

Power press

Power presses are metalworking machines used primarily to cut, punch, or form metal using tooling (dies) attached to the slide (ram) and bed. The slide has a controlled reciprocating motion toward and away from the bed surface and at right angles to it. It is guided in the frame of the machine — either a “C” frame [open back inclined (OBI)] or straight side frame — to give a definite path of motion.

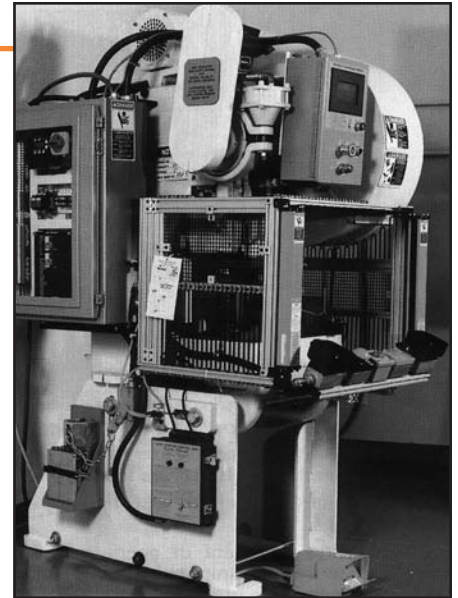
The two most common types of power presses are mechanically and hydraulically powered. Though these two share common features, the mechanical power press is the most widely used throughout industry and has been the subject of most of the research done, primarily due to its tenure in industry and the number of injuries associated with it.

The main components for power transmission on a mechanical power press are the clutch, flywheel, and crankshaft. The slide is attached to a crankshaft with connecting rods (“pitmans”) and the crankshaft is coupled to the flywheel, which always rotates when the motor is running. A clutch is used to connect the spinning flywheel to the crankshaft. The crankshaft converts the rotary motion of the flywheel to the downward and upward motions of the press slide.

Two different types of clutches are used on mechanical power presses: full-revolution and part-revolution clutches. Full revolution clutches, when tripped, cannot be disengaged until the crankshaft has completed a full revolution and the press slide has completed a full stroke. Presses equipped with full-revolution clutches are typically older and more hazardous due to their cycling operation. A part-revolution clutch can be disengaged at any point before the crankshaft has completed a full revolution and the press slide has completed a full stroke. The majority of part revolution clutch presses use air and a brake. When air is trapped and compressed in chambers, the clutch is engaged and the brake is disengaged. To stop the press, the reverse takes place.

Manually fed presses are cycled either by foot or by two-hand controls or trips. With foot controls, the press is activated by pressing down on a foot switch or pedal, leaving the hands free during the cycling of the press. This freedom of hand movement places operators using foot controls at a greater risk of sustaining an injury at a point of operation. Approximately twice as many press injuries are from foot-controlled presses. With two-hand controls or trips, once a work piece is positioned in the press, both hands must be removed from the point of operation to depress the buttons.

The other major aspect of press operation involves safely installing, removing, and transferring the dies.



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Die setters circa 1975

University of Toledo

Power press – continued

Hazard

A machine that punches metal in a blink of an eye leaves little to the imagination as to what it can do to body parts. Severe crushing injuries, amputations, and even death can occur in the point of operation or while performing servicing tasks such as die setting or troubleshooting.

Amputations are the most likely injury and have been a major focus of OSHA, prompting the agency to enhance enforcement and outreach efforts to prevent these injuries. According to the Federal Bureau of Labor and Statistics and the Oregon Department of Consumer and Business Services, approximately 10,000 amputations occur each year nationally and more than 200 occur annually in Oregon, many by power presses. Moreover, about half of all injuries from mechanical power presses result in amputations.

Flying or ejected parts from either the stock or the dies can also strike operators and other workers in the operation area.

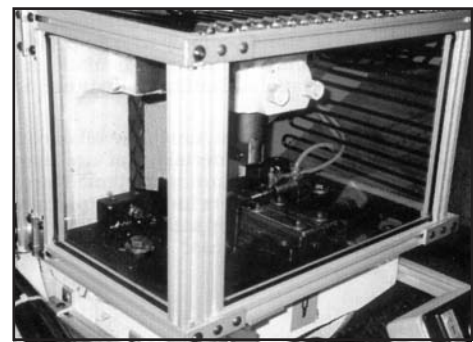
Unprotected operating controls, especially foot pedals, also can introduce the possibility of accidental cycling.

