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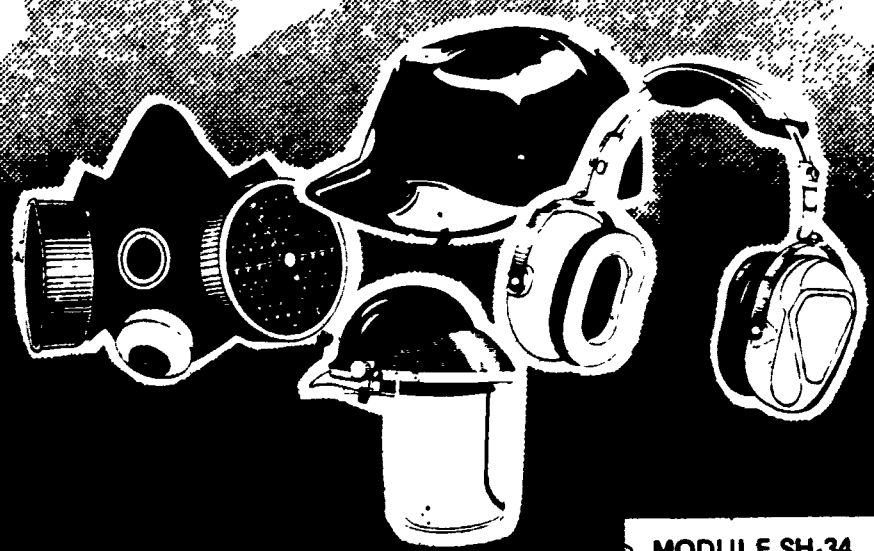
ABSTRACT

This student module on safety guards for machinery is one of 50 modules concerned with job safety and health. This module discusses how machinery can be made safer to use by the installation of safety guards. Following the introduction, seven objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Explain the basic machine motions). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

SAFETY AND HEALTH

SAFETY GUARDS FOR MACHINERY



MODULE SH-34

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INTRODUCTION

It is evident that any machine designed to cut, form, or shape materials such as steel, wood, plaster, and the like is capable of smashing, tearing, or severing flesh and bones. Because of their intended functions, machines or machinery hammer, press, grind, shape, form, and separate materials with great force. An unguarded machine has no respect for materials, releasing its power on fingers, arms, legs, eyes, and any other part of the human body that may get in its way.

These potential accidents can be reduced or eliminated in two ways: (1) by knowledge of, and proper attitudes toward, safe practices, and (2) by designing machinery and guards in such a way that workers are protected from dangerous processes. Nevertheless, records kept by the Occupational Safety and Health Administration during the past few years clearly show that machinery and machine guarding standards are some of the most violated of all standards.

This module discusses how machinery can be made safer to use by the installation of safety guards. A study of machine actions, the functions and application of guards, and some of the requirements for guards is likely to result in safer workplaces.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. Explain why machine guards are necessary, and list their five functions. (Page 3)
2. Explain the basic machine motions. (Page 5)
3. Describe four types of machine guarding and their specific function. (Page 8)
4. Describe the general requirements of guards with regard to design, use, color, and application. (Page 13)
5. Describe proper guard construction and some advantages of factory-built guards, as opposed to shopmade guards. (Page 19)

6. List and discuss two types of machine guard inspections (based on frequency). (Page 20)
7. List four general safety rules for working with guarded machines, and three common reasons for unguarded machinery. (Page 22)

SUBJECT MATTER

OBJECTIVE 1: Explain why machine guards are necessary, and list their five functions.

As recently as forty or fifty years ago, guards on machines were almost nonexistent. During the early decades of the twentieth century, sprockets, chains, belts, pulleys, drive shafts, gears, and the like were normally exposed. When someone was injured or killed on the job, it was accepted as a tragic but almost routine event. However, during the 1960s, there was a concerted move by industry, safety groups, and labor to set up some way to minimize occupational accidents and deaths. As a result of the efforts of these groups, the Occupational Safety and Health Administration (OSHA) was established. One of the many problems OSHA addressed was the guarding of machines.

Since any moving part of a machine creates a hazard, mandatory guidelines were written to govern machines and the devices necessary to guard them. The primary reason for machine guards is to protect the machine operator or others who may be working nearby. However, because of the great expense of most pieces of equipment, some guards are also designed to protect the machine and the power transmission equipment from damage. Damage to machinery can be caused by operator misuse or from tools or materials being placed, dropped, or moved into working parts.

Guards perform a variety of functions. They protect the worker from coming into contact with moving parts of a mechanism; they decrease or remove the likelihood of someone being caught in a machine at the point where material is being machined; and they enclosed belts and pulleys that provide power to the machining operation. They also guard against hazards caused by the work being processed. For example, metal and wood chips can be thrown by metal turning operations and by circular saws; hot metal can be splashed in galvanizing processes, and wood can be kicked back at the operator by ripsaws. The guard illustrated in Figure 1 is designed to protect against these types of hazards.

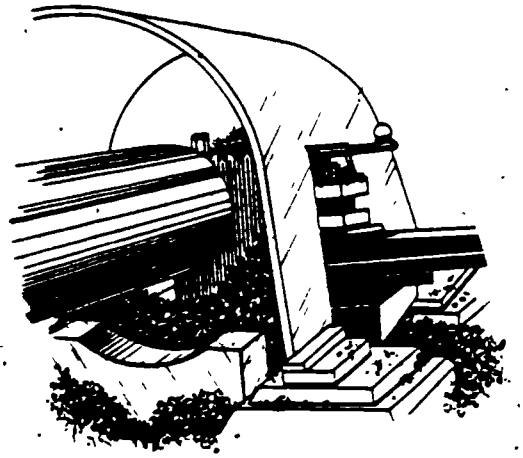

Figure 1. Transparent plastic chip and splash guard.

