

ANSI B11.3 - 2012

American National Standard for Machines –

Safety Requirements for Power Press Brakes

Secretariat and Accredited Standards Developer:
B11 Standards, Inc.
POB 690905
Houston, TX 77269

APPROVED: 20 JULY 2012

by the American National Standards Institute



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	Page
FOREWORD	7
HISTORY	7
EFFECTIVE DATE	8
DEVELOPMENT	8
INTRODUCTION	10
1 SCOPE	13
1.1 General	13
1.2 Exclusions	13
2 NORMATIVE REFERENCES	14
2.1 Informative references	15
3 DEFINITIONS	16
4 RESPONSIBILITY	20
4.1 Supplier responsibilities	20
4.2 User responsibilities	21
4.3 Personnel responsibilities	21
5 RISK ASSESSMENT PROCESS	21
6 DESIGN, CONSTRUCTION, RECONSTRUCTION, AND MODIFICATION	23
6.1 General requirements for all press brakes	23
6.1.1 Hazards associated with broken components	23
6.1.2 Tool fastening provisions	23
6.1.3 Opening of tool space	24
6.1.4 Press brake capacity data plate	24
6.1.5 Pressure rating of components	24
6.1.6 Stored and residual energy	24
6.1.7 Performance of safety-related function(s)	25
6.1.8 Stopping performance monitor	25
6.1.9 Presence-Sensing Device Initiation (PSDI)	28
6.2 Electrical controls	30
6.2.1 Disconnect means	30
6.2.2 General requirements for stop functions, circuits and actuators	30
6.2.3 Motor start actuator	34
6.2.4 Motor starter	35
6.2.5 Top stop control	35
6.2.6 Return (stop-return) control	35
6.2.7 Voltage	35
6.2.8 Grounds	36
6.2.9 External and line interferences	36
6.3 Requirements for mechanical press brakes	36
6.3.1 Ram counterbalance systems	36

6.3.2	Clutches and brakes	36
6.3.3	Cycle control of mechanically actuated or air operated press brakes	38
6.3.4	Mode control	39
6.3.5	Actuating means	45
6.3.6	Motorized ram adjustment	46
6.4	Requirements for hydraulic press brakes	47
6.4.1	Return (stop-return) control	47
6.4.2	Ram counterbalance system	47
6.4.3	Foot pedal (mechanical)	47
6.4.4	Unintended actuation by foot treadle	48
6.4.5	Mode control for hydraulic press brakes	48
6.4.6	Actuating means	54
6.4.7	Hydraulic components and circuits	55
6.5	Requirements for pneumatic press brakes	58
6.5.1	Return (stop-return) control	58
6.5.2	Ram counterbalance systems	58
6.5.3	Air-controlling equipment	58
6.5.4	Actuating means	59
6.5.5	Pneumatic components and circuits	59
7	LAYOUT, INSTALLATION, TESTING AND START-UP	61
7.1	General	61
7.1.1	Lockout/Tagout	61
7.1.2	Lighting	62
7.2	Layout	62
7.2.1	Production operations	62
7.2.2	Set-up and maintenance	62
7.3	Installation	62
7.3.1	Foundation	62
7.3.2	Lifting of machine components	62
7.3.3	Anchoring	62
7.3.4	Safety considerations	62
7.4	Testing and start-up for press brakes	63
7.4.1	Procedures	63
7.4.2	Assigned personnel	63
7.4.3	Safeguarding	63
8	SAFEGUARDING	63
8.1	Hazards associated with press brake production systems other than point-of-operation hazards	63
8.2	Hazards associated with falling or broken components	64
8.3	Performance of the safety-related function(s)	65
8.4	Perimeter safeguarding	66
8.5	Hazards associated with point of operation	66
8.5.1	Safeguarding provisions	66
8.6	Guards: fixed, adjustable, and interlocked	67
8.6.1	Design and construction	67
8.6.2	Installation and operation	69
8.7	Point of operation safeguarding devices	72

8.7.1	Movable barrier devices.....	72
8.7.2	Presence-sensing safeguarding device.....	74
8.7.3	Pull-back safeguarding device	79
8.7.4	Restraint safeguarding device (holdout).....	80
8.7.5	Two-hand control safeguarding device.....	81
8.7.6	Single control safeguarding device.....	83
8.7.7	Close proximity point of operation AOPD safeguarding device	84
8.8	Safe speed safeguarding.....	88
8.9	Safe distance safeguarding	89
8.10	Auxiliary safety aids	90
9	SET-UP, OPERATION AND MAINTENANCE	91
9.1	General	91
9.2	Machine set-up procedures	91
9.2.1	Die set-up procedures.....	92
9.3	Operation.....	96
9.3.1	Observations	96
9.4	Maintenance	98
9.4.1	General	98
9.4.2	Maintenance inspections	100
9.5	Supervision	101
9.6	Control of hazardous energy	101
9.7	Initiation of normal operation.....	101
9.8	Safety signs.....	102
9.9	Personal protective equipment (PPE)	102
10	TRAINING	102
10.1	General	102
10.2	Training elements	103
10.2.1	Training programs.....	104
10.3	Operator training.....	105
10.4	Maintenance personnel training	105
10.5	Supervisor training	105
10.6	Re-training.....	105
11	ADDITIONAL REQUIREMENTS FOR PSDI OPERATION.....	106
11.1	General	106
11.2	"Pass-through" hazards.....	106
11.3	Multiple operators.....	106
11.4	Presence-sensing device used for PSDI	106
11.5	Supplemental guards or devices	107
11.6	Hand tools	107
11.7	Inspection and maintenance	107
11.8	Operator Training.....	107

ANNEX A – FIGURES	109
ANNEX B – TASK / HAZARD IDENTIFICATION.....	120
ANNEX C – PERFORMANCE OF THE SAFETY-RELATED FUNCTION(S).....	122
ANNEX D – EXAMPLE MANUAL TEST PROCEDURE FOR CLOSE PROXIMITY POINT OF OPERATION AOPD SAFEGUARDING DEVICES	123
ANNEX E – SAFEGUARDING FLOWCHART	124
ANNEX F – CHECKLIST	125
ANNEX G – EXAMPLE DIE SETTING PROCEDURE	126
ANNEX H – AUTOMATIC BACKGAGE HAZARDS	130
ANNEX I – GENERAL GUIDELINES FOR OPERATOR TRAINING	131

List of FIGURES

Figure 1: Organization of the B11 Series of Documents	10
Figure 2: Typical layout of B11 base standards showing the various responsibilities.....	12
Figure 5: The Risk Assessment Process	22
Figure A.1: Example of Material Position Gage and Work Support	109
Figure A.2: Example of a Removable and Adjustable Mechanical Foot Pedal and Locking Lever	109
Figure A.3: Example of Awareness Barrier with Safe Distance Safeguarding	110
Figure A.4: Example of a Movable Barrier Device	110
Figure A.5: Example of Presence-Sensing Device	111
Figure A.6: Example of Horizontal and Vertical Presence-Sensing Devices.....	111
Figure A.7: Example of a Pullback Device.....	112
Figure A.8: Example of Restraints with Two Operators.....	112
Figure A.9: Example of a Restraint.....	113
Figure A.10: Example of Two Operators with Two-Hand Control Mounted to Machine.....	113
Figure A.11: Example of Two-Hand Control Mounted on Pedestal	114
Figure A.12: Examples of Hand-Feeding Tools	114
Figure A.13: Example of Hand Tool Feeding.....	115
Figure A.14: Example of Safe-Distance Safeguarding	115
Figure A.15: Proper Holding of Workpiece	116
Figure A.16: Typical Guards on Sides of Point of Operation	116
Figure A.17: Example of Die Space	117
Figure A.18: Example of Foot Treadle with Guard	117
Figure A.19: Example of Foot Control	118
Figure A.20: Protection Zone Dimensions for Close Proximity POO AOPD Safeguarding Devices.....	118
Figure A.21: Close Proximity AOPD.....	119
Figure D: Test Piece for Close Proximity POO AOPD Safeguarding Devices.....	123

Foreword (This Foreword is informative and not part of the normative requirements of American National Standard ANSI B11.3-2012.)

The primary objective of this standard is to eliminate, control or reduce hazards to individuals associated with power press brakes by establishing requirements for the design, construction, operation and maintenance of these machines. To accomplish this objective, responsibilities have been assigned to the supplier (e.g., manufacturer, modifier, rebuilder and integrator), the user, and individuals in the working environment.

The words "safe" and "safety" are not absolutes. An element of safety is attitude. While the objective of this standard is to eliminate, control, or reduce hazards, this standard recognizes that hazards cannot be practically reduced to zero in any human activity. This standard is not intended to replace good judgment, proper training, and personal responsibility. Operator skill, job monotony, fatigue, and experience are safety factors that should be considered by the user.

HISTORY

The original B11.3 standard was approved in 1973 and revised in 1982 and again in 2002. In the 2002 document, powered folding machines were included in the scope of the standard because they were predominantly similar to press brakes in that they are metal bending machines and they were not covered by any other standard. During the current revision process, the subcommittee determined that powered folding machines have evolved into multi-axis machines that process metal in numerous ways, many of which are unlike a press brake. Additionally, there is now a type-A standard, ANSI B11.0, which can be used in conjunction with the type-B standard ANSI B11.19 to provide guidance for the safe use of machines in general. It is for these reasons that the subcommittee decided to exclude powered folding machines in the scope of the 2012 ANSI B11.3 standard.

This current 2012 standard was revised by the B11.3 Subcommittee, processed and administered by the Secretariat, and approved by the B11 Accredited Standards Committee for submittal to the ANSI Executive Standards Council as an American National Standard. New topics included in this revision are the "close proximity point of operation AOPD" safeguarding devices, and a safeguarding means called "Safe Speed." In addition, this revision incorporates the B11 Accredited Standards Committee's "FASTT" initiative, which defined common language to be used by the entire series of ANSI B11 standards. Consequently, many definitions of common terms contained in the previous edition of B11.3 can be now be found in the ANSI B11.0 and ANSI B11.19 standards. This initiative also significantly impacted clauses 4, 5, 7, 9 and a brand new clause 10 and Annex I on training was added.

