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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

DRAFT INTERNATIONAL STANDARD

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Machine tools Safety — Press brakes

Sécurité des machines outils — Presses plieuses

ICS: 25.080.01; 13.110

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 39, *Machine-tools*, Subcommittee SC 10, *Safety*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, market surveillance etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Machine tools Safety — Press brakes

1 Scope

This document specifies technical safety requirements and measures to be adopted by persons undertaking the design, manufacture and supply of press brakes which are intended to work cold metal or material partly of cold metal but which can be used in the same way to work other sheet materials (e.g. cardboard, plastic, rubber, leather, etc.) and also referred to as machines.

NOTE 1 The design of a machine includes the study of the machine itself, taking into account all phases of the “life” of the machine mentioned in ISO 12100:2010, 5.4, and the drafting of the instructions related to all the above phases.

This document covers the following types of machines (see [Annex J](#)):

- Hydraulic press brakes;
- Hydraulic servo-drive press brakes;
- Screw servo-drive press brakes;
- Belt-spring servo-drive press brakes.

The requirements in this document take account of intended use, as defined in ISO 12100:2010, 3.23, as well as reasonably foreseeable misuse, as defined in ISO 12100:2010, 3.24. This document presumes access to the press brake from all directions, deals with all significant hazards during the various phases of the life of the machine described in [Clause 4](#), and specifies the safety measures for both the operator and other exposed persons.

NOTE 2 All significant hazards means those identified or associated with press brakes at the time of the publication of this document.

This document applies to press brakes which can function independently or in combination (e.g. two machines in tandem or more) and can also be used as a guide for the design of press brakes which are intended to be integrated in a manufacturing system.

This document deals with the significant hazards, hazardous situations and events relevant to press brakes and ancillary devices (see [Clause 4](#)). This document specifies the safety requirements for press brakes defined in this clause.

This document does not cover press brakes which transmit energy to impart beam motion by using pneumatic means or mechanical clutch or press brakes that use combination of technologies (e.g. combined hydraulic and screw servo-drive press brake or combined hydraulic servo-drive and screw servo-drive press brake).

This document does not cover machines whose principal designed purpose is:

- a) sheet folding by rotary action;
- b) tube and pipe bending by rotary action;
- c) roll bending.

This document does not cover hazards related to the use of press brakes in explosive atmospheres.

This document is not applicable to press brakes which are manufactured before the date of its publication.

This document does not cover the safety aspect of equipment for automatic loading and unloading where provided. Guidance on how to take into account additional automatic loading and unloading equipment can be found in ISO 11161:2007.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 9355-1:1999, *Ergonomic requirements for the design of displays and control actuators — Part 1: Human interactions with displays and control actuators*

ISO 9355-2:1999, *Ergonomic requirements for the design of displays and control actuators — Part 2: Displays*

ISO 9355-3:1999, *Ergonomic requirements for the design of displays and control actuators — Part 3: Control actuators*

ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13851:2019, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14118:2017, *Safety of machinery — Prevention of unexpected start-up*

- ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*
- ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*
- ISO 14122-1:2016, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access*
- ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*
- ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*
- ISO 14122-4:2016, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*
- ISO 14738:2002, *Safety of machinery — Anthropometric requirements for the design of workstations at machinery*
- ISO/TR 11688-1:1995, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning*
- ISO/TS 15066:2016, *Robots and robotic devices — Collaborative robots*
- IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*
- IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*
- IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
- IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices*
- IEC 61310-2:2007, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking*
- IEC 61496-1:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and test*
- IEC 61496-2:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*
- IEC 61496-3:2018, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*
- IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 1: General requirements*
- IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
- IEC 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements*
- IEC 61800-5-2:2016, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional*
- IEC 62061:2021, *Safety of machinery — Functional safety of safety-related control systems*
- EN 1005-1:2001+A1:2008, *Safety of machinery — Human physical performance — Terms and definition*

EN 1005-2:2003+A1:2008, *Safety of machinery — Human physical performance — Manual handling of machinery and component parts of machinery*

EN 1005-3:2002+A1:2008, *Safety of machinery — Human physical performance — Recommended force limits for machinery operation*

EN 1005-4:2005+A1:2008, *Safety of machinery — Human physical performance — Evaluation of working postures and movements in relation to machinery*

EN 1837:2020, *Safety of machinery — Integral lighting of machines*

EN 50370-1:2005, *Electromagnetic compatibility (EMC) — Product family standard for machine tools — Part 1: Emission*

EN 50370-2:2003, *Electromagnetic compatibility (EMC) — Product family standard for machine tools — Part 2: Immunity*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in in ISO 12100:2010 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

press brake

machine designed or intended to transmit energy to the moving part of the *tools* (3.13) principally for the purpose of bending between narrow forming tools along straight lines

3.2

up-stroking press brake

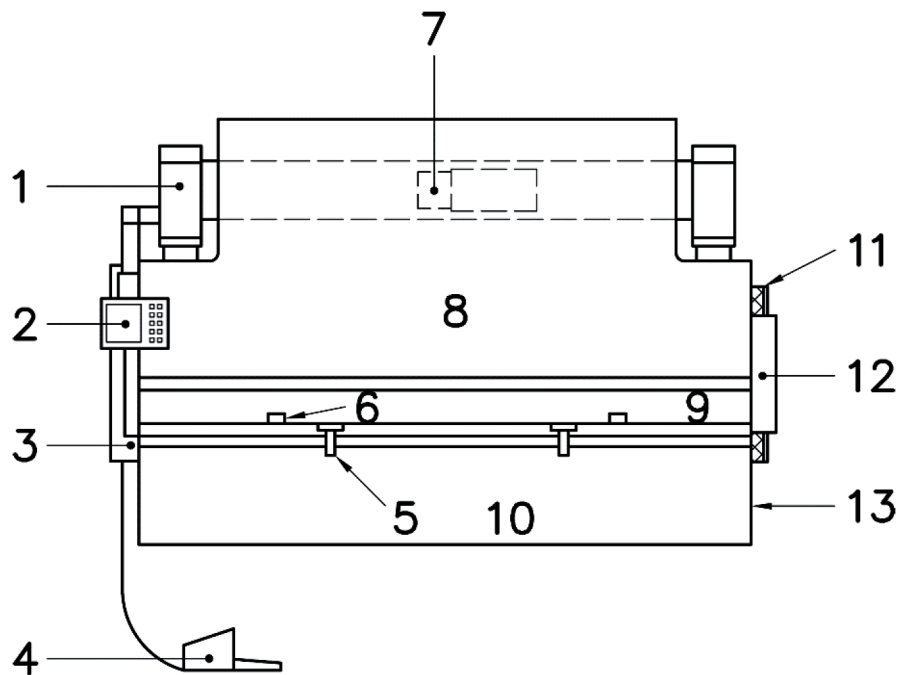
press brake (3.1) in which the lower *tool* (3.13) moves upwards during the closing stroke

Note 1 to entry: The movement is reciprocal to a down-stroking press, see [Figure 1](#).