Another function of guards is to protect against the hazards arising from human failure. Such things as illness, distraction, worry, fatigue, and anger contribute to human failure and thus lead to accidents. Carefully designed guards can significantly decrease these accidents, as well as those arising from mechanical failure such as breakage of parts. When parts are broken, they may be thrown out of position and the machinery may malfunction, causing injury.

Guards also protect against electrical failure that can cause numerous hazards. For example, if a storm causes a power outage and someone is adjusting a machine when power is restored, an unprotected machine may resume its cycle and injure the worker. This kind of accidnet, as well as others caused by power failures, can be prevented by the proper guarding mechanism.

ACTIVITY 1:

1. List two reasons for machine guards.
   a. _____
   b. _____
2. Name five functions that guards perform.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

*Answers to Activities appear on Page 24.

OBJECTIVE 2: Explain the basic machine motions.

Certain actions of machines present very specific hazards that can be eliminated or lessened by guards. Several motions are basic to machine operations: rotary motion, reciprocating (back and forth) motion, transverse motion, cutting motion, and the motion necessary for punching, shearing, or bending.

ROTARY MOTION

Wherever machine parts rotate towards each other, or where one part rotates towards a stationary object, danger always exists. These "in-running nip points," shown in Figure 2, are frequently found where there are rolls for bending, rolls for feeding and conveying stock, gears, belts, and pulleys, belt conveyor terminals, and other such machinery. Part of the danger lies in the fact that clothing or other items can be caught in unguarded, in-running nip points, thus injuring the part or parts of the body pulled into the equipment with the caught materials.

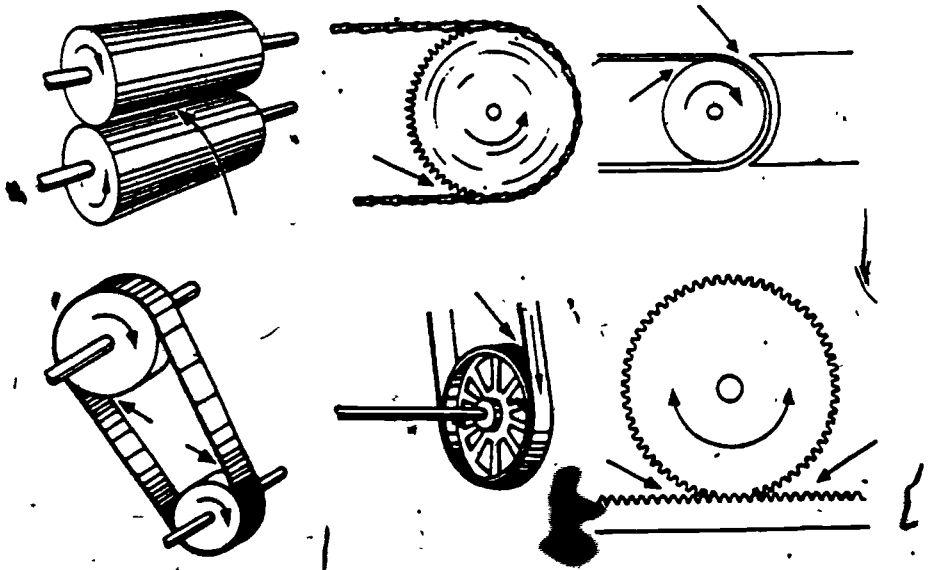

Figure 2. In-running nip points require guarding.

Other mechanisms with dangerous rotating motions are motor shaft ends, rotating bar stock, flywheels, screw conveyors, mixing paddles, and

clutches. Hair, shop aprons, jewelry, loose clothing, gloves, or other items can get caught in rotating mechanisms that are not properly guarded, and can cause serious injury to workers.

Safety standards require that guards be provided with keys that protrude on rotating shafts. When shafts extend past guards, exposed rotating spindles (such as those found on drills and milling machines) create danger points that can cause serious injury.

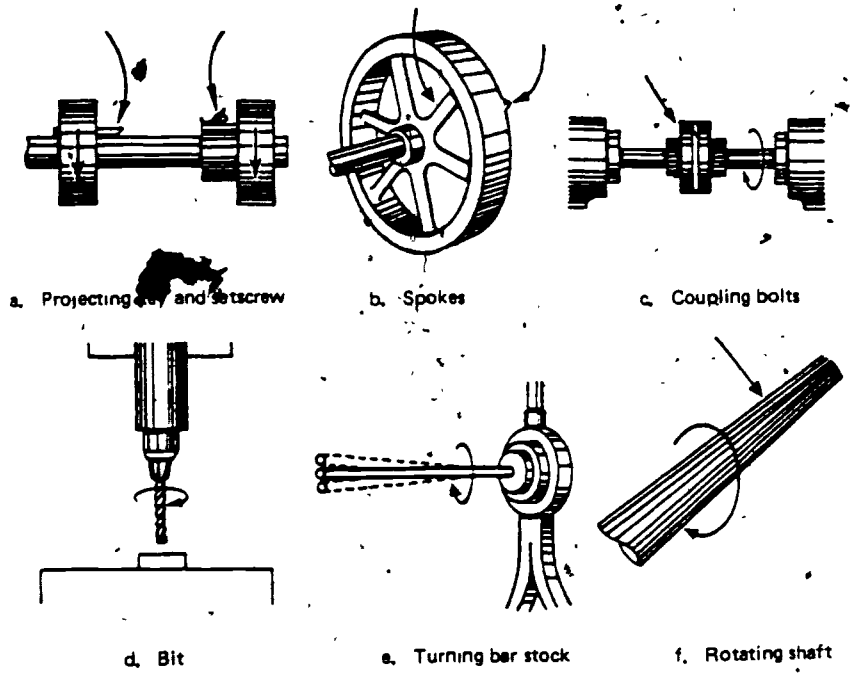

Figure 3. Rotating mechanisms that require guarding.

