

# **Safeguarding Machinery and Equipment**

## ***General Requirements***

**Some Common  
Safeguarding Applications:  
Metal-forming equipment**



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The Occupational Health and Safety Regulation (OHSR) requires that a punch press be safeguarded according to the requirements of CSA Standard Z142, Code for Punch Press and Brake Press Operation: Health, Safety and Guarding Requirements. If you have a punch or brake press, you must refer to this standard to determine how to safeguard it properly.

## Punch presses

### *Types of punch presses*

A punch press is a machine used for piercing holes or other openings in sheet metal or plate. The tooling or *die set* consists of two parts: the upper male punch and the lower female die. The punch is fitted to a *ram* or *slide*, which moves down and up by mechanical, hydraulic, or pneumatic power. The punch pierces the material and enters the lower die. A punch press can be small and manually operated and hold one punch and die, or be very large and CNC (Computer Numerical Control)-operated, and hold many punches and dies of various sizes and shapes.

Punch presses are manufactured in many shapes and sizes, ranging from 2-ton benchtop models to 500-ton floor models and larger. The **tonnage** of a punch presses refers to the total force between the **dies**. In an oversimplified example, a 100-ton punch press with a 25.4 cm (10 inch) 25.4 cm (10 inch) die area (645 cm<sup>2</sup> [100 square inches]) will achieve a force of 13,800 kilopascals (1 ton per square inch).

A press that must complete one full revolution before the stroke can be stopped is called **full revolution clutch**. A press equipped with an air-friction clutch, and with a proper control package, is capable of being safely stopped anywhere during its stroke. This type of press is called **part revolution clutch**. The difference is important because it will dictate the types of safeguards that can be used.

Presses can be further classified by the type of power source: **mechanical** (electrical motor and flywheel for energy transfer to the crankshaft) or **hydraulic**.

Figure 4.7 shows the two most common punch presses found in general use.

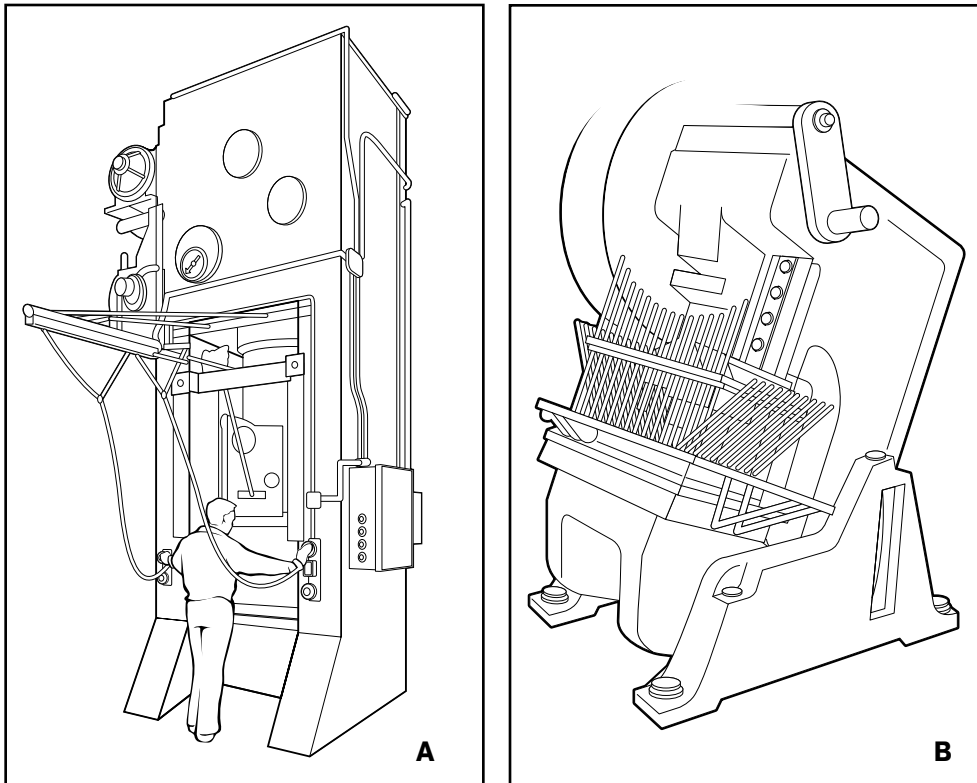


Figure 4.7. Most common punch presses in general use. (A) Straight side hydraulic power press (no flywheel) – press remains in vertical position. (B) OBI (open back inclinable) mechanical punch press – press can be tilted back to allow formed parts to drop out of the back.

