ANSI B11.0 – 2010

American National Standard

Safety of Machinery – General Requirements and Risk Assessment

Secretariat and Accredited Standards Developer:
B11 Standards, Inc.,
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Leesburg, VA 20176, USA

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American National Standards Institute

AMERICAN NATIONAL STANDARDS

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Foreword

(This foreword is not part of the requirements of this B11.0 American National Standard on general safety requirements of machinery and risk assessment)

Overview

This American National Standard was promulgated by the B11 Accredited Standards Committee as a voluntary consensus standard to establish safety requirements for machinery and machinery systems. This standard specifies general safety requirements for the design, construction, operation and maintenance (including installation, dismantling and transport) of machinery and machinery systems. This standard also applies to devices that are integral to these machines.

This is the second edition of this American National Standard on the Safety of Machinery. 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 the series of B11 standards and technical reports. Maintaining these documents with consistent language proved to be a significant challenge. The long term objective of this standard reorganizes the B11 family of standards by gathering the requirements common to most of the B11 standards into this document while retaining the machine tool specific requirements in the machine-specific (C-level) standards.

The concepts and principles contained in this standard can be applied very broadly to a wide variety of systems and applications. Documented risk assessments were first introduced in the machine tool industry in 2000 with the publication of ANSI B11.TR3 – *Risk Assessment and Risk Reduction – A Guide to Estimate, Evaluate and Reduce Risks Associated With Machine Tools;* to the robot industry in 1999 with the publication of ANSI/RIA R15.06-*Requirements for Industrial Robots and Robot Systems;* and to the packaging machinery industry in 2006 with the publication of ANSI/PMMI B155.1-*Safety Requirements for Packaging Machinery and Packaging-Related Converting Machinery.* Since that time the principles of the risk assessment process have been applied to many applications – including traffic control, consumer products, incident investigations, and of course machinery. Interested readers are encouraged to apply these principles and concepts to other systems in addition to machinery as suits their needs.

Prevention Through Design or PTD is recent term in the industry; the objectives of risk assessment, risk reduction and elimination of hazards as early as possible are integral and not new to this standard. Although, the phrase "Prevention Through Design" was not used within the standard, other equivalent terms such as “elimination by design,” "design out," and "substitution" are used in addition to thoroughly addressing risk assessment and applying it to the lifecycle and operations of the machine.

Objective

The objective of the B11 standards is to eliminate injuries to personnel from machinery or machinery systems by establishing requirements for the design, construction, reconstruction, modification, installation, set–up, operation and maintenance of machinery or machine systems. This standard should be used by suppliers and users, as well as by the appropriate authority having jurisdiction. Responsibilities have been assigned to the supplier (i.e. manufacturer, the reconstructor, and the modifier), the user, and the user personnel to implement this standard. This standard is not intended to replace good judgment and personal responsibility. Personnel skill, attitude, training and experience are safety factors that must be considered by the user.

The safeguarding of machinery is complicated by the wide variety of operations and operating conditions, including, but not limited to the following: the variations in size, speed, and type of machinery used; the size, thickness, and kind of pieces to be worked; the required accuracy of the finished work; the skill of operators; the length of run; and the method of feeding, including part and scrap removal. Because of these varying factors in the operations and in the workplace, a wide variety of safeguarding measures has been covered in this standard as well as the ANSI B11 machine-specific (C-level) standards.

Harmonization

This standard has been harmonized with international (ISO) and European (EN) standards by the introduction of hazard identification and risk assessment as the principal method for analyzing hazards to personnel to achieve a level of acceptable risk. This standard integrates the requirements of ANSI / ISO 12100 parts 1 and 2, and ISO 14121(now combined into a single standard – ISO 12100), as well as selected U.S. standards. Suppliers meeting the requirements of this ANSI B11.0 standard may simultaneously meet the requirements of these three ISO standards.