3.3

down-stroking press brake

press brake (3.1) in which the upper *tool* (3.13) moves downwards during the closing stroke



Key		
1	press cylinder	6 backgauge (3.53)
2	control panel	7 hydraulic system
3	electrical switch gear cabinet	8 beam (3.14)
4	foot pedal	9 tools (3.13)
5	workpiece support	10 bed
		11 side safeguard
		12 light curtain (3.17)
		13 frame

Figure 1 — Example of a down-stroking hydraulic press brake

3.4
hydraulic press brake

press brake (3.1) utilising hydraulic power to impart movement of the beam (3.14) whose characteristics are dependent on hydraulic valve(s)

Note 1 to entry: The hydraulic valve(s) includes servo-valve(s) and proportional control valve(s).

Note 2 to entry: Examples of characteristics are the speed, the pressure, the direction.

Note 3 to entry: Example of a down-stroking (3.3) hydraulic press brake (3.4), see Figure 1

3.5
hydraulic servo-drive press brake

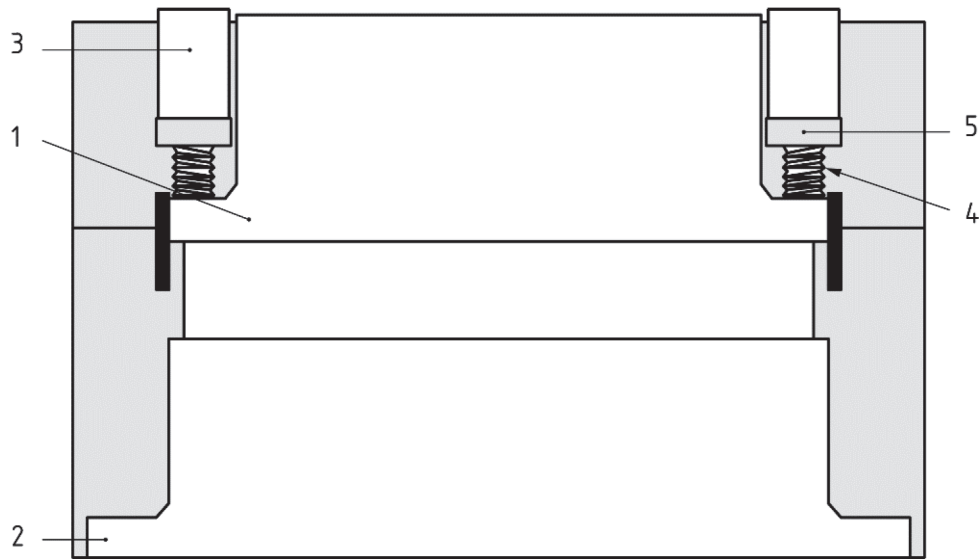
press brake (3.1) utilising hydraulic power to impart movement of the beam (3.14) whose characteristics are directly dependent on servo-pump(s) (3.31)

Note 1 to entry: Examples of characteristics are speed, pressure, direction.

3.6
screw servo-drive press brake

press brake (3.1) utilising servo-motor(s) and screw(s) to impart movement of the beam (3.14).

Note 1 to entry: The characteristics of movements (e.g. speed, force, direction) are directly dependent on servo-motor(s)



Key

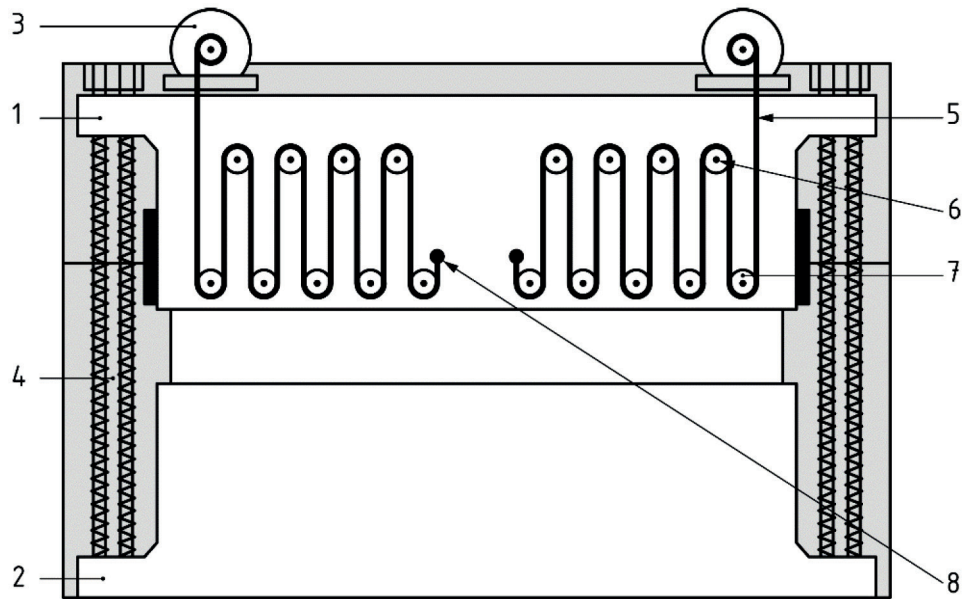
- | | | | |
|---|----------------------|---|------------------|
| 1 | down-stroking beam | 4 | right side screw |
| 2 | bed | 5 | right side brake |
| 3 | left side servomotor | | |

Figure 2 — Example of a down-stroking screw servo-drive press brake

**3.7
belt-spring servo-drive press brake**

press brake (3.1) utilising servo-motor(s), belt(s), pulley(s) and spring(s) to impart movement of the *beam* (3.14).

Note 1 to entry: The characteristics of movements (e.g. speed, force, direction) are directly dependent on servo-motor(s)



Key

- | | |
|-------------------------------------|---------------------------------------|
| 1 down-stroking beam | 5 right side belt |
| 2 bed | 6 idle pulley mounted on the beam |
| 3 left side servomotor | 7 idle pulley mounted on a fixed part |
| 4 left side twin spring arrangement | 8 attachment of the belt |

Figure 3 — Example of a down-stroking belt-spring servo-drive press brake

3.8

tools area

area between moving and stationary tools

EXAMPLE Space between punch and die of a press brake.

3.9

ancillary device

any device intended for use with the *press brake* (3.1) and/or integrated with it

Note 1 to entry: Examples of these devices are *backgauges* (3.53), adjustable front sheet supports, tool loading devices

3.10

dead centre(s)

point at which the *tool* (3.13), during its travel, is:

- either nearest/closest to the die (generally it corresponds to the end of the closing stroke), known as the bottom dead centre (BDC);
- or furthest from the die (generally it corresponds to the end of the opening stroke), known as the top dead centre (TDC)

Note 1 to entry: On an *up stroking press brake* (3.2), the centres are reversed.

