MACHINE SAFEGUARDING: POTENTIAL FOR A REDUCTION IN AMPUTATIONS

safe state

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These guidelines are intended to provide information for the development of safe work practices of safeguarding machines. This information is not considered a substitute for any provision of the OSHA standards pertaining to machine guarding requirements.

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INTRODUCTION

Amputations have a tremendous cost for both the employer and the employee.

For the employee, it means a permanent physical disability that could profoundly affect that individual's livelihood. Many times there are psychological implications.

The employer may lose a valuable, well-trained employee, pay thousands of dollars in medical bills, legal fees and/or stiff regulatory penalties.

As part of its' strategic plan activity, OSHA has targeted industries that have woodworking, metal working machines, or any machinery or equipment which could cause an amputation, for inspection. The agency is determined to reduce the rate of injuries and amputations associated with the use of un-safeguarded equipment.

In an attempt to assist the employer in understanding the regulations and safe work practices of safe guarding machines, this pamphlet is a guide toward recognizing and correcting associated hazards, conducting a job hazard analysis and a reference toward understanding the applicable standards.

Of course, insuring safe guarding of woodworking and metal working machinery will help in the reduction of amputations in the workplace.

GUIDELINES FOR MACHINE SAFEGUARDING

The Occupational Safety and Health Administration (OSHA) requires that machine guarding be provided and maintained in a manner sufficient to protect machine operators and other persons present in machine areas from hazards associated with the operation of machines. Such hazards include those created by points of operation, in-running nip points, rotating parts, flying chips and sparks. The following information is provided to assist machine operators and machine shop supervisors and managers in carrying out their responsibilities for assuring machine safety through hazard identification and evaluation, safeguarding, and safe operation.

Types and Points of Hazardous Machine Operations

Motions

Rotating: in-running nip points, spindles, shaft ends, couplings
Reciprocating: back-and-forth, up-and-down
Transverse: movement in a straight, continuous line

Operations

Cutting: bandsaws, drills, milling machines, lathes
Punching: punch presses, notchers
Shearing: mechanical, pneumatic, or hydraulic shears
Bending: press brakes, tube benders, plate rolls

Safeguarding Requirements

Machine safeguards should be installed and maintained to ensure that they:

PREVENT CONTACT
Safeguards must minimize the possibility of the operator or another worker placing their hands into hazardous moving parts.

REMAIN SECURE
Workers should not be able to easily remove or tamper with the safeguard.

PROTECT FROM FALLING OBJECTS
Safeguards should ensure that no objects can fall into moving parts.

CREATE NO NEW HAZARDS
A safeguard defeats its purpose if it creates a hazard of its own.

CREATE NO INTERFERENCE

A safeguard should not create an unacceptable impediment for the worker.

ALLOW SAFE MAINTENANCE AND LUBRICATION

It should be possible to lubricate the machine without removing the safeguard.

Types of Machine Safeguards

- Barriers and guards that prevent contact with machinery.
- Mechanical or electrical devices that restrict contact, such as presence-sensing, restraining, or tripping devices, two-hand controls, or gates.
- Feeding and ejection methods that eliminate part handling in the hazard zone.
- Aids such as awareness signs that do not provide physical protection, but warn of a danger area.

COMMON ELEMENTS FOR SAFEGUARDING ALL MACHINES

Job Hazard Analysis

A job hazard analysis can be performed for all jobs in the workplace, whether the job task is “special” (non-routine) or routine. Even one-step jobs – such as those in which only a button is pressed – can and perhaps should be analyzed by evaluating surrounding work conditions.

To determine which jobs should be analyzed first, review your job injury and illness reports. Obviously, a job hazard analysis should be conducted first for jobs with the highest rates of disabling injuries and illnesses. Also, jobs where “close calls” or “near misses” have occurred should be given priority. Analyses of new jobs and jobs where changes have been made in processes and procedures should follow. Eventually, a job hazard analysis should be conducted and made available to employees for all jobs in the workplace.

Involving the Employee

Once you have selected a job for analysis, discuss the procedure with the employee performing the job and explain its purpose. Point out that you are studying the job itself, not checking on the employee’s job performance. Involve the employee in all phases of the analysis – from reviewing the job steps and procedures to discussing potential hazards and recommended solutions. You also should talk to other workers who have performed the same job.

