

The background of the page is a close-up photograph of red curtains. The curtains are pulled back, creating a dark, shadowed opening in the center. The lighting is dramatic, with highlights on the folds of the fabric and deep shadows in the opening.

Are Your Light Curtains Doing Their Job?

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Light curtains protect personnel from press hazards. But just mounting a light curtain on your press does not guarantee protection. The curtain is only a part of the point-of-operation safeguarding system, which is only part of your plant-wide safety strategy.

Light curtains have been used in the pressroom for decades. In many ways, they are ideal for protecting personnel from the hazards of power presses and other types of fabricating equipment. As the press runs, a light curtain still allows operators to see the die, but at the same time protects them from injury, detecting when they reach hands toward the die and signaling the press to stop.

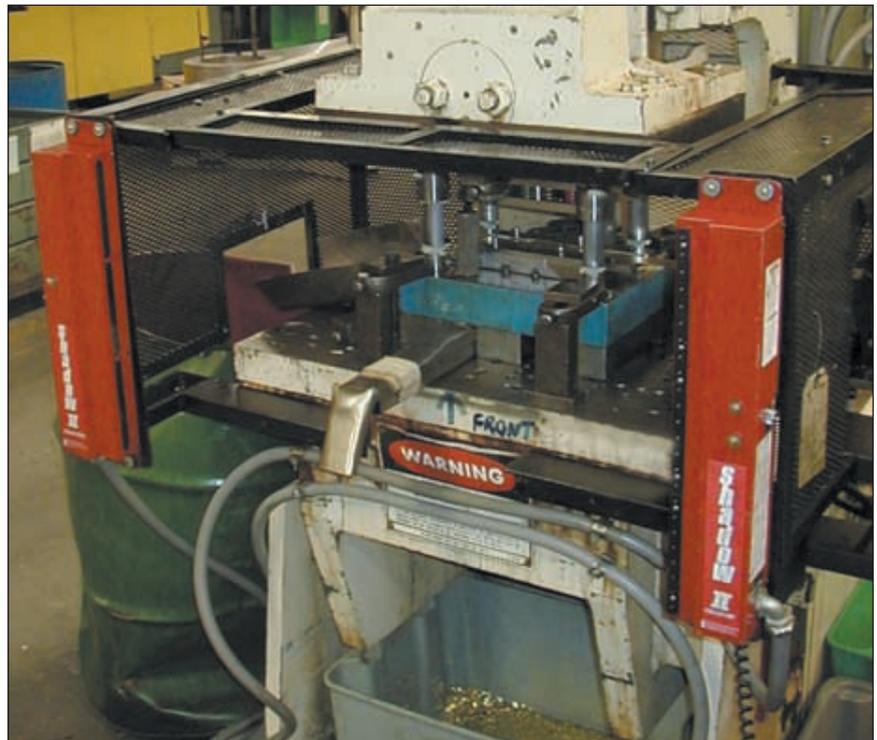
The advantages are clear. Light curtains:

- Provide protection for personnel exposed to the point of operation;
- Allow full visibility of the point of operation;
- Can eliminate the need for lockout/tagout during die changes;
- Reduce maintenance, compared to mechanical barriers.

Many press operators depend on light curtains—the sight of them mounted on a machine inspires confidence that this press has proper safeguards. Unfortunately, just mounting a light curtain on a press does not provide total personnel protection. The light curtain comprises only one part of the point-of-operation safeguarding system, which is only part of a plant-wide safety strategy. Other factors contribute to making the pressroom safe, including mechanical guarding, press and operator controls, brake monitors, sound press-maintenance procedures and good general safety practices.

Pressroom Walkthrough

As an important part of the safety system, light curtains must be installed properly to do their job. Sometimes, even in the best-intentioned, most skillfully executed light-curtain installation, overlooked factors may result in unsafe conditions. To catch these problems, man-



Eighteen-inch Shadow light curtains from Honeywell's Wintriss Controls Group as well as mechanical guarding are installed on a 60-ton press at Standard-Thomson Corp., Waltham, MA.

agers and operators should look around the pressroom to identify and remedy these oversights.

Take a walk around the shop and see how your light curtains are installed and used. Look at each press with fresh eyes. Move around the press to see it from the front, the sides and the back. Would you feel safe working at that press every day? Look at the die currently running. Locate the nearest pinch point, in most cases a separated leader pin. Look at the light curtains and mechanical guarding. Is there any way someone could put a hand in the die or some other pinch point by reaching under, over or behind a light curtain or guard?