3.11

guard locking

measures to maintain an interlocking guard in the closed position until the risk of injury from the hazardous machine *functions* (3.46) has ceased

[SOURCE: ISO 16092-1:2017, 3.2.8, modified — “(3.4.3)” was deleted]

3.12

position switch

switch which is operated by a moving part of the machine when this part reaches or leaves a predetermined position

3.13

tools

combination of punch and die

3.14

beam

main reciprocating *press brake* (3.1) member which normally holds the punch on a *down-stroking press brake* (3.3), and which normally holds the die on an *up-stroking press brake* (3.2)

3.15

electro-sensitive protective equipment

ESPE

assembly of devices and/or components working together for protective tripping or presence-sensing purposes comprising

- a sensing device;
- controlling monitoring devices;
- output devices;
- all interconnecting wiring.

[SOURCE: ISO 13855:2010, 3.1.4, modified — “at minimum” was deleted in the first part of the definition, and the last list item replaced by 2 list items]

Note 1 to entry: For the purposes of this document, *ESPE* (3.15) covers *AOPD* (3.16), *AOPDDR* (3.19), laser actuated *AOPD* (3.16).

3.16

active opto-electronic protective device

AOPD

device whose sensing *function* (3.46) is performed by opto-electronic emitting and receiving elements detecting the interruption of optical radiation, generated within the device, by an opaque object present in the specified detection zone

Note 1 to entry: IEC 61496-2:2020 gives detailed provisions.

[SOURCE: IEC 61496-2: 2020, 3.201]

3.17

light curtain

AOPD (3.16) comprising an integrated assembly of one or more emitting element(s) and one or more receiving element(s) forming a detection zone with a detection capability specified by the supplier

[SOURCE: IEC 61496-2: 2020, definition 3.205]

3.18

blanking

optional *function* (3.46) that permits an object of a size greater than the detection capability of the *AOPD* (3.16) to be located within the detection zone without causing an OFF-state of the *OSSD(s)* (3.49)

Note 1 to entry: Fixed *blanking* (3.18) is a technique wherein the locations of the blanked areas of the detection zone do not change during operation. The detection capability of the other parts of the detection zone remains unchanged.

Note 2 to entry: Floating *blanking* (3.18) is a technique wherein the blanked area of the detection zone follows the location of a moving object(s) during operation. The detection capability of the other areas remains unchanged.

Note 3 to entry: Progressive *blanking* (3.18) also known as successive *blanking* (3.18) or sequential *blanking* (3.18) is a particular *blanking* (3.18) technique related to laser actuated AOPD, where the *blanking* (3.18) is done progressively at high speed, at less than 10 mm gap to the workpiece.

[SOURCE: ISO 16092-1:2017, 3.2.19]

3.19

active opto-electronic protective device responsive to diffuse reflection

AOPDDR

device, whose sensing *function* (3.46) is performed by opto-electronic emitting and receiving elements, that detects the diffuse reflection of optical radiations generated within the device by an object present in a detection zone specified in two dimensions

[SOURCE: IEC 61496-3:2018, 3.301]

3.20

monitoring

safety *function* (3.46) which ensures that a safety measure is initiated if the ability of a component or an element to perform its *function* (3.46) is diminished, or if the process conditions are changed in such a way that hazards are generated

[SOURCE: ISO 16092-1:2017, 3.3.1, modified — “(3.4.3)” was deleted]

3.21

muting

temporary automatic suspension of a safety *function(s)* (3.46) by safety-related parts of the control system during otherwise safe conditions in the operation of a machine

[SOURCE: ISO 16092-1:2017, 3.3.2, modified — “(3.4.3)” was deleted]

3.22

overall system stopping performance

overall response time

time occurring from actuating the protective device to the cessation of hazardous motion, or to the machine assuming a safe condition

[SOURCE: ISO 16092-1:2017, 3.3.3, modified — “press (3.1.1)” was replaced with “machine”]

3.23

reset

function (3.46) within the SRP/CS (3.50) used to restore manually one or more safety *functions* (3.46) before re-starting a machine

[SOURCE: ISO 16092-1:2017, 3.3.4, modified — “(3.4.3)” was deleted]

3.24

restraint valve

hydraulic device which protects against a gravity fall of the *beam* (3.14)

3.25

brake

mechanism for slowing, stopping and holding the *beam* (3.14)

3.26

mechanical brake

brake (3.25) using dry or fluid friction

3.27

moving direction monitoring

monitoring function (3.46) which monitors the *beam* (3.14) moving direction, directly or indirectly

3.28

standstill monitoring

monitoring function (3.46) which monitors the *beam* (3.14) position, directly or indirectly

3.29

stopping-performance (overrun) monitoring

monitoring function (3.46) which monitors the *beam* (3.14) stopping time or distance

3.30

servo drive system

system directly connecting a servo motor to the transmission system such as gear (motor reducer), timing belt drive mechanism, mechanical link, ball screw, harmonic drive reducer, etc.

3.31

servo pump

hydraulic pump driven by a servo motor

3.32

protective stop (function)

stop function (3.46) initiated by a protective measure

3.33

safe energized standstill

safety function (3.46) preventing an unexpected movement of the *beam* (3.14) of more than a defined amount from the stopped position, with energy supplied to the servomotor(s) to resist to external forces, and without actuation of the mechanical *brake(s)* (3.25) or the hydraulic/mechanical restraint device(s)

3.34

safe de-energized standstill

safety function (3.46) preventing an unexpected movement of the *beam* (3.14) by removing the energy supply to the servomotor(s) and either the mechanical *brake(s)* (3.25) or the hydraulic/mechanical restraint device(s)

3.35

safe stop (function)

stop function (3.46) initiated by a *monitoring* (3.20) *function* (3.46)

3.36

safe torque off

STO

function (3.46) which prevents force-producing power from being provided to the servo-motor

Note 1 to entry: For details, see also IEC 61800-5-2:2016, 4.2.3.2

3.37

worst case

condition of the *press brake* (3.1) when it would be under foreseeably unfavourable situations

EXAMPLE The *press beam* (3.14) is in its most disadvantageous position, with a *tool* (3.13) of maximum weight being used, etc.

3.38

operating mode

specific manner of operation of a *press brake* (3.1) or press brake production system determined by the control system

Note 1 to entry: For specifications on safety facilities and security measures relating to different operating modes, see [Clause 5](#).