This document contains references to federal Occupational Safety and Health Administration (OSHA) standards. OSHA standards represent the minimum level of regulatory compliance requirements within the United States. Federal OSHA-approved individual state safety and health programs (e.g., California OSHA, known as Cal-OSHA) have standards that may exceed these minimum requirements. Accordingly, care must be exercised to ensure that the appropriate standards are being used.

General

"Safe" is the state of being protected from recognized hazards that are likely to cause physical harm. There is no such thing as being absolutely safe, that is, a complete absence of risk. In turn, there is no machine that is absolutely safe. All machinery contains hazards, and some level of residual risk. However, the risk associated with those hazards should be reduced to an acceptable level.

This standard guides machinery suppliers and users through a risk assessment process designed to ensure that reasonably foreseeable hazards are identified, and corresponding risks are reduced to an acceptable level. In this standard, the terms "acceptable" and "tolerable" are used as synonyms. Although engineers have long applied an informal risk assessment framework, this standard includes a formal method to conduct and document the risk assessment process. This standard identifies some preparations that need to be made before a risk assessment begins, and presents the basic risk assessment process in a step by step approach to assist in achieving this goal.

The outcome of completing the risk assessment process should be:

- A clear understanding of risk(s) including the potential severity of harm and the probability of the occurrence of harm;
- Machinery with risks reduced to an acceptable level;
- Risk reduction measures appropriate to the circumstances;
- Documentation of the risk assessment.

This standard reflects the best industry practice at the time of its approval. The inclusion or omission of language relative to any evolving technology, either in the normative or informative areas of this standard, in no way infers acceptance or rejection of such technologies. The presentation style used in this standard mixes both informative and explanatory text with normative requirements and was chosen to enhance the readability of the information. The distinction between these texts is illustrated as follows:

Normative requirements

The normative requirements appear aligned to the left margin. To meet the requirements of this standard, machinery suppliers and users must conform to these normative requirements. These requirements typically use the verb "shall."

Informative text

The informative or explanatory text in this standard appears indented, in italics, in a reduced font size and colored blue (for those with electronic or color printed versions), all of which are in an effort to provide a visual signal to the reader that this is informative text, not normative text, and is not to be considered part of the requirements of this standard; this text is advisory in nature only. The suppliers, the users and the machines themselves are not required to conform to the informative text. The ANSI B11 machine-specific (C-level) standards all use a two-column format, and the informative text appears as the right hand column and is titled "Explanatory Information." This standard uses the single column format common to many international standards. The informative text is included in this manner in an attempt to enhance readability.

Effective Date

The following information on effective dates is informative guidance only, and not a normative part of this standard. The 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, and/or modify existing designs or manufacturing processes in order to incorporate the new and/or revised requirements of this standard into their product development or production system.

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

The committee 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 or the machine-specific (C-level) standard to implement risk reduction measures (protective measures) for appropriate risk reduction.

Development

This standard was prepared by the B11.0 Subcommittee, 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 standard was approved as an American National Standard, the ANSI B11 Accredited Standards Committee was composed of the following Members:

John W. Russell, PE, CSP Chairman
Gary D. Kopps, Vice-Chairman
David A. Felinski, Secretary