Conducting the Job Hazard Analysis

Before actually beginning the job hazard analysis, take a look at the general conditions under which the job is performed and develop a checklist. Below are some sample questions you might ask.

- Are there materials on the floor that could trip a worker?
- Is lighting adequate?
- Are there any live electrical hazards at the jobsite?
- Are there any chemical, physical, biological, or radiation hazards associated with the job or likely to develop?
- Are tools – including hand tools, machines, and equipment – in need of repair?
- Is there excessive noise in the work area, hindering worker communication or causing hearing loss?
- Are job procedures known and are they followed or modified?

Naturally this list is by no means complete because each worksite has its own requirements and environmental conditions. You should add your own questions to the list. You also might take photographs of the workplace, if appropriate, for use in making a more detailed analysis of the work environment.

Breaking Down the Job

Nearly every job can be broken down into job tasks or steps. In the first part of the job hazard analysis, list each step of the job in order of occurrence as you watch the employee performing the job.

Be sure to record enough information to describe each job action, but do not make the breakdown too detailed. Later, go over the job steps with the employee.

Identifying Hazards

After you have recorded the job steps, next examine each step to determine the hazards that exist or that might occur. Ask yourself these kinds of questions.

- Is the worker wearing personal protective clothing and equipment, including safety harnesses that are appropriate for the job?
- Are work positions, machinery, pits or holes, and hazardous operations adequately guarded?
- Are lockout procedures used for machinery deactivation during maintenance procedures?
- Is the worker wearing clothing or jewelry that could get caught in the machinery or otherwise cause a hazard?
- Are there fixed objects that may cause injury, such as sharp machine edges?
- Is the flow of work improperly organized (e.g., Is the worker required to make movements that are too rapid)?
- Can the worker get caught in or between machine parts?
- Can the worker be injured by reaching over moving machinery parts or materials?
- Is the worker at any time in an off-balance position?
- Is the worker positioned to the machine in a way that is potentially dangerous?
- Is the worker required to make movements that could lead to or cause hand or foot injuries, or strain from lifting – the hazards of repetitive motions?
- Can the worker be struck by an object or lean against or strike a machine part or object?
- Can the worker be injured from lifting or pulling objects, or from carrying heavy objects?

- Do environmental hazards – dust, chemicals, radiation, welding rays, heat, or excessive noise – result from the performance of the job?

Repeat the job observation as often as necessary until all hazards have been identified.

Recommending Safe Procedures and Protection

After you have listed each hazard or potential hazard and have reviewed them with the employee performing the job, determine whether the job could be performed in another way to eliminate the hazards, such as combining steps or changing the sequence, or whether safety equipment and precautions are needed to control the hazards. An alternative or additional procedure is to videotape the worker performing his or her job and analyze the job procedures.

If safer and better job steps can be used, list each new step, such as describing a new method for disposing of material. List exactly what the worker needs to know to perform the job using the new method. Do not make general statements about the procedure, such as “Be Careful.” Be as specific as you can in your recommendations.

You may wish to set up a training program using the job hazard analysis to retrain your employees in the new procedures, especially if the are working with highly toxic substances or in hazardous situations. (Some OSHA standards require that formal training programs be established for employees.)

If no new procedures can be developed, determine whether any physical changes – such as redesigning equipment, changing tools, adding machine guards, personal protective equipment, or ventilation – will eliminate or reduce the danger.

If hazards are still present, try to reduce the necessity for performing the job or the frequency of performing it.

Go over the recommendations with all employees performing the job. Their ideas about the hazards and proposed recommendations may be valuable. Be sure that they understand what they are required to do and the reasons for the changes in the job procedures.

Job Hazard Analysis Form

JOB TITLE: Grinding Iron Castings

DATE OF ANALYSIS: January 1, 2000

JOB LOCATION: Finishing Area, Plant #2

STEP	HAZARD	RECOMMENDED ACTION / PROTECTIVE MEASURES
1. Reach into metal box to right of machine, grasp casting, and carry to wheel. 2. Push casting against wheel to grind off burr. 3. Place finished casting in box to left of machine.	1. Strike hand on edge of metal box or casting; cut hand on burr. Drop casting on toe. 2. Strike hand against wheel. Flying sparks or chips. Wheel breakage. Not enough of wheel guarded. No dust removal system. Sleeves could get caught in machinery. 3. Strike hand against metal box or castings.	1. Provide gloves and safety shoes. 2. Provide larger guard over wheel. Install local exhaust system. Provide safety goggles. Instruct worker to wear short or tight-fitting sleeves. 3. Provide for removal of completed stock.