3.39**OFF**

operating mode (3.38) in which the *press brake* (3.1) is rendered inoperative

3.40**single cycle**

operating mode (3.38) where each operating cycle of the *beam* (3.14) is positively actuated by the operator

3.41**single stroke function**

function (3.46) used to limit the motion of the *tool* (3.13) to one operating cycle even if the stroke initiating means is held in the operating position

Note 1 to entry: Initiating mean can be a foot pedal

3.42**automatic cycle**

operating mode (3.38) where the operating cycle is repeated continuously or intermittently, all *functions* (3.46) achieved without manual intervention after initiation

3.43**light curtain single break**

single cycle where a *light curtain* (3.17) is used for cycle initiation after clearing the *light curtain* (3.17) following a single interruption for manual loading and unloading

3.44**light curtain double break**

single cycle where a *light curtain* (3.17) is used for cycle initiation after clearing the *light curtain* (3.17) following a double interruption for manual loading and unloading

3.45**operating mode selection device**

facility consisting of an access, selection and activation system for manual selection of the machine's *operating mode* (3.38) to which only a restricted group of persons has access

[SOURCE: ISO 16092-1:2017, 3.4.2, modified — “(3.4.1)” and Note 1 were deleted]

3.46**function**

operation of a machine or a part of a machine which is specific or required for the intended machine task

[SOURCE: ISO 16092-1:2017, 3.4.3]

3.47**cycle**

complete movement of the *beam* (3.14) and other devices of the *press brake* (3.1) used for production

EXAMPLE *Ancillary devices* (3.9) including feeding and removal of the material or workpiece along a programmed motion path from the programmed start position (*TDC* (3.10)) back to the programmed end position (*TDC* (3.10))

3.48**programmable electronic system****PES**

system for control, protection or monitoring based on one or more programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices

[SOURCE: IEC 61508-4:2010, 3.3.1, modified — “(see [Figure 2](#))”, Note to entry and [Figure 2](#) were deleted.]

3.49

output signal switching device

OSSD

component of the *ESPE* ([3.15](#)) connected to the machine control system which, when the sensing device is actuated during normal operation, responds by going to the OFF-state

[SOURCE: IEC 61496-1:2020, 3.19]

3.50

safety-related part of a control system

SRP/CS

part of a control system that responds to safety related input signals and generates safety related output signals

Note 1 to entry: the combined safety related parts of a control system start at the point where the safety related input signals are initiated (including, for example, the actuating cam and the roller of the position switch) and end at the output of the power control elements (including, for example, the main contact of a contactor)

Note 2 to entry: If monitoring systems are used for diagnostics, they are also considered as *SRP/CS* ([3.50](#)).

[SOURCE: ISO 13849-1:2015, 3.1.1]

Note 3 to entry: *SRP/CS* ([3.50](#)) generally use mechanical, hydraulic, electrical, pneumatic or software parts

3.51

overrun monitoring device

device which provides a signal to inhibit further complete stroke when the overrun exceeds the pre-set limit(s)

3.52

bending plane

vertical plane passing through the first contact line with the material from the upper *tool* ([3.13](#)) nearest to the operator

3.53

backgauge

mechanism comprising all necessary parts to move *backgauge finger(s)* ([3.54](#)), including transmission parts and mobile supports of backgauge finger(s)

Note 1 to entry: See [Figure 4](#)

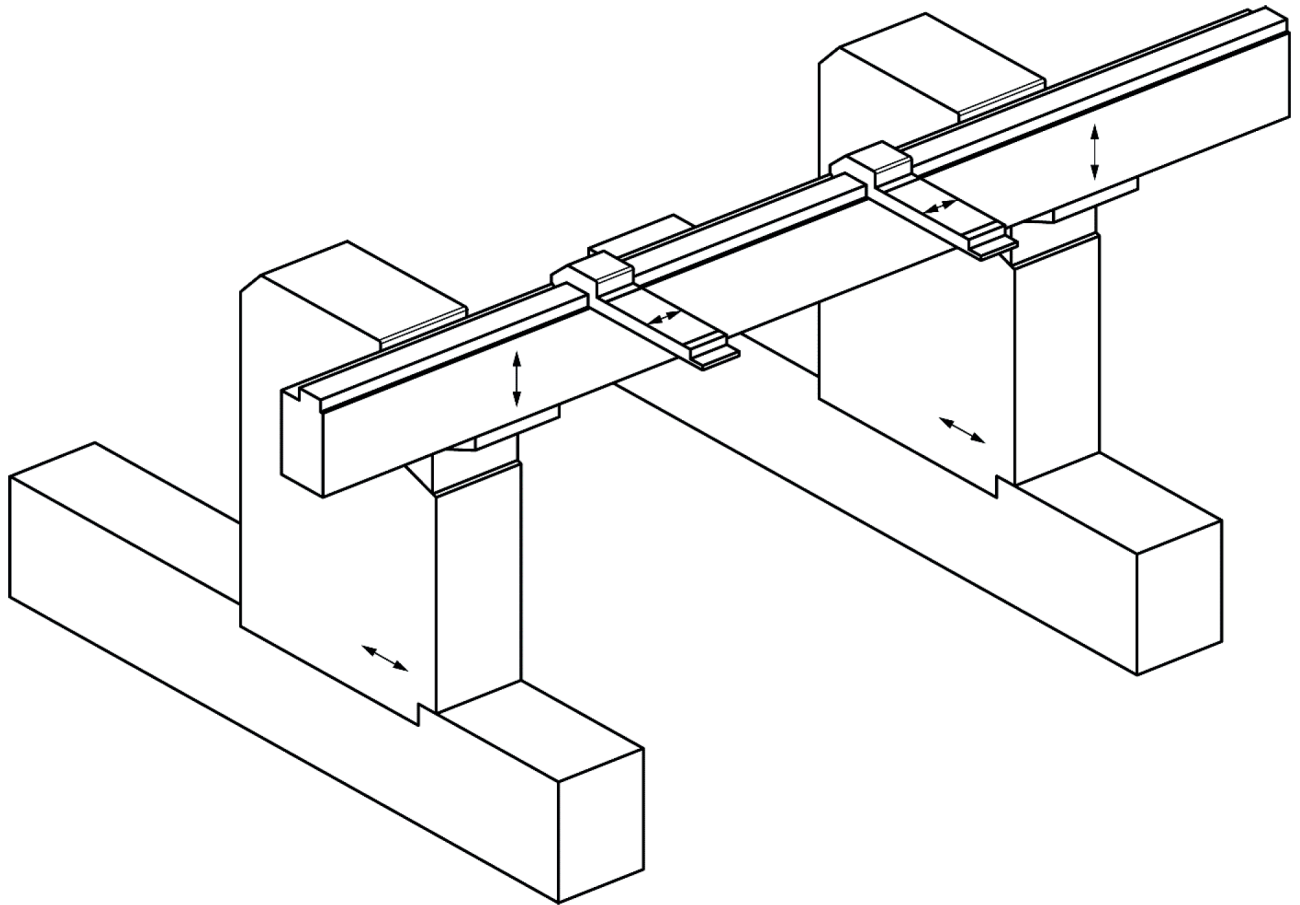


Figure 4 — Example of a backgauge for a press brake

3.54

backgauge finger

mechanical part moved by *backgauge* (3.53) against which the workpiece is positioned before bending

Note 1 to entry: See [Figure 5](#)

