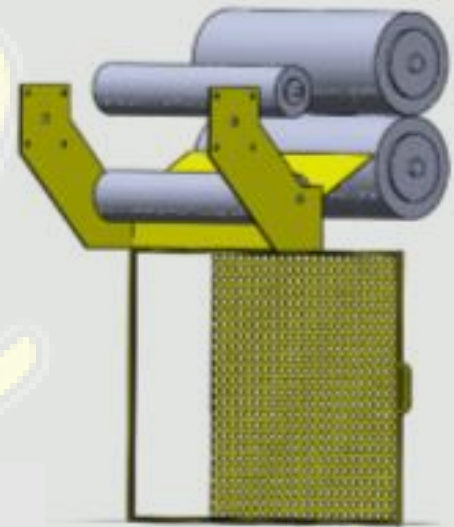
Example of Poka-Yoke



Example of Poka-Yoke



Examples of Poka-Yoke in safety



Machine Guard Training

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Safety Through Innovation



Six Sigma Risk Assessment

EXAMPLE: Bench Grinder

Safety Through Innovation





ODIZ Safety Risk Assessment & Project Tracker

Combining Safety & Lean Six Sigma

Name: _____ Date: _____

Area Reviewed: _____

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Current State												Future State									
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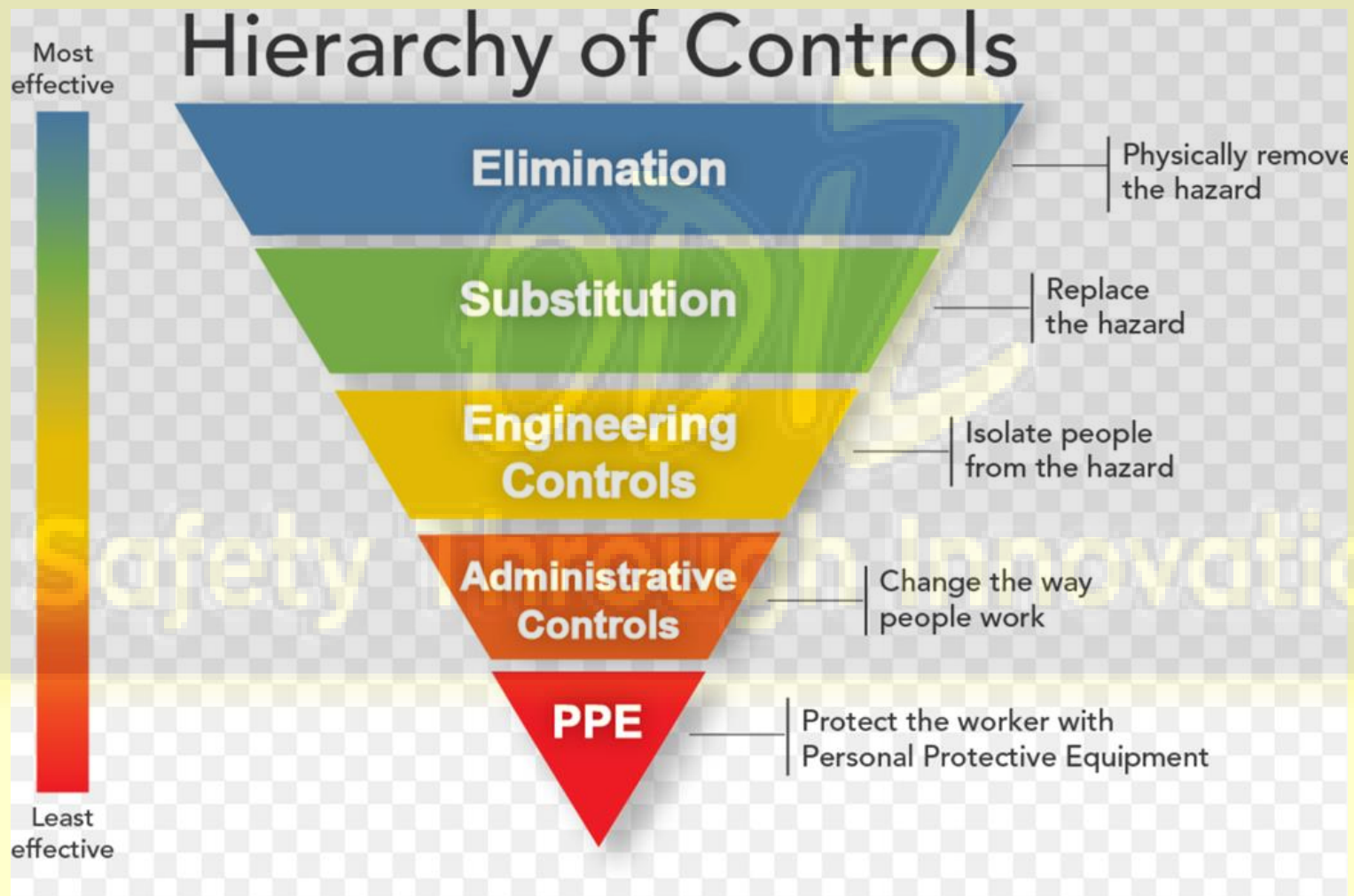