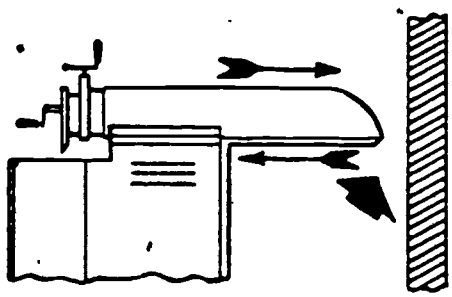

Figure 4. A reciprocating mechanism creates pinch points at fixed objects.

RECIPROCATING MOTION

Reciprocating (back and forth) motions create pinch points whenever the machine approaches a fixed object. The ram of a metal shaper (Figure 4), and the belt of a surface grinder both use reciprocating motions.

Transverse motions are those caused when a portion of the machine continually moves in one direction while another protion of it moves in a cross direction. A belt sander and a pulley and belt mechanism both provide transverse motion. Enclosure or barrier guards must be used to reduce or eliminate the hazards caused by reciprocating and transverse motions.

CUTTING MOTION

When a machine cuts through metal, wood, or any other material, the cutting action presents a hazard at the point where stock is inserted and withdrawn (the point-of-operation). See Figure 5. Milling machines, band saws, planing machines, lathes, drill presses, circular saws, and grinders are dangerous because of their cutting action. Guards must be used to eliminate injuries that can be caused by cutting actions.

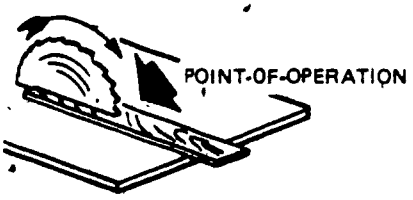

Figure 5. Table saw illustrating cutting action.

PUNCHING, SHEARING, OR BENDING

Machines used for punching, shearing, blanking, stamping, trimming, bending, and other similar operations are also dangerous at the point-of-operation. When the power is applied to a ram, a blade, or a die, a punching shearing, or bending action occurs. These actions normally take place under great force. As a result, unguarded machines of this nature can result in smashed, broken, or severed limbs. Each point-of-operation (Figure 6) must be closely guarded according to OSHA standards.

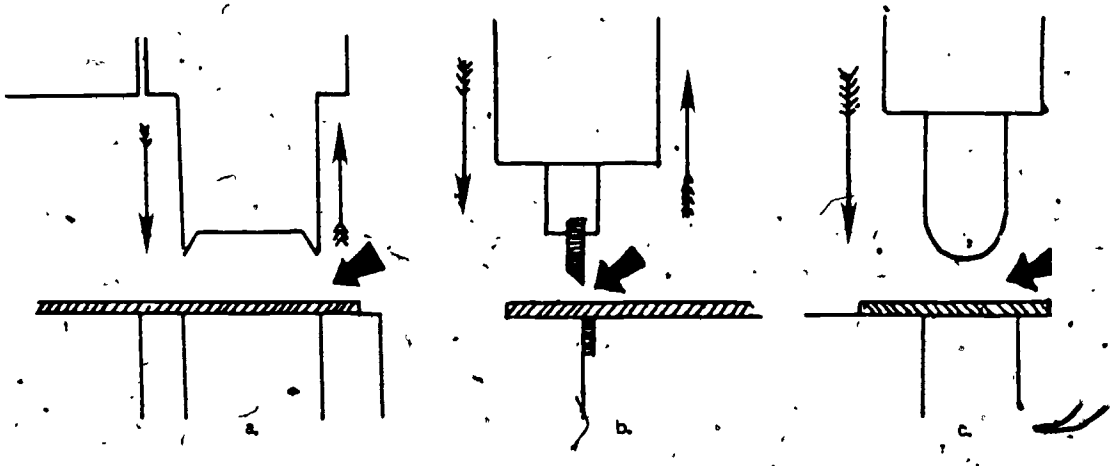

Figure 6. Machine motions of (a) punching, (b) shearing, and (c) bending can cause safety hazards.

ACTIVITY 2:

List and describe the five basic machine motions.

1. _____
2. _____
3. _____
4. _____
5. _____

OBJECTIVE 3: Describe four types of machine guarding and their specific function.

There are usually several ways to reduce or eliminate the exposure to dangerous power transmission mechanisms and points-of-operation. Dangerous equipment must be replaced, redesigned, or have hazardous areas guarded. In practice, the five functions of guards (see Objective 1) must be carefully considered in relation to each particular piece of equipment. Then, if it is considered feasible to make the equipment safe by a guarding system, a guard or guards should be designed or selected to serve the intended functions.