### *Methods of safeguarding*

The two critical areas of safety on punch presses are:

- Point-of-operation (feed point) safeguarding
- Control reliability (can the machine come to a safe stop consistently and reliably in the event of an unsafe condition or when an emergency stop signal is given?)

Because a punch press can be used for many different operations (hand feeding, automatic strip/coil feeding, and so on) there are several effective ways to safeguard the point of operation. Figure 4.8 shows the many options available.

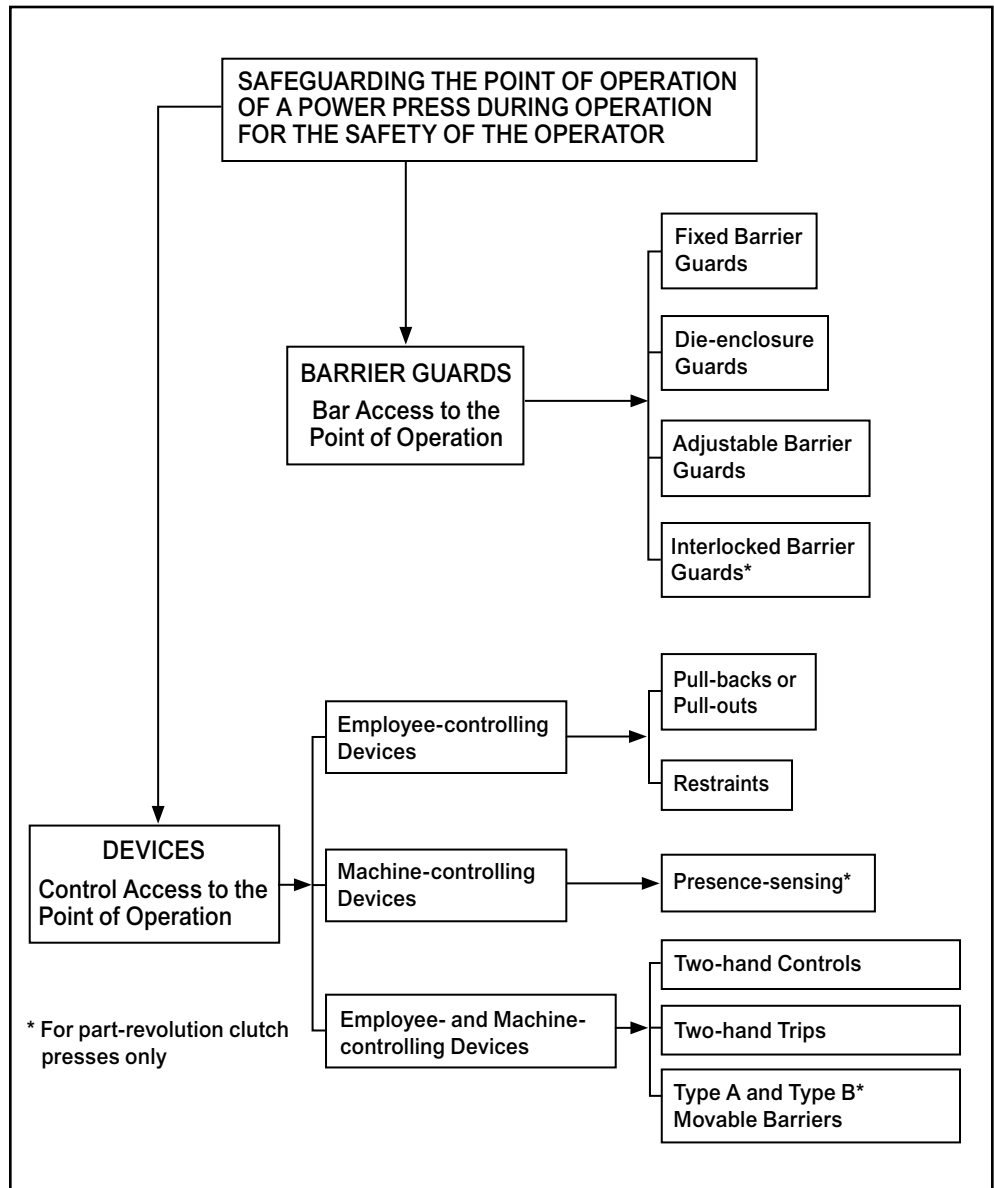


Figure 4.8. Safeguarding options for punch and brake presses.