Job Hazard Analysis

Revising the Job Hazard Analysis

A job hazard analysis can do much toward reducing accidents and injuries in the workplace, but it is only effective if it is reviewed and updated periodically. Even if no changes have been made in a job, hazards that were missed in an earlier analysis could be detected.

If an illness or injury occurs on a specific job, the job hazard analysis should be reviewed immediately to determine whether changes are needed in the job procedure. In addition, if a “close call” or “near miss” has resulted from an employee’s failure to follow job procedures, this should be discussed with all employees performing the job.

Any time a job hazard analysis is revised, training in the new job methods, procedures, or protective measures should be provided to all employees affected by the changes. A job hazard analysis also can be used to train effectively new employees on the steps and job hazards.

Cooperation and Assistance

Safety in the workplace demands cooperation and alertness on everyone's part. Supervisors, operators, and other workers who notice hazards in need of safeguarding, or existing systems that need repair or improvement, should notify the proper authority immediately.

Supervisors have these additional, specific responsibilities with regard to safety in the workplace; encouraging safe work habits and correcting unsafe ones; explaining to the worker all the potential hazards associated with the machines and processes in the work area; and being responsive to employer requests for action or information regarding machine hazards. The first-line supervisor plays a pivotal role in communicating the safety needs of the worker to management and the employer's safety rules and policies to the worker.

Sometimes the solution to a machine safeguarding problem may require expertise that is not available in a given establishment. The readers of this manual are encouraged to find out where help is available and, when necessary, to request it.

The machine's manufacturer is often a good place to start when looking for assistance with a safeguarding problem. Manufacturers can often supply the necessary literature or advice. Insurance carriers, too, will often make their safety specialists available to the establishments whose assets they insure. Union safety specialists can also lend significant assistance.

Some government agencies offer consultation services, providing for onsite evaluation of workplaces and the recommendation of possible hazard controls. OSHA funds one such program, which is offered free of charge to employers in every state. Delivered by state governments or private contractors, the consultation program is completely separate from the OSHA inspection effort; no citations are issued and no penalties are proposed. The trained professional consultants can help employers recognize hazards in the workplace and can suggest general approaches for solving safety and health problems. In addition, the consultant can identify sources of other available help, if necessary.

Anyone with questions about Federal standards, about the requirements for machine safeguarding, or about available consultation services should contact OSHA.

Training

Employees must be trained on all machinery or equipment they are required to use. Usually, shop personnel are trained by their supervisor or a designated trainer, only trained personnel or those undergoing supervised on-the-job training should be allowed to operate shop machinery or equipment. All operators should be trained in the proper operation, safety procedures, hazard recognition, and emergency shutdown procedures for each machine or piece of equipment they use.

The operator training programs should be tailored to an employee's work area. Employees learn more and draw a greater benefit from training that duplicates their daily work rather than a "canned program." As a minimum, the training program should include:

- The nature of hazards for each piece of equipment.
- Safety procedures for special set-ups for each tool.
- How to use safeguards.
- What to do in case guards are missing.
- How to perform work in a safe manner.

Additionally, the training should be devised so employees can demonstrate their knowledge and skills required to perform their tasks. The supervisor must determine that the employee knows and understands the features of the equipment, all applicable safety rules, and is skilled in operating the equipment.

Employers should certify that employees have been trained by preparing a certification record which includes the identity of the person trained, the signature of the employer or the person who conducted the training, and the date the training was completed. The certification should be prepared at the completion of the training and maintained on file for the duration of the employee's employment. The certification record should be made available upon request.