When looking at the light curtains

and mechanical guards at each press, you might find any of the following oversights:

Problem: Light curtain installed too close to the pinch point.

If a light curtain is installed too close to the hazard, the press cannot stop before someone's hand reaches the pinch point. The minimum distance between the light curtain and the pinch point—the safety distance—depends on press stopping time and light-curtain response time.

Sometimes a light curtain obviously is too close to a pinch point. If you see a 400-ton straight-side press with the light-curtain heads mounted on the columns less than 12 in.

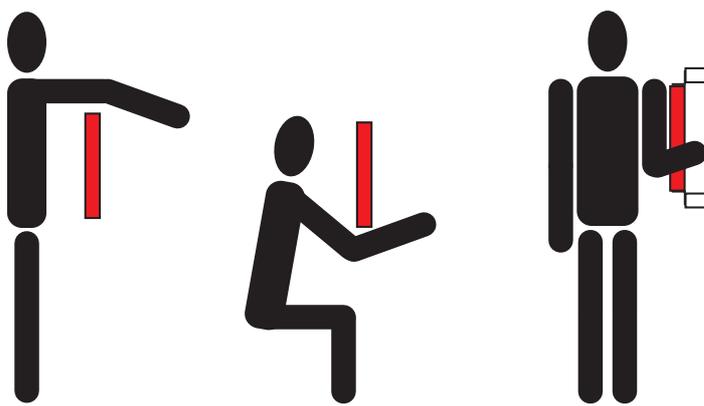


Fig. 1—Position light curtains so that employees cannot reach over, under or around them.

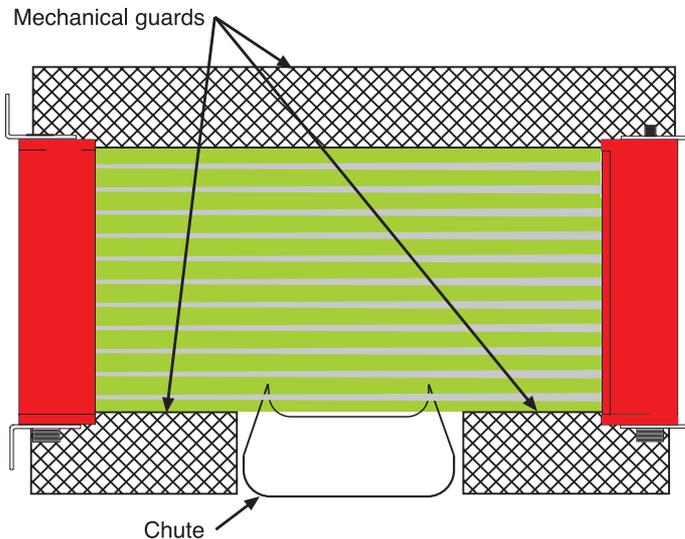


Fig. 2—Install mechanical guards to cover gaps.

Distance of opening from point of operation hazard (inches)	Maximum width of opening (inches)
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	2½

Distance from Hazard and Opening Width (similar to OSHA 1910.217 Table 0-10)

from the die, you know at a glance that this is much too close. In this example, the stopping time of the press might be 300 ms and if the response time of the light curtain is 30 ms, the safety distance is at least 21 in., according to the OSHA safety-distance formula.

For less obvious cases, determine the press stop time and use a formula to calculate the safety distance.

Solution: Use the OSHA or ANSI formula to calculate the correct safety distance (see sidebar). Re-install the light curtains at the correct safety distance, or farther, from the nearest pinch point.

If you do not know the light curtain's response time, check the product specifications. If you do not have a brake monitor on the press and do not know its stopping time, measure the stopping time. Call the light-curtain supplier for information. For several presses, you may want to purchase a portable stop-time measurement device.

Problem: A space between the light curtain and the press large enough for a person to stand undetected.

If operators stand between the light curtain and the hazard, inside the protected area, they are completely unprotected and have unrestricted access to the die while the ram is moving. This is extremely dangerous.

Determining how much space is too much is a judgment call. Some companies use a guideline of 6 in.

Solution: Install a second light curtain horizontally between the light curtain and the press to detect a person in this zone. Mount the light curtain at the knee-to-waist height. Some light-curtain controls can operate two pairs of heads, an economical feature that makes it easy and cost-effective to add the second light curtain.

As an alternative, install a mechanical barrier to keep a person out of the area between the vertical light curtain and the hazard.

Problem: A person could reach over or under the light-curtain field.

Visualize the tallest and shortest operators working at a press. Could

either reach over or under the light field and reach the die? What if they were sitting or standing? See Fig. 1.