## Brake presses

### Types of brake presses

Whereas punch presses are generally used for *piercing* metal, brake presses are used mostly for *bending* sheet or plate metal. Brake presses are generally rated by the length of the press bed. The longer the bend, the longer the piece that can be inserted into the dies. Each cycle of a brake press is called a **stroke**.

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Brake presses are normally fed by hand and operated with a foot control, which places them at high risk for amputations. Brake presses have **part revolution clutch** operation; if the foot treadle or electrical control is released, the ram (the part that holds the upper die and moves down and up) either stops or returns to top of stroke.

Brake presses are also classified by the type of power source:

- Mechanical (electrical motor and flywheel for energy transfer to the crankshaft)
- Hydraulic
- Hydro-mechanical (a combination of mechanical actuation with hydraulic assist)

### *Methods of safeguarding*

The two critical areas of safety on brake presses are:

- Point-of-operation (feed point) safeguarding
- Control reliability (can the machine come to a safe stop consistently and reliably in the event of an unsafe condition or when an emergency stop signal is given?)

The options for safeguarding the point of operation of a brake press are somewhat limited. This is because the profile of the formed piece is substantially different after the bending process. What goes into a narrow die space as flat stock may have to be removed as a complex shape, so brake press operations generally require a fair amount of open space between the dies. The exception to this would be small-piece parts that can be fed into an open die space of 6 mm ( inch) or less (safeguarded by minimum opening) and removed without difficulty. Additional safeguarding is required at the ends of the press.

Besides point-of-operation safeguarding, an **awareness barrier**, usually in the form of a chain or rope with appropriate signage, should be installed across the back of the brake press to deter access by unqualified persons.

Point-of-operation safeguarding is generally limited to three options:

- **Light curtain** devices that are mounted at either end of the press bed and detect entry of a hand or body part into the die space. These devices can be programmed to recognize the varying profiles of piece parts and selectively mute or blank out the light beam channel(s) that may interfere with the proper functioning of the light curtain.

The Occupational Health and Safety Regulation requires that a brake press be safeguarded according to the requirements of *CSA Standard Z142, Code for Punch Press and Brake Press Operation: Health, Safety and Guarding Requirements*. If you have a punch or brake press, you must refer to this standard to determine how to safeguard it properly.

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These devices offer the least interference with normal press operation. They are particularly well suited to hydraulic brake presses. If they are retro-installed on a mechanical brake press, modifications will have to be made to the existing brake and clutch system, and a control-reliable package will have to be installed.

- **Two-hand controls** coupled with foot switch operation. This type of conversion package uses control-reliable components to enable the operator to bring the ram down to a 6 mm ( inch) or less closure using two-hand controls, then change over to foot control operation. The foot control is inoperative during the initial part of the downstroke. This method normally requires the piece part to be supported for productive operation.
- **Pull-back or restraint devices.** Although not commonly used, they might be considered for some dedicated brake press operations with infrequent die and piece part changes.

#### *Exception to safeguarding*

The OHSR and other health and safety jurisdictions recognize that there may be practical limitations on safeguarding the point of operation of a brake press, such as in the case of one-time only fabrication of made-to-order or custom-made piece parts. Small-quantity runs, typically performed in job shop or model shop establishments, may be affected by these exemptions. *High-volume piece part production runs will not be affected.*

#### **Power shears (sheet metal and plate)**

The OHSR requires that the point of operation of a power guillotine shear used for forming sheet metal and plate be safeguarded according to the requirements of *ANSI Standard B11.4, American National Standard for Machine Tools – Shears – Safety Requirements for Construction, Care and Use*. This section summarizes the point-of-operation safeguarding requirements contained in the standard. If you have an unusual application for a shear, you should refer to this standard for specifics on how to safeguard it properly.

The two critical points of operation on a guillotine shear are:

- The **blade**, which does the actual cutting
- The **hold-down clamps** or “feet,” which hold the work piece in position during the cutting cycle

#### **HOOD – Hands Out Of Die**

Keep your hands, fingers, and all parts of your body from between the dies or point of operation when the machine is energized or the motor is running ... unless the motor is locked out, the flywheel has stopped, and the ram is blocked and secured.

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The hazards posed by the blade and clamps are hidden by the guard (Figure 4.9).