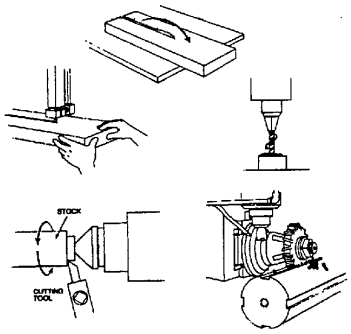
Standards That Are Common

29 CFR 1910.212 is applicable to machines found in general industry.

1910.212(a)(1) Requires employees to be protected from the point-of-operation. In-going nip points and rotating parts.

The Following are some machines which usually require point-of-operation guarding:

Guillotine Cutters
Shears
Alligator Shears
Hydraulic Presses
Riveters
Milling Machines
Power Saws
Jointers
Portable Power Tools
Forming Rolls and Calenders

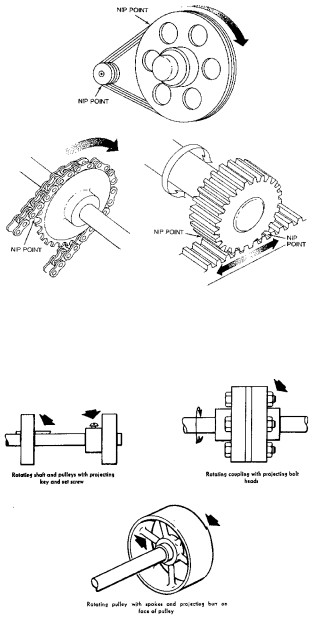


This standard also covers revolving barrels, drums and containers, guarding of fan blades and the anchoring of fixed machinery.

29 CFR 1910.219 Is applicable to mechanical power transmission apparatus.

The Following Is a List of Some Items Covered under this Standard:

V-belts
Cranks
Fly Wheels
Connecting Rods, Tails Rods
Extension Rod Pistons
Shafting, Projected Shaft Ends
Key Ways, Projected Keys or Set Screws
Belt, Rope and Chain Drives
Gear, Sprocket and Chains
Collars and Couplings
Pulleys



SPECIFIC REQUIREMENTS FOR WOODWORKING MACHINES

Overview

Many injuries that occur in woodworking occupations result from employees failing to follow prescribed safe operational practices. These failures arise from worker attitudes, inadequate training, and supervisory failure to enforce safe job procedures. The use of machine guards, environmental controls, good training, and maintenance programs, coupled with supervisory enforcement of protective equipment use and safe job practices can eliminate most mishap-producing factors.

Among the most frequently occurring woodworking accidents are two involving saws: (1) blade cuts or abrasions, (2) kickbacks.

Standards

29 CFR 1910.213 is the specific standard that covers the principle hazards of woodworking equipment.

The following is a breakdown by category of some types of equipment covered under this standard.

Circular, Crosscut, and Rip Saws

Guarding beneath the table level should be provided to enclose the saw blade from unintentional contact and prevent contact with moving parts of the drive mechanism. Saws must be equipped with a hood that covers the blade and automatically adjusts itself to the thickness of the material upon which it rides. The hood covers the part of the saw blade exposed above the material and is adaptable to cover tilted blades. When ripping, table saws must be provided with a spreader to prevent the wood's internal stresses from clamping down on the saw blade and an anti-kickback device to prevent the stock from possible kickback.

Radial Saws

Radial saws must be equipped with a hood that encloses the saw blade and the arbor ends. The lower section of the hood must be hinged so it rises and falls and adjusts itself automatically to the thickness of the material as the saw passes through it. An anti-kickback device or hold-down wheels must also be installed on saws used for ripping. The device must be adaptable to any thickness of stock.

Band Saws

Both upper and lower wheels must be completely enclosed on both sides. The enclosures should be capable of being removed easily to permit saw blade maintenance. The working part of a saw blade, between the guide rolls and the upper wheel enclosure, must be guarded to prevent accidental contact with the saw blade. The guard must be self-adjusting and attached to the gauge so that, in any position of the gauge, the guard completely covers the portion of the saw blade between the guide rolls and the upper wheel enclosure.