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OSHA Hierarchy of Controls



Typical Bench Grinder



Typical Bench Grinder



Safety - JHA					
Current State					
Process	Potential Failure Modes	Engineering	Administration	PPE	Potential Effect of Failure
Pedestal/Bench Grinder	Tongue Guard Gap is > than 1/4"		Yes		Wheel explodes & kills operator
	Work Rest is > than 1/8"		Yes		Pinch point amputation
	Spark Shield not in place		Yes	Yes	Eye Injury
	Pedestal not mounted		Yes		Machine falls on operator
	Changing wheels with improper tools		Yes	Yes	Knuckle buster
	No Start on power loss	Yes	Yes		Unexpected start up



Typical Bench Grinder



Safety - JHA						6σ - PFMEA					
Current State						Current State					
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Pedestal/Bench Grinder	Tongue Guard Gap is > than 1/4"		Yes		Wheel explodes & kills operator	9	Grinding wheel shrinks	10	Admin - Training	10	900
	Work Rest is > than 1/8"		Yes		Pinch point amputation	8	Grinding wheel shrinks	10	Admin - Training	10	800
	Spark Shield not in place		Yes	Yes	Eye Injury	8	Shield not in place or used; PPE can be used to prevent.	8	Admin - Training	8	512
	Pedestal not mounted		Yes		Machine falls on operator	7	Installation failure combined with aggressive usage	5	Admin - Training	4	140
	Changing wheels with improper tools		Yes	Yes	Knuckle buster	6	Lack of standardized tools; PPE could be used to prevent.	2	Admin - Training	8	96
	No Start on power loss	Yes	Yes		Unexpected start up	7	Multiple machines on same circuit breaker	2	Eng - Contactor	3	42
											2490



Typical Bench Grinder



Lean - Automation					
Future State					
Actions Recommended	Actions Taken	Severity	Occurrence	Controls	Risk Priority #
Engineer Controls - Give the Machine Intelligence	No-Go Grinder Safety Stand; Sensors & controls on tongue guards	9	1	3	27
Engineer Controls - Give the Machine Intelligence	No-Go Grinder Safety Stand; Sensors & controls on work rests	8	1	3	24
Engineer Controls - Give the Machine Intelligence	Eyeshield with switches	8	1	3	24
Engineer Controls - Give the Machine Intelligence	No-Go Grinder Safety Stand; Mounting holes in the base	7	1	3	21
Engineer Controls - Give the Machine Intelligence	Point of Use Tooling Kits, Continue to use PPE	6	3	3	54
Engineer Controls - Give the Machine Intelligence	No-Go Grinder Safety Stand; Contactor electrical logic incorporated in design	7	1	3	21
					171