The B11 standards for machine tools were first approved beginning with safety requirements for power presses in 1922. Since that time, safety requirements for a variety of machine tools have been developed and continually updated and revised to become a series of some 30 B11 standards and technical reports. Maintaining these documents with consistent language proved a significant challenge. In 2008 ANSI B11 was published with the long term objective to reorganize the B11 family of standards by gathering the requirements common to many or most of the B11 standards into a single document while retaining the machine tool specific requirements in the machine-specific standards. This B11.3 standard is intended to be used with ANSI B11.0 and ANSI B11.19. The requirements of all three standards must be met as applicable to a particular machine.

Power press brake technology is continuously evolving. This standard reflects the most commonly used and time-tested state of the art at the time of its approval. The inclusion or omission of language relative to any evolving technology, either in the requirements or explanatory area of this standard, in no way infers acceptance or rejection of such technologies.

Suggestions for improvement to the content of this standard are welcomed. Similarly, any inquiries with respect to the application of the substantive requirements of this standard are to be sent to B11 Standards, Inc., PO Box 690905, Houston, Texas 77269-0905, USA. Attention: B11 Secretariat.

EFFECTIVE DATE

The following information on effective dates is informative guidance only, and not a normative part of this standard. This Subcommittee recognizes that some period of time after the approval date on the title page of this document is necessary for suppliers and users to develop new designs, or modify existing designs or manufacturing processes in order to incorporate the new or revised requirements of this standard into their product development or production system.

This Subcommittee recommends that suppliers complete and implement design changes for new machines and machinery systems within 30 months of the approval of this standard.

The Subcommittee recommends that users evaluate whether existing machinery and machinery systems have acceptable risk within 30 months of the approval date of this standard using generally recognized risk assessment methods. If the risk assessment shows that modification(s) is necessary, refer to the requirements of this standard to implement risk reduction measures (protective measures) for appropriate risk reduction.

Explanation of the format of the standard

This ANSI B11.3 – 2012 standard uses a two-column format to provide supporting information for requirements. The material in the left column is confined to “Standards Requirements” only, and is so captioned. The right column, captioned “Explanatory Information” contains information that the writing Subcommittee felt would clarify the standard. This column should not be construed as being a part of the requirements of this American National Standard.

Operating rules (safe practices) are not included in either column of this standard unless they are of such nature as to be vital safety requirements, equal in weight to other requirements, or guides to assist in compliance with the standard.

As in all American National Standards, the term “SHALL” denotes a requirement that is to be strictly followed in order to conform to this standard; no deviation is permitted. The term “SHOULD” denotes a recommendation, a practice or condition among several alternatives, or a preferred method or course of action. Similarly, the term “CAN” denotes a possibility, ability or capability, whether physical or causal, and the term “MAY” denotes a permissible course of action within the limits of the standard.

By convention, the B11 standards generally do not use the term “and/or” but instead, the term “OR” is used as an inclusive disjunction, meaning *one or the other or both*. When “and/or” is used, it is intended by the standard writers to emphasize the point.

DEVELOPMENT

This standard was processed and submitted for ANSI approval by the B11 Accredited Standards Committee on Safety Standards for Machines. Committee approval of this standard does not necessarily imply that all committee members voted for its approval. At the time this document was approved as an American National Standard, the ANSI B11 Accredited Standards Committee was composed of the following member organizations:

Alan Metelsky, Chairman
Barry Boggs, Vice-Chairman
David A. Felinski, Secretary

Organizations Represented	Name of Representative	
	Delegate	Alternate
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Aluminum Extruders Council	Melvin Mitchell	Scott J. Burkett
American Society of Safety Engineers	Bruce W. Main, PE, CSP	George Karosas, PE, CSP
Association For Manufacturing Technology	Russell A. Bensman	Alan Metelsky
The Boeing Company	Willard J. Wood, ARM	Don R. Nelson
Canadian Standards Association	Elizabeth Rankin, CRSP	Walter Veugen
Deere & Co.	Gary D. Kopps	Scott Fowler
FDR Safety	Michael Taubitz	Flavius Brown
Komatsu America Industries	George Schreck	James Landowski
General Motors Corporation	Michael Douglas	
Metal Building Manufacturers Association	Charles M. Stockinger	Charles E. Praeger
Metal Powder Industries Federation	Dennis R. Cloutier, CSP	Teresa F. Stillman
National Institute for Occupational Safety & Health	Richard S. Current, PE	James R. Harris, PhD, PE
Occupational Safety & Health Administration	Kenneth Stevanus	Robert Bell
Omron Scientific Technologies Incorporated	Frank Webster	Christopher Soranno
Packaging Machinery Manufacturers Institute	Charles F. Hayes	Maria Ferrante
Pilz Automation Safety, LP	Michael Beerman	Lee Burk
Precision Metalforming Association	James G. Barrett, Jr. PhD	Bill Gaskin
Presence Sensing Device Manufacturers Assn.	James V. Kirton	Michael S. Carlson
Property Casualty Insurers	John W. Russell, PE, CSP	
Robotic Industries Association	Jeffrey Fryman	Claude Dinsmoor
Rockwell Automation	Patrick Barry	Michael B. Miller
Safe-T-Sense	Samuel M. Boytor	Mark Witherspoon
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System Safety Society	John Etherton, PhD, CSP	Rod Simmons, PhD
Toyota Motor Manufacturing North America	Barry Boggs	Todd Mills
International United Automobile Workers	Tom Ford	

At the time this standard was approved, the ANSI **B11.3 Subcommittee** had the following members who participated in the development of this revision:

Name	Company
James V. Kirton, Co-Chairman	Kirton Industrial Equipment, LLC
Christopher Soranno, Co-Chairman	Omron STI
David A. Felinski, Secretary	B11 Standards, Inc.
Rob Appleyard	LazerSafe, Pty.
Doug Boyer	Advanced Manufacturing Solutions
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Introduction

The primary purpose of every machine tool is to process parts. This is accomplished by the machine imparting process energy onto the workpiece. Inadvertent interference with, or accidental misdirection of the released energy during production, maintenance, commissioning and de-commissioning may result in injury. This standard recognizes that zero risk does not exist and cannot be attained. However, a good faith approach to risk assessment and risk reduction should achieve an acceptable risk level. Additional activities might be needed to monitor the ongoing effectiveness of the risk reduction measures in place.

The primary purpose of the ANSI B11 series of machine safety standards is to devise and propose ways to minimize risks of the potential hazards. This can be accomplished either by an appropriate machine design or by restricting personnel or other individuals' access to hazard zones, and by devising work procedures to minimize personnel exposure to hazardous situations. This is the essence of the ANSI B11 series of safety standards.

Organization and Application of B11 Series of Documents

The B11 series of documents can be associated with the ISO “Type A-B-C” structure as described below:

- **Type-A standards** (basis standards) give basic concepts, principles for design, and general aspects that can be applied to machinery;
- **Type-B standards** (generic safety standards) deal with one or more safety aspects or one or more types of safeguards that can be used across a wide range of machinery;
- **Type-C standards** (machinery safety standards) deal with detailed safety requirements for a particular machine or group of machines.

This ANSI B11.3 standard on power press brakes is a “Type-C” standard. The ANSI B11.0 standard on general safety requirements common to ANSI B11 machines is primarily a “Type-A” standard in that it applies to a broad array of machines and contains very general requirements. However, in many areas it also contains very specific requirements. B11.19, B11.20 and the B11 series Technical Reports are all typical “Type-B” documents addressing general safety elements that can be applied across a wide range of machinery (B11.19) or as a standard when combining machines (B11.20). The B11 series of Technical Reports are informative documents that may be generally applied to many machines, and as such would fall into the “Type-B” group. The machine-specific (Type-C) B11 standards contain detailed safety requirements for a particular machine or group of machines (such as in the case of this standard). The B11.0 and the machine-specific B11 standards are intended to be used concurrently by the supplier and user of machines. When a Type-C standard deviates from one or more provisions dealt with by this standard or by a Type-B standard, the Type-C standard requirement generally takes precedence. Any deviation in conforming to a requirement of any standard should be carefully evaluated and based on a documented risk assessment.

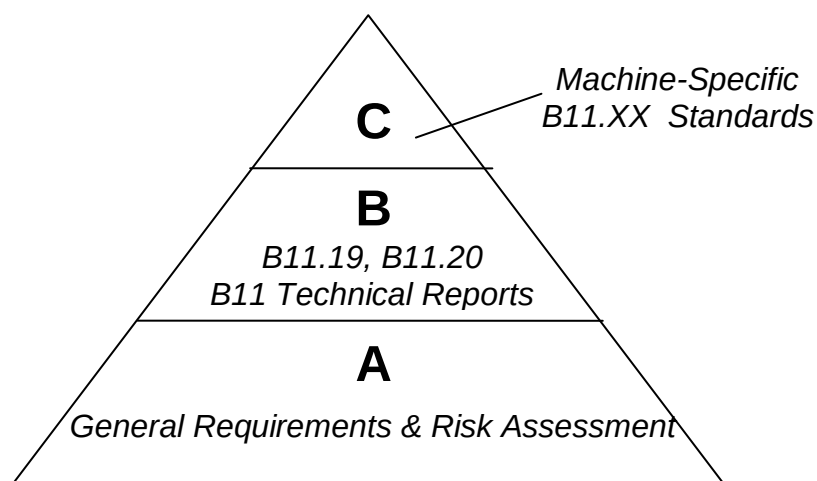


Figure 1 — Organization of the B11 Series of Documents

Figure 2 (following page) provides an overview of this standard and in particular, the responsibilities of and requirements for the supplier and user, including the user personnel. Numbers in parentheses denote the particular clause or subclause of the standard. A solid line between a block showing reference standard(s) and a block showing a normative clause denotes part of the requirements. A dashed line denotes an informative reference.