Jointers

Each hand-fed planer and jointer with a horizontal or vertical head should be equipped with a cylindrical cutting head, the knife projection of which must not exceed 0.125 inch (0.31 centimeters) beyond the cylindrical body of the head. Also, jointers with front-table-mounted fences must be equipped with an adjustable device to prevent thin stock from slipping laterally under the portion of the fence at the rear of the table. An automatic guard must be provided that covers the section of the cutter head near the operator (on working side of the fence) and contacts the wood to prevent any opening from remaining between the guard and wood during the operation. The guard should also cover the section of the cutter head on the non-working side of the fence, especially when the fence is moved toward the automatic guard. The guard over the section of the cutting head on the rear side of the fence should consist of a sliding metal shield that automatically adjusts to the exposed length of the cutter head.

Power Feed Planers

Guards must be provided for feed rolls, cutting heads, and hold-down rolls at the discharge end. Feed rolls should be guarded by a metal strip in front of the rolls under which the material may pass. This prevents an operator’s fingers from being drawn into the rolls while feeding the machine. Where the top roll is corrugated, the strip should extend over the top of the roll. Cutting heads and discharge rolls must be guarded by a solid metal enclosure of substantial construction. The hood of an exhaust system may form part or all of the enclosure. When other than corrugated top feed rolls are used, an anti-kickback device should be installed.

Shapers

Shapers must be equipped with a braking device that brings the cutting head to a stop within 10 seconds after power is shut off. Cutting heads must be enclosed by a guard. The guard must not be less than the greatest diameter of the cutter. Whenever possible, hold-downs and jigs should be used to limit exposure of hands to cutters. It is good practice when a blade is removed from a spindle for

sharpening, or for some other purpose, that all other blades be removed at the same time.

Lathes

Rotating, cutter-head type lathes must be provided with a hinged metal shield or hood that completely covers the knifes and material when the machine is in operation. Exhaust system hoods may be included as part of the guard if they comply with standard guard designs. Automatic lathes should be equipped with a brake that brings the rotating material to a quick, but not instantaneous, stop after power is shut off.

Sanding Machines

Feed rolls of self-feed sanding machines should be protected with a semi-cylindrical guard to prevent hands from coming in contact with the in-running rolls at any point. The guard and its mounting should be designed to remain in adjustment for any thickness of stock. Drum/disk sanding machines should have an exhaust hood, or other guard, so arranged as to enclose the revolving drum/disk, except for the working portion of the drum/disk above the table. Belt sanding machines should be provided with guards at each nip point. These guards must effectively prevent hands or fingers from coming in contact with the nip points. The unused run of the sanding belt must be guarded against accidental contact.

Boring and Mortising Machines

The top of the driving mechanism must be enclosed.

Tenoning Machines

Feed chains and sprockets of double end tenoning machines must be completely enclosed, except for that portion of chain used for conveying the stock. Sprockets and chains must be guarded at the sides by plates projecting beyond the periphery of sprockets and the ends of lugs at the rear ends of frame over which feed conveyors run. Each tenoning machine that has cutting heads and saws must be covered by metal guards when used. These guards should cover at least the unused part of the periphery of the cutting head. Where an exhaust system is used, the guard may form part or all of the exhaust hood.

SPECIFIC REQUIREMENTS FOR METAL WORKING MACHINES

Overview

Metal working machine safeguarding must protect the operator from mechanical hazards and prevent any part of the operators body from making contact with dangerous moving parts, yet not create new hazards or create interference from performing.

OSHA requirements for safeguarding metal working machines are intended to minimize potential for injury while rotating, revolving, reciprocating, slitting, shearing, punching, or bending actions are occurring and to prevent entry of the hands or fingers or any part of the body into the point-of-operation by reaching over, through, under or around a guard through the use of guarding, safe distance location, hand tools or other devices.

Standards

29 CFR 1910.215	Abrasive wheel grinders, control wheel breakage, prevent contact with abrasive surfaces, control angular exposure of the grinding wheel and insure secure mounting of the wheel.
29 CFR 1910.216	Mills and calendars, provide for and arrangement of safety stopping devices for rolls, control the stopping limits and provide for an alarm system for assistance in an emergency.
29 CFR 1910.217	Mechanical power presses, limit exposure to the point-of-operation by enclosing the dies with barrier guards, or through the use of presence sensing devices, two-hand controls, pull-backs, restraints or gates while initiating the stroke, as long as the devices maintain proper adjustment. Hand-feeding tools can be used in conjunction with some of the mentioned devices but are not recognized as a point-of-operation device themselves. Training and die-setting procedures are required before operation.
29 CFR 1910.218	Forging machines, require certification of records, recording inspections of guards and protective devices, training for proper inspection and maintenance and for proper anchoring of the hammer as well as the machine itself and the use of hand-tools.