Solution

The point of operation of all power presses must be safeguarded. Safeguarding is accomplished either by barrier guarding or the use of devices. Barrier guarding *prevents* entry into the die area by physically enclosing the point of operation. Devices *control* entry by allowing the operator to reach into the die area to feed or remove parts and will either prevent a machine cycle, stop the hazardous downstroke, or pull the operator's hands out if his or her hands are detected or remain in the point of operation. Guarding is not required if the point of operation opening is 1/4-inch or less.

Safeguarding choices for mechanical power presses depend on the clutch systems. Feasible methods for full-revolution presses include fixed or adjustable barrier guarding, two-hand trips, pullbacks, restraints, or type "A" gates. Part-revolution presses are usually equipped with barrier guarding, presence-sensing devices, two-hand controls or trips, type "A" or "B" gates, pullbacks, or restraints. The safeguarding options for a part-revolution press also can be installed on hydraulic presses.

Fixed, interlocked, or adjustable barrier guarding is best for applications where the operator does not need frequent access to the point of operation, for example, on a mechanical power press in continuous mode. An advantage to using barrier guarding is that it presents a physical barrier between people (the operator and other workers) and the machine's pinch point in addition to capturing any flying parts from either the stock or the die.



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Barrier guarding on an OBI mechanical power press.

Power press – continued

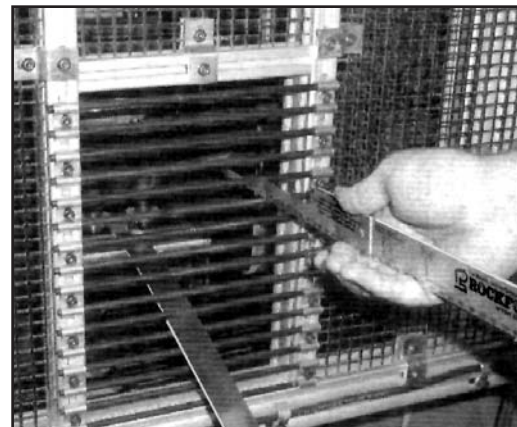
Barrier guarding must be designed and constructed so that people cannot reach over, under, around, or through the guard and reach the pinch-point hazard. If there are openings in the barrier guard, the openings must be in compliance with the OSHA (or ANSI) guard-opening requirements. The following are the maximum permissible openings as listed in Table O-10 of OSHA’s *Mechanical Power Press Standard*:

Distance of opening from point of operation hazard (in.):	Maximum width of opening (in.):
½ to 1½	¼
1½ to 2½	⅜
2½ to 3½	½
3½ to 5½	⅝
5½ to 6½	¾
6½ to 7½	⅞
7½ to 12½	1¼
12½ to 15½	1½
15½ to 17½	1⅞
17½ to 31½	2⅞

The various openings are such that for average-size hands, an operator’s fingers won’t reach the point of operation.

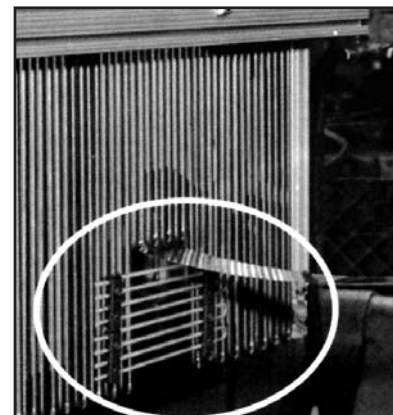
Fixed barrier guards are, as the term implies, firmly fixed to the frame of the press or to the bolster plate, and do not have hinged, movable, or adjustable sections. Interlocked press barrier guarding has hinged or movable sections interlocked with the clutch/brake control so that the clutch cannot be engaged unless the guard sections are in proper position. When the interlocked guard section is opened, the press slide must either stop immediately or have already completed the die-closing portion of the stroke (full revolution clutch presses normally cannot be equipped with interlocked guarding). Adjustable barrier guarding can be adjusted for different material widths and thicknesses and still meet the acceptable guard opening distances (Table O-10).

Devices can be effective safeguards at the point of operation. They include presence-sensing devices, two-hand controls or trips, gates, pullbacks, or restraints. Presence-sensing devices (photoelectric “light curtains” are most commonly used) create an invisible sensing field and are designed to detect an operator’s hand, arm, or other body part entering the hazard area and either prevent a machine cycle or stop the hazardous motion of the machine. They are a versatile and popular method of safeguarding because they do not create a physical barrier between the operator and the point of operation, they allow complete visibility, and they can be “blanked” or “muted” (certain channels are bypassed) to allow material movement. They must be located at the proper *safety distance* (see page 42) from the point of operation and can only be used on part revolution presses and hydraulic presses that are capable of stopping hazardous motion quickly.