Typical Bench Grinder

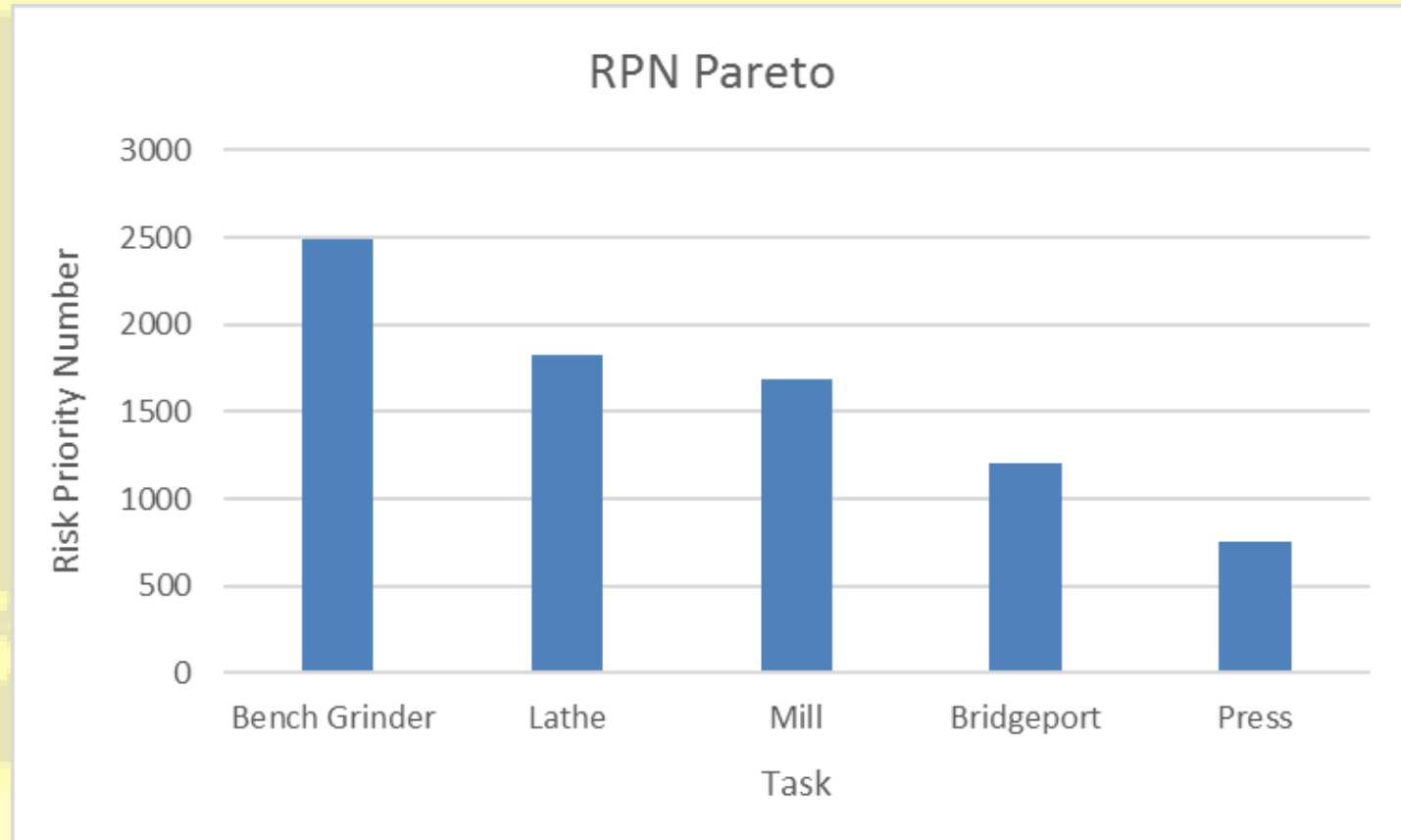


Safety - JHA						6σ - PFMEA						Lean - Autonomation								
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		Work Rest is > than 1/8"		Yes		Pinch point amputation	8	Grinding wheel shrinks	10	Admin - Training	10	800	Engineer Controls - Give the Machine Intellegence	No-Go Grinder Safety Stand; Sensors & controls on work rests	8	1	3	24		
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		No Start on power loss	Yes	Yes		Unexpected start up	7	Multiple machines on same circuit breaker	2	Eng - Contactor	3	42	Engineer Controls - Give the Machine Intellegence	No-Go Grinder Safety Stand; Contactor electrical logic incorporated in design	7	1	3	21		
												2490							171	