Solution: Install supplemental guards to prevent reaching over and/or under the light field.

You also might install a taller light curtain, mounted so that no one can reach over or under it. This is most cost-effective, of course, in new installations. For the added protection, the price difference is small between one size and the next. A 24-in. light curtain, for example, might cost \$200 to \$300 more than an 18-in. model.

Problem: Openings large enough to put a hand through and reach the die.

Examine the press for any place a person could reach into the hazardous area. See Table 0-10 in OSHA Section 1910.217 (reproduced in the table) for how far one can reach through an opening of a certain size.

Look for situations like these: The light curtain is raised to clear a chute or conveyor, leaving the space on either side of the chute or conveyor unprotected (Fig. 2). Or there may be space to reach behind a light curtain (Fig. 1).

Solution: Install supplemental mechanical guarding to prevent access at these locations (Fig. 2).

Problem: Light curtain inactivated at any time.

In some installations, the light curtain is deactivated in the inch mode. Do a simple test: Run the press in inch mode and have someone block the light curtain. If the ram stops, the curtain is active.

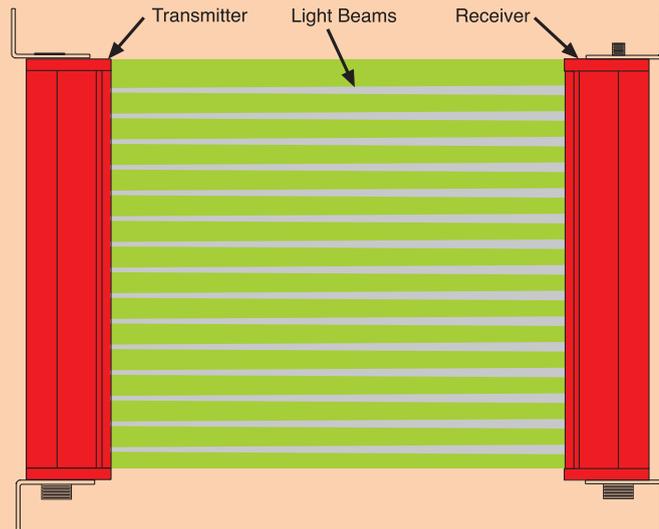
Solution: Many modern press controls have a light-curtain input that ensures the light curtain is active in all modes of operation. In older-style relay-based controls, and even in some modern controls, you can wire the curtain into the control circuit so that it is ignored while the press is in the inch mode. A knowledgeable electrician, in conjunction with the control manufacturer, can fix this.

It is unsettling to think that someone or something needs to be in the light-curtain field while the ram is moving, but some setup people resist making the curtain active in the inch mode. With experience, they will find in at least 95 percent of cases,

How a Safety Light Curtain Works

A safety light curtain uses a sensing field consisting of infrared light beams to detect intrusion into a dangerous area.

Two optic heads, the transmitter and receiver, are mounted so that light beams produced by the transmitter's light-emitting diodes (LEDs) strike the sensing phototransistors in the receiver. When the light curtain is active, the transmitter LEDs emit pulses of infrared light in rapid sequence. When the light reaches the corresponding phototransistor in the receiver, it produces an electrical



Safety light curtains use infrared light beams to detect intrusion.

signal. Each phototransistor signal must turn on and off in the correct sequence to maintain a "curtain-clear" condition that allows the hazardous machinery to continue operating. The sequence of light pulses happens so quickly that the effect is a continuous light field across the guarded area.

When an opaque object such as an operator's hand blocks one of the light beams, the phototransistor that normally detects that beam receives no light. As a result, the phototransistor does not produce the signal it normally would at that time in the sequence. The light-curtain control circuitry senses this and sends a stop signal to the machinery.

Light Curtain Checklist

- Correct safety distance
- No space to stand undetected between light curtain and machine
- No reach-over, reach-under or reach-behind
- No large gaps left open
- Always active
- Not used where they shouldn't be

that an active light curtain does not hamper the die-change process.

Also, depending upon your situation, keeping light curtains active could eliminate the need for press lockout during die changes, as required by OSHA.

Problem: Light curtains that do not work for all the dies used on a press.

Light curtains sometimes are installed where they must be moved to offer proper protection for different dies. In practice, they are unlikely to be moved when dies are changed, creating a dangerous situation. With a different die setup, the safety distance may be different or gaps may occur in the guarding. Press-room staff depend on light curtains for protection from injury. But a light curtain, even if it is not in the correct location, can create a false sense of security, which may be much more dangerous than not using a light curtain at all.

