

SAFEGUARDING POWER PRESSES WITH INTERLOCKED BARRIER GUARDS

As a result of the high number of injuries associated with mechanical power presses, this equipment has been targeted by the Occupational Safety and Health Administration (OSHA) for special enforcement emphasis.

Specifically, OSHA has targeted industries with high rates of amputations and other injuries related to power press hazards for enforcement and education. Ten manufacturing industries totalling more than 22,000 plants and 1 million workers are receiving special focus. These include companies within the following Standard Industrial Classifications (SICs):

- 1) SIC 3469 Stamping
- 2) SIC 3444 Sheet Metal
- 3) SIC 3442 Metal Doors
- 4) SIC 3441 Fabricated Steel
- 5) SIC 3429 Hardware
- 6) SIC 2542 Furniture Manufacture
- 7) SIC 3714 Motor Vehicles
- 8) SIC 3499 Miscellaneous Metals
- 9) SIC 3443 Boiler Shops
- 10) SIC 3496 Wire

In addition, each OSHA regional office is preparing its own list of target firms, choosing those with the highest incidence of power press injuries and/or fatalities. These determinations may be based, for example, on workers' compensation data, OSHA 200 data, and hospital discharge data.

OSHA's National Emphasis Program targeting point-of-operation guarding on mechanical power presses consists of two major phases. The first, which began in April 1997, involved alerting those firms that were selected for inspection. The enforcement phase, which began in July 1997, was to continue until "measurable results have been achieved," according to the agency.

Users of such presses have a number of ways in which they may comply with OSHA's requirements and reduce the risk of injuries, most of which occur at the point of operation. Depending on the type of press and its installation, these include:

- 1) Press controls such as two-hand press actuating controls that ensure that hands are not in the die area during operation.
- 2) Hand-feeding tools or part-feeding/removal tools that keep hands out of the die area.
- 3) Tooling that minimizes hand exposure to press hazards.
- 4) Full barrier guards with electrical interlocks that stop press operation if a guard is opened.

This article focuses on the use of tamper-resistant, interlocked movable guards. While permitting access to hazardous points of operation for tool changes, part removal, lubrication, and other process adjustments, these guards do so only after power to the press is inter-

rupted so that safe conditions exist. This controlled access can be achieved through use of safety interlock switches designed to ensure circuit interruption whenever a guard is opened.

Movable Barrier Guard Interlocks

Guard design is usually dictated by the press configuration, the manner in which it is operated, and how frequently access is required. Typically, barrier guards fall into one of the following categories:

- 1) Sliding guards
- 2) Hinged guards
- 3) Lift-off guards

Each of these guards, when properly installed, can be used to prevent access to a point-of-operation hazard until safe conditions are restored.

Regardless of the type of guard, a variety of single- and two-piece safety-approved interlock switches is available to meet a user's specific requirements. These include:

- 1) Keyed interlocks with positive-break contacts.
- 2) Solenoid-latched, keyed interlocks with positive-break contacts.
- 3) Limit switches with positive-break contacts.
- 4) Hinged interlocks with positive-break contacts.
- 5) Coded-magnet switches.

The most commonly used switches, the keyed interlocks (see **Figure 1**), feature a geometrically-unique actuating key that is usually mounted to the movable



Figure 1
A typical two-piece positive-break safety interlock switch.

guard. When the guard is opened, the actuating key mechanically forces the switch's normally closed contacts to open, ensuring circuit interruption so that power to the press is halted.

Because the switch can only be operated by the special actuating key, it is difficult to defeat or bypass using readily available items such as wire, tape, etc. However, the use of such keyed interlocks requires guards that have sufficient space for mounting the switch mechanism and actuating key, and alignment with the press structure that is not compromised over time by press vibration, etc.

For some applications, access to a hazardous work or service area must be blocked until safe conditions exist, such as when moving parts come to a stop, clamping points close completely, or the ram comes to rest in a safe position. In such situations, access can be controlled by a solenoid-latching, positive-opening, keyed safety interlock. Here, the guard is held closed by the interlock's solenoid-latched locking bolt (see **Figure 2**) until a safe condition exists.

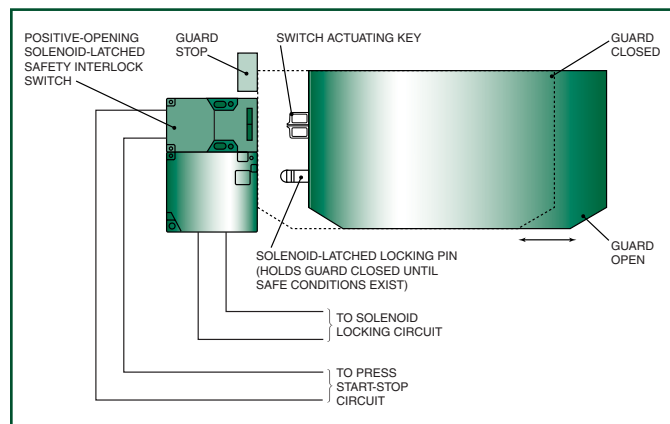


Figure 2
The components of a solenoid-latched, interlocked movable barrier guard.

Release of a locking bolt typically is controlled by a timer, motion detector, or other appropriate sensor that is activated when safe conditions exist. Only after the locking bolt is released can the guard be opened. When the guard is opened, the switch's actuator key directly drives open the normally closed contacts to interrupt press operation.

To accommodate the diversity of guard designs and space limitations, single-piece, safety-approved limit switches and hinge switches are also available. These switches are equipped with positive-break, normally-closed contacts to ensure circuit interruption when the guard is opened. These switches are more forgiving of guard misalignment than are two-piece keyed interlocks. The one-piece construction enables these switches to operate after a relatively small displacement of the movable guard. This safety feature is important in applications in which the point-of-operation hazard is close to the guard opening because it ensures interruption of the

press cycle before the guard is open far enough to allow the entry of a worker's hand.