The selection of a type of guard is dependent upon several factors. Fixed enclosure guards are almost always best for the protection of power transmission machinery. However, point-of-operation guarding is often more

difficult to accomplish because of the variety of shapes and sizes of the materials that must be processed. The four common types of machine guards are enclosure, interlocking barriers, automatic, and guarding by location. Their variations are discussed here.

ENCLOSURE GUARDS

An enclosure guard protects persons by preventing access to dangerous moving parts by keeping the persons away from the hazard and from its effects. Enclosed guards may be either fixed or adjustable.

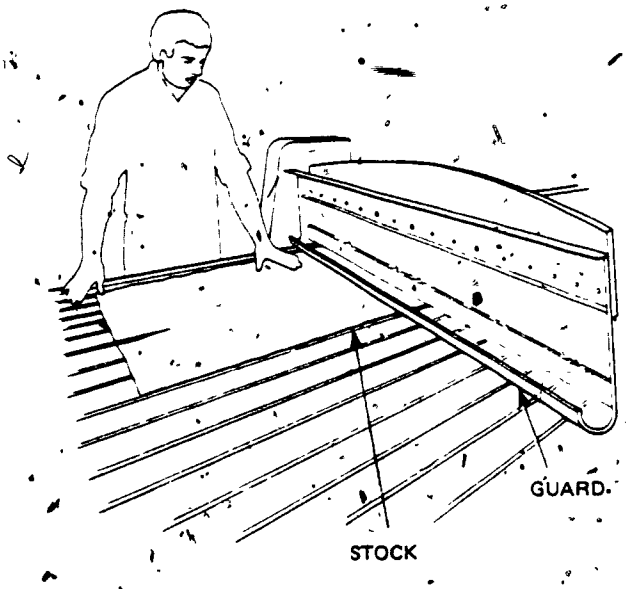

Figure 7. Fixed guard on veneer clipper.

The preferred method is the fixed enclosure guard that prevents access to hazardous areas by enclosing them completely. When guards are used on power transmission equipment, the motion is enclosed at all times. When used at the point-of-operation (Figure 7), the guard allows passage of the stock but will not admit fingers because of the limited size of the feed opening.

An adjustable enclosure guard forms a barrier around a work point. This barrier can be adjusted manually to conform to various sizes of cutters and/or materials. The adjustable guard requires frequent adjustment and careful maintenance. A spring-loaded guard over the knives of a wood jointer (Figure 8) is an example of an adjustable enclosure guard.

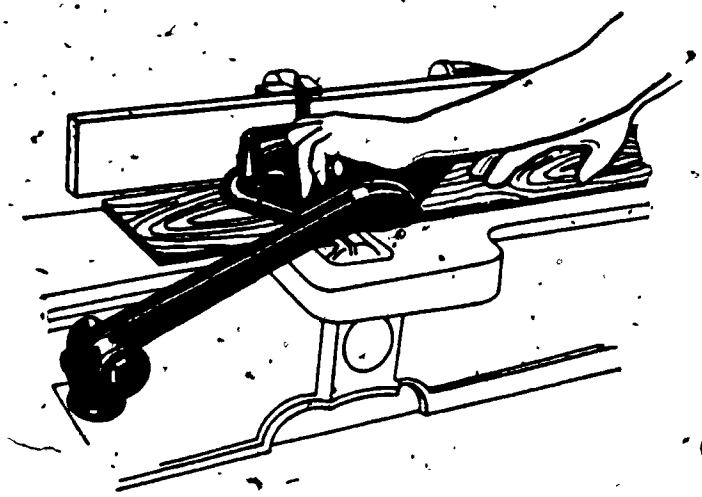

Figure 8. An example of an adjustable enclosure guard on a wood jointer.

INTERLOCKING GUARDS

A second major type of guard is an interlocking guard (Figure 9). An interlocking barrier guard is not fixed, and may be opened or removed as required. When the guard is in an opened position, operation of the machine is prevented until the guard is returned to its protective position. Some interlocking guards do not allow removal of the guard until the machine is turned off and the moving parts come to a stop. Other interlocking guards cause the mechanism to come to a rapid stop if the guard is altered or removed.

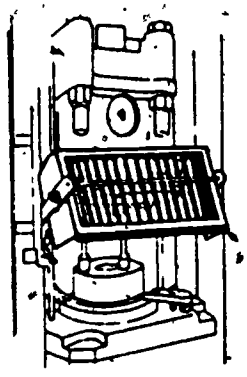

Figure 9. An interlocking guard.

An interlocking barrier guard is used to stop the machine or to prevent application of injurious pressure when any part of the operator's body contacts the barrier. The barrier may be a bar, a rod, a wire, or some similar device (other than an enclosure) extended across the danger zone and interlocked electrically or mechanically with a braking mechanism. Electrical interlocking devices should be designed so that if they fail, they make the guarded machine inoperative.

One variation of the interlocking guard is the two-hand trip or control guard. This type of guard prevents the machine from operating unless the

operator uses the pressure of both hands on two switch buttons or control levers at the same time. Thus, the operator's hands are always clear of the point-of-operation while the machine is in motion.

AUTOMATIC GUARDS

When neither an enclosure guard nor an interlocking guard is practicable, an automatic guard may be used. An automatic guard works independently of the operator. It stops the machine operation in case of danger, or removes the danger from the work area with a sweep or push-away action. Automatic guards are used almost exclusively for point-of-operation guarding. The three types of automatic guards are sweep, pull-away, and electric eye guards.