93% Risk Reduction – 2490 RPN to 171 RPN



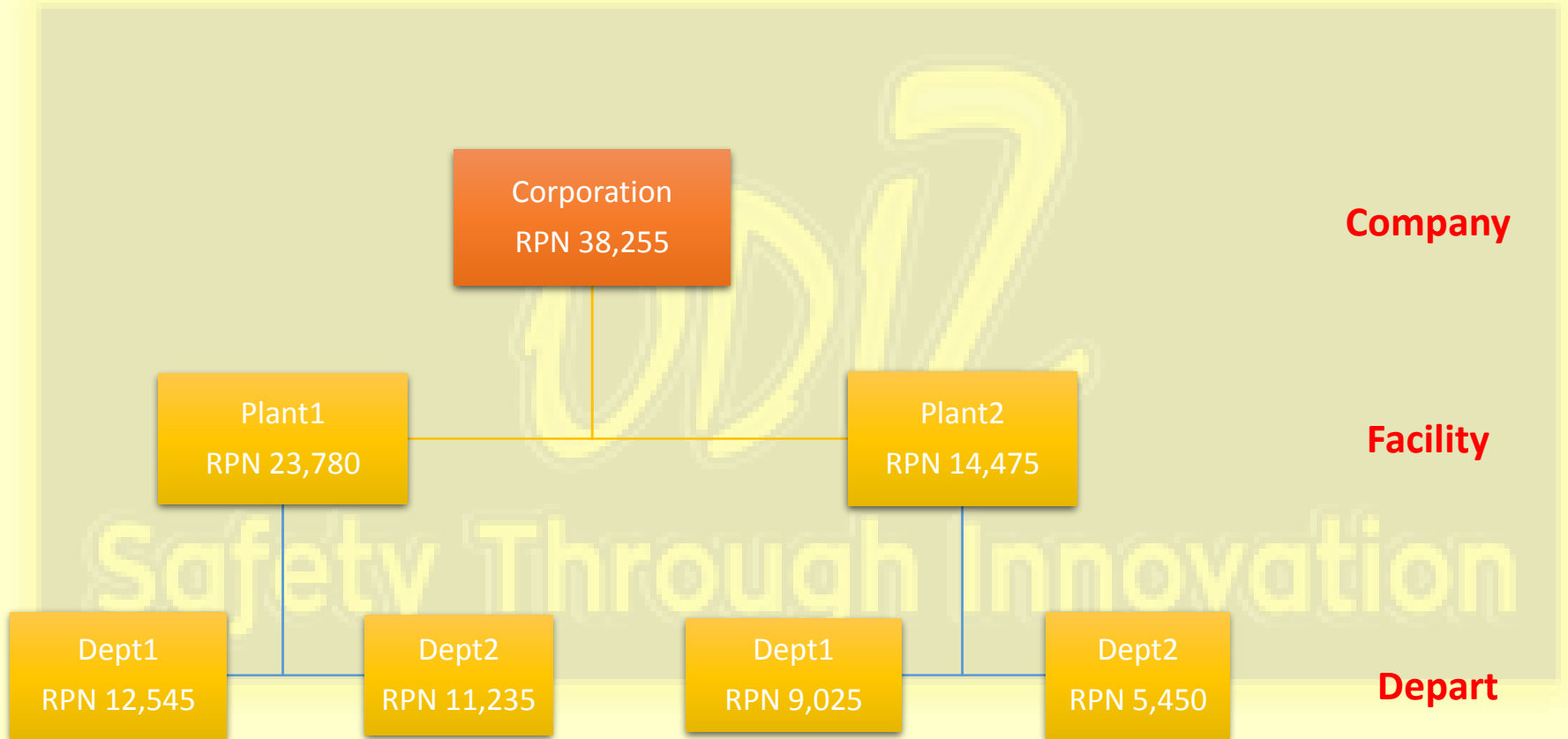
Big Picture Management



Pareto by Task, What to work on... Biggest Bang for the Buck!



Big Picture Management



Big Picture Management



- Corporate Summary
 - Plant 1 has 40% more risk than Plant 2
 - Plant 1 Department 1 is the highest risk department in company
 - Put Initial Focus here

Business is a function of opportunity costs. Where to put labor, effort, and money into to get the largest result.

As an EH&S professional, if you can show upper management where the risks are and where the efforts and capital is needed. You are more likely to get support and further more, results.

Results differentiate performance and risk reduction.