Notes for Figure 2:

- 1) Scope – Provides the boundaries or limits of the standard (i.e., what is/is not included in the coverage or requirements).
- 2) Normative references – Other standards which in whole or in part provide additional requirements when referenced in the normative text (i.e., left-hand column of clauses 4 – 9) of this standard.
- 3) Definitions – Terms used in this standard in a unique or particular manner, together with their definitions (terms used in the same context as are generally understood and commonly used in everyday English are not defined).
- 4) Responsibility – The general responsibilities of the supplier (builder), user, and the user personnel are listed in clause 4 together with which of the remaining clauses they have primary responsibility.
- 5) Risk assessment process – Clause 5 presents the general approach to risk assessment (see B11.0 [B11.TR3] for further explanation of hazard/task identification and risk assessment/risk reduction).
- 6) Design and construction – Generally, the supplier will be responsible for the requirements of clause 6, understanding that the user may add to or modify these requirements through the purchase agreement.
- 7) Layout, installation, testing and start-up – Although the requirements of clause 7 are predominantly the responsibility of the user, the supplier will normally provide assistance either directly (providing personnel) or indirectly (instruction materials).
- 8) Safeguarding – This is normally a shared responsibility between the supplier and user but often, either the supplier or the user will provide and/or meet most or even all of the requirements of clause 8.
- 9) Setup, operation and maintenance – The user is generally responsible for the requirements of clause 9, with possible assistance from the supplier for training.
- 10) Training – The user is generally responsible for the requirements of clause 10, with possible assistance from the supplier for materials or the training itself.

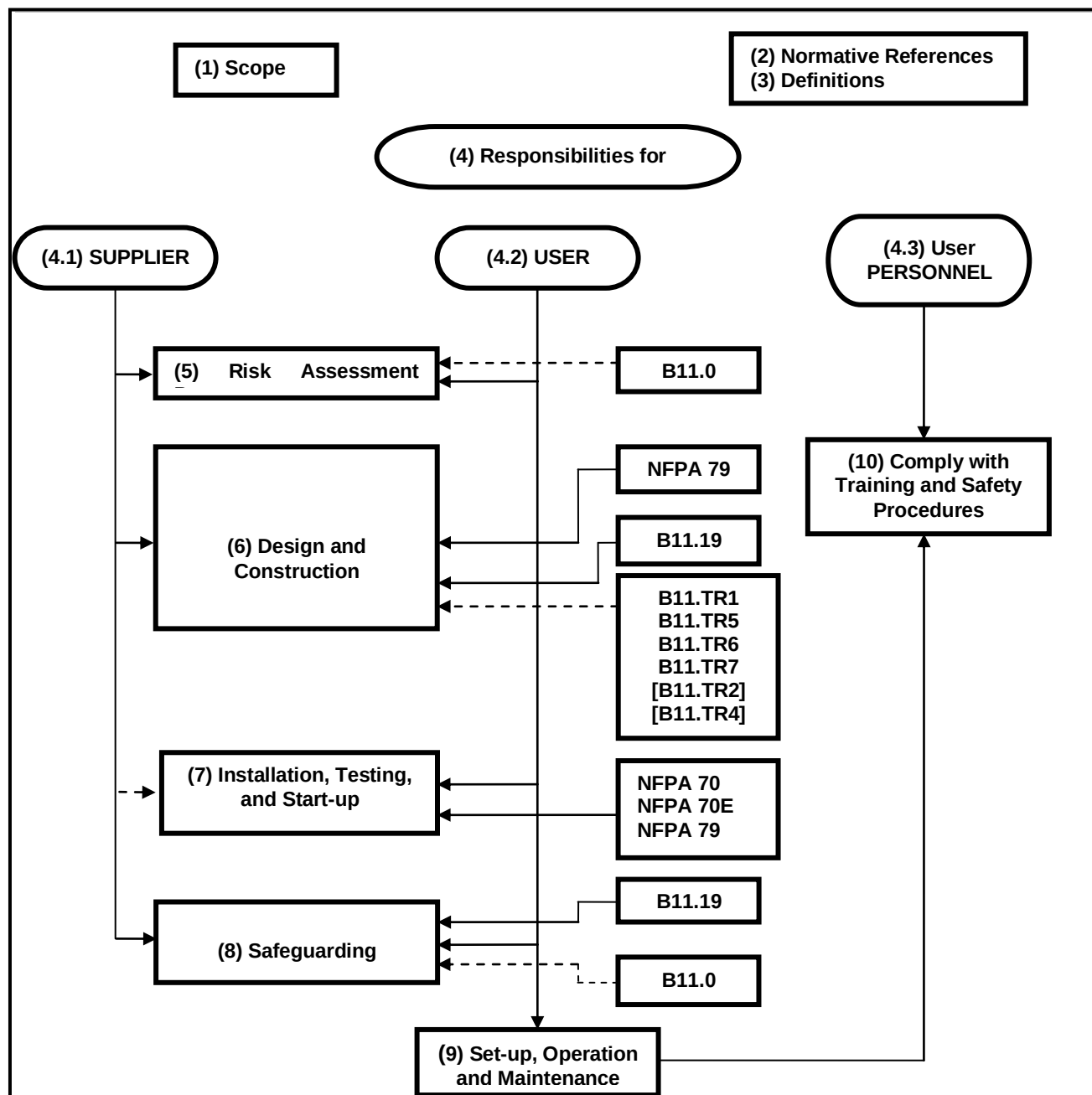


Figure 2 – Typical layout of B11 base standards showing the various responsibilities

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

American National Standard for Machines- Safety Requirements for Power Press Brakes

STANDARD REQUIREMENTS**1 Scope****1.1 General**

The requirements of this standard apply to those machines classified as power press brakes (hereinafter referred to simply as “press brakes”), which are designed and constructed for the specific purpose of bending material.

Where used in this standard, the terms *machine* or *machine system* refer to the press brake or press brake production system, respectively.

1.2 Exclusions

Excluded from the requirements of this standard are:

- Manual apron brakes;
- Folding machines;
- Hand brakes;
- Hydraulic or pneumatic power presses;

EXPLANATORY INFORMATION

(Not part of the requirements of this American National Standard for Machines - *Safety Requirements for Power Press Brakes* - ANSI B11.3–2012)

E1.1

To achieve this purpose, the press brake is provided with a plate-type ram and a plate-type bed with standard provisions for attaching standardized press brake tooling.

When used for operations other than bending material, other standards may provide additional information and requirements for the specific use or application.

E1.2

These exclusions exempt machines that normally do not have the characteristics of power press brakes, or are addressed by specific standards. If a machine is not addressed by a specific B11 standard, see ANSI B11.0 for guidance on general safety / risk assessment, and ANSI B11.19 for guidance on safeguarding.

- An apron brake uses a clamping bar and several removable blocks which may be removed and rearranged to permit bending of restricted areas of a piece of sheet material or of already partially formed pieces. Also called ‘box-and-pan brake.’
- A folding machine typically uses a clamping beam and a folding beam to fold the workpiece. Also called a ‘powered folding machine’ or ‘bending brake.’
- A hand brake bends material by using a hinged clamping bar to hold the metal down against the bed. A hinged bending “leaf” is manually lifted to fold the metal around the fulcrum point of the clamping bar to the desired angle. Also called ‘leaf brake.’
- A hydraulically or pneumatically powered machine which transmit force hydraulically or pneumatically to cut, form, or assemble metal or other materials by means of tools or

STANDARD REQUIREMENTS

- Mechanical power presses;
- Manual tangent benders;
- Other similar types of metal-bending machines.

EXPLANATORY INFORMATION

dies attached to or operated by plungers or slides. See ANSI B11.2.

- A mechanically powered machine which transmit force mechanically to cut, form, or assemble metal or other materials by means of tools or dies attached to or operated by slides. See ANSI B11.1.
- A tangent bender is designed to wing-form or die-form flanges while holding the part or panel in the horizontal flat panel position. They can be used as a primary forming unit or to operate in conjunction with a rollforming system to endform the leading and trailing ends of a part.

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements subject to this American National Standard should apply the most recent editions of the normative documents listed below. This standard is intended to be used in conjunction with the following American National Standards:

ANSI B11.0-2010, *Safety of Machinery – General Requirements and Risk Assessment*.

ANSI B11.19-2010, *Performance Criteria for Safeguarding*.

ASME Boiler and Pressure Vessel Code, 2010. Division 1 (Section VIII)

ANSI / ASSE Z244.1-2003 (R2008), Control of Hazardous Energy – Lockout/Tagout and Alternative Methods.

NFPA 70 – 2012, The National Electrical Code.

NFPA 70E – 2012, Standard for Electrical Safety in the Workplace.

NFPA 79 – 2012, Electrical Standard for Industrial Machinery.

E2 Informative references

NOTE: ANSI B11.TR3-2000 has been incorporated into ANSI B11.0.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

ANSI / IES-RP-7-2001, Practice for Industrial Lighting.

2.1 Informative references

The following documents to the right are not normative references, but may be helpful in conforming to the requirements of this standard.

E2.1

29 CFR 1910.147, Control of hazardous energy (lockout/tagout) (For more information, go to www.osha.gov)

29 CFR 1910.333(b), Selection and Use of Electrical Work Practices (For more information, go to www.osha.gov)

ANSI / ASME B20.1–2006, Safety Standard for Conveyors and Related Equipment

ANSI B11.1–2009, Safety Requirements for Mechanical Power Presses

ANSI B11.2–2012, Safety Requirements for Hydraulic / Pneumatic Power Presses

ANSI B11.20–2004 (R2009), Safety Requirements for Integrated Manufacturing Systems

ANSI B11.18–2006, Safety Requirements for Machines Processing or Slitting Coiled or Non-coiled Metal

ANSI B11.TR1–2012, Ergonomic Guidelines for the Design, Installation and Use of Machine Tools

ANSI B11.TR4–2004, Selection of Programmable Electronic Systems (PES/PLC) for Machine Tools

ANSI B11.TR6–2010, Safety Control Systems for Machines (at the time of publication, under revision as B11.26 - 201X)

ISO 4413-2010, Hydraulic Fluid Power Systems – General Rules and Safety Requirements for Systems and their Components

ISO 4414-2010, Pneumatic Fluid Power Systems – General Rules and Safety Requirements for Systems and their Components

ANSI Z535.1–2011, Safety Colors

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

ANSI Z535.2–2011, Environmental and Facility Safety Signs

ANSI Z535.3–2011, Criteria for Safety Symbols

ANSI Z535.4–2011, Product Safety Signs and Labels

ANSI Z535.5–2011, Accident Prevention Tags and Labels

ANSI Z535.6–2011, Product Safety Information on Product Manuals, Instructions, etc.