The sweep device on an automatic guard cycles with the machine operation. That is, when the machine is activated by the operator, the guard automatically "sweeps," or pushes across the point-of-operation, removing with it misplaced tools, materials, or other items that should not be in the guarded area, including the operator's hands.

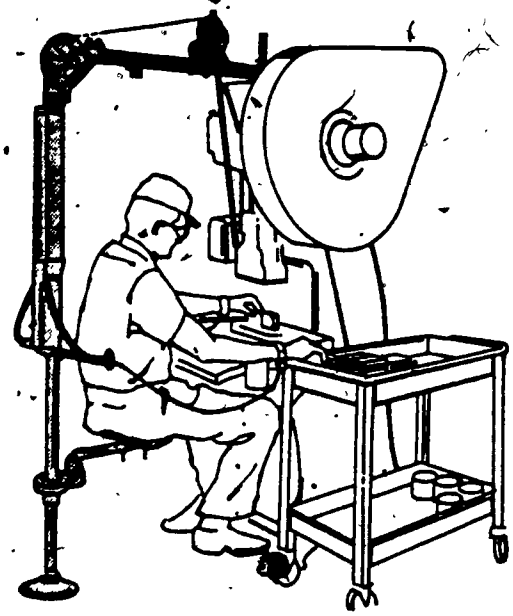

Figure 10. Pull-away guard.

Pull-away guards (Figure 10) are similar to sweeps. However, pull-aways incorporate a cable-operated attachment. When the cables are connected to the machine operator's hands or arms, they act to pull the operator's body parts out of the danger zone if they are left at the point-of-operation. Otherwise, the pull-aways do not interfere with the machine's normal operation.

An automatic guard is sometimes operated by an electric eye device and a brake mechanism. If hands are in the danger zone as the machine starts to cycle, the beam is obscured from a photoelectric switch. This causes the power to the machine to be interrupted, and a brake rapidly stops the machine cycle.

The electric eye method of machine guarding has several limitations. First, it is expensive to install. Also, its use is generally limited to slow-speed machines, with friction clutches or other means of stopping the machine during the operating cycle.

GUARDING BY LOCATION

Operators of machinery used exclusively for power transmission purposes can be protected from hazards by the "guarding by location" method. For example, if the belt and pulley drive on an exhaust fan were located in a special locked room or a basement, (and if some other conditions were met), guarding requirements could be waived. In most cases, power transmission equipment can be left unguarded if it is permanently located more than seven feet above the floor. Everyone should be advised, however, that shafting, belts and pulleys, and other such power transmitting machinery under work benches are hazardous and must be guarded on all exposed sides.

A barrier guard protects persons from injury by keeping them from moving into a danger area. The barrier may be designed to keep someone from falling or slipping into a dangerous opening, or it may prevent access to a piece of service equipment (such as an air compressor or an electric transformer). A barrier guard may also serve to keep persons out of an area that is subject to acid splash.

ACTIVITY 3:

List four types of machine guards and describe the function of each.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 4: Describe the general requirements of guards with regard to design, use, color, and application.

All power transmitting mechanisms and all points-of-operation on machines must be guarded, and guards must be properly maintained. Where possible, the guard should be fixed to the machine or secured elsewhere if attachment to the machine is impossible. Care must be taken to ensure that the guard itself does not pose a hazard.

Other specific recommendations for the design of acceptable machine guards are listed below. Guards must always -

- Conform to the standards set by the American National Standards Institute (ANSI).
- Be considered and used as a permanent part of the machinery.
- Be designed and constructed to afford maximum protection to the machine operator and all co-workers.
- Prevent access to the danger zone while the machine is in operation.
- Not weaken the structure of the machine.
- Not cause undue discomfort to the operator nor interfere with the operator's efficient use of the machine.
- Be designed to provide for ease of oiling, adjusting, inspecting, and repairing the machine. (Guards that must be removed so that the machine can be inspected and serviced often cause considerable loss of production time. When this happens, the guard is often removed from the machinery and left off. This is, of course, against regulations.)
- Be durable and resistant to fire, wear, and corrosion.
- Be strong enough to resist normal wear and impact. They should also be relatively maintenance-free.

Guards should not contribute to safety hazards by causing a sense of false security or by actually creating pinch points, sharp corners, rough edges, splinters, or other danger points.

- They should, if possible, be the interlocking type so that a removed or out-of-position guard will cause the machinery to be inoperative.
- They should be painted to meet ANSI (American National Standards Institute) color coding recommendations.

These guard design characteristics, if adhered to, could help save countless numbers of workers and students from injury each year.

While the use of colors is often for safety purposes, it never was intended that color coding substitute for proper guarding. Standard colors are used to identify both safe and unsafe parts of mechanical devices. Bright orange is the color designated by ANSI (American National Standard Z53.1) as the standard color to highlight dangerous parts of machines, or energized equipment which will shock, cut, crush, or otherwise injure.

Orange should be painted on such parts of machinery as the exposed edges or cutting devices, the inside of enclosure doors, and on other guards around moving equipment to emphasize a "caution" situation.

In addition to the requirement that guards be designed properly, care and instruction should be given in an attempt to ensure that they are properly used. All persons operating and working near machinery and machines must develop a proper attitude of respect for both the equipment and the guards. Students and workers alike must be properly supervised in safe work procedures, and compliance with safety regulations must be demanded.

The following are recommendations of the National Safety Council (NSC) for the safe use of guarded machinery.