METHODS OF MACHINE SAFEGUARDING

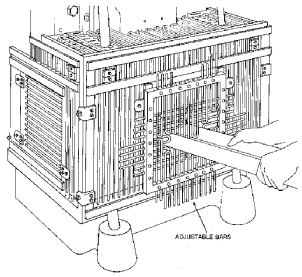
There are many ways to safeguard machinery. The type of operation, the size or shape of stock, the method of handling, the physical layout of the work area, the type of material, and production requirements or limitations will help to determine the appropriate safeguarding method for the individual machine.

As a general rule, power transmission apparatus is best protected by fixed guards that enclose the danger area. For hazards at the point-of-operation, where moving parts actually perform work on stock, several kinds of safeguarding are possible. One must always choose the most effective and practical means available.

We can group safeguards under five general classifications.

Guards

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



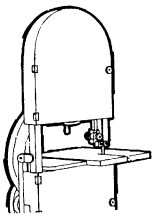
Fixed:

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

Interlocked:

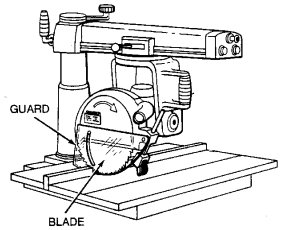
When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, and the machine cannot cycle or be started until the guard is back in place.

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.



Adjustable:

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

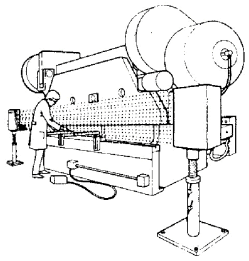


Self-Adjusting:

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, other substantial material. Self-adjusting guards offer different degrees of protection.

Devices

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

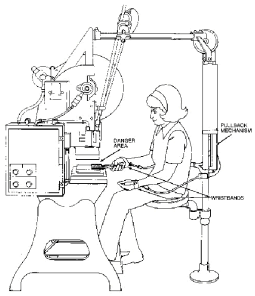


Presence-Sensing

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 will not cycle. This device must be used only on machines which can be stopped before the worker can reach the danger area.

The *radiofrequency* (capacitance) presence-sensing 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.

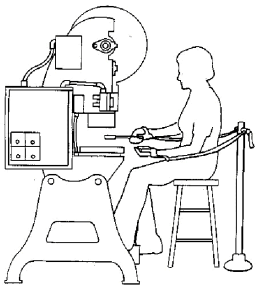
The *electromechanical* sensing device has a probe or contact bar which descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full predetermined distance, the control circuit does not actuate the machine cycle.



Pullback[1]

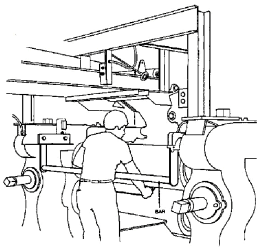
Pullback devices utilize a series of cables attached to the operator's hands, wrists, and/or arms. This type of device is primarily used on machines with stroking action. When the slide/ram is up, the operator is allowed access to the point-of-operation. When the slide/ram begins to descend, a mechanical linkage automatically assures withdrawal of the hands from the point-of-operation.

[1]Pullback or Restraint devices are used on power presses only.



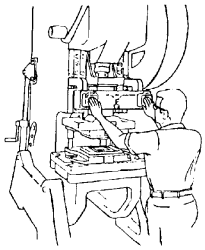
Restraint[1]

The restraint (holdout) 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.



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 into the machine, applying pressure to the bar will stop the operation. The positioning of the bar, therefore, is critical.



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 a safe location (on control buttons) and at a safe distance from the danger area while the machine completes its closing cycle.

Two-Hand Trip

The two-hand trip requires concurrent application of both of 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 possible 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. Thus the operator's hands are kept far enough away to prevent them from being accidentally placed in the danger area prior to the slide/ram or blade reaching the full "down" position.

Gate

A gate is a movable barrier which 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.