ANSI / IESNA-RP-7-2001, Industrial Lighting

ANSI / RIA R15.06-1999 (R2009), Safety Requirements for Industrial Robots and Robot Systems

3 Definitions

In addition to the definitions in ANSI B11.0 (clause 3), the following shall apply.

3.1 adjustable guard: A guard with provisions for adjustment to accommodate various jobs or tooling set-ups.

3.2 awareness barrier: An awareness device that warns individuals by means of physical contact.

3.3 barrier guard: See *guard*.

3.4 blanking: Bypassing a portion of the sensing field of a presence-sensing safeguarding device.

3.5 brake: A mechanism for stopping, slowing or preventing motion.

3.6 bypass: To render ineffective any safety-related function of the control system or safeguarding device.

3.7 close proximity point of operation AOPD: **E3.7** See also, 8.7.7.

A safeguarding device with a sensing field located within the point of operation which provides protection from crushing hazards occurring at closing tools by utilizing collimated light, and the location of the sensing field monitored relevant to the stopping distance of the machine.

STANDARD REQUIREMENTS

3.8 continuous: Uninterrupted multiple cycles of the ram without intervening stops at the end of each individual cycle.

3.9 cycle: The closing of the ram from the initial start position to the point where work is performed and then opening to the next start position. This may include feeding, repositioning or removal of the material or workpiece.

3.10 device: A component, attachment or mechanism designed to serve a specific purpose or perform a specific function.

3.11 die(s): The tooling used in a press brake to form the material.

3.12 die setting: The process of installing or removing and adjusting the dies, other tooling or equipment.

3.13 die space: The area encompassed by the ram length projected to the bed.

3.14 electric drive press brake: A mechanical press brake with a drive system that replaces the need for a flywheel, clutch, pump or cylinder by connecting a motor to the drive train.

3.15 feeding: The process of placing the material or workpiece into the tooling, or removing the material or workpiece from the tooling.

EXPLANATORY INFORMATION

E3.8 “Continuous” is not to be confused with the type of operation known as “on the hop,” which is basically a single cycle mode wherein the tripping means is released and re-operated (to reset the anti-repeat circuit) on the upstroke of the press brake.

E3.13 See Figure 17, Annex A.

E3.14 Also commonly referred to as *servo drive press brakes*, *servo electric drive press brakes* or *direct drive press brakes*.

Typically a servo motor is used in the drive system but is not limited to the use of a servo motor.

E3.15 Types of feeding include but are not limited to the following:

- a) Automatic feeding is a mechanical means, press brake or self-driven, for placing and removing the material. A typical example is an automatic roll feed.
- b) Manual feeding is the process whereby the operator(s) places the material or workpiece into the tooling or removes the material or workpiece from the tooling.
- c) Semiautomatic Feeding typically involves the material being processed and placed within, or removed from, the point of operation by either:
 - A movable mechanism which is a fixed part of the tooling and which requires manual action by the operator; or
 - A part or material to be processed in a succeeding cycle.
- d) Hand-Tool Feeding. A type of manual feeding wherein the material is placed

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

3.16 fluid: Any liquid or gas.

3.17 foot pedal (mechanical): A foot operated mechanical actuating control attached to the press brake operating mechanism.

3.18 foot treadle: A foot operated full-length non-removable mechanical actuating control attached to the press brake operating mechanism.

3.19 helper: An individual who assists in the operation, maintenance, repair or die setting of the machine.

3.20 inch: To impart incremental motion to the machine by momentary manual actuation.

3.21 interlocked guard: A barrier, or section of a barrier, interfaced with the press brake control system in such a manner as to prevent access to the point of operation or other hazard during normal operation.

3.22 material position gage: A stop against which the material or workpiece is placed to locate it within the point of operation.

3.23 movable barrier device: A safeguarding device arranged to enclose the point of operation before machine motion can be initiated.

3.24 muting: The automatic temporary bypassing of any safety-related function(s) of the control system or safeguarding device.

3.25 operator control: Any operator actuated push button, switch, lever, pedal, or other device that initiates, cycles, controls or stops press brake motion.

3.26 operator's station: The complement of controls used by an operator to operate the press brake.

within, and processed parts removed from, the point of operation by use of a hand-feeding tool.

See Figure 13, Annex A.

E3.17 See Figure 2, Annex A.

E3.18 See Figure 18, Annex A.

E3.20 Use of the term INCH in this document is not to be confused with the dimensional distinction between “inch” and “metric”, which is commonly available on press brakes manufactured at the time of the publication of this standard.

E3.22 See Figure 1, Annex A.

E3.23 Note that there are two types of movable barrier devices:

- a) Type A, which encloses the point of operation during the complete machine cycle; and
- b) Type B, which encloses the point of operation during the hazardous portion of the machine cycle.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

3.27 press brake production system: A press brake and auxiliary equipment that is set up for production operations.

E3.27 Typically, the system may include but not be limited to:

- dies (tooling);
- feeding methods;
- point-of-operation safeguarding;
- gaging.

3.28 protection zone (close proximity point of operation AOPD): The area under the upper die where an object of 14 mm (0.55 in) or larger must be detected.

E3.28 The height of the protection zone in high speed may vary as determined by the stopping distance of the press brake. The protection field may be larger than the protection zone. See Figure 20, Annex A.

3.29 pullback device: A safeguarding device with attachments for the operator's hands and wrists connected to the ram or die, that when properly adjusted, prevents the operator from reaching into the point of operation, or withdraws the operator's hands from the point of operation, during the hazardous motion.

E3.29 See 8.7.3 and Figure 7, Annex A.

3.30 restraint device: A safeguarding device with attachments for the operator's hands and wrists that prevents the operator from reaching into the point of operation at all times.

E3.30 See 8.7.4 and Figures 8 and 9 in Annex A (operator's restraint device for point of operation protection).

3.31 safe-distance: A safeguarding method that requires the operator to hold the workpiece, as determined by the user, so that the operator does not reach closer than the determined safe distance to the point of operation during the hazardous portion of the machine cycle.

E3.31 See Figure 14, Annex A.

3.32 safe speed: A safeguarding method that requires the press brake to operate at or below a maximum speed, at which the operator has time to take action.

E3.32 See also 6.4.5.9.2 and 8.8.

3.33 safeguarding device: Any mechanical attachment or control device, other than a guard, that:

- a) prevents inadvertent access into a hazard zone by individuals during the hazardous motion of the machine; or
- b) prevents or stops hazardous motion of the machine when individuals are detected by the device.

E3.33 Safeguarding devices achieve this requirement by:

- a) Restraining the operator from inadvertently reaching into the hazard zone; or
- b) Preventing normal or hazardous operation if any part of an individual's body is inadvertently within the hazard zone; or
- c) Automatically withdrawing the operator's hands, if they are inadvertently within the hazard zone during the hazardous portion of the machine cycle; or
- d) Maintaining the operator or the operator's hands at a safe distance from the hazard zone during the hazardous portion of the machine cycle.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

3.34 servo drive press brake: See *electric drive press brake*.

3.35 single control safeguarding device: A single actuating control used to initiate or maintain machine motion located at a safe distance from the hazard.

3.36 single cycle: The closing of the ram from the initial start position to the point where work is performed and then opening to the next start position.

3.37 stop control: An operator control used to initiate a machine stop.

3.38 stroke: The movement of the ram from the open to the closed position, or from the closed to the open position.

E3.35 Examples of single control safeguarding devices may include a foot control or hand control fixed at a distance from the point of operation.

E3.36 On some press brakes such as hydraulic or servo drive machines, the open point (start position) may not be the same for each cycle.

4 Responsibility

Press brake / press brake production system suppliers and users have responsibilities for defining and achieving acceptable risk. The supplier and user either separately or jointly shall identify hazards, assess risks and reduce risks to an acceptable level within the scope of their respective work activities. See ANSI B11.0 (clause 4).

4.1 Supplier responsibilities

Within the scope of its work activity, the supplier(s) shall be responsible to ensure that the design, construction, modification, installation and safeguarding are in accordance with clauses 5, 6, 7 and 8.

The supplier shall be responsible for providing documentation to the user that establishes guidelines for the installation, operation and maintenance of the press brake. See ANSI B11.0 for additional documentation requirements.

E4

Additional activities might be needed to monitor the ongoing effectiveness of the risk reduction measures in place.

E4.1

See Annex B for a list of sources of hazards associated with a press brake / press brake production system.

The documentation should include but not be limited to the following, where applicable:

- performance specifications;
- electrical or fluid power schematics and diagrams;
- physical environment for which the machine or production system is designed;
- function and location of the operator controls, indicators, and displays;
- schedules for periodic maintenance, lubrication and inspection;
- application of risk reduction measures;
- auxiliary equipment.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

4.2 User responsibilities

Within the scope of its work activity, the user shall be responsible for identifying and mitigating sources of hazards, including point of operation hazards, associated with the installation, set-up, production operation and maintenance of the press brake and press brake production system in accordance with clauses 5, 7, 8, 9, 10 and 11.

Under certain circumstances (i.e., while acting as a builder, modifier or integrator), the user is considered to be the supplier of that portion of the press brake production system so constructed, modified or integrated.

4.3 Personnel responsibilities

Personnel shall be responsible for following the training and safety procedures provided by the user in the operation and maintenance of the press brake and press brake production system in accordance with clause 9 and 10.

5 Risk assessment process

Press brake / press brake production system suppliers and users have responsibilities for identifying hazards and reducing risk. See ANSI B11.0 (clauses 5, 6 and 7).

