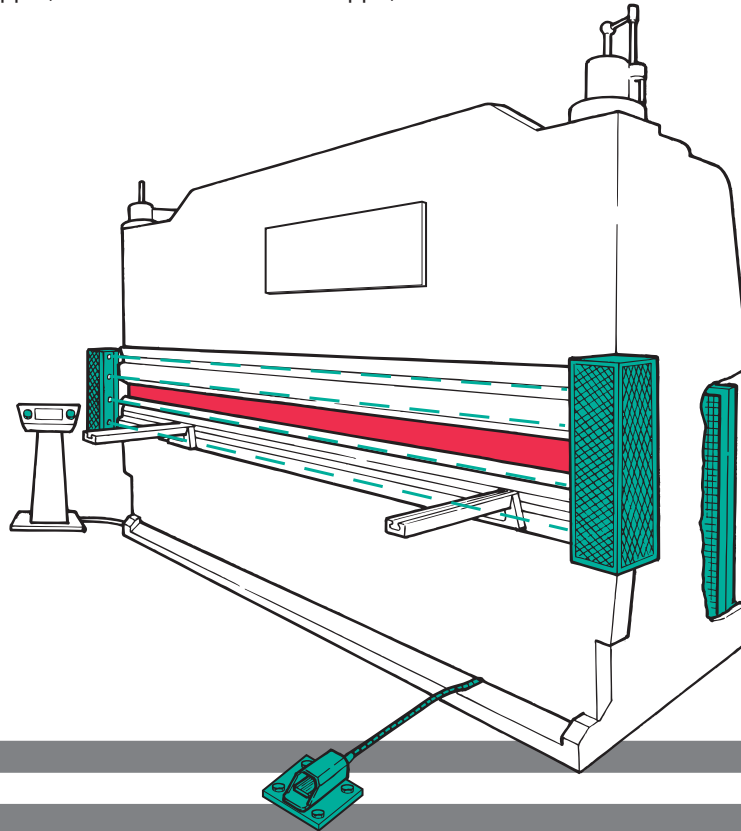


2.4.13 Press brake

Legislative Decree 81/08 App. V, Presidential Decree 459/96 App. I, UNI EN 12622/05



HAZARD

PROTECTION

Machine that cold-forms sheet metal by a punch fitted on a moving element (crossbeam) moving towards a die (or prism) fitted on a fixed part. Punch and die are appropriately shaped based on the bending to be obtained. These machines can be mechanically actuated with friction, hydraulic or pneumatic clutch.

2.4.13.1 HAZARDS

Crushing of upper limbs due to the crossbeam moving towards the die reachable from the front of the machine

Operation with automatic cycle, with automatic loading and unloading

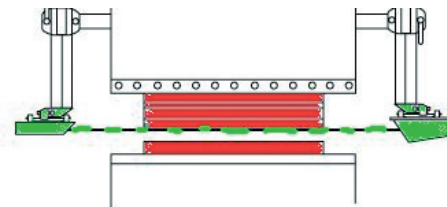
The front of the machine can be protected with:

- Closed tools in which the maximum distance (see 2.2.4 "Safety distances") reachable between punch and die is too small for fingers to get through.
- Fixed guards (see "Fixed guards" in 2.2.3.2) placed in such a way as to prevent the hazardous part being reached during the closing phase.

Operation with single cycle and manual feed

As this work mode is very hazardous, the front of the machine can be protected in one of the following ways:

- Movable interlocked guards (see “Movable guards” in 2.2.3.2) with or without guard-locking (see “Movable interlocked guards with guard-locking” in 2.2.3.2) that prevent the hazardous area being reached during the closing movement.
- Slow closing speed (see 2.4.13.1B) (≤ 10 mm/s) combined with a hold-to-run control device (see 2.2.6.2 “Hold-to-run”).
- Immaterial barriers positioned vertically or horizontally. This safety device placed in front of the hazardous area creates a protected area. Crossing the barrier during machining causes the machine to stop immediately; releasing it does not start it immediately.
- Laser scanner systems. This device also creates a protected area in front of the hazardous area of the machine. This area can be shaped and sized by the user based on work requirements. Entry of a person into the area controlled by the laser scanner is detected immediately and the machine is first put into an alarm state and then into fully safe condition.
- Laser protection devices (with flat surface control) applied to the moving crossbeam. These devices are fixed to the moving equipment (moving crossbeam and punch) and the protection system explores the area that the punch is about to reach, protecting this area around the bending line. During the descent movement, if the laser ray (which has a specially shaped geometric form) detects a body or obstacle before getting near to the sheet metal to be machined, a command is instantaneously sent to stop the hazardous movement or another safety movement is ordered (e.g. upstroke).



