Machine Safeguarding

Machine guarding is an engineering control that protects workers from being exposed to hazards created by moving machine parts and from any chips, splashes, etc. that are created during operation. The broader topic of Machine Safeguarding involves a systematic process for considering many additional aspects of making machinery as safe as possible in an overall safety program.

As part of your effort to approach machine safeguarding at your facility, it is important to become familiar with OSHA's machine guarding regulations, the types of hazards created by machinery, the types of injuries that machinery can cause, how to evaluate the risk posed by your machines, the available techniques for safeguarding, and the importance of operating instructions and maintenance procedures. You may also want to complete a machine operation hazard assessment to establish a baseline of existing machine safeguards for your facility. When employees notice that management is taking an interest in inspecting machine guards and is providing complete operation and maintenance procedures, they will be more eager to follow your example and participate in the safety program.

This article is intended to provide information for establishing a facility review process for machine safeguarding. In addition, such a process can also improve communication with employees and reduce the potential for injuries due to contact with machinery components.

Machine Guarding Policy Basics

A basic machine guarding policy contains the following elements:

- Conducting a hazard assessment throughout the location to identify potential machinery hazards, which will serve as the basis for appropriate machine guarding methods and their implementation.
- Where it is determined that additional guarding is required, the first resource for guarding design is the equipment manufacturer. Where the original equipment manufacturer is no longer in business, a qualified third party consultant/manufacturer can be utilized for the design and installation of guarding devices.
- Requires that all new machinery be purchased with requirements for guarding.
- Provides training to all machine operators and their supervisors on proper inspection and use of guarding devices and proper implementation of procedures. Also provides training to
  - Maintenance technicians regarding the design of guards and the repair and preventive maintenance of guarding devices, and
  - Engineers regarding the machine guarding policy and the types of machine guards and devices available.
Machine Safeguarding Risk Assessment and Risk Reduction Process

A step-by-step Machine Safeguarding Risk Assessment and Risk Reduction Process is provided below as a basic roadmap of the individual steps for safeguarding machinery and equipment.

1. Identify Machine/Process

A review of a facility's accident history will assist in the identification of hazardous scenarios. Additionally, common sense also can play a large role. For example, a hand-fed mechanical power press usually presents a greater risk than a drill press. On a global view, the power press is more likely to have a high risk associated with it, requiring immediate attention in terms of safeguarding. Traditionally, employers address the high-risk machines first, and then move down the line towards the lower risk applications until all of the machines are at a tolerable risk level. To accommodate this, some facilities conduct risk assessments on every machine present before implementing the risk reduction portion of the plan in order to prioritize the plan of attack.

2. Collect Proper Information

Once the machine or process has been identified for a risk assessment, the next step is to collect all of the pertinent information relating to the application. This information includes the limits of the machine, its lifecycle requirements, any information concerning energy sources, and all available design drawings, sketches, system descriptions, or other means of establishing the nature of the machine. In addition, previous incident history (on the subject machine), information regarding damage to health, as well as details regarding existing or proposed system and building layouts, also are important to the risk evaluation process. Finally, a list of the exposed people, as well as others who could be exposed to the hazards of the machine, is useful in identifying the majority of the scenarios that could lead to an accident.

3. Gather Proper Individuals

Initially, gather input from all individuals who have a vested interest in the safeguarding process. To do so, compile a team of individuals who would normally use the equipment or are involved in the facility safety program. Most likely, the EHS professional will be involved, and sometimes this person may also act as the team leader.

Obtaining feedback from the operators and maintenance personnel is essential for two reasons. First, these individuals work on and around the machine on a daily basis, which means they are most likely to be able to identify hazards otherwise hidden to people less involved in the day-to-day operation of the machine. Second, it is important to gain buy-in from these individuals. If a safeguarding system is installed and the people who have to work with it are not pleased and their concerns are not heard at the planning stage, the safeguarding system may not meet their needs or may prevent them from conducting specific required tasks. Therefore, their input at the earliest stages is important to reduce the likelihood of implementing an impractical or ineffective safety measure.