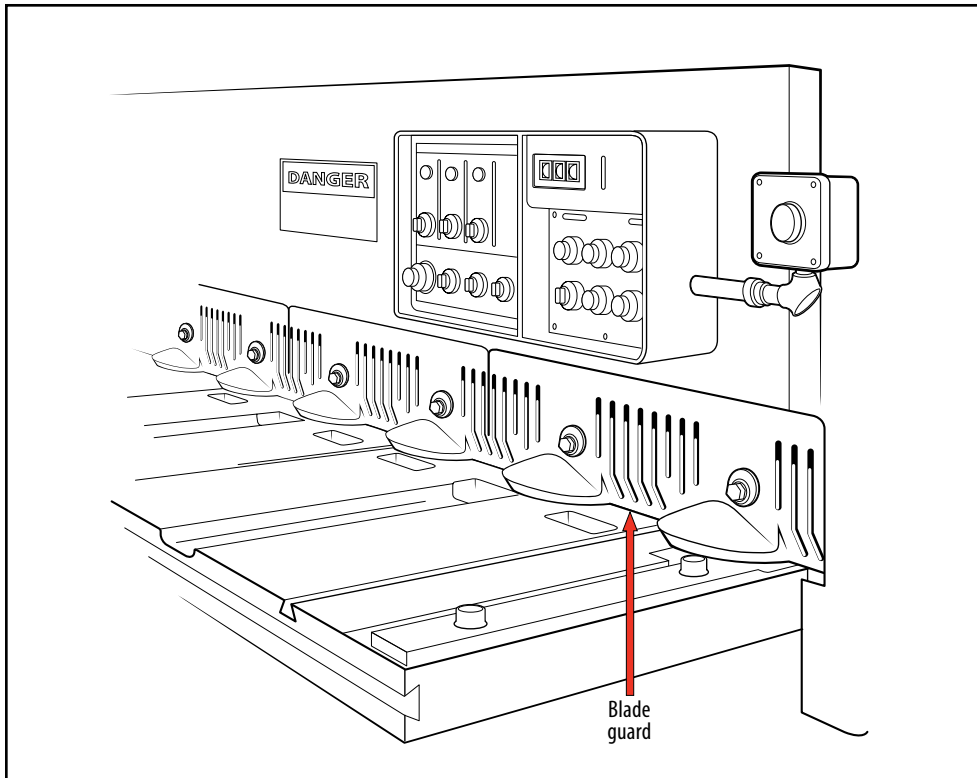


Figure 4.9. Power guillotine shear with point-of-operation safeguarding.

### *Methods of safeguarding*

Three type of safeguards are used to protect the point of operation of shears:

- A **fixed barrier guard** designed with openings large enough to allow the flat stock into the shear but small enough to keep fingers out
- A **fixed barrier guard with an awareness modification** that allows larger thicknesses of plate steel (greater than 12 mm [ inch]) to enter the shear but warns the operator that his or her fingers are approaching the danger area.
- **Two-hand controls**, which are not common but are found in some specialized cut-to-length operations

Besides point-of-operation safeguarding, an awareness barrier, usually in the form of a chain or rope with appropriate signage, should be installed across the back of the shear to deter access by unqualified persons.

ANSI Standard B11.4, American National Standard for Machine Tools — Shears — Safety Requirements for Construction, Care and Use, provides the dimensions for the maximum openings permitted in and under the guard, and the minimum distances from the guard to the nearest point-of-operation hazard.

ANSI Standard B11.4, American National Standard for Machine Tools — Shears — Safety Requirements for Construction, Care and Use, has a diagram showing the locations of the fixed and movable guards and the dimensions for point-of-operation awareness barrier guards.

#### **Guard design criteria for shears with capacities up to 12 mm (½ inch)**

Flat metal stock of 3 mm (⅛ inch) thickness or less is referred to as **sheet metal**. Material of greater thickness is called plate. Shears used for sheet metal and plate up to 12 mm ( inch) require a **non-adjustable fixed barrier guard** that protects the operator from contact with both the clamps and the blade.

#### **Guard design criteria for shears with capacities over 12 mm (½ inch)**

When plate thickness exceeds 12 mm ( inch), it is not possible to design a guard that will allow material into the cutting area and still keep fingers out. A compromise called an **awareness barrier modification** will alert operators when their hands approach the danger area near the clamps and blade. It consists of a movable section (usually 102 mm [4-inch] segments of high-visibility coloured plastic pipe) mounted on the lowest fixed section of the guard with a warning sign (for example, “Do not extend fingers or hands beyond guard or barrier”) displayed.