Organizations Represented	Name of Representative	
	Delegate	Alternate
Aerospace Industries Association of America	Willard Wood	Lance Chandler, PE
Aluminum Extruders Council	Melvin Mitchell	Scott Burkett
American Society of Safety Engineers	Bruce Main, PE, CSP	George Karosas, PE,CSP
Association For Manufacturing Technology	Russell Bensman	Alan Metelsky
Automotive Industry Action Group	Nancy Malo	David Lalain
The Boeing Company	Don Nelson	Joe Oberuc
Canadian Standards Association	Elizabeth Rankin, CRSP	Thomas Eastwood
Deere & Co.	Gary Kopps	Scott Fowler
General Motors Corporation	Michael Douglas	
Komatsu America Industries	George Schreck	James Landowski
MetalBuilding Manufacturers Association	Charles Stockinger	Charles Praeger
Metal Powder Industries Federation	Dennis Cloutier, CSP	Teresa Stillman
National Institute for Occupational Safety & Health	Richard Current, PE	James Harris, PhD, PE
Occupational Safety & Health Administration	Kenneth Stevanus	Robert Bell
Omron Scientific Technologies Incorporated	Frank Webster	Christopher Soranno
Packaging Machinery Manufacturers Institute	Charles Hayes	Maria Ferrante
Pilz Automation Safety, LP	Michael Beerman	Lee Burk
Precision Metalforming Association	James Barrett, Jr. PhD	Bill Gaskin / Christen Carmigiano
Presence-sensing Device Manufacturers Association	James V. Kirton	Michael Carlson
Property Casualty Insurers	John Russell, PE,CSP	
Robotic Industries Association	Jeffrey Fryman	Claude Dinsmoor
Rockwell Automation	Michael Miller	
Sheet Metal & Air Conditioning Contractors Nat'l. Assn.	Michael McCullion	Roy Brown
System Safety Society	John Etherton, PhD, CSP	Rod Simmons, PhD
Toyota Motor Manufacturing North America	Barry Boggs	Todd Mills
International United Automotive Workers	Tom Ford	

At the time this standard was approved, the **B11.0** *Safety of Machinery - General Requirements and Risk Assessment* **Subcommittee** had the following members who participated in the development of this American National Standard:

Name	Affiliation
Bruce Main, PE, CSP – Chair	design safety engineering, inc.
Dennis Cloutier, CSP – Vice Chair	Cloutier Consulting
Anne Mathias, PE – Vice Chair	Engineering Systems, Inc.
Dave Felinski, Secretary	B11 Standards, Inc.
Jim Barrett, PhD	Link Systems
Steve Boyette	Ross Controls
Sam Boytor	Fox Controls
Mike Carlson	Banner Engineering
Eric Cummings	Ross Controls
Rick Current, PE	NIOSH
Gil Dominguez	Pilz
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Al Karvelis, PhD, PE	Exponent
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Mike Miller	Rockwell
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John Piampiano	Kodak
John Russell, PE, CSP	Liberty Mutual
Ted Sberna	Applied Engineering Concepts
Chris Soranno	Omron STI
Steve Stevens	MAG Powertrain
Mike Taubitz	FDR Safety / Lean Journey
Troy Uahinui	Toyota
Dave Withrow	Withrow Industries
Will Wood	Boeing

Introduction

Organization and Application of B11 Documents

The B11 standards and technical reports can be associated with the ISO "A-B-C level" structure as described immediately below, and as shown in Figure 1 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 B11.0 standard on general safety requirements common to ANSI B11 machines is primarily an "A-level" 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 of Technical Reports are all typical B level documents addressing general safety elements that can be used 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 different machines, and as such would fall into the "B-Level" group. The machine-specific (C-Level) B11 standards contain detailed safety requirements for a particular machine or group of machines (see the list of machine-specific (C-level) standards at 7.15). 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.