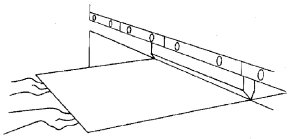
[1]Pullback or Restraint devices are used on power presses only.

Safeguarding by Location/Distance

The examples mentioned below are a few of the numerous applications of the principle of safeguarding by location/distance. A thorough hazard analysis of each machine and particular situation is absolutely essential before attempting this safeguarding technique.

To safeguard a machine by location, the machine or its dangerous moving parts must be so positioned that hazardous areas are not accessible or do not present a hazard to a worker during the normal operation of the machine. This may be accomplished by locating a machine so that a plant design feature, such as a wall, protects the worker and other personnel. Additionally, enclosure walls or fences can restrict access to machines. Another possible solution is to have dangerous parts located high enough to be out of the normal reach of any worker.

The feeding process can be safeguarded by location if a safe distance can be maintained to protect the worker's hands. The dimensions of the stock being worked on may provide adequate safety. For instance, if the stock is several feet long and only one end of the stock is being worked on, the operator may be able to hold the opposite end while the work is being performed. An example would be a single-end punching machine. However, depending upon the machine, protection might still be required for other personnel.



Guarding by Distance

The positioning of the operator's control station provides another potential approach to safeguarding by location. Operator controls may be located at a safe distance from the machine if there is no reason for the operator to tend it.

Feeding and Ejection Methods to Improve Operator Safety

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

Some feeding and ejection methods may even create hazards themselves. For instance, a robot may eliminate the need for an operator to be near the machine but may create a new hazard itself by the movement of its arm.

Using these feeding and ejection methods does not eliminate the need for guards and devices. Guards and devices must be used wherever they are necessary and possible in order to provide protection from exposure to hazards.

Types of Feeding and Ejection Methods:

Automatic Feeds reduce the exposure of the operator during the work process, and sometimes do not require any effort by the operator after the machine is set up and running.

With ***semi-automatic feeding***, as in the case of a power press, the operator uses a mechanism to place the piece being processed under the ram at each stroke. The operator does not need to reach into the danger area, and the danger area is completely enclosed.

Automatic ejection may employ either an air-pressure or a mechanical apparatus to remove the completed part from a press. It may be interlocked with the operating controls to prevent operation until part ejection is accomplished. This method requires additional safeguards for full protection of the operator.

Using a ***semi-automatic*** *ejection* mechanism on a power press. When the plunger is withdrawn from the die area, the ejector leg, which is mechanically coupled to the plunger, kicks the completed work out.

Robots are machines that load and unload stock, assemble parts, transfer objects, or perform other tasks. Essentially, they perform work otherwise done by an operator. They are best used in high production processes requiring repeated routines. However, they may create high hazard themselves, and if they do, appropriate guards must be used.

Miscellaneous Aids

While these aids do not give complete protection from machine hazards, they may provide the operator with an extra margin of safety. Sound judgement is needed in their application.

The awareness barrier does not provide physical protection, but serves only to remind a person that he or she is approaching the danger area. Generally, awareness barriers are not considered adequate where continual exposure to the hazard exists.

Shields, another aid, may be used to provide protection from protection from flying particles, splashing cutting oils, or coolants.

Holding tools can place or remove stock. A typical use would be for reaching into the danger area of a press or press brake.

A push stick or block may be used when feeding stock into a saw blade. When it becomes necessary for hands to be in close proximity to the blade, the push stick or block may provide a few inches of safety and prevent injury.

NOTES:

RESOURCES

CONSULTATION PROGRAM

www.alabamasafestate.ua.edu

Safe State Program, The University of Alabama
425 Martha Parham West
P.O. Box 870388
Tuscaloosa, AL 35487-0388
1-800-452-5928
(205) 348-7136

OSHA

www.osha.gov

Birmingham Area Office
Todd Mall
2047 Canyon road
Birmingham, AL 35216-1981
(205) 731-1534
(205) 731-0504 FAX

Mobile Area Office
3737 Government Boulevard, Suite 100
Mobile, AL 36693-4309
(334) 441-6131
(334) 441-6396 FAX

NATIONAL SAFETY COUNCIL

www.bhm.tis.net/~nacnsc

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