Solution: Determine if some other guarding method, such as mechanical barriers, would be more effective. In general, if a light curtain cannot be fixed in position to provide effective protection on a given machine, use an alternative method.

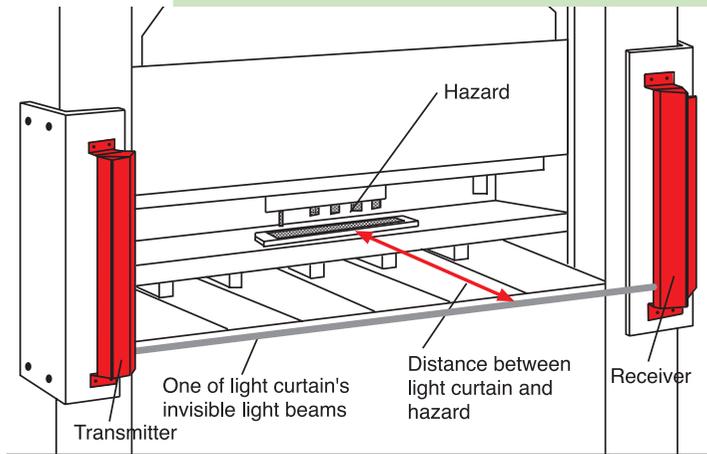
A Reliable Guarding Solution

Light curtains offer good, reliable safeguarding when they are used correctly as part of a comprehensive point-of-operation safety system. Errors in installation sometimes go unnoticed, so be sure to check safeguarding systems periodically and correct any errors. When used correctly, light curtains offer metal stampers a very safe and productive guarding solution. **MF**

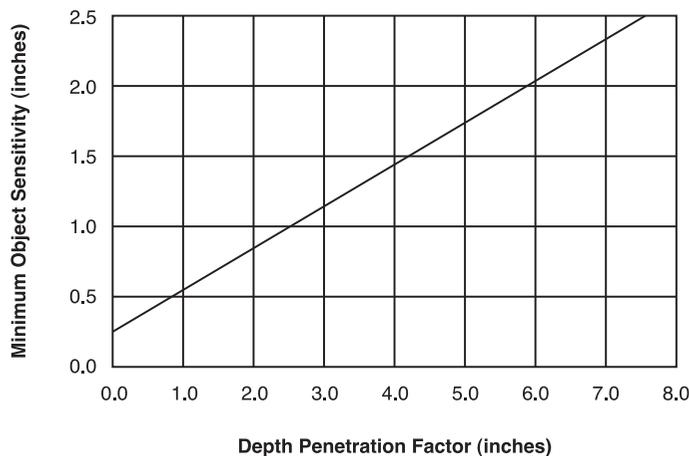
Calculating Safety Distance

Technicians must install light curtains at a location that is at least the "safety distance" away from the pinch point on a press. The safety distance is a calculation of how far a person's hand can move from the time it breaks a light beam until the ram stops moving.

There is no way to determine this distance absolutely for every user and every situation. However, shops can calculate a reasonable safety distance using one of the two well-accepted formulas shown below. The OSHA formula is a simpler calculation; the ANSI B11.1 formula takes more factors into account and normally results in a larger safety distance.



Install a safety light curtain at the prescribed safety distance from the pinch point.



Object Sensitivity vs. Depth Penetration Factor

To determine the correct safety distance for light-curtain installation on a particular press, determine the press stopping time. Using a brake monitor or other instrumentation on the press that measures stopping time, run a 90-deg. stop-time test. Or, measure the stopping time for each press using a portable stop-time measurement device. Call the light-curtain supplier for information.

OSHA 1910.217 (c)(3)(iii)(e) Safety Distance Formula

$$D_s = (63 \text{ in./sec.}) T_s$$

Where D_s = minimum safety distance, inches

63 in./sec. = hand speed constant

T_s = time for press to stop after light-curtain intrusion, seconds

ANSI B11.1, 1988 E6.3.2(13) Safety Distance Formula

$$D_s = K (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

Where D_s = the minimum safety distance in inches

K = hand speed constant (63 in./sec.)

T_s = press stopping time measured at 90 deg. of crankshaft rotation, seconds

T_c = response time of the press control, seconds

T_r = response time of the light curtain system (see light curtain specifications), seconds

T_{bm} = additional stopping time allowance for brake wear, seconds

D_{pf} = depth penetration factor, inches

Find out, from the manufacturer, the minimum object sensitivity of your light curtain. Find the corresponding depth penetration factor in Fig. 2 of the ANSI B11.1 standard (see chart).