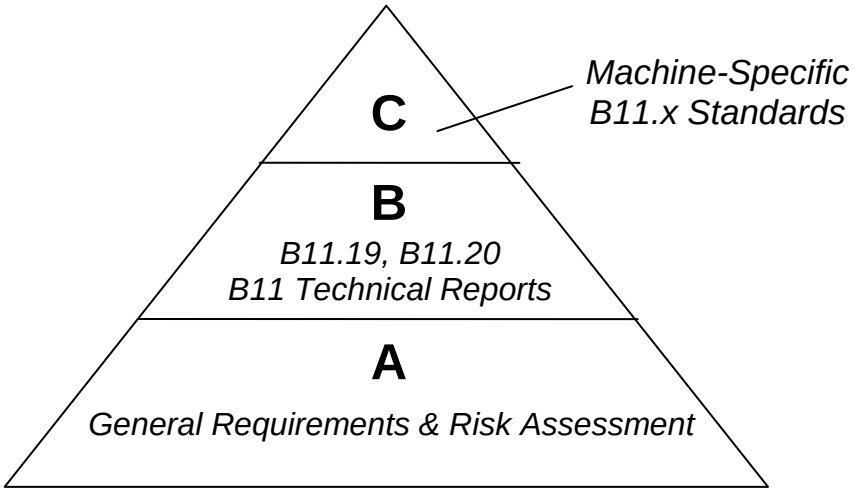

Figure 1 — Organization of the B11 Series of Documents

This standard is intended for readers with differing levels of familiarity with the B11 series of safety standards and the risk assessment process. Readers new to these standards may benefit from starting with the B11.0 and then reading the applicable machine-specific B11.x standard, B11.19, and other relevant or appropriate standards and technical reports. More experienced users may find efficiencies in beginning with the machine-specific B11.x standard and then reviewing portions of the B11.0 as necessary. The requirements of the machine-specific ANSI standards are grouped according to those that apply to the supplier (i.e., manufacturer, rebuilder, modifier) and those that apply to the user. Some are shared between the supplier and user and are so indicated. Table 1 provides an overview of the organization of B11.0 as compared with that of the machine-specific B11.x standards.

Table 1 — Comparison of Structure between B11.0 and Machine–Specific B11 Standards

Clause	B11.0 Title B11.X Title	B11.0 Content B11.X Content
1	B11.0 Scope	Scope of this Safety of Machinery standard. Provides the boundaries or limits of the standard (i.e., what is or is not included).
	B11.X Scope	Scope of the B11.X standard. Provides the boundaries or limits of the standard (i.e., what is or is not included).
2	B11.0 References	List of normative and informative references used in the B11.0 which, in whole or in part, provide additional requirements when referenced in the normative text.
	B11.X References	List of normative and informative references used in the B11.X standard which, in whole or in part, provide additional requirements when referenced in the normative text of the standard.
3	B11.0 Definitions	The B11.0 draws the common terms from the machine-specific B11 standards into one location. Terms that are generally understood and commonly used in everyday English are not defined.
	B11.X Definitions	Terms that apply to a specific machine tool and are not already included in clause 3 of the B11.0 appear in clause 3 of the machine-specific B11 standards.
4	B11.0 Responsibilities	The general responsibilities of machinery suppliers, integrators, users and personnel are listed to more clearly define who is responsible for what. The common responsibilities appear in the B11.0.
	B11.X Responsibilities	The machine-specific B11 standards list any additional or special responsibilities associated with the specific machine tool.
5	B11.0 Requirements	The B11.0 explicitly states the fundamental machinery requirement that suppliers and users must achieve acceptable risk. Note that this requirement does not limit new technology or new application of existing technology.
	B11.X Hazard Control	The machine-specific B11 standards list any additional or special requirements associated with the specific machine tool.
6	B11.0 Risk Assessment Process	The B11.0 describes the risk assessment process which has been required in the B11 community since 2000 when ANSI B11.TR3 was first published. Although clause 6 is intended to require a shared responsibility between supplier and user, the requirements of this clause may fall on either entity. When possible, the user should participate in the supplier's risk assessment of the machine design.
	B11.X Design and Construction	Clause 6 addresses requirements for design and construction for the specific machine. The supplier is responsible for the requirements for design and construction while understanding that the user or other entities assume this responsibility when modifying a machine.
7	B11.0 Risk reduction	Common risk reduction requirements for many machines appear in B11.0 clause 7. This clause is intended to be used with clauses 6-10 in the machine-specific B11.X standards. If a conflict occurs between the clause 7 B11.0 standard requirements, the requirements of the machine-specific (C-level) standard generally apply.
	B11.X Installation, testing and start-up	In the machine-specific B11 standards, clause 7 contains requirements for installing, testing and starting-up specific machine tools. The requirements for installation, testing and start-up are predominantly the responsibility of the user. The supplier will normally provide assistance either directly (providing personnel) or indirectly (instruction materials).
8	B11.0 Info for Maintenance/Use	The B11.0 clause addresses requirements for manuals and warnings.
	B11.X Safeguarding	Clause 8 in the machine-specific B11 standards presents requirements for safeguarding that are appropriate for the specific machine tool. Safeguarding is normally a shared responsibility between the supplier and user. This clause will frequently reference ANSI B11.19 on safeguarding performance criteria.
9	B11.0 Training	The B11.0 clause addresses the common training requirements for machinery.
	B11.X Operation and Maintenance	Clause 9 of the machine-specific B11 standards contains requirements for operation and maintenance of the specific machine tool. The user is normally responsible for the requirements of operation and maintenance, with possible assistance from the supplier for training.
10	B11.0	(None)
	B11.X Other	Some machine-specific B11 standards have one or more additional clauses that address topics related to the specific machine tool.
Annex	Informative or Normative	The B11.0 and machine-specific B11 standards typically have multiple informative (and infrequently, normative) annexes that describe special topics in greater detail.