Summary



- Identify the Tasks
- Perform JHAs for each
- Perform a PFMEA
- Analyze RPNs by Task
- Analyze RPNs by Department/Facility
- Generate future state solutions
 - Substitution or Eliminations of tasks
 - Engineered solutions
 - Off the shelf products

Safety Through Innovation



Machine Guard Training

The logo for ODI2, featuring the letters 'ODI2' in a stylized, yellow, outlined font. The letters are bold and have a slight 3D effect with a yellow-to-orange gradient. The 'O' and 'D' are connected, and the 'I' and '2' are also connected. The entire logo is set against a black background within a yellow-bordered box.

Safety Through Innovation



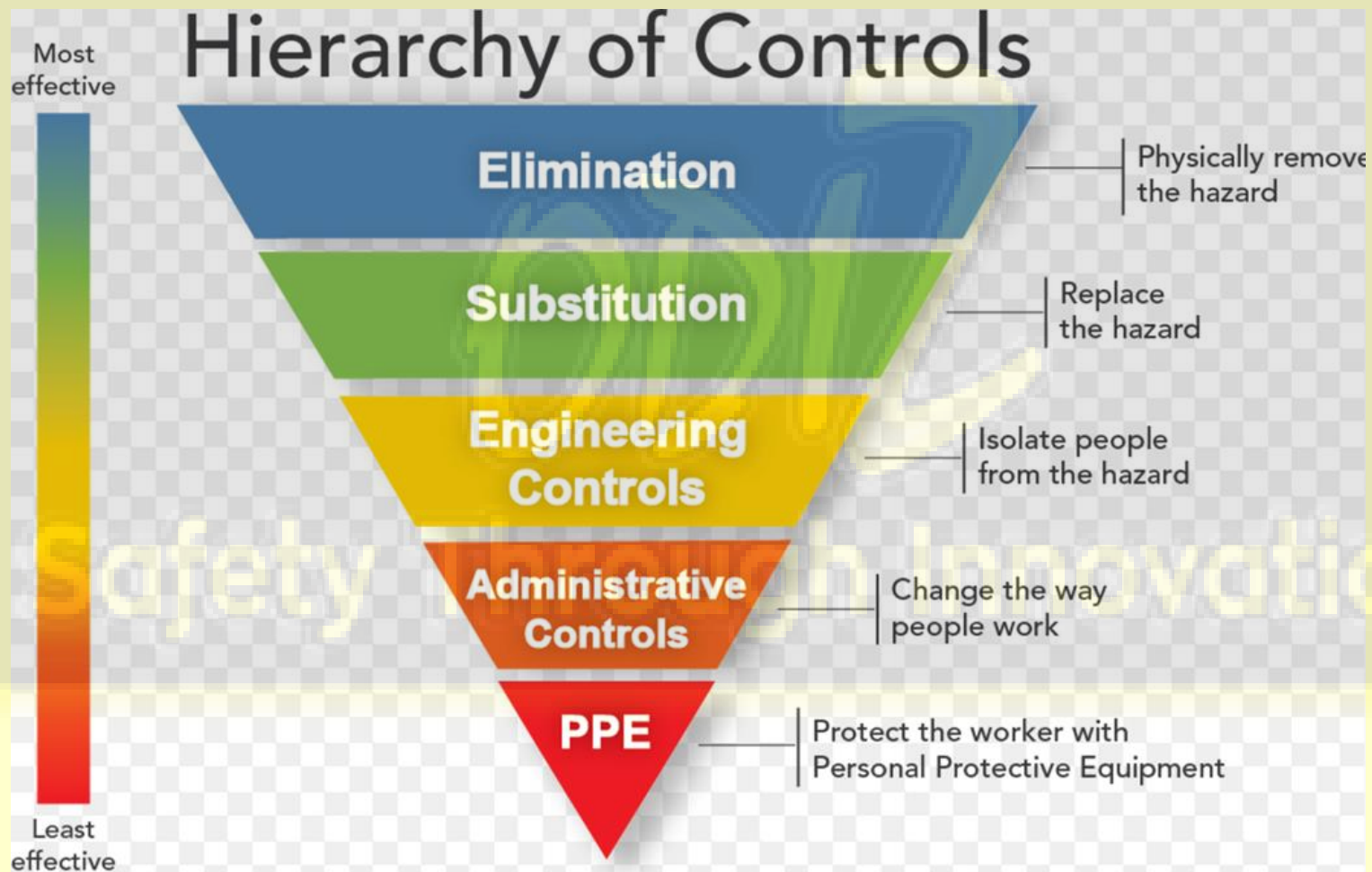
Machine Guarding Training

**Module presentation to meet:
Code of Federal Regulations 26 CFR 1910.212
Company Machine Safeguard Standard**

Safety Through Innovation



OSHA Hierarchy of Controls



DEVICES

- Photoelectric (optical)
- Radiofrequency (capacitance)
- Electromechanical
- Pullback
- Restraint (holdback)
- Safety Trip Controls (pressure-sensitive body bar, safety tripod, safety tripwire)
- Two-Hand Control
- Two-Hand Trip
- Gate