Laser protection system fixed to the moving equipment

Mechanical presses

If the presses are mechanical with friction clutch and manual workpiece feed, the protective measures described above must be supplemented with other safety devices.

Old presses (before July 2003)

The following safety devices are often found on old press brakes:

- Single-beam systems (photocell or laser) fastened to the machine structure;
- Two-hand control.

These last two devices are part of obsolete technology which is not safe enough. They can therefore be used only after carefully assessing the risks of using the machine in these conditions and the possibility of constantly checking their correct positioning and operation. In these cases the employer should update the machine with more suitable devices that are harder to tamper with.

2.4.13.1A SAFETY DEVICES TO AVOID STROKE REPETITION

The protective measures described for single-cycle press brakes with manual feed can be used without further measures only on hydraulic presses. In mechanical presses with friction clutch and manual workpiece feed, the protective measures must be supplemented with the following devices to prevent stroke repetition:

- Friction-brake unit powered by a double-body solenoid valve or by two single solenoid valves;
- Solenoids connected to the control circuit with separate wiring from the devices controlling the upper dead centre;
- Solenoid management and control circuits fitted with automatic monitoring (see 2.2.5.1 "Interlock devices")

2.4.13.1B SLOW CLOSING SPEED (≤ 10 mm/s) COMBINED WITH A HOLD-TO-RUN CONTROL DEVICE

If the machine can operate at a speed of more than 10 mm/s, this speed must be selected manually with a key selector (see 2.2.6.5 "Operating mode selector"). Selecting a speed of more than 10 mm/s must activate at the same time one of the other alternative safety systems.

For machines build after July 2003, UNI EN 12622 requires the hold-to-run control to be the 3-position type:

- | | |
|--------------------|------------------|
| • First position: | machine stopped |
| • Second position: | running |
| • Third position: | machine stopping |



1st position
Machine stopped



2nd position
Running



3rd position
Machine stopping

2.4.13.1C IMMATERIAL BARRIERS

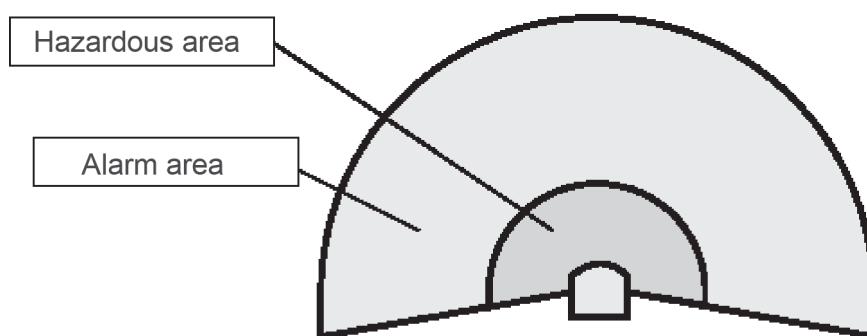
These safety devices must ensure that:

- Access to the hazardous area is only possible by crossing the immaterial barrier detection area;
 - No hazardous movement can be started while a part of a body is detected by the barrier;
- Immaterial barriers can be fitted vertically or horizontally (see "Press brake: Configuration and safety distance calculation" appendix) based on the manufacturing features of the press brake, the barrier and the work modes.

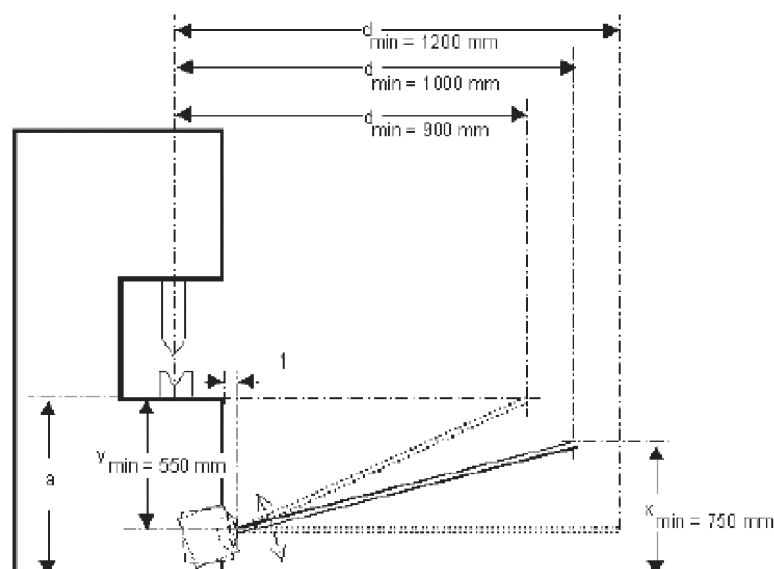
2.4.13.1D LASER SCANNER SYSTEMS

These safety devices must ensure that:

- Access to the hazardous area is only possible by crossing the device detection area;
- If an operator goes into the "alarm" area, towards the machine, an acoustic alarm signal is triggered and if the operator continues into the "hazardous" area, the machine stops;
- No hazardous movement can be started while a part of a body is inside the hazardous area;

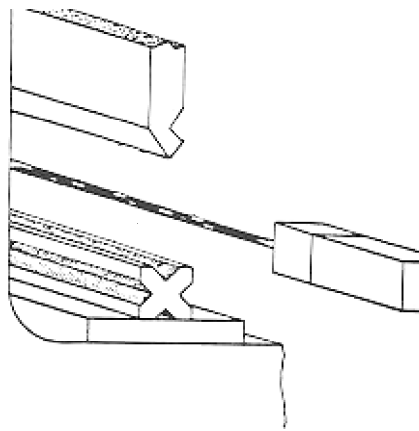


- The distance "y" between the machine work table and the start of the detection area must be at least 550 mm;
- When setting the size of the protected area, remember that the minimum safety distance depends on the overall machine response time.



2.4.13.1E SINGLE-BEAM SYSTEMS (photocell or laser)

Single-beam photocell or laser systems are made up of two elements: an emitter that emits a beam and a receiver that receives it. The beam position is adjusted along the bending axis at a height of 6-8 mm above the surface of the sheet metal to be machined. If the beam is interrupted before the hazardous machine closure movement is completed, the machine stops. These devices do not give adequate guarantees of safety as they do not provide fine adjustment to keep the beam at the necessary distance to protect the operator. It is also easy to tamper with them.

**2.4.13.1F TWO-HAND CONTROL** (see 2.2.5.2 "Two-hand control")

The two-hand control, which can be used only when there is just one press operator, must always meet the following safety conditions:

- Use of both hands at the same time;
- Hold-to-run (see 2.2.6.2 "Hold-to-run") throughout the hazardous phase;
- Interruption of the cycle if even one of the controls is released;
- Release of both controls to start a new cycle;

Remember that the device on its own is not safe enough as:

- It protects only the worker activating it, but not other people with the sheet metal or who are in the hazardous area of the dies;
- It does not protect against the risk of impact or crushing between the workpiece and the cross-beam;
- It is hard to use as the workpiece normally has to be supported with hands;

However, it is safe enough for "setting" functions on their own (setting the tools, maintenance and lubrication of parts).

For these functions, the two-hand control must be used together with low work speed (≤ 10 mm/s) and arranged so that it cannot be used for normal production.

In all cases, there must be a specific company procedure for using the two-hand control.

Crushing of upper limbs due to the crossbeam moving towards the die reachable from the sides of the machine

Possible solutions are:

- Movable interlocked guards (see "Movable guards" in 2.2.3.2)
- Hold-to-run control and slow closing speed.

Crushing of upper limbs due to the crossbeam moving towards the die reachable from the rear of the machine

Possible solutions are:

- Movable interlocked guards (see "Movable guards" in 2.2.3.2) and in combination with fixed guards (see "Fixed guards" in 2.2.3.2);
- Immaterial barriers.

2.4.13.1G IMMATERIAL BARRIERS AT THE REAR OF THE MACHINE

These devices protecting the rear must have at least two light beams at a minimum safety distance calculated using the following formula

$$d = (K \times T) + C$$

(See Appendix 1 "Press brake: Configuration and safety distance calculation").

When two or three light beams are used, the minimum distance from the nearest hazardous point cannot be less than:

No. of light beams	Minimum distance from hazardous point
Three beams	1000 mm
Two beams	1200 mm

The height of the beams above the floor must meet the following criteria:

No. of beams	Height of beams above floor (mm)
4	300, 600, 900, 1200
3	300, 700, 1100
2	400, 900

At the rear of the press brake there must be a barrier reset device, located outside the protected area and from which there is a clear view of the hazardous area. This device must reset the immaterial barrier functionality if these barriers are crossed by a body.

Crushing of upper limbs during maintenance or repair operations

To prevent the risk of the moving crossbeam falling due to gravity caused by a fault in the hydraulic, mechanical or electrical system, there must be a mechanical (spacer) or hydraulic (shut-off valve) locking system or a combined system, capable of supporting the moving crossbeam.