1. No guard should be adjusted or removed for any reason by anyone, unless (a) specific permission is given by the supervisor, (b) the person concerned is specifically trained, and (c) machine adjustment is considered a normal part of the worker's job.
2. No machine should be started unless the guards are in place and in good condition. Defective or missing guards should be reported to the foreman immediately.
3. Whenever safeguards or devices are removed to repair, adjust, or service equipment (lubrication and maintenance), the power for the equipment should be turned off, and the main switch locked and tagged.
4. No one should be permitted to work on or around mechanical equipment while wearing neckties, loose clothing, watches, rings, or other jewelry.

Although the OSHA regulations (in "General Industry, Safety and Health Regulations," Part 1910) should be consulted for specific detailed requirements of machinery and machine guarding, the following is intended to point out some of the more frequently needed guarding practices for different types of common equipment.

Circular saw guards must be constructed to slide in grooves or tracks that are accurately machined. This will ensure exact guard alignment with the blade for all positions.

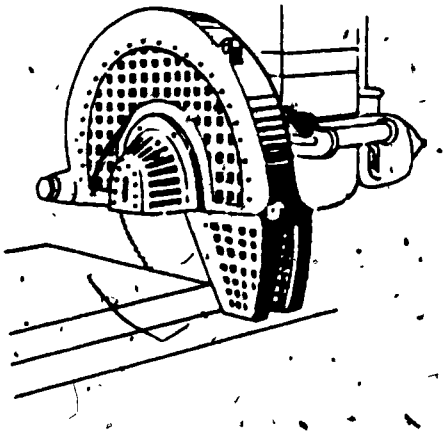

Figure 11. Guard on saw with circular blade.

Hinged saw tables must be constructed so that the table can be firmly secured in any position in true alignment with the saw. Belts, pulleys, gears, shafts, and other moving parts must be guarded at all times.

Each power-driven woodworking machine should be provided with a disconnect switch that can be locked in the OFF position. Circular saws must be provided with a hood that covers the saw at all times to the depth of the teeth, and the hood should automatically adjust itself to, and remain in contact with, the material being cut (Figure 11). A spreader and anti-kickback device should be provided, and any exposed part of the saw behind or beneath the table should be guarded.

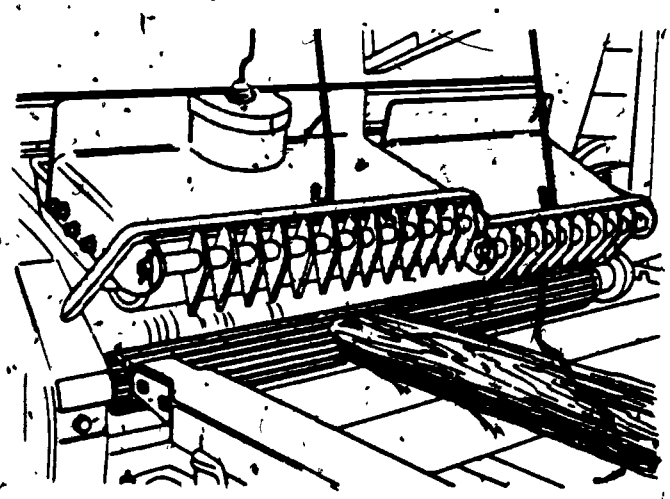

Figure 12. Anti-kickback device on the feed side of an edging machine.

In addition to the hood enclosing the blade of a radial saw, an adjustable stop should be provided to limit forward travel. The head should atomatically return to the starting position. When used for ripping, a spreader and anti-kickback device (Figure 12) must be used to prevent material from squeezing the blade, or from being thrown back at the operator.

No saw, cutter head, or

tool collar should be placed or mounted on a machine arbor unless the tool has been accurately machined to fit the arbor.

Combs (featherboards) or suitable jigs, for use in holding work against the shaper or cutter, must be provided when a standard guard cannot be used in such operations as dadoing, grooving, molding, or rabbeting.

All portions of a band saw blade, except for the working portion between the guide rolls and the table, must be fully enclosed. The machine must also be provided with a tension-control device to indicate the proper tension for the saws used on the machine.

Hand-fed planers or jointers must be equipped with cylindrical -- not square -- heads, and the opening in the table must be kept as small as possible. The cutting heads of this machine, both horizontal and vertical, must be covered with a guard.

The chains and sprockets of all double-end tenoning machines must be entirely closed, except for the portion of the chain used for conveying the stock. All cutting heads and saws, if used, must be covered by metal guards.

Whether rotating or not, the cutting heads of wood-turning lathes must be covered as completely as possible by hoods or shields hinged to the machine so that they can be lifted back to allow for adjustments. Lathes used for turning long pieces of wood stock, and held only by the two centers, must be equipped with long curved guards extending over the tops of the lathes to prevent any stock that is loose from being thrown.

The feed rolls of self-fed sanding machines must be protected with a firmly secured, semi-cylindrical guard to prevent the operator's hand from coming into contact with the in-running rolls at any point. Drum, disk, and belt sanding machines must be enclosed by exhaust duct hoods that cover all but the work portions of those machines. Belt sanders should have guards at each in-running nip point on the power transmission and feed roll parts.

All abrasive wheels must be covered with guards strong enough to withstand the shock of a bursting wheel, and the exposed (or work contact) portion of the wheel should not be more than one-fourth of the entire wheel.