DEVICES



Photoelectric

The photoelectric (optical) presence-sensing device uses a system of light sources and controls which can interrupt the machine's operating cycle. If the light field is broken, the machine stops and will not cycle. This device must be used only on machines which can be stopped before the worker can reach the danger area. The design and placement of the guard depends upon the time it takes to stop the mechanism and the speed at which the employee's hand can reach across the distance from the guard to the danger zone.

Safeguarding Action

- Machine will not start cycling when the light field is interrupted
- When the light field is broken by any part of the operator's body during the cycling process, immediate machine braking is activated

Advantages

- Can allow freer movement for operator
- Simplicity of use
- Used by multiple operators
- Provide passerby protection
- No adjustment required

Limitations

- Does not protect against mechanical failure
- Limited to machines that can be stopped



DEVICES



Radiofrequency

The radiofrequency (capacitance) presence-sending device uses a radio beam that is part of the machine control circuit. When the capacitance field is broken, the machine will stop or will not activate. Like the photoelectric device, this device shall only be used on machines which can be stopped before the worker can reach the danger area. This requires the machine to have a friction clutch or other reliable means for stopping.

Safeguarding Action

- Machine cycling will not start when the capacitance field is interrupted.
- When the capacitance field is disturbed by any part of the operator's body during the cycling process, immediate machine breaking is activated

Advantages

- Can allow freer movement for operator

Limitations

- Does not protect against mechanical failure
- Antennae sensitivity must be properly adjusted; this adjustment must be maintained properly
- Limited to machines that can be stopped



DEVICES

Electromechanical

The electromechanical sensing 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.

Safeguarding Action

- Contact bar or probe travels a predetermined distance between the operator and the danger area.
- Interruption of this movement prevents the starting of machine cycle.

Advantages

- Can allow access at the point of operation

Limitations

- Contact bar or probe must be properly adjusted for each application; this adjustment must be maintained properly



DEVICES



Pullback

Pullback devices utilize 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.

Safeguarding Action

- As the machine begins to cycle, the operator's hands are pulled out of the danger area

Advantages

- Eliminates the need for auxiliary barriers or other interferences at the danger area

Limitations

- Limits movement of operator
- May obstruct work space around operator
- Adjustments must be made for specific operations and for each individual
- Requires frequent inspections and regular maintenance
- Requires close supervision of the operator's use of the equipment



DEVICES

Restraint

The restraint (hold-back) device utilizes cables or straps that are attached to the operator's hands and a fixed point. The cables or straps must be adjusted to let the operator's hands travel within a predetermined safe area. There is no extending or retracting action involved. Consequently, hand-feeding tools are often necessary if the operation involves placing material into the danger area.

Safeguarding Action

- Prevents the operator from reaching into the danger area

Advantages

- Little risk of mechanical failure

Limitations

- Limits movement of operator
- May obstruct work space
- Adjustments must be made for specific operations and each individual
- Requires close supervision of the operator's use of the equipment



DEVICES



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 the operator 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 danger area.

Safeguarding Action

- Stops machine when tripped

Advantages

- Simplicity of use

Limitations

- All controls must be manually activated
- May be difficult to activate controls because of their location
- Only protects the operator
- May require special fixtures to hold work
- May require a machine brake



DEVICES



Two-Hand Control

The two-hand control 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.