A risk assessment shall be conducted considering the reasonably foreseeable hazards associated with the design, installation, operation and maintenance of the press brake / press brake production system in accordance with ANSI B11.0.

Whenever the press brake / press brake production system is modified or its intended use is changed, related tasks and associated hazards shall be identified and reassessed.

When performing risk reduction, the requirements of clauses 6, 7, 8, 9 and 10 shall be implemented.

Figure 5 below shows the iterative process as it relates to risk assessment and risk reduction.

E4.2

See Annex B for a list of sources of hazards associated with a press brake / press brake production system.

E4.3

The Occupational Safety and Health Act of 1970 – Public Law 91-596, states in Clause 5(b), “Each employee shall comply with occupational safety and health standards and all rules, regulations and orders issued pursuant to this Act which are applicable to his own actions and conduct.”

E5

The user should ensure that the risk reduction measures are appropriate for the specific machine to which this standard is being applied.

See Annex B for a list of examples of reasonably foreseeable hazards related to press brake / press brake production system.

Risk reduction is complete when the risk reduction measures, consistent with this standard, are applied and acceptable risk has been achieved for the identified task/hazard combinations.

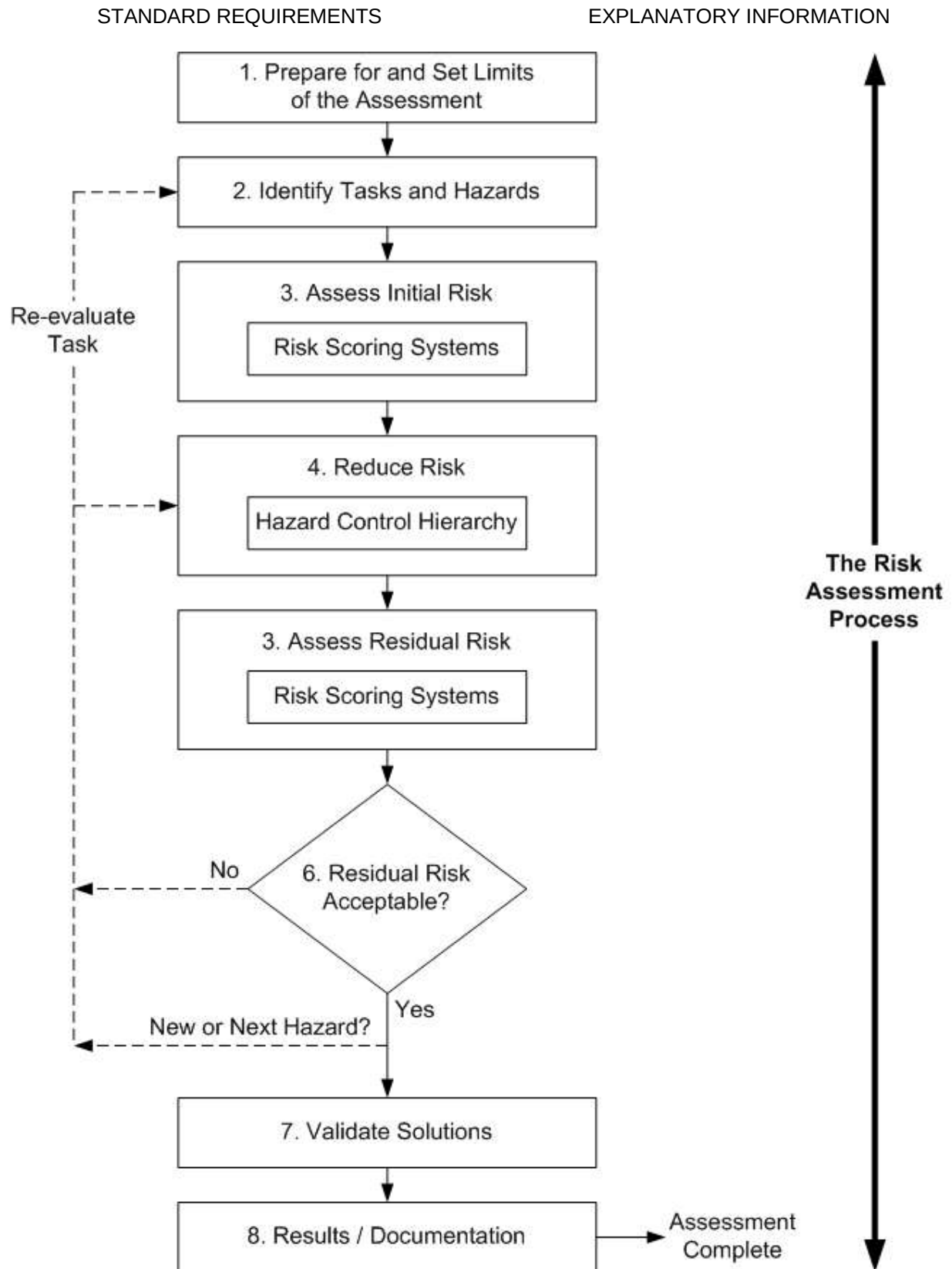


Figure 5 – The Risk Assessment Process

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

6 Design, construction, reconstruction, and modification

For the purpose of this clause, press brakes are divided into three general groups based upon the energy source utilized to perform the forming action: mechanical press brakes (including servo drive press brakes), hydraulic press brakes and pneumatic press brakes. This clause is structured to address the general requirements that universally apply to all groups and the unique requirements for each group.

6.1 General requirements for all press brakes

6.1.1 Hazards associated with broken components

Machine components shall be designed, secured, or covered to minimize hazards caused by loosening, falling, breakage or the release of either mechanical or fluidic energy.

E6.1.1

The hazards that can exist include but are not limited to:

- bursting of hydraulic / pneumatic piping, cylinders, accumulators, control components or other parts under pressure;
- breakage of piston rod or ram connection;
- breakage of shafts causing falling motor parts or other moving parts;
- loosening or fracturing of mounting bolts or other fasteners causing the falling of motors, pumps, valves, piping, protective covers, nameplates or other stationary parts;
- breakage of springs causing the release of hazardous energy.

6.1.2 Tool fastening provisions

All press brakes shall be provided with a tool clamping means to allow for the mounting and secure fastening of the tool holder and tools, and shall have provisions made to permit alignment.

E6.1.2

Commonly, the tooling consists of an upper punch(s) and a lower tool(s).

6.1.2.1 Capability

Fluid-powered tool clamps, if provided, shall have the capability of holding the upper and lower tool in the clamped position throughout the slide cycle.

An evaluation of all force vectors that can be applied to the clamps by the tooling shall be completed and appropriate action taken to ensure that tools do not move during the cycle of the press brake.

E6.1.2.2

The intent here is to maintain clamping while the machine control system is de-energized, or in the event of loss of the fluid supply.

6.1.2.2 Fluid–supply failure

Fluid–powered tool clamping, if provided, shall incorporate means to prevent failure of clamping capability (loss of pressure) in the event of fluid–supply failure.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

6.1.2.3 Loss of clamping capability

Where fluid pressure is used to retain the tool, the tool shall not be released from the tool holder in the event of loss of pressure, and the loss of pressure shall stop the cycling of the press brake.

EXCEPTION: When the loss of pressure does not result in a hazardous condition, this requirement does not apply.

6.1.3 Opening of tool space

A means shall be provided for the opening of the tool space in the event that the completion of the closing portion of the cycle cannot be safely accomplished.

6.1.4 Press brake capacity data plate

Each press brake shall have the maximum rated tonnage posted.

6.1.4.1 Pressure setting data plate(s)

Each manually adjustable pressure regulating valve shall have the recommended setting posted near the pressure regulating means.

6.1.5 Pressure rating of components

The safe working pressure rating of all components used in any hydraulic / pneumatic system on a press brake shall be equal to or greater than the maximum anticipated working pressure of the press brake.

6.1.6 Stored and residual energy

The supplier shall provide means for the isolation, containment or controlled release of stored or residual energy that can create a hazardous condition. See ANSI / ASSE Z244.1.

E6.1.2.3

Loss of clamping capability may result from the loss of clamping pressure or from loss of clamping control signals.

Hazardous conditions include but are not limited to:

- Loss of control of the tool (falling tool);
- Misaligned tools.

E6.1.3

This requirement is needed in case someone gets caught or inserts too thick a workpiece.

Some methods to accomplish this include but not limited to:

- ram height adjustment;
- reverse drive motor;
- return (opening) mode on a hydraulic / pneumatic press brake.

E6.1.4

This requirement is not to be confused with the nameplate requirements contained in ANSI B11.0.

E6.1.4.1

These data plates are typically found mounted in close proximity to main relief valves, counterbalance valves, regulating valves and other system pressure control means.

E6.1.5

Examples of components can include but are not limited to valves, pressure sensors, accumulators, cylinders, regulators, fittings, pumps and piping.

See also, ISO 4413 (hydraulic fluid power systems) and ISO 4414 (pneumatic fluid power systems).

E6.1.6

Examples of isolation, containment or controlled release of stored energy include but are not limited to:

- blocking;

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

- pinning;
- chaining;
- locking;
- controlled bleeding;
- accumulator bleed-off;
- discharging;
- dynamic braking;
- mechanical braking;
- powerdown procedures.

See also, 29 CFR 1910.147.

6.1.7 Performance of safety-related function(s)

The safety-related components of the press brake control system shall meet the requirements of 8.3.

E6.1.7

The safety-related functions of the control system relate to sensing devices used to detect conditions that are considered a personnel hazard and pose a risk of injury, and are determined from the clause 5 risk assessment. See also, ANSI B11.0 and ANSI B11.19.

6.1.7.1 Ladder diagram

A ladder diagram designed for electromechanical relays shall not be used without prior conversion for use in a programmable logic controller or in some other programmable microprocessor logic system.

E6.1.7.1

Differences in electromechanical relays and solid-state devices should be taken into consideration. Note that simply replacing each contact from the relay logic diagram into the equivalent instruction in the ladder diagram in the programmable controller or other programmable microprocessor logic system will not always produce the desired logic function. This is primarily due to the fact that the programmable logic controller executes the ladder diagram in a different manner from the electromechanical relay system. As a result, any safety that was provided by mechanically interlocked relay contacts can be lost.