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It’s important to check the “safe distance” of the guard opening to the point of operation. A guard opening scale, like the one above, can be used to easily determine compliance.



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Adjustable barrier guarding.



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Photoelectric “light curtain” on a hydraulic press.

Power press – continued

Two-hand controls are also used on part-revolution or hydraulic presses and require the use of both operator's hands to concurrently depress two individual palm buttons to cycle the machine. These controls must also require the operator to hold them down through the die-closing portion of the stroke (downstroke). Two-hand trips are similar to two-hand controls but are usually equipped on full-revolution presses. Trips require only momentary actuation of the palm buttons, and once the buttons have been actuated, they can be released quickly and the machine will make one full cycle or stroke. Of course, locating two-hand controls or trips at their proper *safety distances* (see below) are critical for operator safety. Also, they must incorporate both anti-tiedown and anti-repeat features. Anti-tiedown prevents "tying" one button down and still being able to cycle the machine by depressing the other. Anti-repeat prevents continuous cycling. If more than one operator is operating a press, each operator must have their own set of controls/trips.



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Two-hand controls on a part revolution press.

Safety distance, as applied to press safeguarding using presence-sensing devices, two-hand controls, two-hand trips, and interlocked barrier guards, is a calculation to determine where these devices must be located from the point of operation hazard so that hazardous motion is effectively stopped or prevented before contact can be made. Safety distance is calculated with an equation using the maximum speed that someone can approach the hazard (63 inches/second) and the total time it takes to stop hazardous motion (seconds). Additional factors such as, but not limited to, depth penetration (presence sensing) and reaction times of the control system and safeguard interface are also included. Stopping time is normally measured using the brake monitor or a portable stop-time measurement device. *The ANSI formula takes more factors into account and normally results in a larger safety distance.*

Gates are movable barriers that enclose (in combination with barrier guards) the point of operation before the machine cycle can be started, and remain closed until the downstroke has completed. There are two types: A type "A" gate remains closed during the entire cycle and a type "B" gate remains closed during the downstroke only. Gates are normally constructed of clear polycarbonate and powered by air and gravity.

Pullback devices use a series of cables attached to the operator's hands or wrists. Slack is taken up during the downstroke cycle, pulling the operator's hands from the point of operation, if they are still there. Restraint (holdout) devices are also attached to the operator using cables or straps

but must be anchored and adjusted so the operator's hands can never reach into the point of operation. There is no retracting action involved. Consequently, hand-feeding tools are often necessary if the operation involves placing small material into the dies.



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Pullback devices.



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Type "A" gate.

Power press – continued

It's important to remember that most devices do not provide protection from flying parts. Also, control reliability (see Glossary) and a brake monitor (see Glossary) must be incorporated in part revolution mechanical power presses using a presence sensing device, two-hand control, type "B" gate, or interlocked barrier guarding.

Full-revolution mechanical power presses must incorporate a single-stroke (or anti-repeat) feature that allows the clutch to engage and the press to cycle only once each time the foot control or two-hand trips are depressed.

To prevent accidental cycling, effectively cover or guard all hand and foot controls. Furthermore, foot pedals must be attached to a nonslip surface to prevent the pedal from sliding.

Hand tools can be used for placing and removing material but they do not replace guarding.

Appropriate die-setting procedures must be established and followed to ensure the safe design, handling, installation, and removal of the dies. Safety blocks must be used and enforced. Weekly inspections and regular maintenance of presses, parts, auxiliary equipment, and safeguards must be followed and documented.

If the back of the press presents a hazard to others, prevent access with a barricade.

Notification of mechanical power press injury

All point of operation injuries associated with a mechanical power press must be reported to Oregon OSHA within 30 days of occurrence. Information such as the type of press, task performed, type of safeguards, cause of injury, and feeding method must be provided.

References

■ General Industry

Oregon OSHA Division 2/Subdivision O 29 CFR 1910.217 Mechanical Power Presses

Oregon OSHA Division 2/Subdivision O 29 CFR 1910.212 General Requirements for All Machines

- Oregon OSHA Program Directive A-69 "Power Presses: Mechanical Power Presses" (March 9, 2001)
- OSHA Instruction CPL 03-00-003 "National Emphasis Program on Amputations" (October 27, 2006)
- ANSI B11.1 *Safety Requirements for Mechanical Power Presses*
- ANSI B11.19 *Safeguarding When Referenced by the Other B11 Machine Tool Safety Standards — Performance Criteria for the Design, Construction, care, and Operation*
- NIOSH Publication No. 87-107 "Injuries and Amputations Resulting From Work With Mechanical Power Presses" (May 22, 1987)