The operator should use only the exposed periphery (or circumference) of the wheel. Work rests that support the material being ground must be strongly constructed and designed to be adjustable to the wearing down of the wheel. The work rest must have a maximum wheel clearance of one-eighth of an inch to prevent the work from becoming jammed between the wheel and the rest itself. Since an operator stands in front of the wheel opening, the guard must be constructed so that it can be adjusted to the decreasing diameter or wearing down of the wheel. The distance between the guard and the wheel should never be more than one-fourth of an inch.

The operator of a grinder, and of any power equipment, must wear a face shield and goggles at all times.

Machines using full revolution clutches must have a single-stroke mechanism. Foot treadles must be protected with a fixed guard to prevent unintentional operation caused by falling objects, or by a foot accidentally placed on the treadle. A nonslip pad must cover the treadle.

The operating levers of hand-operated power presses and shears must be equipped with a spring latch to prevent premature or accidental tripping. The levers of presses with more than one operating station must be interlocked. The machine must be protected against unintentional repeats, and the operator must be able to lock the main power disconnect switch only in the OFF position. It is the employer's responsibility to provide and ensure the proper use of point-of-operation guards and devices on every operation performed by a power press or shear. The guards and devices used must prevent hands or fingers from entering the danger zone at all times. The guard must not create a pinch point between itself and moving machine parts.

When using metal turning lathes, caution must be taken to guard against flying chips and to prevent loose clothing from being caught by revolving work or a workholding attachment. A clear plastic shield (refer back to Figure 1) should be attached at the back of the lathe so that the shield can be lowered into place over the stock and the stock holding devices. With the guard in place, the operator is then protected from the revolving chuck or lathe dog, from metal chips, and from the splash of cutting fluids. The guard will also help prevent accidental contact with the revolving work. Contact with pinch points, and the cutting tool point-of-operation is also

prevented. All gearing, belts, and other power transmitting machinery on the lathe must be completely enclosed.

When drilling or boring, work must be secured in position for drilling. Work must not be held manually, as it might be pulled out of the hands and cut or crush them as it rotates. Hands must not be used to clear away chips from the drill table or materials being drilled.

To guard the point-of-operation for boring and drilling operations, a telescoping or spring safety guard may be attached to the machines. As the spindle descends, the guard compresses and contains the chips, while at the same time keeping fingers and loose clothing or hair from contacting the revolving cutter.

The primary danger present at milling machines is contact of the fingers, arm, or clothing with revolving cutters. To avoid this, chips should not be brushed away from the work area with the hands. Adjustments should never be made to the machine while the machine is in motion. Transparent plastic splash and enclosure guards, similar to those recommended for lathes, should be used.

ACTIVITY 4:

1. List six requirements for all types of guards.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
   f. _____
2. Name four recommendations of the National Safety Council for the safe use of guarded machinery.
   a. _____
   b. _____
   c. _____
   d. _____

OBJECTIVE 5: Describe proper guard construction and some advantages of factory-built guards, as opposed to shopmade guards.

To ensure that a guard functions as it is intended, it is important that it be constructed of suitable materials, that it have proper opening dimensions for needed visibility, and that distortion or movement be negligible. Metal is generally the preferred material for guards; however, wood and plastic are often suitable.

The framework (or structure) of guards is usually made of such materials as bar stock, strap steel, or pipe. Enclosures are then made from expanded metal, perforated sheet, solid sheet metal, or wire mesh. The use of wood for a guard should be especially avoided if the guard will be subjected to high impact or to rot. Wooden guards that become oil-soaked can also present a fire hazard.

While there are advantages and disadvantages of the use of various guard materials, all should have certain features. Some of these features are presented here:

- The material selected should be in accordance with accepted standards.
- As nearly as possible, guards should be designed to appear to be an integral part of the machine.
- They should guard what they are intended to guard.
- They should have no sharp edges.
- They should create no additional hazards, such as tripping or obstructing.
- They should be secured firmly to the machine or to the floor.
- They should not distract the operator.
- They must not interfere with controls, the oiling, or the adjusting of the machine. (Hinged or removal parts should be provided for this purpose.)
- It should be possible to remove them for repairs.
- Filler materials should conform to accepted standards.

The cost-conscious teacher, industrial manager, or supervisor often makes a decision to shop-make guards rather than to buy them from the manufacturer. In most cases, this practice is undesirable and unproductive. However, factory-built guards for older pieces of equipment are often not available and must be shop-built. If so, the utmost care should be taken to ensure that the guard meets required standards and needs. Studies have shown that factory-built guards are generally much more advantageous than shop-made guards in the following ways:

- They are less expensive. When the costs of materials, engineering time, construction time, and retrofitting are considered, the cost of shop-made guards is high.
- They conform to machine design and OSHA requirements. A factory-built guard, professionally engineered, produced, and tested for a specific piece of equipment, is most likely to conform to design, production, and regulatory requirements.
- They have improved durability and need less maintenance. Purchased guards are generally known to be more serviceable than shop-made guards.
- They are generally installed properly and guaranteed. When guards are purchased from the factory there is little chance that the guard must be forced to fit. If the guard is installed at the factory, it is usually installed properly, and the manufacturer bears the legal responsibility for the guard, guaranteeing its fit and function.

ACTIVITY 5:

Describe four advantages of factory-built guards, as opposed to shop-made guards.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 6: List and discuss two types of machine guard inspections (based on frequency).

One of the results of the Occupational Safety and Health Act of 1970 was that inspections of workplaces and equipment are now regularly made.

The frequency of these inspections varies with the different aspects of the workplace, but machines should be inspected at least every 60 days. When machines are inspected, guards should also be inspected. In addition, guards should be checked on a periodic, planned basis, both when the equipment is not in use, and when the machines are being operated.