Risk assessment is a scalable process, which simply means that risk assessment can be applied to a single hazard, to multiple hazards of a simple machine, or to hazards on more complex (automated) machine systems.

Risk assessment can be applied to new machines, to existing machines, or modified machines. To facilitate the process, the risk assessment leader may need to create ad hoc teams that meet together or with individuals that meet at different times to capture the appropriate information. Much of the risk assessment process can be effectively conducted at the shop floor level in the environment where the tasks and hazards occur.

Figure 2 below captures the five major principles (I – V) inherent in all forms of risk assessments and the three critical communication paths (arrows) essential for a successful risk assessment.

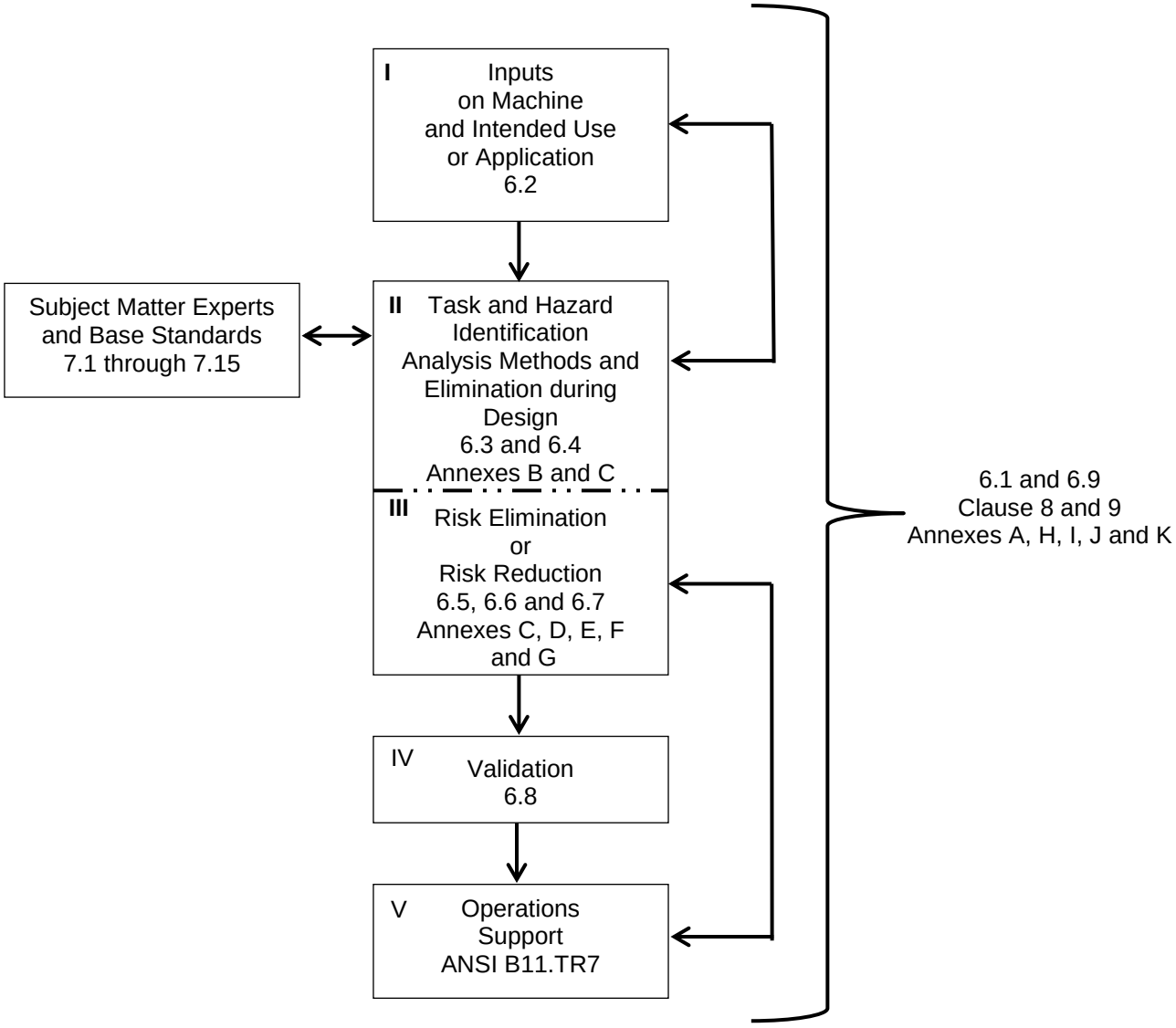

Figure 2 — Application of the Risk Assessment Process

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.

Safety of Machinery – General Requirements and Risk Assessment

1 Scope

This standard applies to new, modified or rebuilt power driven machines, not portable by hand, used to shape and/or form metal or other materials by cutting, impact, pressure, electrical or other processing techniques, or a combination of these processes.

This can be a single machine or a machinery system(s).

Informative Note 1: *To improve readability, the terms "machine," "machinery," "machine tool" or "machinery system(s)"are used interchangeably throughout the document, either in singular or plural form.*

Informative Note 2: *See 7.15 for a list of example machine tools.*

Other industry sectors may benefit from applying this standard. Where a machine-specific (C-level) standard exists and the requirements of that standard conflict with the requirements in this standard, the requirements of the machine-specific (C-level) standard shall generally apply.

Informative Note: *For example, ANSI/RIA R15.06 on safety requirements for robots and robotic systems is a "C-level standard" that would take precedence over the requirements in this standard.*

Deviations from the requirements of this standard or from any machine-specific (C-level) standard shall be based on a documented risk assessment.

Informative Note: *See clause 6 for additional information on risk assessment.*

2 Normative References

The following standards contain provisions which constitute additional requirements of this American National Standard and are incorporated into this standard by reference. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. See Annex K for a list of informative references.

Informative Note 1: *Not all of the above normative standards will necessarily apply to a specific application. The reader is responsible to determine and obtain the normative references that apply to the particular situation under consideration.*

Informative Note 2: *The normative standards cited by reference in turn include other normative standards. The reader is responsible to determine and obtain the normative references that apply to the particular situation under consideration. For example, ANSI B11.0 lists the entire series of machine tool standards as normative references, but a supplier of a metal saw need not purchase the entire ANSI B11 standard series, just ANSI B11.10 on saws and ANSI B11.19 on safeguarding.*