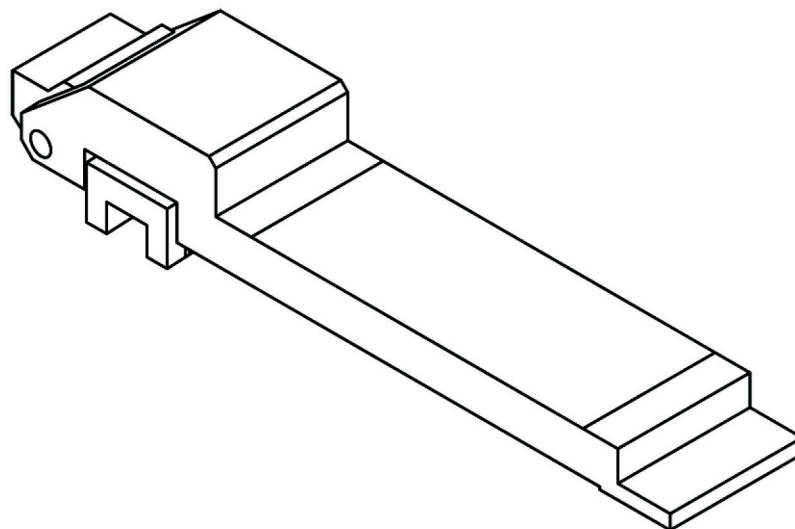


Figure 5 — Example of a backgauge finger for a backgauge

3.55

numerical control (NC)

automatic control of a process performed by a device that makes use of numeric data introduced while the operation is in progress

3.56

programmable logic controller (PLC)

digitally operating electronic system, designed for use in an industrial environment, which uses a programmable memory for the internal storage of user-oriented instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic, to control, through digital or analogue inputs and outputs, various types of machines or processes. Both the PLC and its associated peripherals are designed so that they can be easily integrated into an industrial control system and easily used in all their intended functions

[SOURCE: IEC 61131-1:2003, definition 3.5]

4 List of significant hazards

This clause contains all significant hazards, hazardous situations and events as far as they are dealt with in this document, identified by risk assessment as significant for the machines defined in the scope and which require a specific action to eliminate or reduce the risk:

These hazards are listed in [Table A.1](#).

Particular attention is given to hazards dealing with the following:

- crushing and shearing between moving parts such as tools, beam, back gauges, workpiece supports;
- entanglement on or drawing into moving parts of the machine, guards, motor and drive machinery;
- ejection of machine components;
- release of hydraulic fluids.

Main danger zones are the following:

- tools area with moving beam, back gauges, workpiece supports, front gauges, angle correction device, automatic tools changer;
- workpiece handling device;
- motor and drive machinery.

5 Safety requirements and/or measures

5.1 General

The methods or measures to be implemented to eliminate the significant hazards or reduce their associated risks are detailed in this clause in the following manner:

- Protection of mechanical hazards ([5.2](#));
- Control systems ([5.3](#));
- Mode of operation ([5.4](#));
- Consideration of basic design and other mechanical hazards ([5.5](#));
- Protection against non-mechanical hazard ([5.6](#))

5.2 Protection of mechanical hazards

5.2.1 Description of the safeguarding of access to moving parts

5.2.1.1 General

The major danger zones at press brakes are the tools, associated area and ancillary loading and unloading devices which are an integral part of the machine. Preventive measures shall be taken to deal with the relevant hazards.

Safeguarding measures described in ISO 12100:2010, 6.3 which are appropriate for the protection of any operator at the tools are listed below. Designers, manufacturers and suppliers shall select the safeguarding measures which reduce the risks as far as possible, considering the significant hazards (see [Table A.1](#)) and the mode of production.

The selected combination of safeguarding measures shall protect all exposed persons, i.e. those who can gain access to the danger zone during operation, setting, maintenance, cleaning and inspection activities.

Access to the danger zone(s) shall be prevented by one or a combination of the following safeguarding measures.

5.2.1.2 Guards

Guards shall comply with ISO 14120:2015. They shall be firmly secured to the machine, another rigid structure or the floor. Any openings in the guards or between the guard and the machine shall meet the requirements of ISO 13857:2019, Table 4.

5.2.1.3 Interlocking guards with or without guard locking

Interlocking guards shall comply with ISO 14120:2015 and prevent, in conjunction with fixed guards, access to the danger zone, during any dangerous movement. Initiation of the dangerous movement shall be prevented until the guard is closed. The associated interlocking devices shall be designed and constructed in accordance with ISO 14119:2013 and the safety-related parts of the control system shall conform to [Table 1](#) or [2](#).

Interlocking guards without guard locking shall be placed in such a position that the operator does not have time to reach the danger zone before any dangerous movement has ceased (see ISO 13855:2010).

5.2.1.4 ESPE using AOPD

5.2.1.4.1 Light curtain

ESPE using AOPDs in the form of light curtain shall comply with the following:

- a) light curtains shall conform to type 4 of IEC 61496-1:2020 and be designed and constructed according to IEC 61496-2:2020;
- b) access to the danger zone shall only be possible through the detection zone of the light curtain. Additional safeguarding shall prevent access to the danger zone from any other direction. The gap between bars in a fixed guard, or between the frame and the edge of the fixed or interlocking guard or single light beam shall follow the safety distances set out in ISO 13857:2019;
- c) an additional safeguarding shall be provided to ensure that no hazardous movement is possible when standing in position between the light curtain and the danger zone of the press brake. The gap shall be equal to or less than 75 mm (see [5.2.1.4.2](#));

- d) it shall not be possible to initiate any dangerous movement while any part of the body is interrupting the light curtain, except when using automatically alternating safeguarding measures (see [5.2.1.4.3](#));
- e) the means of resetting shall be positioned so that there is a clear view of the whole hazardous zone. When more than one hazardous zone is protected with a protective device, a reset control device shall be provided for each protective device. For the requirements of the resetting function, see ISO 13849-1:2015, 5.2.2;
- f) blanking may only be incorporated into the light curtain as long as the minimum distance is such as to ensure that it is not possible to reach the danger zone (see [B.1](#)). It shall not be possible for the user to increase the blanking range.

The determination of the minimum distance according to the detection capability at the blanked zone is not required if the following conditions are fulfilled:

- only one zone is blanked;
 - the detection capability of the light curtain at the blanked zone is equal or less than 30 mm;
 - the detection capability in the rest of the area is equal or less than 14 mm;
 - the minimum distance is equal or greater than 150 mm;
 - no possibility to initiate cycles using the light curtain.
- g) In order to avoid a negative influence on the detection capability of reflective surfaces in the detection plane of the light curtain; the instructions provided in the technical documentation of the light curtain shall be applied.

Where the light curtain operates by reflecting the transmitted light back along its own path and additional reflector(s) are placed within the detection zone, then the configuration of the additional reflector(s) shall not allow an item of thickness equal to or greater than the specified test piece size (see IEC 61496-2:2020, 4.1.2.1) to be undetected by the light curtain within the whole of the detection zone, unless other measures are taken to ensure that it is not possible to reach the danger zone.