Safeguarding Action

- Concurrent use of both hands is required, preventing the operator from entering the danger area

Advantages

- Operator's hands are at a pre-determined location
- Operator's hands are free to pick up a new part after first half of the cycle is completed

Limitations

- Requires a partial cycle machine with a brake
- Some two-hand controls can be rendered unsafe by holding with arm or blocking, thereby permitting one-hand operation
- Protects only the operator



DEVICES



Two-Hand Trip

The two-hand trip requires concurrent application of both the operator's control buttons to activate the machine cycle, after which the hands are free. This device is usually used with machines equipped with full-revolution clutches. The trips must be placed far enough from the point of operation to make it impossible for the operator to move his or her hands from the trip buttons or handles into the point of operation before the first half of the cycle is completed. The distance from the trip button depends upon the speed of the cycle and the band speed constant. Thus the operator's hands are kept far enough away to prevent them from being placed in the danger area prior to the slide/ram or blade reaching the full "down" position. 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.

Safeguarding Action

- Concurrent use of two hands on separate controls prevents hands from being in the danger area when machine cycle starts

Advantages

- Operator's hands are away from danger area
- Can be adapted to multiple operations
- No obstruction to hand feeding
- Does not require adjustment for each operation

Limitations

- Operator may try to reach into danger area after tripping machine
- Some trips can be rendered unsafe by holding with arm or blocking, thereby permitting one-hand operation
- Protects only the operator
- May require special fixtures



DEVICES

Gate

The gate is a moveable barrier that protects the operator at the point of operation before the machine cycle can be started. Gates are, in many instances, designed to be operated with each machine cycle. To be effective, the gate must be interlocked so that the machine will not begin a cycle unless the gate guard is in place. It must be in the closed position before the machine can function. If the gate is not permitted to descend to the fully closed position, the press will not function.

Another potential application of this type of guard is where the gate is a component of a perimeter safeguarding system. Here the gate may provide protection not only to the operator but to pedestrian traffic as well.

Safeguarding Action

- Provides a barrier between danger area and operator or other personnel

Advantages

- Can prevent reaching into or walking into the danger area

Limitations

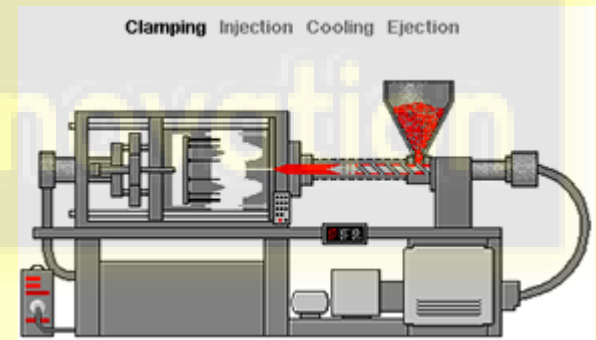
- May require frequent inspection and regular maintenance
- May interfere with operator's ability to see the work



FEEDING & EJECTION METHODS



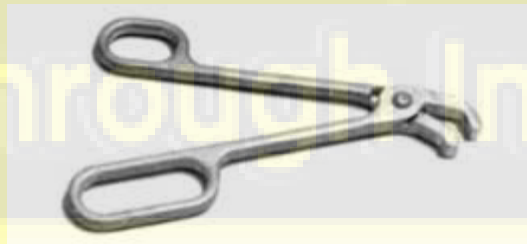
- **AUTOMATIC FEED**
- **SEMI- AUTOMATIC FEED**
- **AUTOMATIC EJECTION**
- **SEMI- AUTOMATION EJECTION**
- **ROBOT**