2.4.13.2 CONTROL EQUIPMENT

Starting

The only way to start the machine is to use specific control devices (see 2.2.6.1 "Starting") that are easy to recognise and are protected against the risk of being accidentally activated (e.g. pushbuttons with guard ring, shrouded pedals, etc.).

Unexpected restart

Spontaneous restarts (see 2.3 "Machine electrical systems") of the machine after power is restored must be prevented using a specific device.

Stopping

The machine must have a control device (see 2.2.6.3 "Stopping") to stop it safely.

Emergency stop

All machines must have at least one emergency stop device (see 2.2.6.4 "Emergency stop") placed within easy reach of the operator. If there are several operators (large machines) there must be emergency stop devices that can be activated quickly by each worker.

2.4.13.3 ERGONOMICS

Positioning

Machines must be installed so that there is free access to the work area when setting, loading and unloading devices, etc. are being used (for example, devices for lifting or transporting the sheet metal, such as wheeled workbenches).

2.4.13.4 OCCUPATIONAL HEALTH AND SAFETY

Noise

Find out the noise levels to which staff are exposed when using the machine and follow the employer's instructions.

2.4.13.5 PERSONAL PROTECTIVE EQUIPMENT

The machining work must be assessed carefully so that the use of PPE can be defined:



Gloves (see 5.6.4 "Gloves giving protection from mechanical risks") protecting against mechanical and cutting risks and which are waterproof when oils are used.



Safety shoes (see 5.7 "Foot protection") with protective toe cap (S1).



Hearing protectors (see 5.3 "Hearing protection").



2.4.13.6 OPERATING INSTRUCTIONS

The machine must come with a manual, in Italian, explaining correct use and maintenance, including a programme of periodic inspections.

2.4.13.7 OCCUPATIONAL HEALTH AND SAFETY ACTIONS

Before use

- Read the Operating and Maintenance Instructions provided with the machine.
- Check that the guards (see 2.2.3 "Guards") and safety devices (see 2.2.5 "Safety devices") are present and positioned correctly.
- Check that the guard interlock systems work (see 2.2.5.1 "Interlock systems").
- Check that the emergency stop button works (see 2.2.6.4 "Emergency stop").
- Remove from the press all punches not needed for the bending process (use punches of the same length as the sheet metal to be bent).
- Adjusting and setting the rear references must be done only from the rear of the press (do not put hands or other body parts between the tools).
- Remove the keys from the mode selectors on the machine; these keys should be kept by a supervisor.
- Wear the personal protective equipment (PPE) shown in this data sheet.

During use

- Keep the guards on the machine positioned correctly.
- Do not deactivate or tamper with the safety devices. If they have to be deactivated for a specific job, other safety measures must be adopted immediately, such as very slow machining speed and hold-to-run controls, etc.
- Report any malfunctions or faults promptly to the machine supervisor.
- During bending, if the workpiece needs to be held in hands, hold it at the end furthest from the bending line and avoid supporting the sheet metal on the side.
- When producing "box" sections, totally avoid supporting the workpiece with hands, holding it above the edges already bent.
- Pay particular attention to the risk of impact or crushing caused by the bent workpiece, released when opening the press, falling; in this case, reduce the return speed until the workpiece is released from the tools or set a non-automatic return of the punch.
- If possible, based on the machining type, fit the machine with adjustable supports or guides or with manipulators to support or guide the workpiece being bent.
- Keep as far as possible away from the workpiece during the bending phase.

Hazard signs highlighting the residual risks on the press brake for particular machining operations on the machine

a)



b)



c)

- a) Crushing hazards between the workpiece and parts of the press brake;
- b) Lesions due to deviation of protruding workpieces;
- c) Crushing and shearing hazards between tools during low speed work and bending operations are indicated below

After use

- At the end of the shift, or in any case before switching off the machine, fully lower the moving crossbeam so that the upper tool rests on the lower element.
- Switch off the machine.
- Leave the area around the machine (especially the workstation) free, clean and tidy.
- Put measuring equipment and instruments back in their containers.
- Restore the operation of any deactivated safety devices.