6.1.7.2 Programmable electronic systems

Programmable electronic systems or other microprocessor-based logic systems used to control hazardous motion of the press brake shall be designed to meet the requirements of 8.3.

E6.1.7.2

See Annex C and ANSI B11.TR4 (e.g., Table 1).

6.1.8 Stopping performance monitor

6.1.8.1 General requirements

If provided, the stopping performance monitor shall be:

- a) Designed, constructed, installed, and incorporated with the press brake control to prevent the initiation of a successive cycle if there is an increase in the stopping time, angle or distance beyond the predetermined limit and to display a fault condition;
- b) Designed and constructed in accordance with the requirements of 6.1.7 and 8.3, or to meet the safety performance level as determined by a risk assessment;

E6.1.8.1

For additional requirements on stopping performance monitors installed with close proximity point of operation AOPDs, see 8.7.7.1.7.

STANDARD REQUIREMENTS

- c) Constructed and installed in a manner to monitor stopping performance on each stop where the action of stopping relies on friction-type brakes;
- d) Capable of supervisory control for adjustment;
- e) Capable of monitoring the stopping performance of a protective (safety) stop, and display the stopping performance in time, angle or distance;

Periodic testing shall be required to confirm the stopping capability of press brake types that utilize components or systems for stopping during a protective (safety) stop not used for a normal or controlled stop. The interval between testing shall be determined based on a risk assessment.

EXPLANATORY INFORMATION

- c) Programmed deceleration is not considered a stop. For mechanical treadle-operated press brakes, release of the treadle to control the ram speed (including stopping) does not constitute a stop.
- e) A visual display of the stopping performance in time, angle or distance serves to aid the set-up person with positioning the safeguarding at the correct location.

The period between testing may vary based on machine types. Refer to supplier recommendations for testing interval(s). For press brakes that utilize additional mechanical braking, the time period should be more frequent than hydraulic machines where the components or systems for protective stops are used on a regular basis.

For mechanical press brakes, the stopping performance at the ninety degree position of crank rotation or the mid-stroke of a cycle is typically the critical value for establishing safety distance. For additional information, see 8.7 and ANSI B11.19, Annex D.

Types of stopping performance monitors include:

- a) stopping angle monitor;
- b) stopping time monitor;
- c) stopping distance monitor.

Previously, a stopping position (TOP-STOP) monitor could be used to meet the requirements of this subclause. Due to technology advances and the requirements of 6.1.7 and 8.3, other systems have proven more reliable and provide more protection than simply monitoring the stopping position of the ram at the top of the cycle. As a result, the stopping position monitors may no longer meet the requirements of this subclause.

A stopping performance monitor will not prevent a repeat cycle caused by a major failure or multiple simultaneous component failures.

Stopping performance monitors are required for certain press brake operations as indicated in clause 8. They may be used in other applications to enhance operator safety

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

or as a preventive maintenance tool.

Factors which can affect stopping performance of the press brake may include but are not limited to:

- clutch air supply;
- counterbalance pressure;
- tooling weight;
- mechanical power press brake cycle speed;
- brake wear adjustment;
- clutch wear adjustment;
- exhaust restrictions;
- servo motor drive tuning;
- worn seals;
- sluggish valves;
- ram speed;
- oil viscosity/purity/temperature;
- fluid pressure;
- operating mechanisms (hydraulic / pneumatic motors, cylinders, valves) may become sticky, sluggish or may wear.

When the stopping time, angle or distance changes, necessary repairs or adjustments shall be performed to restore the stopping performance or correct the safety distance.

Adjustments may include but are not limited to:

- changing the counterbalance air supply pressure;
- changing the clutch pressure;
- adjusting the brake;
- adjusting the ram speed;
- adjusting the position of the safeguarding device.

6.1.8.2 Servo drive press brakes

These additional design requirements pertain to stopping performance monitors for servo drive press brakes:

- a) Designed, constructed, installed, and incorporated with the press brake control to prevent the initiation of a successive cycle when there is a following error beyond a preset limit in the ram vs. the commanded position;
- b) The predetermined following error limit shall not be adjustable by the user;
- c) Designed to detect any non-commanded ram motion and capable of removing the electric power from the drive control system and engaging the brake; and
- d) Designed to require a manual reset action, by the operator, to return to the predetermined cycle start position, when a positioning or stopping error is detected.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

6.1.9 Presence-Sensing Device Initiation (PSDI)

When a presence-sensing device (PSD) is used to perform both the safeguarding function and to initiate the press brake cycle, the presence-sensing device, PSDI control logic and the operator station shall meet the requirements of this subclause, 8.7.2 and the requirements of clause 11.

6.1.9.1 Control system

The control system shall require a set-up/reset action by the operator after selection of PSDI mode, or after cycling is disarmed by any stop signal, to arm the PSDI mode so that the presence-sensing device can be used to initiate cycles.

E6.1.9

See ANSI B11.19 for additional information regarding PSDI.

E6.1.9.1

Some methods of meeting this requirement include but are not limited to:

Arming method:

- a) Select the PSDI mode;
- b) Momentarily depress a “PSDI Set-up / Reset” (arming) actuating device;
- c) Break the presence-sensing device field the required number of times (single break or double break) within a predetermined time after the set-up (arming) actuating device is actuated to initiate a cycle.

Hand control method:

- a) Select the PSDI mode;
- b) Manually actuate the operator hand control(s) to initiate the first cycle;
- c) Break the presence-sensing device field the required number of times (single break or double break) within a predetermined time after the first cycle is completed to initiate the next cycle with the presence-sensing device.

NOTE: The term “break” as used with PSDI operations refers to one intrusion into, and subsequent withdrawal from, the sensing field of the presence-sensing device.

Part in place sensors may be utilized to assist with proper sequencing in the PSDI mode.

6.1.9.2 Interruptions of the sensing field

The PSDI system shall distinguish between an intended break and rapid unintended interruptions of the presence-sensing device field.

E6.1.9.2

Rapid changes of the presence-sensing device output may occur as a result of fingers or parts intermittently interrupting individual beams of the sensing field or minor misalignments between the transmitter and receiver of the PSD. One method to meet this requirement is to establish a minimum time between presence-sensing field interruption and clear signals.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

While placing a minimum interval between PSD tripping can invalidate a high speed trip action from being interpreted as a second work cycle in multiple entry PSDI application, a useful solution may be to use part sensors and logic which monitors the movement and position of the workpiece before initiating the cycle.

6.1.9.3 Continuous mode

PSDI shall not be used to initiate continuous mode.

6.1.9.4 Timer

A timer shall be provided to disarm cycling in the PSDI mode if the time between cycles exceeds a predetermined time established by the user. Re-arming of PSDI cycling shall require use of the set-up/reset action of 6.1.9.1. Adjustment means for the timer shall be capable of supervisory control.

6.1.9.5 Stop signals

A Stop signal from any source shall stop any cycling action of the press brake and shall prevent further cycling until PSDI is manually re-armed by use of the set-up/reset action of 6.1.9.1.

6.1.9.6 Number of breaks

When a means is provided to select the number of breaks required to initiate a cycle, the selection means shall be capable of being supervised.

6.1.9.7 Position indication

If more than one break is used to initiate a cycle, a means of indicating the position in the PSDI break sequence shall be provided.

6.1.9.8 Status indication

A means shall be provided to indicate to the operator when PSDI is armed and located so that it is in view of the operator when at the normal operating position.

6.1.9.9 Rearming

Any change in the selection of mode or number of

E6.1.9.4

The time limit should be set for the shortest practicable duration for the production requirements of the operation being performed.

E6.1.9.5

Examples of Stop signals that stop and disarm PSDI mode cycling are those that result from:

- stop signals from any safeguard(s);
- the actuation of the red STOP or emergency stop control(s). See 6.2.2;
- actuation of TOP STOP or RETURN (STOP-RETURN) control(s). See 6.2.5 or 6.2.6;
- actuation of the press brake drive motor stop control;
- intrusion into the presence-sensing field of a presence sensing device used for PSDI after the required number of breaks or during the hazardous portion of a cycle.

E6.1.9.6

Depending on the production operation, more than one break may be necessary to initiate a cycle.

E6.1.9.7

One means of accomplishing this is with indicator lights.

E6.1.9.8

One means of accomplishing this is with an indicator light.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

breaks required to initiate a cycle shall stop any cycling action and shall prevent further cycling until PSDI is manually rearmed by use of the set-up/reset action of 6.1.9.1.

6.2 Electrical controls

When electrical controls are supplied, the requirements of this subclause are applicable to all types of press brakes.

6.2.1 Disconnect means

A main-power disconnect means capable of being locked only in the OFF position shall be provided with every press brake control system.

E6.2

For additional guidance, refer to NFPA 79.

E6.2.1

A circuit breaker or plug can be used to meet this requirement. The disconnect means provides a Category 0 stop (see 6.2.2.2).

If properly labeled and colored, and made readily available to an individual, a disconnect switch can also qualify as an emergency stop device.

Capability to lock the disconnect means in the OFF position facilitates machine lockout. Emergency shutoff should be accessible and designed to prevent locking the disconnect means in the ON position. See also, ANSI / ASSE Z244.1, 29 CFR 1910.147 and 1910.333.

6.2.2 General requirements for stop functions, circuits and actuators

The requirements of this subclause shall apply to stop functions, stop circuits, and the operator actuators that initiate the stop function. Some stop requirements are specified. Other stops that are provided in accordance with the functional requirements and risk assessment of a specific press brake production system and associated auxiliary equipment shall comply with these requirements.

6.2.2.1 Press brake stop function

All press brakes shall include an emergency stop control function.

6.2.2.2 Stop category functional requirements

Immediate stop functions specified in other clauses of this standard shall conform to the functional requirements listed in this subclause for the stop category specified.

Additional stop functions provided based on risk assessment of a specific press brake production system and associated equipment shall conform to the stop category indicated by the risk assessment and functional requirements of the production system.