MISCELLANEOUS AIDS

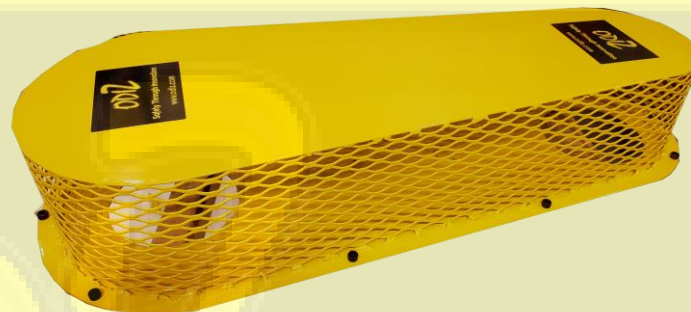
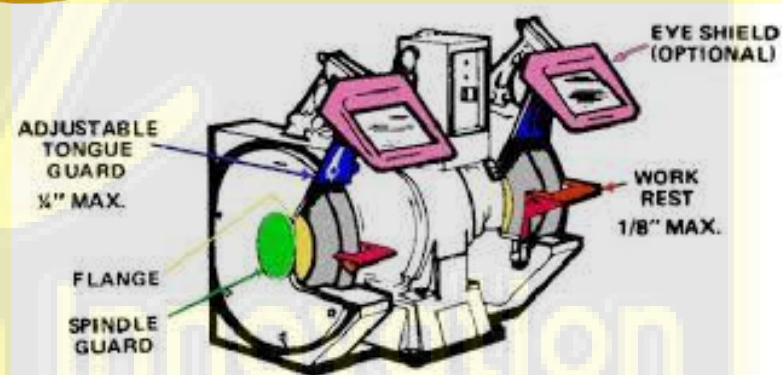
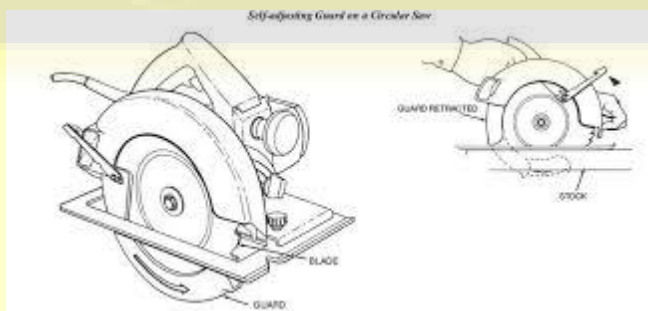


- **AWARENESS BARRIERS**
- **PROTECTIVE SHIELDS**
- **HAND-FEEDING TOOLS & HOLDING FIXTURES**



GUARDS

- FIXED
- INTERLOCKED
- ADJUSTABLE
- SELF-ADJUSTING



GUARDS

Fixed

As its name implies, a fixed guard is a permanent part of the machine. It is not dependent upon moving parts to function. 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.

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

Limitations

- May interfere with visibility
- Can be limited to specific operations
- Machine adjustment and repair often require its removal, thereby necessitating other means of protection for maintenance personnel



GUARDS

Interlocked

When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, the moving parts of the machine are stopped, and the machine cannot cycle or be started until the guard is back in place. An interlocked guard may use electrical, mechanical, hydraulic, or pneumatic power or any combination of these. Interlocks should not prevent "inching" by remote control if required. Replacing the guard should not automatically restart the machine. To be effective, all removable guards should be interlocked to prevent occupational hazards.

Safeguarding Action

- Shuts off or disengages power, stops the moving parts and prevents starting of the machine when the 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 the machine for removing jams without time consuming removal of the fixed guards

Limitations

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



GUARDS



Adjustable

Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock.

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

Limitations

- 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



GUARDS

Self-adjusting

The openings of these barriers are determined by the movement of the stock. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening which is only large enough to admit the stock. After the stock is removed, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator. The guards may be constructed of plastic, metal, or other substantial material. Self-adjusting guards offer different degrees of protection.

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

Limitations

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



METHODS OF MACHINE SAFEGUARDING

- BARRIER GUARDS
- DEVICES
- LOCATION/DISTANCE
- FEEDING & EJECTION METHODS
- MISCELLANEOUS AIDS



Two-hand Control on a Press



Stop Calculations



ANSI Minimum Safety Distance (D_s) Calculation

A safety professional can help you determine the stopping time (T_s) of your machine.

Then use the following formula to calculate the minimum safety distance for your application.

$$D_s = K \times (T_s + T_c + T_r + T_{spm}) + D_{pf}$$

Where:

K = Hand speed constant (63 inches/second)

T_s = Stop time of your machine (measured with a stop time measurement device)

T_c = Safety Related Parts of the Control System response time

T_r = Response time of the safety light curtain (provided by the supplier)

T_{spm} = Additional time to compensate for normal stop time variations

D_{pf} = Depth penetration factor



SUMMARY



- **REMEMBER! SAFETY IS NO ACCIDENT**
Design for success, Hierarchy of Controls!
- **BUILD GUARDING THAT WILL WORK FOR YOU!**
- **Review company Policy & Procedures and update if necessary.**
- **If you need help implement or engineering a solution, contact me at jgasparino@odiz.com**