#### **Iron workers**

An iron worker is a multi-purpose powered tool used for punching, shearing, notching, and coping (“nibbling”) metal parts. It may be powered either **mechanically** (flywheel) or **hydraulically**. Each machine function is called a **work station**.

The in-feed side of an iron worker station, particularly the structural shearing station, is generally safeguarded by design. Access to the point of operation is limited by the **restrictor**, which holds the work piece in position during punching and shearing operations. Provision must be made, however, to ensure that the offside (blind side) of each machine station is safeguarded to prevent someone other than the operator from accidentally reaching into the point of operation. Guarding usually consists of self-closing guards that are open only when material is in the cutting area. *All the work stations on mechanical clutch iron workers operate at the same time, so any work stations not in use must be guarded.*

The punch station of an iron worker presents a risk of injury to the operator and nearby workers from flying debris if a punch gets broken. The restrictor should always be properly adjusted during punching operations, and some guarding installed to contain flying fragments in the event of a punch failure.

### Hand-fed powered metal-forming rolls

Steel fabrication shops make use of equipment for rolling sheet metal or plate into cylinders. These metal-forming machines are often referred to as “pyramid rolls” or “initial pinch offset rolls” (Figure 4.10). They present a unique safeguarding challenge: the point of operation must remain accessible during the entire forming operation. This exposes both the operator and helper to the risk of being drawn into the powered rolls. Safeguarding usually consists of an emergency body contact device such as cable wire or a bumper bar (see “Miscellaneous emergency body contact devices” on page 40 of *Safeguarding Machinery and Equipment*) that will be involuntarily activated by the operator or helper in case of entrapment in the rollers.

Because the rolls are under very high operating pressure, the equipment will normally come to a very sudden stop when the emergency stop device is activated. It is important that this device be installed so that both the operator and the helper can access it.

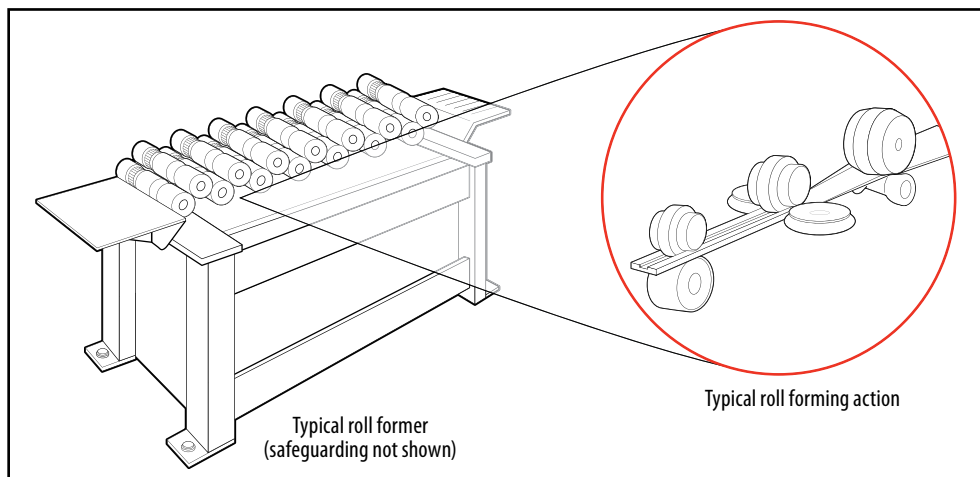


Figure 4.10. Typical metal-forming rolls.

### Other powered roll formers

There are a number of production machines that produce formed metal products such as continuous gutters, corrugated roofing panels, steel studs, and so on. They usually consist of a set of rollers through which coil or pre-cut sheet metal stock is fed. Safeguarding these machines is usually accomplished by **barrier guards** that cover the exposed rollers and prevent access to the point of operation. On some production lines, presence-sensing devices such as light curtains or pressure mats could be employed, provided that the technical restrictions associated with these devices can be overcome.

The OHSR requires that the point of operation of an iron worker be safeguarded according to the requirements of *ANSI Standard B11.5, American National Standard for Machine Tools — Iron Workers — Safety Requirements for Construction, Care and Use*. This section summarizes the point-of-operation safeguarding requirements contained in the standard. For specific information on how to safeguard an iron worker properly, refer to the standard.