E6.2.2.2

Stop functions may be initiated by:

- Disconnect switch(es);
- Operator controls (such as stop buttons);
- Non-protective sensor inputs;
- Protective sensor inputs from safety devices or guard interlocks;
- Protective or non-protective interlocks from equipment or auxiliary equipment used in the production system.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

The three categories of stop functions shall be as follows:

- a) A Category 0 stop shall initiate an uncontrolled stop by immediately removing power from the actuator(s).
- b) A Category 1 stop shall immediately initiate a controlled stop with power available to the actuator(s) to achieve the stop, then removal of power to the actuator(s) after the stop is achieved.
- c) A Category 2 stop shall initiate a controlled stop with power left available to the actuator(s).

Category 0 and Category 1 stops shall be operational regardless of the mode of press brake operation.

Category 0 stops shall take priority over (override) all other stops.

Category 0 and Category 1 stops shall operate by de-energizing the relevant circuit and shall override their related start functions.

Category 2 stops shall override their associated start functions.

The cessation or reset of a stop command shall not initiate motion.

Once the stop condition is removed, the use of operator controls to start or initiate motion shall be required to restart or reinitiate motion.

EXCEPTION: For optical presence-sensing safeguarding devices used to initiate strokes in PSDI, see clause 11.

6.2.2.3 Stop circuits

6.2.2.3.1 Stop circuits shall meet the following requirements:

- Where indicated by functional requirements or risk assessment, stop circuits shall have provisions to connect additional operator stop controls, devices or interlocks.
- The components of the stop circuit shall be designed, selected, constructed and interconnected in such a manner so as to withstand the anticipated operational and environmental operating conditions.

- 1) Stop or emergency stop actuator control circuits provided to immediately stop the cycling of the press brake ram, or to prevent or stop hazardous motion related to auxiliary equipment or other machines used with the press brake, shall conform

E6.2.2.3.1

Local code and design selection may also require additional stop controls, devices, or interlocks.

Consideration should be given to:

- frequency of operation;
- need for periodic testing (especially where operation is infrequent);
- vibration, shock, temperature, dust, foreign or corrosive materials, fluids, etc.

- 1) Depending on system design, circuits for stop or emergency stop actuators for immediate stop of hazardous motion may stop only the cycling of the press brake ram or stop the press brake motion.

STANDARD REQUIREMENTS

to the following requirements:

The stop function executed for clutch type mechanical press brake cycling shall be Category 0. The stop function executed for servo drive, hydraulic and pneumatic press brake cycling shall be Category 0 or Category 1:

- The stopping of hazardous motion of other auxiliary equipment and machines used with the press brake production system by such circuits shall be Category 0 or Category 1;
- The selection of a Category 0 or Category 1 stop shall be determined by the functional characteristics of the stopping mechanism(s) and the risk assessment of the equipment or machine;
- Where a Category 0 or Category 1 stop is used for the hazardous motion stop function, the circuits shall have only hardwired electromechanical components.

EXCEPTION: An electronic logic (hardware or software) system as well as a communication network or link that complies with 8.3 shall be permitted. Final removal of power may be by means of electromechanical components or solid-state output devices.

If the emergency stop function impairs any provision designed to release trapped individuals, alternate measures shall be provided.

2) Circuits for stop or emergency stop of hazardous motion shall:

- override all other functions and operations in all modes;
- remove power to the machine actuators as soon as possible without creating other hazards;
- not initiate restart of hazardous motion when reset;
- not be used as an alternative for proper safeguarding. See clause 8.

3) Within the scope of their work activity, the supplier shall provide circuits to connect safeguarding devices and interlocks to stop hazardous motion of

EXPLANATORY INFORMATION

addition to stopping the press brake ram. Where associated equipment or other machines are used with the press brake production system, they may also stop or signal to stop the other equipment or machines.

See also NFPA 79 for additional requirements of solid-state output devices when incorporated in an emergency stop function application.

Alternative measures may include but are not limited to:

- predetermined procedures;
- supervised by the user electrical control functions;
- trained personnel;
- design features.

See also, clause 9.

STANDARD REQUIREMENTS

the press brake and related equipment and machines.

Circuits for safeguarding devices and interlocks shall conform to the requirements of 6.1.7 and 8.3, or shall be designed and constructed to meet the level of risk reduction as determined by a risk assessment.

- 4) The control system's logic shall be signaled that a stop command has been initiated.
- 5) When required for production system utility, or when risk assessment indicates that it is necessary, a press brake production system that utilizes auxiliary equipment or other machines that have individual controls working in a coordinated manner shall incorporate provision to signal the related control systems that a stop condition exists.
- 6) When the press brake is incorporated into a process or manufacturing cell which is divided into several emergency stop zones, the cell or machine control system shall be designed and constructed to facilitate easy identification as to which emergency stop device corresponds to which zone.

6.2.2.4 Stop or emergency stop actuators

Stop or emergency stop actuators to initiate immediate stop of hazardous motion shall:

- be continuously operable and readily accessible;
- not be flat switches or graphic representations based on software applications;
- be readily accessible at each operator control

EXPLANATORY INFORMATION

5) Cooperative efforts of suppliers and users are recommended, where possible, to attain the goal of risk assessment and risk reduction. The success of a risk assessment is not dependent upon this relationship.

See also, ANSI B11.20 for more information on Integrated Manufacturing Systems.

6) Zone is also referred to as “span of control.” See also, ANSI B11.20.

E6.2.2.4

For the purpose of this subclause, stop actuator is the device the operator utilizes to initiate the stop function.

Stop actuators are normally not guarded. If it is necessary to protect an emergency stop pushbutton from inadvertent operation, risk reduction measures may be incorporated which do not impede intentional operation of the actuator. See also, ANSI B11.19.

The intent of this requirement is to provide a clear and unobstructed operation of the emergency stop that will not expose personnel to additional hazards.

Device types include, but are not limited to:

- pushbutton-type devices;
- rope pull (cable pull) devices;
- foot-operated devices without protective covers;
- rod-operated devices;
- push-bar operated devices.

Flat switches are typically a touch-sensitive membrane.

STANDARD REQUIREMENTS

station and at other locations where such stop is required;

- be colored RED;
- pushbutton-type actuators be of the palm or mushroom head type.

EXCEPTION: this does not apply to motor stop pushbuttons.

Additional requirements for emergency stop actuators shall meet the following requirements:

- pushbutton-type actuators have a yellow background;
- initiate a Category 0 or Category 1 stop function;
- be of the self-latching type and use normally closed contacts with positive (direct) opening operation.

For servo drive press brakes, re-initiation of machine cycling shall require manual re-set of all operated emergency stop actuators, using the motor start actuator to re-enable the drive motor, and the use of the actuating means selected.

6.2.2.5 Motor stop actuator

The motor stop actuator shall initiate a Category 0 or Category 1 stop.

When the motor stop actuator is a pushbutton, it shall be of the extended operator, palm or mushroom head type.

6.2.3 Motor start actuator

All motor start actuators or servo drive enable (power ON) actuators shall be protected against unintended actuation.

EXPLANATORY INFORMATION

See also, ANSI B11.19 for additional requirements of emergency stop devices.

E6.2.2.5

Press brakes may have several motors in addition to the drive motor to provide motorized lubrication, shut height adjustment, and other functions. There may be individual stop actuators for each motor, master stop or emergency stop actuator(s) that stops all motors, or a combination of stop actuators. The only stop pushbutton provision to de-energize the servo drive motor on some servo drive press brakes may be the emergency stop pushbutton(s), which should meet the requirements of 6.2.2.4.

E6.2.3

Examples of protection against unintended actuation may include but are not limited to:

- recessed buttons;
- flush buttons;
- pull-on/push-off buttons;
- ring guards;
- footswitches;
- fabricated shields.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

Caution should be exercised when utilizing Human Machine Interface (HMI) technology for motor start controls. Actuators for up and down on ram adjust motors and other devices whose actuation must be maintained by the operator to energize the motor should be protected against unintended actuation.

The servo drive enable (power on) actuators for the servo drive motor on servo drive press brakes are sometimes labeled other than START, although they execute the start function. Some servo drive press brakes label the actuator RESET. Others have used the term SERVO DRIVE ENGAGEMENT or SERVO POWER ON.

6.2.4 Motor starter

All press brakes, except pneumatic press brakes, shall incorporate a type of drive motor starter that will disconnect the drive motor from the power source in the event of control voltage or power source failure, and require actuation of the motor start button to restart the motor when voltage conditions are restored to normal.

EXCEPTION: When electronic motor controllers are utilized, they shall stop or prevent motor motion in the event of control voltage or power source failure and require reactivation of the motor controller system when voltage conditions are restored to normal.

6.2.5 Top stop control

When provided, a top stop control shall stop the press at the completion of its normal cycle. Resumption of ram motion shall require re-actuation of the normal actuating means. A top stop control shall be yellow in color and be unobstructed.

6.2.6 Return (stop-return) control

When provided, the return control shall stop the closing motion of the ram or return the ram to the top or initial starting position. Resumption of closing motion shall require re-actuation of the normal actuating means. It shall be yellow in color and unobstructed.

When the stop function is combined with other functions such as stop return, the stop portion of the control shall be considered a stop control. See 6.2.2.

6.2.7 Voltage

All AC control circuits and solenoid valve coils shall be powered by not more than a nominal 120 volt AC supply obtained from an isolation transformer with a grounded secondary.

E6.2.6

The return functions include, but are not limited to, one of the following:

- 1) Momentary actuation of the return control will cause ram closing motion to stop and automatically return to initial ram position; or
- 2) Momentary actuation of the return control will cause ram closing motion to stop. To return to the initial ram position, continuous or intermittent actuation of the stop-return control may be used.

E6.2.7

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

Higher voltages that may be necessary for operation of machine or control mechanisms shall be isolated from any control mechanism handled by the operator.

All DC control circuits shall be powered by not more than a nominal 240 volt DC supply isolated from any higher voltages.