ANSI B11.1—2009 *Safety Requirements for Mechanical Power Presses*

ANSI B11.2—1995 (R2010) *Safety Requirements for Hydraulic Power Presses*

ANSI B11.3—2002 (R2007) *Safety Requirements for Power Press Brakes*

ANSI B11.4—2003 (R2008) *Safety Requirements for Shears*

ANSI B11.5—1998 (R2008) *Iron Workers – Safety Requirements for Construction, Care and Use*

ANSI B11.6—2001 (R2007) *Safety Requirements for Manual Turning Machines*

ANSI B11.7—1995 (R2010) *Safety Requirements for Cold Headers and Cold Formers*

ANSI B11.8—2001 (R2007) *Safety Requirements for Manual Milling, Drilling, and Boring Machines*

ANSI B11.9—2010 *Safety Requirements for Grinding Machines*

ANSI B11.10—2003 (R2009) *Safety Requirements for Metal Sawing Machines*

ANSI B11.11—2001 (R2007) *Safety Requirements for Gear & Spline Cutting Machines*

ANSI B11.12—2005 (R2010) *Safety Requirements for Roll Forming and Roll Bending Machines*

ANSI B11.13—1992 (R2007) *Safety Requirements for Single or Multiple Spindle Automatic Bar and Chucking Machines*

ANSI B11.15—2001 (R2007) *Safety Requirements for Pipe, Tube and Shape Bending Machines*

ANSI B11.16—2003 (MPIF #47) *Safety Requirements for Metal Powder Compacting Presses*

ANSI B11.17—2004 *Safety Requirements for Horizontal Hydraulic Extrusion Presses*

ANSI B11.18—2006 *Safety Requirements for Machines Processing or Slitting Coiled or Non-Coiled Metal (this standard includes the requirements from the 1996 B11.14, which has been withdrawn)*

ANSI B11.19—2010 *Performance Criteria for Safeguarding*

ANSI B11.20—2004 *Safety Requirements for Integrated Manufacturing Systems*

ANSI B11.21—2006 *Safety Requirements for Machine Tools Using a Laser for Processing Materials*

ANSI B11.22—2002 (R2007) *Safety Requirements for Numerically Controlled Turning Machines*

ANSI B11.23—2002 (R2007) *Safety Requirements for Machining Centers*

ANSI B11.24—2002 (R2007) *Safety Requirements for Transfer Machines*

ANSI / RIA R15.06-1999 *Safety Requirements for Industrial Robots and Robot Systems*

ANSI / PMMI B155.1-2006 *Safety Requirements for Packaging Machinery and Packaging-Related Converting Machinery*

MIL STD 882D: 2000 *Systems Safety Program Requirements*

NFPA 70-2008 *National Electrical Code*

NFPA 79-2007 *Electrical Standard for Industrial Machinery*

NFPA 70E-2009 *Standard for Electrical Safety in the Workplaces*

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

NFPA T2.25.1 R2-2005 *Pneumatic fluid power – Systems Standard for Industrial Machinery*

NFPA T2.24.1 R1-2007 *Hydraulic fluid power – Systems Standard for Industrial Machinery*

ANSI A1264.1-2007 *Safety Requirements for Industrial Fixed Stairs, Floor and Wall Openings, and Industrial Railings and Toe Boards*

ANSI A14.3-2002 *American National Standard for Safety Requirements for Fixed Ladders*

ANSI Z535.1-2006 *American National Standard for Safety Color Code*

ANSI Z535.2-2007 *American National Standard for Environmental and Facility Safety Signs*

ANSI Z535.3-2007 *American National Standard for Safety Symbols*

ANSI Z535.4-2007 *American National Standard for Product Safety Signs and Labels*

ANSI Z535.6-2006 *American National Standard for Product Safety Information in Product Manuals, Instructions and Other Collateral Material*

ANSI/ASME B20.1-2006 *Safety Standards for Conveyors and Related Equipment*

ANSI Z136.1-2007 *Standard for Safe Use of Lasers*