- h) where the light curtain is also used for cycle initiation using either single or double break, the following additional conditions shall be fulfilled:
 - 1) the detection capability shall not exceed 30 mm (see also [Annex B](#));
 - 2) if, in the front of the press brake, additional guards [see [5.2.1.4.1](#) b) and c)] are needed, they shall either be permanently fixed guards (e.g. by welding) or interlocking guards (see [5.2.1.3](#)).
 - 3) while a part of the body is still in the danger zone (e.g. arms) it shall not be possible to clear the light curtain for cycle initiation [see also [5.2.1.4.1](#) d) and [Annex B](#)];
 - 4) before the first cycle initiation and/or in the event of an intervention of another safety system preventing access to the tools area, the reset function(s) shall be actuated (e.g. push button, foot pedal);
 - 5) the facility to initiate the press brake motion upon clearing of the curtain shall be limited to the pre-set time; this pre-set time shall not be capable of exceeding 30 s starting from the end of the previous operating cycle. The light curtain shall be required to be manually reset, if the pre-set time has been exceeded;
 - 6) if there is more than one light curtain safeguarding the press brake, only one of them shall be selectable for cycle initiation at any one time;
 - 7) technical measures shall be taken to ensure that the stroke is only initiated after an intrusion into the protection field of at least 100 ms and releasing of the protection field;

- 8) commonly two possibilities for starting sequences are made available:
- intrusion and releasing of the protection field, and subsequent actuation of the reset switch;
 - pressing of the reset switch, and subsequent intrusion and releasing of the protection field.
- i) switching off the light curtain by the selector switch shall also switch off its indicator lights.

5.2.1.4.2 Size and positioning of light curtains

Light curtains shall be positioned in the following configurations:

- vertical format, see [5.2.1.4.2 a\)](#);
- horizontal format, see [5.2.1.4.2 b\)](#);
- angled format, see [5.2.1.4.2 c\)](#);
- a combination of formats, see [5.2.1.4.2 d\)](#).

For up stroking press brakes, the position of the bed is measured at its lowest point.

NOTE a risk assessment should be done if V punches are not used.

- a) vertical format light curtains shall be configured as shown in [Figure 6](#). The minimum effective vertical height of the detection zone of the light curtain shall be 800 mm, where the height of the bed, a , is 850 mm or more. If the height of the bed is below 850 mm, the detection zone of the light curtain shall need to increase in length accordingly. The minimum vertical overlapping distance, b , between the bed and the bottom edge of detection zone of the light curtain shall be at least 50 mm (see [Figure 6](#)).

The minimum height, c , of the top edge of the detection zone of the light curtain shall be 1 600 mm above the reference plane. The minimum height $c = 1\ 600$ mm or the minimum height of the detection zone 800 mm of the light curtain may be reduced only if additional safeguarding prevents any access to the danger zone.

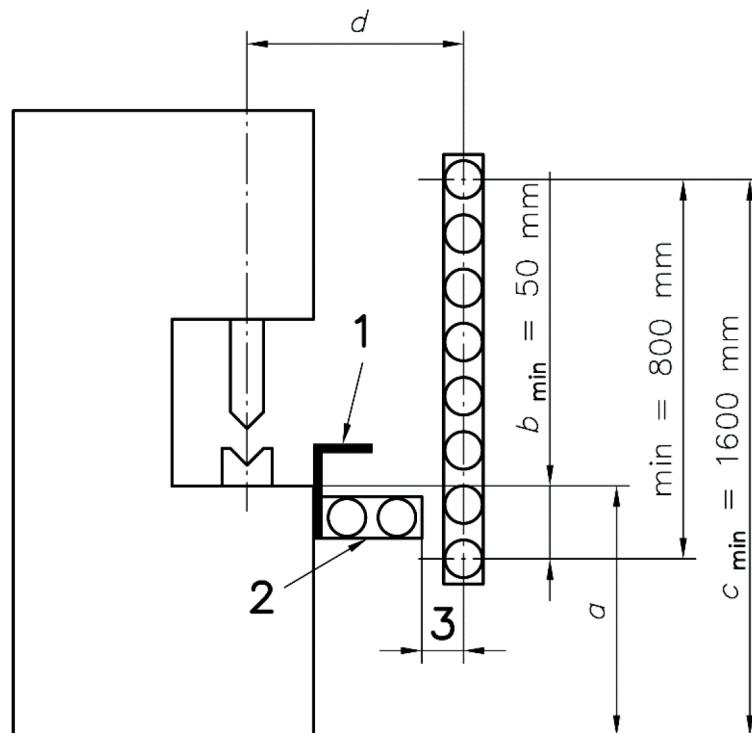
The light curtain object detection capability shall be 14 mm or less if no additional distance, c , is used to achieve the required minimum distance (see [Annex B](#)).

The minimum distance, d , shall be calculated according to the formula given in [Annex B](#), but shall never be less than 100 mm.

Where the vertical format light curtain cannot be placed against the press brake frame, then the resulting gap shall be guarded by:

- either fixed or interlocking guards; or
- additional light beams.

If dimension 3 has a value higher than the light guard resolution 2, then the minimum overlapping distance, b between the bed and the bottom edge of the light curtain shall be a minimum of 50 mm (see [Figure 6](#))

**Key**

- | | | | |
|---|--|----------|---|
| 1 | sheet support | <i>a</i> | height of the bed to operator's stand |
| 2 | additional light beam(s)/guard(s)/curtain(s) | <i>b</i> | overlapping distance |
| 3 | max. distance (see text) reference plan | <i>c</i> | height of top edge of the detection zone of the light curtain |
| | | <i>d</i> | minimum distance |

NOTE Side and rear guards omitted for the purpose of this figure.

Figure 6 — Configuration of the vertical format light curtain

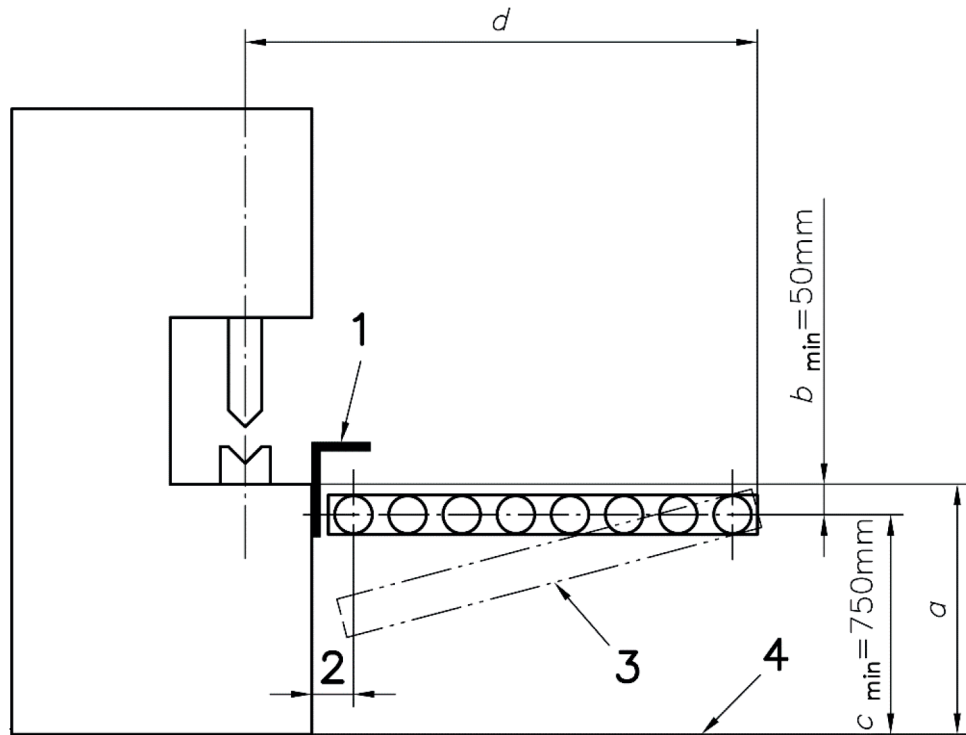
- b) horizontal format light curtains shall be configured as shown in [Figure 7](#) when the height of the bed, *a*, is not less than 800 mm or more than 1 200 mm. The minimum overlapping distance *b* between the bed and the bottom edge of the light curtain shall be 50 mm (see [Figure 7](#)).