During shift shut-down, thorough inspection should be made to ensure that the guards are of the proper types, both for guarding power transmission equipment and for point-of-operation guarding. Persons inspecting guards should check to determine whether guards are in place, whether they are properly adjusted, whether the guards themselves present safety hazards, and whether they meet applicable ANSI standards and state requirements.

Periodic inspections during work times should seek to determine two things: (1) that safety guards are being used properly, and (2) that protective devices are available and used.

Sometimes it may be necessary to make special inspections of machinery and machine guards. Special inspections should be made (1) when new equipment is installed, (2) when there has been a report that a guard is missing, out of adjustment, or otherwise incorrect, and (3) when an accident has occurred. If any of these conditions exist, immediate attention should be given to determine that all guarding is suitable.

ACTIVITY 6:

Name three occasions which may necessitate a special inspection.

1. _____
2. _____
3. _____

OBJECTIVE 7: List four general safety rules for working with guarded machines, and three common reasons for unguarded machinery.

Four general rules apply to the operation of guarded machines.

1. Replace all broken or missing guards. DO NOT OPERATE THE MACHINE WITHOUT THEM.
2. Only qualified personnel should remove or adjust guards. It may be necessary to remove a guard to allow for equipment repair or adjustment. Sometimes the guard itself may require adjustment because of wear or damage, or so that it will accommodate stock being used.
3. Shut off power to a machine before adjusting or removing a guard.
4. NEVER circumvent a guard. To circumvent a guard means to make the guard inoperative or to defeat its purpose. If the guard is an interlocking type, workers may alter the interlocking device so the machine will run without proper guard protection.

Usually an altered guard is worse than no guard at all. Since an altered guard, or a guard that has been circumvented in some way, often gives a false sense of security, injuries often occur.

Although guards are required by law and exist primarily for the protection of workers, some workers resent them and avoid using them. Some of the reasons given by workers for removing or circumventing guards are listed below. None of them is acceptable.

- The guard interferes with work - While a guard sometimes makes work less convenient, there is usually only a short adjustment period while the worker becomes accustomed to it. After this period, the worker falls into the new pattern or rhythm of movement made necessary by the guard, and accepts its presence.
- The guard is not needed - Usually workers who say this are overconfident of their abilities or intent upon proving their superior skills and coordination. However, overconfidence or a need to prove oneself are often the cause of accidents.
- The guard slows down production - Guards that slow down production should be redesigned to meet safety and production requirements.

ACTIVITY 7:

1. Name the four general safety rules for working with guarded machines.

   a. _____

   _____

   b. _____

   _____

   c. _____

   _____

   d. _____

   _____

2. Name three unacceptable reasons for unguarded machinery.

   a. _____

   b. _____

   c. _____

REFERENCES

National Safety Council. Accident Prevention Manual for Industrial Operations. 6th ed. Chicago: National Safety Council, 1973.

Strong, Merle E. ed. Accident Prevention Manual for Training Programs. American Technical Society, 1975.

U.S. Dept. of Labor. Concepts and Techniques of Machine Safeguarding. Occupational Safety and Health Administration, No. 3067. Washington, D.C.: U.S. Goverment Printing Office, 1981.

_____. Occupational Safety and Health Standards for General Industry. (29 CFR Part 1910). Washington, D.C.: U.S. Government Printing Office, 1979.

ANSWERS TO ACTIVITIES

ACTIVITY 1

1. a. To protect the machine operator.
   b. To protect the machine.
2. a. Protect against contact with moving parts of a mechanism.
   b. Protect against hazards of work in process.
   c. Protect against human failure.
   d. Protect against mechanical failure.
   e. Protect against electrical failure.

ACTIVITY 2

1. Rotating - machine parts rotate toward each other or a part rotates toward a stationary object.
2. Reciprocating motion - back and forth movement (as the belt of a surface grinder).
3. Transverse - a portion of the machine moves in one direction while another portion moves in a cross direction.
4. Cutting - when a machine cuts through wood, metal, or other material.
5. Punching, shearing, bending - take place under great force; motion is carried out when power is applied to a ram, blade, or die.

ACTIVITY 3

1. Enclosure guard protects persons by covering a danger area or by keeping persons away from the hazard.
2. Interlocking guard prevents operation of a mechanism when a guard is not in its intended position of safe guarding.
3. Automatic guard stops machine operation in case of danger, or removes the danger from the work area by pulling or pushing operator's body parts out of the danger zone.
4. Guarding by location - the location of the dangerous machinery or machine action is such that personnel will not have access to it or be near enough to be injured.

ACTIVITY 4

1. Any six of the bulleted list on page 11; also, that the guards should be affixed to the machine, or elsewhere.
2. All four of the numbered list on page 12.

ACTIVITY 5

1. Less expensive.
2. Conform to machine design and OSHA requirements.
3. Improved durability.
4. Properly installed and guaranteed.

ACTIVITY 6

1. When new equipment is installed.
2. When there has been a report that a guard is missing, that a guard is out of adjustment, or other guard complaint.
3. When an accident has occurred.

ACTIVITY 7

1. a. Replace or report all broken or missing guards.
   b. Only qualified personnel should remove or adjust guards.
   c. Shut off power to a machine before adjustment or removal of a guard.
   d. Never circumvent (defeat the purpose) of a guard.
2. a. Guard interferes with work.
   b. Guard is not needed.
   c. Guard slows down production.