In addition, completely sealed coded magnet switches (see **Figure 3**) are available for applications in which the



Figure 3
Sealed coded magnet switches such as those shown here can be used in applications that include exposure to grease or oil.

interlock is exposed to grease, lubricating oils, or other harsh elements. These submersible coded units are not easily defeated/bypassed. Their array of multiple reed switches can only be actuated by a magnetic field pattern matched to the multiple reed switch orientation. Therefore, they cannot be operated with a simple magnet.

However, because reed switches typically fail in the closed (unsafe) position, coded magnet safety switches should always be used with a safety circuit monitoring module (shown in **Figure 3**). As with keyed interlocks, alignment is critical to their operation.

A simple lift-off guard interlocked via a coded magnet switch is illustrated in **Figure 4**. Here, the coded-magnet array mounted in the lift-off guard must be aligned with and in proximity to the matched reed switch array located on the stationary portion of the guard or press structure.

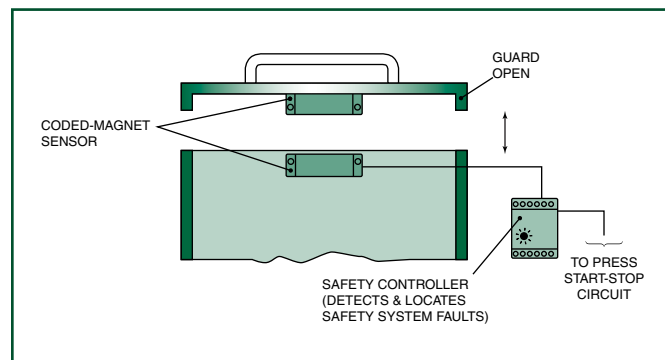


Figure 4
Coded magnet switches such as the one shown attached to the lift-off guard illustrated here are typically used with monitoring and control modules.

Because the reed switch cannot be positive-opening because of its design, it is used in conjunction with a monitoring and control module (safety relay module) to

increase the reliability of the safety system. Here, too, the press can only be enabled if the lift-off guard is properly closed.

All of these safety interlocks are designed to tolerate the jarring environment inherent in press applications. More importantly, each can prevent press operators and maintenance workers from accessing points of operation when potentially hazardous conditions exist.

Safety Circuit Monitoring Modules

To increase the reliability of movable machine barrier guard safety systems, control modules that monitor the integrity of a guard's safety circuit are available. These devices are designed to detect and locate faults in the barrier guard safety circuit and its interconnections (see **Figure 5**).

Should a fault such as a welded or stuck contact, a short circuit, or a ground fault occur, the control module



Figure 5

stops the machine until the fault has been corrected. This type of module allows the press user to satisfy standards of OSHA and the American National Standards Institute (ANSI) for a “control-reliable” safety system.

Control-reliable systems ensure that the failure of any component within the safety circuit does not prevent the stopping action from taking place, and does ensure that successive system cycles cannot occur until the failure has been corrected.

Movable Barrier Guard Design

One of the simplest interlocked movable barrier guards uses a single-keyed interlock switch. In **Figure 6**, the switch actuating key is mounted directly to the movable hinged guard.

When the guard is opened, the switch's normally closed contacts are forced open, interrupting power to the press. When the guard is closed, circuit continuity is reestablished, and the press may be restarted by operating a pushbutton or other “start” switch.

The actual design of barrier guard interlock safety systems varies based on the severity of potential injury, the

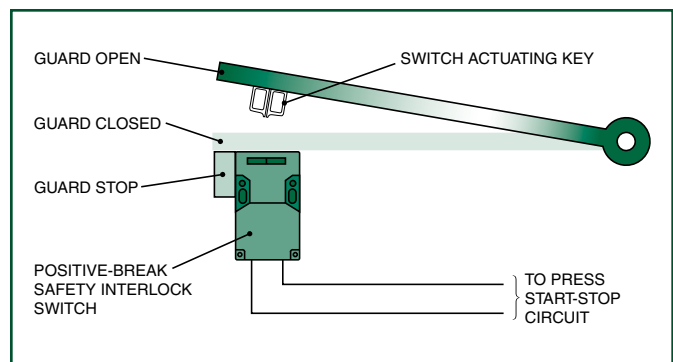


Figure 6

The interlock switch actuating key can be mounted directly to a movable hinged guard, as this illustration shows.

frequency of exposure, and the probability of an injury occurring if the safety system should fail. The greater the potential of injury, frequency of exposure to a hazard, and/or the probability that an injury will occur should the safety system fail, the more complex the barrier guard safety system will be.

Depending upon the level of assessed risk, users may choose to install multiple interlocks on each guard, employ an appropriate safety circuit monitoring and control module, and/or monitor the operation of the controlled relay/contactors to ensure that it does not become stuck or welded closed. The use of redundant safety interlock switches, dual-channel safety circuit monitors, and controlled output device monitoring enhances the overall reliability of the barrier guard safety system, while the use of safety relay modules capable of locating system faults minimizes equipment downtime.

Conclusion

In applications in which their use is appropriate, movable barrier guards that are installed with tamper-resistant safety interlock switches and safety circuit monitoring and control modules offer press users options for meeting OSHA safeguarding requirements. They can help:

- 1) Prevent access to hazardous points of operation until power is interrupted and/or safe conditions exist.
- 2) Eliminate risks associated with workers defeating or bypassing switches used as interlocks.
- 3) Reduce a company's potential liability.

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