Also involve engineers and electricians in the process. These people are able to provide detailed information about the machine, including what measures are currently in place.
and what options are available. Whenever possible, it is also beneficial to have production managers involved. Their buy-in and involvement help to implement a practical safety solution that does not reduce the output of the machine or the operators. Adequately addressing the concerns of all affected individuals avoids incentives to defeat or circumvent a protective measure.

4. Observe Machine in Use

Although many machines are similar in design, end users adapt machinery to produce specific parts based on customer and market demands. Even when machines are similar in design, their alteration can drastically affect the level of risk. For example, changing a die or the workpiece may affect the exposed hazards of a machine. Because of this, view each machine as it is used for each application. Watch how different personnel work on or near the machine, as different techniques may lead to a best safety practice that could be adopted elsewhere within the company.

5. Identify Hazardous Areas

Next, create a detailed list of all potentially hazardous scenarios. First, the team should identify every task imaginable during the entire lifecycle of the machine. This list will include tasks required for loading and unloading, all modes of operation, planned and unplanned maintenance, tool change, troubleshooting and housekeeping. In addition, the team can consider tasks required for transporting, start up, installation, decommissioning, and even disposal of the machine. The team can then use this list to identify potential hazards associated with each task, such as in-running nip points, pinch points, crushing, electric shock, release of stored energy, ergonomic strain, and slips, trips and falls.

6. Identify the Risk Level

Identifying levels of risk typically involves considering the main characteristics of a hazard: severity of the potential injury, frequency of exposure to the potential hazard, possibility of avoiding the hazard as it occurs, and likelihood of occurrence in event of a failure. It is important that the individuals involved in the risk estimation be familiar with and agree upon the definitions of the criteria for these factors. Often, the resulting risk levels are classified into three or four categories, ranging anywhere from high to negligible.

The initial risk estimation assumes that no safeguards are installed. By doing so, the risk evaluation will produce a risk level that will more accurately identify the proper safeguarding methods to help reduce the risk of existing hazards.

7. Evaluate the Risk Level

Evaluating the risk level helps determine if further safeguarding methods are needed for the machine or process to make it as safe as possible. The risk level chosen is considered a reasonable and acceptable level of risk that a person would normally expect to take. It is widely recognized that zero risk does not exist. However, a good faith approach to risk assessment and risk reduction achieves a tolerable risk level for the purpose of machine safeguarding.
Note – If the level of risk after the first risk estimation is at a tolerable level, the safety team continues on to step 12 below. If, however, the risk level is too high, the team continues with steps 8 – 11 to reduce the risk to a tolerable level.

8. Create an Appropriate Risk Reduction System

If each risk is not initially tolerable, protective measures are applied that will effectively reduce the risk of a hazard to an acceptable level. When selecting appropriate protective measures, evaluate the application of the solution against factors such as risk-reduction benefit, usability, productivity, technological feasibility, economic and ergonomic impact, durability, and maintainability.

8a. Hazard Elimination or Substitution

Although elimination or substitution of a hazard is an effective method of reducing risk, often it is only possible during the design stages of a machine or process line. Because of this, introduce the Original Equipment Manufacture to the risk assessment and risk reduction process at an early stage. Sometimes, the end user is applying a risk reduction strategy to a machine that is already on the plant floor, so eliminating or substituting a hazard may not be a feasible option. In this case, the next best measure is to apply engineering controls.

8b. Engineering Controls

When implementing engineering controls to mitigate risks, select effective solutions that are adequate for the hazard. In addition to the appropriate technology and devices, the proper control system (electric, hydraulic, and pneumatic circuits) is needed.

Whenever a discrepancy arises regarding which level of protective measure or circuit reliability to select, it is always safest to choose the higher of the two. A conservative method such as this is a good-faith approach that will help to provide a safer work environment for your employees.