Where the overall response time is 200 ms or less, the minimum distance, *d*, shall be at least 1 000 mm. Where the overall response time exceeds 200 ms, 20 mm shall be added to the figure of 1 000 mm for each additional 10 ms.

The detection capability shall be 40 mm or less from the bending line to a distance of 550 mm. Beyond 550 mm, the detection capability shall not exceed 75 mm.

Where the horizontal format light curtain cannot be placed against the press brake frame, then the resulting gap shall be guarded by:

- either fixed or interlocking guards; or
- additional light beams.

**Key**

- | | | | |
|---|--|----------|---|
| 1 | sheet support | <i>a</i> | height of the bed |
| 2 | max. distance (see text) | <i>b</i> | overlapping distance |
| 3 | possible alternative position of light curtain | <i>c</i> | height of the detection zone of the light curtain |
| 4 | reference plan | <i>d</i> | minimum distance |

NOTE Side and rear guards omitted for the purpose of this figure.

Figure 7 — Configuration of the horizontal format light curtain

- c) Where an angled format light curtain is used, the light curtain in the vertical and horizontal positions shall meet the dimensional criteria laid down in [5.2.1.4.2 a\)](#) and [5.2.1.4.2 b\)](#) respectively (see [Figures 6](#) and [7](#)). If the light curtain can be adjusted to less than 45° from the vertical position, the detection capability shall be in accordance with [Table B.1](#).
- d) When a combination of light curtains is used, the formats shall achieve the same level of protection as required in [5.2.1.4.2 a\)](#) and [5.2.1.4.2 b\)](#) above.

NOTE In relation to muting, see [5.3.5.20](#).

5.2.1.4.3 Automatically alternating safeguarding methods

For the use of automatically alternating safeguarding measures with a foot pedal for cycle initiation, the following conditions shall apply:

- a) Alternating starting conditions at the chosen top dead centre (TDC) are:
- the active light curtain is not interrupted: high closing speed, or
 - the light curtain is interrupted: only slow closing speed.

- b) Interruption of the active light curtain during the high closing speed or release of the foot pedal shall lead to:
- stop; or
 - reverse to the chosen top dead centre (TDC).

- c) Restart after interruption: starting conditions as at the chosen top dead centre (TDC) (see [5.3.6.2](#)).

Muting function may be also provided (see [5.3.5.20](#)).

5.2.1.5 ESPE using laser actuated AOPD

ESPE using laser actuated AOPD shall be suitable for the bed length of the machine, the thermal influences, the overrun performances and optical reflections expected at the press brake, see also [7.2.2](#) o).

These devices are designed specifically for “V” type tools and the manufacturer shall provide instructions on which tools can be used. If the tool creates crushing hazards outside the detection zone defined in [5.2.1.5](#) b) (e.g. a non “V” type tool is used), additional safety measures shall be provided to achieve at least the same level of protection as defined for “V” type tools in [5.2.1.5](#) b).

EXAMPLE move or increase the detection zone, additional detection zones, additional safety systems, earlier slow speed to suit crushing hazards.

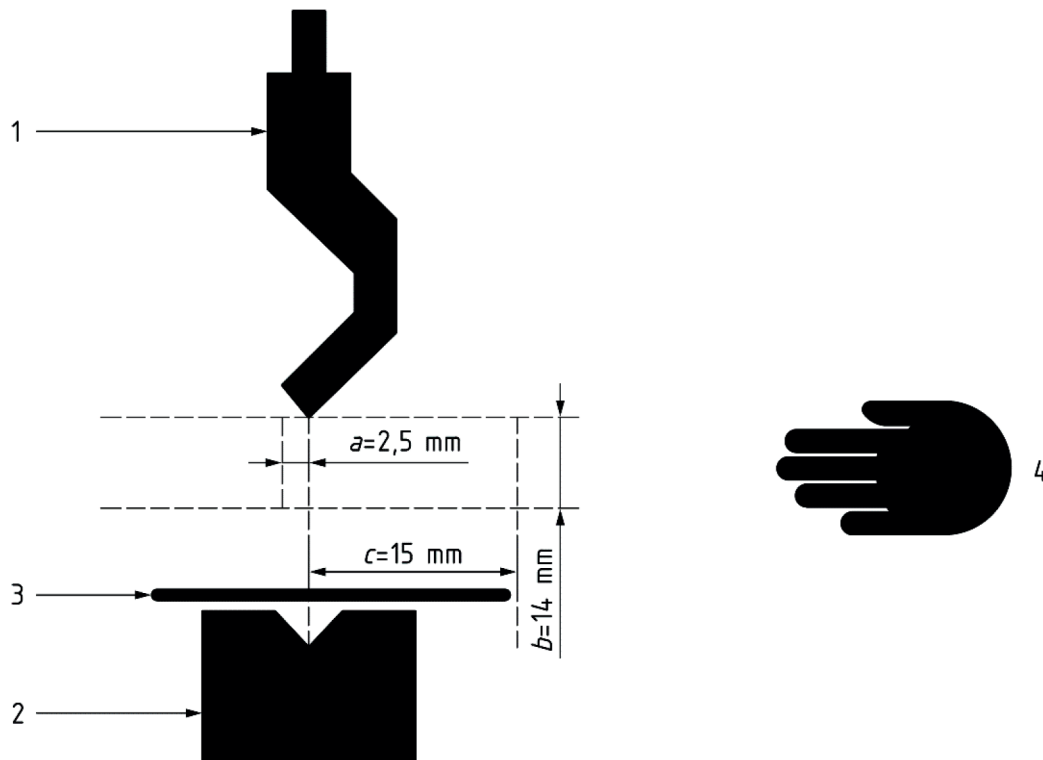
The laser actuated AOPD shall comply with the following:

- a) Laser actuated AOPD shall be in accordance with IEC 61496-1:2020 and IEC 61496-2:2020. In addition, special optical requirements shall be met to ensure complete detection even with reflective surfaces in the proximity. The optical design of a laser actuated AOPD shall be in a manner that no optical bypassing can occur on reflecting surfaces.

NOTE 1 This can be achieved by using parallel emitting beams with an angle of aperture approaching zero.