6.2.8 Grounds

All electrical control circuits shall be protected against false operation of the press brake due to an unintended ground or improper shielding in the control circuit.

6.2.9 External and line interferences

The supplier shall design and construct the control or power system(s) so that external and line interferences do not adversely affect the safe operation of the press brake and its associated equipment.

6.3 Requirements for mechanical press brakes**6.3.1 Ram counterbalance systems**

Spring, mechanical or air counterbalance systems, if provided, shall:

- incorporate means to retain system parts in the event of breakage;
- have the capability of holding the ram and its attachments at any point in the cycle without the brake applied; and
- if air operated, incorporate means to prevent failure of capability (sudden loss of pressure) in the event of air supply failure.

6.3.2 Clutches and brakes

Clutches and brakes of mechanical press brakes shall be actuated in a coordinated manner. The clutch shall not fail to disengage and the brake shall not fail to engage upon release of the actuating force.

When the power to the motor on servo drive press brakes is removed, the brake shall be applied. In the event of loss of disengaging force to the brake, the drive motor shall be de-energized.

6.3.2.1 Friction Brakes

Friction brakes shall be engaged by compression spring(s), guided on a rod or in a hole and be prevented from interleaving. A disengaging force shall be required to release the brake. Brake capacity shall be sufficient to stop the motion of the ram when the disengaging force is removed and to hold the ram and its attachments at any point in the ram's travel.

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For more information, see NFPA 79.

E6.2.8

Ground faults in the control circuits shall not cause unintentional motion or prevent stopping of the press brake.

E6.2.9

Some sources of external and line interferences are:

- Electro-Magnetic Interference (EMI);
- Electro-Static Discharge (ESD);
- Radio Frequency Interference (RFI);
- shock and vibration.

E6.3.1

System parts may include but are not limited to the piston and rod of a cylinder.

Common practice is to use a check valve in the air supply to the counterbalance.

E6.3.2

With some servo drive press brakes, upon loss of electric power, energy stored in capacitors may be used to execute a Category 1 stop using the motor and then application of the brake.

E6.3.2.1

Because friction brakes cannot meet 8.3, there are additional requirements for maintenance

Certain major components of press brake systems that are designed to be reliable if maintained properly (such as clutch brakes

STANDARD REQUIREMENTS

Servo drive press brake rams shall be stopped by:

- the drive motor;
- the friction brake; or
- a combination of the drive motor and the friction brake.

The friction brake shall be capable of holding the ram and its attachments at any point in the cycle with the motor de-energized.

If any circumstances of drive motor de-energization cause the friction brake to be the primary means of stopping the ram, the brake shall be capable of stopping the ram quickly.

A single failure of a component, a subassembly or a module of the drive train that affects the performance of the safety-related functions shall not affect the stopping capability and shall be designed and constructed in accordance with 8.3.

The brake shall always be engaged when the servo motor is de-energized on a servo drive press brake.

EXCEPTION: When the servo drive press brake design prevents the ram from falling due to gravity when the motor is de-energized, a friction brake is not required.

6.3.2.2 Clutches

Mechanical and fluid-operated clutches shall be of the friction type and shall self-disengage when the external engaging force has been removed.

6.3.2.3 Clutch and brake air valve failure

Air valves used to actuate friction clutch and brakes shall be designed to ensure that there is no significant increase in the normal stopping time of the press brake ram motion due to a failure within the operating valve mechanism. Further press brake ram motion shall be prevented if such failure does occur.

6.3.2.4 Engaging method failure

The clutch and brake control of air actuated press brakes shall automatically deactivate in the event of the failure of adequate air-pressure supply for the actuating control.

Reactivation of the ram motion shall require restoration of normal air supply and re-initiation of the operator's control.

EXPLANATORY INFORMATION

and servo motors) need not be duplicated.

On servo drive press brakes, the brake may be disengaged during a motor hold or "lock" condition unless other conditions require the brake to be engaged.

The brake should stop the ram within the time frame required to maintain the calculated safety distance. When calculating safety distances, use the worst case stopping performance.

Methods used to meet this requirement include but are not limited to:

- redundant drive components;
- friction brake location;
- sensors;
- monitoring devices;
- ram support counterbalance.

E6.3.2.3

The use of a monitored dual air valve is one method of meeting this requirement.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

6.3.3 Cycle control of mechanically actuated or air operated press brakes

A press brake with a mechanically actuated clutch and brake or an air cylinder driven air operated press brake shall be designed so as to allow the die setter to have complete control over the ram movement for setting dies.

6.3.3.1 Foot pedal (mechanical)

When provided, a mechanical foot pedal shall have a pad that will allow even distribution of the actuating pressure as applied by the operator's foot. The pad shall have a non-slip contact area and shall be firmly attached to the mechanical foot pedal. The mechanical foot pedal shall be removable, and adjustable to the left or right, to permit actuation by the operator at a location to suit the work.

6.3.3.1.1 Unintended actuation of press brake by foot pedal

When provided, a mechanical foot pedal shall be equipped with a means for preventing unintended press brake actuation.

6.3.3.2 Unintended actuation of press brake by foot treadle

When provided, a foot treadle of the type that serves as an operator control shall be equipped with a means to prevent unintended press brake actuation.

E6.3.3

Special operator training on mechanically actuated press brakes is recommended because the operator has complete control of the ram movement during production and set-up. See clause 10 for additional information on training requirements.

E6.3.3.1

See also, Figure 2, Annex A.

E6.3.3.1.1

Two methods of fulfilling this requirement include but are not limited to the following:

- removing the mechanical foot pedal and placing it in a safe location;
- providing a locking pin or locking lever, as noted in Figure 2, Annex A. These locking mechanisms should be designed to prevent unintended machine actuation. The locking mechanism should not allow locking in the operating position. For additional operator safety in mechanical foot pedal type operations, the locking device (pin or lever) is recommended to be used to prevent actuation of the press brake when not in operation.

E6.3.3.2

Two methods of fulfilling this requirement include but are not limited to the following:

- providing a protective cover over the treadle bar to prevent unintended machine actuation;
- providing a locking pin or locking lever to lock the treadle bar in a fixed position. These locking mechanisms should be designed to prevent unintended machine actuation. The locking mechanism should not allow locking in the operating position. See Figure 18, Annex A.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

6.3.4 Mode control

The mode control for mechanical press brakes with hydraulic, pneumatic and electrically actuated clutch brake mechanisms shall be designed and constructed in accordance with 8.3.

EXCEPTION: This subclause does not apply to mechanically actuated press brakes or air operated press brakes without control systems.

6.3.4.1 Mode selection

A means for selecting a mode of operation shall be provided. This means shall be capable of supervisory control. OFF and other modes of operation for set-up and production such as but not limited to, INCH and SINGLE shall be supplied within the cycle control system. Changing of the selection from one mode to another shall not cause motion.

This subclause is intended for mechanically driven press brakes that have ram control systems other than the straight mechanical linkage systems of early press brakes.

Many of these early press brakes have been modified with aftermarket hydraulic, pneumatic or electrical control systems.

This paragraph applies to those retrofit packages as well as any OEM mechanical press brakes with controls of this type.

E6.3.4.1

The operating modes described in this subclause may be provided for both clutch-type press brakes and servo drive press brakes. However, the cycle of a servo drive press brake is programmable and often has more complex motion than the unidirectional eccentric motion of clutch-type press brakes.

On a servo drive press brake, different program motion paths, stroke lengths, and speed profiles can be selected by the user. Once the program motion path is defined, the normal modes of operation (SINGLE, CONTINUOUS, etc.) may be available to cycle the press brake ram using the defined motion path.

The types of machine motion available from a servo drive press brake may include but not be limited to the following:

- crank motion;
- link motion;
- soft motion;
- pulse motion;
- program motion;
- pendulum motion;
- coining motion;
- repeat motion;
- special customer-defined motion.

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

6.3.4.2 Off

The OFF mode shall prevent initiation or continued operation of the press brake by removing the source of power to the cycle control.

OFF shall not be used as the sole energy isolation means.

6.3.4.3 Inch

The INCH mode shall not be used as a production mode. The INCH means shall be designed to prevent exposure of the worker's hands within the point-of-operation by:

- a) requiring the synchronous use of both hands to initiate ram motion; or
- b) being a single control protected against accidental actuation and so located that the worker cannot reach into the point-of-operation while operating the single control; or
- c) being a single control protected against accidental actuation and used in conjunction with appropriate safeguarding.

6.3.4.4 Single cycle

A press brake cycle control system that provides a SINGLE CYCLE mode of operation shall include the following:

- a) A control adjustment shall be provided to establish a point during the hazardous portion of the cycle, prior to which ram motion will be halted if any actuating control is released, but after which ram motion will automatically continue if any actuating control is released. Where the control adjustment is achieved by electronic means, it shall be capable of supervisory control;
- b) The control system shall incorporate an anti-repeat feature;
- c) Before an interrupted cycle can be resumed, the design of the control system shall require the release and re-actuation of all active actuating controls; and
- d) Control systems with more than one operator station shall require:
 - the release and concurrent (re-)actuation of all active actuating controls prior to (re-)initiation of a subsequent machine cycle;
 - the selection of the use of each operator station by a means capable of supervisory control;
 - the design and construction to prevent ram motion if all operators' stations are inactive.

E6.3.4.2

See also, 6.1.6.

E6.3.4.3

Manually controlled incremental ram motion for die setting in the INCH operating mode is affected by clutch/brake action for the part revolution press brake. When a single or two-hand control is used as a safeguarding device, see 8.7.5 and 8.7.6 and ANSI B11.19.

E6.3.4.4

a) Press brake control systems may also include an operational feature that allows the ram to stop upon release of the operational controls during the opening portion of the ram cycle. The hazardous portion of the cycle may include the opening movement of the ram. The point at which the actuating control may be released for automatic ram opening may need to be adjusted for each set-up.

b) Anti-repeat provides for automatic stopping of the ram at the end of a cycle, and requires the release and re-actuation of all operator controls in order to initiate a subsequent cycle.

d)

Concurrent does not infer that multiple operator stations be activated within a specific period of time (synchronous operation).