Another concept to keep in mind when selecting engineering controls is safe mounting distance. Safety devices that do not physically prevent individuals from reaching into a hazard area must either stop or prevent the start of hazardous motion (or situation) when an individual is exposed to the hazard. To do so, the devices must be located at a distance from the hazard such that hazardous motion (or situation) is prevented, completed, or stopped before the individual can be harmed. OSHA provides minimum requirements for safe mounting distance of protective devices in OSHA 1910.217; more stringent and conservative requirements are provided in national consensus standards, such as ANSI B11.19 and ANSI/RIA R15.06.

8c. Awareness Means

After appropriate engineering controls have been considered, the next step is to apply any awareness means that could help reduce the level of risk further, such as:

- Appropriate signage
• Visual and audible awareness devices
• Color coding

8d. Administrative Controls

The next step toward reducing risk is to implement administrative controls, including training and safe work procedures. When deciding if safe work procedures would be beneficial, consider when:

• tasks are complex or have an inherently high risk;
• training, skill, or work experience is limited;
• tasks require other safeguards to be removed or bypassed; or
• tasks are required to augment other safeguarding measures.

Training programs are needed for operators, helpers, maintenance personnel, supervisors, and other individuals who may be exposed to hazards of a machine or process. The objectives of the training process include increasing understanding of:

• the purpose of the safeguarding measures and their function;
• procedures, especially those dealing with health and safety;
• hazards presented by, capabilities of, and tasks associated with the machine or process; and
• safety concepts.

Finally, document all training procedures as well as when training has been completed by each individual.

Another concept to be addressed at this stage includes lockout/tagout. This method of controlling hazardous energy protects personnel who could be exposed to an unexpected release. This can include any unintended motion, energization, start-up, or release of stored energy, deliberate or otherwise, from the perspective of the individuals at risk. Proper guidelines, including OSHA 1910.147 and ANSI/ASSE Z244.1, are important when creating such programs.

8e. Personal Protective Equipment

Even though engineered safeguards, awareness means, administrative controls, or a combination thereof may provide an acceptable level of protection, appropriate personal protective equipment (PPE) is also needed to protect operators from injury. Personal protective equipment includes safety glasses, hearing protection, gloves, hard hats, respirators, and adequate foot protection.

9. Accurately Estimate System Costs

Whether the implementation of the selected safeguarding system will be performed by in-house resources or an outside supplier, accurately identify all costs associated with the final system. Common mistakes committed by facilities installing their own systems include the omission of costs associated with labor and seemingly trivial material costs,
including conduit and wiring, which can noticeably add to final expenditures.

10. Provide All Required Services and Materials

Regardless of how the installation will be completed, it is important that proper materials are selected and installed using established methods. These methods align with appropriate national, regional, and local regulations; applicable consensus standards; user specifications; and device and machine manufacturers’ recommendations.

11. Conduct Follow-Up Risk Assessment

After installing safeguards, it is important to conduct a follow-up risk assessment to verify that the risk level has been reduced to a tolerable level. If it has not, the process should be repeated until a tolerable risk level is achieved. Then, the process is near completion.

12. Process Close-Out and Sign-Off

Before releasing the machine to full production capacity, the final step is to complete the required documentation by:

- Identifying any residual risk,
- Verifying the safeguarding system for effectiveness and compliance,
- Following the device and machine manufacturers' recommended set-up and try-out procedures, and
- Updating safe work procedures and training material to reflect the changes of the system.