- b) The design of protection zone as shown in [Figure 8](#) shall be:

- 1) positioned near the upper tool. (e.g. the laser actuated AOPD is moving with the beam for downstroking press brake),
- 2) extended in the vertical plane directly under the centre line of the upper tool but not more than 2,5 mm behind (bending line), see distance *a*,
- 3) extended forward of the bending plane by at least 15 mm, see distance *c*,
- 4) positioned so that the maximum detection capability between the protection zone and the tip of the tool is 14 mm, see distance *b*. The AOPD shall be capable of detecting an object with a thickness of 14 mm when inserted directly under the tip of the upper tool,
- 5) designed to pass the tests in [Annex H](#).



Key

- 1 punch/upper tool
- 2 die/lower tool
- 3 material/workpiece
- 4 operator side/front side of the press brake
- a* active protective zone directly under the punch
- b* maximum allowable gap between the active protection zone and the tip of the punch/upper tool
- c* minimum distance from the front of the active protection zone to the bending line

Figure 8 — Protection zone dimensions for ESPE using laser actuated safeguarding devices.

NOTE 2 When a special mode (box mode) is used, it is normal practice that the center detection point of the protection zone is slightly behind the center line to give some tolerance so as the part flange does not obstruct the center detection point. Therefore this 2,5 mm dimension is specified.

NOTE 3 The 15 mm minimum distance prevents fingers from being exposed to the hazard during normal operation. See h) for special modes.

c) The protection zone shall comply with the following:

- 1) Have a detection capability of ≤ 14 mm.
- 2) The protection zone shall be positioned or extended below the upper tool in the vertical plane by a distance that will detect a stationary obstruction and stop the closing movement of the beam without the upper tool making contact with the obstruction
- 3) When the lower extremity of the protection zone approaches the bottom die and reaches a point 10 mm above the top of the material to be bent, the beam shall stop with at least 5 mm distance (clearance) between the tip of the upper tool and the obstruction.

- 4) The protection zone may extend in a vertical distance, and parts of the protection zone may be progressively blanked during the fast closing speed if:
- The distance between the active protection zone and the workpiece (gap) shall be less than 10 mm;
 - The overall detection capability of the whole protection zone shall be a maximum 10 mm;
 - Blanking any part of the protection field shall have no effect on the above requirements of c);
 - Blanking of the protection zone shall only be performed by the SRP/CS achieving the performance level PL e.

The close proximity point of operation AOPD shall provide a means of verifying any differing stopping distances required in this progressive blanking process, and to ensure the progress of the closing movement during this process is meeting the performance required to achieve these stopping distances.

If this function is not provided by the AOPD, it shall be provided by the machine itself.

NOTE 4 The 10 mm step of the test rod in [Annex H](#) shall always be detected even during sequential blanking. Before starting sequential blanking it shall be ensured that the operator's fingers are at least 15 mm in front of the bending line to prevent injury from slipping in during the fast closing speed.

- d) Any interruption of the protection zone shall result in a stop or inversion of the movement of the beam. The hold-to-run control device shall be reactivated to initiate a further closing stroke of the press brake beam. If the protection zone remains interrupted it shall only be possible to run the press brake with a slow closing speed in conjunction with a hold-to-run control device (see [5.2.1.6](#));

The slow closing speed shall conform to [5.3.5.19](#).

- e) Muting (see also [5.3.5.20](#)) of the entire protection zone described in b.2 and b.3 shall only be possible if:
- 1) The die opening at the beginning of the closing movement is equal to or less than 6 mm. (starting of the stroke at higher openings is dealt with by d), or
 - 2) The closing speed of the beam is equal to or less than 10 mm/s. The 10 mm/s speed shall be achieved before the muting function is initiated. Means shall be provided to ensure that the speed does not exceed 10 mm/s, and if the speed exceeds 10 mm/s then the closing movement shall be stopped

NOTE 5 The 6 mm indicated above is the distance between the tool and the die, not the distance between the material to be bent and the top tool tip.

- f) Blanking any part of this detection zone that affects the test in [Annex H](#) or has any reduction on the requirements of c) above shall only be possible if:
- 1) The die opening at the beginning of the closing movement is equal to or less than 6 mm. (starting of the stroke at higher openings is dealt with by d), or
 - 2) The closing speed of the beam is equal to or less than 10 mm/s. Means shall be provided to ensure that the speed does not exceed 10 mm/s, while the muting function is initiated, and if the speed exceeds 10 mm/s then the closing movement shall be stopped.

NOTE 6 The 6 mm indicated above is the distance between the tool and the die, not the distance between the material to be bent and the top tool tip.

- g) Switching off the laser actuated AOPD by the selector switch shall also switch off the indicators lights.

- h) When a special mode of operation for box bending is provided, the following conditions shall apply:

For special modes of operation (such as box mode) blanking of the protection zone in front of the centre line, described in b) 3), is permitted while travelling more than 10 mm/s if the centre section, described in b) 2), remains active, the requirements of c) above are not affected, and with the following additional requirements:

A separate confirming action by the operator shall be required (e.g., a separate additional depression of the foot pedal or push button) before each stroke when the front (or rear) section of the zone is blanked from the top of stroke position down to the bending action, or

The front (or rear) section of the protection zone shall be blanked only at the position of the top edge of the flange, then this confirmation action by the operator can be replaced by conformation of the position of the top edge of the box upstand (flange) by two separate and independent means, provided that the front section of the protection zone remains unobstructed before the closing stroke is initiated, or

The blanking function shall be activated before each bending stroke by the control system (e.g. by information coming from the numerical control to determine the sequence of blanked and non blanked strokes). For each of the identical bend batches requiring the blanking and fast speed, the operator shall have specific message and a separate confirming action (e.g. push button, a second actuation of the foot pedal) before the blanking is permitted. After 120 s of inactivity the bending execution is interrupted (e.g. operator switch), and the specific message and separate confirming action shall be repeated to restart bending execution.

Means of selection shall be provided for this special mode of operation;

This special mode of operation shall be automatically de-activated:

- at each power on of the machine;
- after a mode selection change;
- after a change of program of the numerical control; and
- within 8 h running time;

A clear indicator, active when the protection zone is blanked, shall be provided;

- i) There shall be indicators of the mode of operation of laser actuated AOPD (e.g. box bending mode) visible by the operator.
- j) The position setting of laser actuated AOPD shall be lockable against unexpected change, e.g. due to vibrations, mechanical shock.
- k) Access to the tool zone shall only be possible from the front side of the press brake. The laser actuated AOPD shall prevent in conjunction with other safeguarding access to the danger zone from any other direction.
- l) It shall not be possible to initiate travel faster than 10 mm/s while any interruption exists in the detection zone appropriate to the selected mode of operation.
- m) The press brake stroke shall be controlled by a three positions hold-to-run control device.
- n) An automatic press brake overrun monitoring function shall be provided.
- o) The design of parts other than those protected by the AOPD (e.g. moving tool support dies for crushed bends) shall be such that no trapping point is created during the closing and opening movement. If this requirement cannot be fulfilled, complementary protection measures shall be taken.