PRESS BRAKE: CONFIGURATION AND SAFETY DISTANCE CALCULATION

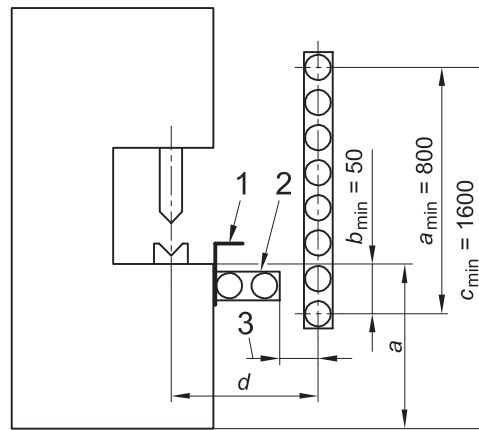
Vertical configuration

As well as the conditions shared with immaterial barriers (see 2.2.5.3 Immaterial barriers), the device must have the following characteristics:

- The minimum height of the optical barrier must be 800 mm with a bench ≥ 850 mm above the floor;
- The minimum safety distance “d” must not be less than 100 mm and must be calculated with the specific formula.

Legend

- 1 Sheet support
 - 2 Light beam(s)/additional guard(s)
 - 3 Reference plane for maximum distance
 - a Bench height
 - b Overlap distance
 - c Height of top edge of optical barrier
 - d Safety distance
- Dimensions in mm



- The safety system is deactivated when the “muting” point is reached; therefore, a hold-to-run control must be automatically activated combined with slow closing speed.

Calculation of safety distance for the vertical positioning of immaterial barriers

$$d = (K \times T) + C$$

Where:

d: Minimum safety distance between the immaterial barrier and the hazardous area [mm]

K: Speed of movement towards body or its parts [mm/s]

= 2000 mm/s (with $d \leq 500$ mm)

= 1600 mm/s (with $d > 500$ mm)

T: Total stopping time of the press brake [seconds]

C: Additional distance [mm] based on the device's detection capacity (provided by the manufacturer) using the following table:

Detection capacity mm	Additional distance C mm	Start of cycle using optical barrier
≤ 14	0	Permitted
$> 14 \leq 20$	80	
$> 20 \leq 30$	130	
$> 30 \leq 40$	240	Not permitted
> 40	850	

Examples of front immaterial barrier in the vertical position**Example 1**

Barrier with detection capacity of 24 mm

Total stopping time T of 0.2 seconds

$$d = (2000 \times 0.2) + 130 = 530 \text{ mm } (> 500)$$

$$d = (1600 \times 0.2) + 130 = 450 \text{ mm } (< 500)$$

In this case the barrier should be placed at least 500 mm from the hazardous point

Example 2

Barrier with detection capacity of 14 mm

Total stopping time T of 0.2 seconds

$$d = (2000 \times 0.2) + 0 = 400 \text{ mm}$$

In this case the barrier should be placed at least 400 mm from the hazardous point

Example 3

Barrier with detection capacity of 20 mm

Total stopping time T of 0.3 seconds

$$d = (2000 \times 0.3) + 80 = 680 \text{ mm } (> 500)$$

$$d = (1600 \times 0.3) + 80 = 560 \text{ mm}$$

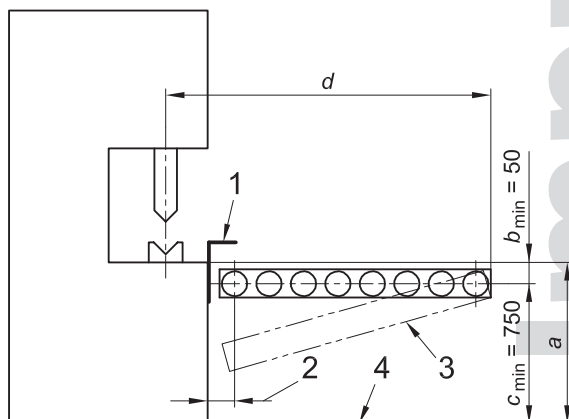
In this case the barrier should be placed at least 560 mm from the hazardous point

Horizontal configuration

Legend

- 1 Sheet support
- 2 Maximum distance (see text)
- 3 Possible alternative position of optical barrier
- 4 Reference plane
- a Bench height
- b Overlap distance
- c Height of optical barrier
- d Safety distance

Dimensions in mm



It can be used in the following conditions:

- The bench must be between 800 mm and 1200 mm high.
- The safety distance "d" must be at least 1000 mm provided that the immaterial barrier ([see 2.2.5.3 "Immaterial barriers"](#)) is placed at a minimum height of 750 mm above the ground and the total response time is ≤ 200 ms (milliseconds).
- With a total response time of > 200 ms (milliseconds), the safety distance is calculated by adding 20 mm to the figure of 1000 mm for each additional 10 ms (milliseconds).