(Source - Machine Safeguarding: Risk Assessment and Risk Reduction 12-Step Process
By; Chris Soranno, STI Machine Services Anaheim Calif.
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For your convenience, the attached worksheet can be used as a tool to complete the "Machine Safeguarding Risk Assessment and Risk Reduction Process" for individual machinery and equipment in your facility.
## Machine Safeguarding: Risk Assessment and Risk Reduction 12-Step Process

<table>
<thead>
<tr>
<th>Step</th>
<th>Description of Activity or Information Required</th>
<th>Findings</th>
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<tbody>
<tr>
<td>1. Identify Machine/Process</td>
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| 2. Collect Proper Information | - the limits of the machine  
- its lifecycle requirements  
- any information concerning energy sources and all available design drawings, sketches, system descriptions or other means of establishing the nature of the machine  
- previous incident history (on the subject machine or similar machines)  
- information regarding damage to health  
- details regarding existing or proposed system and building layouts  
- a list of the exposed people, both the affected personnel (including their level of training, experience or ability), as well as others who could be exposed to the hazards of the machine where it can be reasonably foreseen | |
### 3. Gather Proper Individuals

- identify individuals who have a vested interest in the safeguarding process
- collect feedback from:
  - operators and maintenance personnel
  - engineers and electricians
  - production managers
  - outside specialists

  for insight into capabilities, benefits and disadvantages regarding specific machines, devices or safety measures.

### 4. Observe Machine in Use

### 5. Identify Hazardous Areas

- identify each foreseeable task during the
entire lifecycle of the machine (e.g., loading and unloading, all modes of operation, planned and unplanned maintenance, tool change, troubleshooting and housekeeping).

- identify hazard potential associated with tasks required for transporting, start up, installation, decommissioning, and disposal of the machine:
  - in-running nip points
  - pinch points
  - crushing
  - electric shock
  - release of stored energy
  - ergonomic strain
  - slips, trips, and falls

| 6. Identify the Risk Level | • after the foreseeable tasks/hazards have been identified, assign a risk level to each one |
- in identifying levels of risk, most methods consider the main characteristics of a hazard: severity of the potential injury, frequency of exposure to the potential hazard, possibility of avoiding the hazard as it occurs, and likelihood of occurrence in event of a failure

- the resulting risk levels can be classified into three or four categories, ranging anywhere from high to negligible

- the initial risk estimation is conducted assuming no safeguards are installed; by doing so, the risk evaluation will produce a risk level that more accurately identifies the proper safeguarding methods to help reduce the risk of existing hazards

| 7. Evaluate the Risk Level | • evaluating the risk level helps determine if further safeguarding methods can be applied to the machine or process to make it safe |
- the risk level chosen is considered a reasonable and acceptable level of risk that a person would normally expect to take (it is widely recognized that zero risk does not exist); however, a good faith approach to risk assessment and risk reduction achieves a tolerable risk level.

- if the level of risk after the first risk estimation is at a tolerable level, the safety team continues on to step 12 below. If, however, the risk level is too high, the team continues with steps 8 – 11 to reduce the risk to a tolerable level.

8. Create an Appropriate Risk Reduction System

- if each risk is not initially tolerable, protective measures are applied that will effectively reduce the risk of a hazard to an acceptable level.
- when selecting appropriate protective measures, evaluate the application of the solution against factors such as risk-reduction benefit, usability, productivity, technological feasibility, economic and ergonomic impact, durability, and maintainability

8a. Hazard Elimination or Substitution

8b. Engineering Controls

8c. Awareness Means

8d. Administrative Controls

8e. Personal Protective Equipment

| 9. Accurately Estimate System Costs |   |   |
| 10. Provide All Required Services and Materials | • identify which guidelines are relevant and are important to the application  
• find installers with an intimate familiarity and understanding of these standards |
| 11. Conduct Follow-Up Risk Assessment | |
| 12. Process Close-Out and Sign-Off | • before releasing the machine to full production capacity, the final step is to complete the required documentation by:  
• identifying any residual risk |
• verifying the safeguarding system for effectiveness and compliance

• following the device and machine manufacturers' recommended set-up and try-out procedures.

• updating safe work procedures and training material to reflect the changes in the system.

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