ANSI B11.19-2019

AMERICAN NATIONAL STANDARD FOR MACHINERY SAFETY

Performance Requirements for Risk Reduction Measures: Safeguarding and other Means of Reducing Risk

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AMERICAN NATIONAL STANDARDS

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Foreword

(This Foreword is not part of the requirements of American National Standard B11.19-2019)

General

The primary objective of this standard is to establish the requirements for the design, construction, installation, operation and maintenance of the risk reduction measures used to eliminate or control hazards to individuals associated with machines. This standard relies on other standards to determine which risk reduction measure(s) is required or allowed to control identified hazards / hazardous situations and is intended to be used in conjunction with the ANSI B11.0 standard on general safety requirements and risk assessments of machines, and any relevant ANSI B11 "base" standard for a given machine. To accomplish this objective, this standard has established responsibilities for the supplier (e.g., manufacturer, rebuilder, installer, integrator, and modifier), the user, and individuals in the working environment. The overall goal is to achieve acceptable risk in the work practices and work environment.

Application

Other industry sectors may benefit from applying this standard. Where a machine-specific "base" (type-C) safety standard exists, ANSI B11.19 may be constructively used to supplement that standard.

The words "safe" and "safety" are not absolutes. Safety begins with good design. While the goal of this standard is to eliminate injuries, this standard recognizes that risk factors cannot practically be reduced to zero in any human activity. This standard is not intended to replace good judgment and personal responsibility. Operator skill, attitude, training, job monotony, fatigue, and experience are factors that affect safety and that must be considered by the user.

Throughout its history, ANSI B11.19 has not provided the requirements for the selection of the risk reduction measures, but only the implementation of the risk reduction measure once chosen. No hierarchical order, no level of risk reduction, or any relationship between risk reduction measure options are implied within this standard.

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 date of this standard.

The B11.19 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 or the machine-specific "base" safety standard to implement risk reduction measures (protective measures) for appropriate risk reduction.

Alignment

The requirements of this standard have been harmonized with similar requirements in several international (ISO and IEC) and European (EN) standards. Harmonization means that the requirements have been aligned in essence to achieve a similar level of risk reduction. Harmonization does not necessarily mean duplication of exact requirements.

ANSI B11.19 implements a standardization philosophy that differs significantly from that often found in some ISO, IEC, and EN standards. ISO, IEC, and EN standards tend towards individual documents for each type of risk reduction measure (e.g., light curtains, emergency stop controls, prevention of unexpected start-up, etc.). ANSI B11.19 has historically combined the various requirements into this single standard, thereby allowing readers to understand and compare the requirements for different approaches to reducing risk.

Considerable effort has been made to avoid conflicting requirements, however, the task is quite challenging because the various standards do not 'align' directly in scope, requirements, approaches, and revision dates. Several annexes are provided in ANSI B11.19 to assist readers in identifying and understanding the correlation of the various national and international standards. ISO standards tend to be very directive or prescriptive in nature, thus possibly limiting solutions for particular applications. ANSI B11.19 tends to include more performance-based requirements and allows suppliers and users to develop effective solutions using risk assessment as justification.

Differences between ANSI B11.19 and ISO standards result from different analytical methods or approaches. However, the differences between the requirements are generally considered inconsequential to the achievement of acceptable risk or to compliance with the EU Machinery Directive 2006/42/EC, OSHA (specifically, 29 CFR 1910.212(a)(1)), or other legal requirements. As a result, using risk assessment as described by ANSI B11.0, complying with the requirements of type-C (base) standards and ANSI B11.19 will enable a machine supplier to meet the essential safety and health requirements contained in Annex I of the EU Machinery Directive 2006/42/EC when used as alternate technical specifications to EU harmonized standards.

History

ANSI B11.19 was established as a writing subcommittee to the ANSI B11 Accredited Standards Committee in 1980 to attempt to consolidate widely scattered information into a single document. Mr. Barry Stockton (B11.19 Chairman 1980-2003) guided a diverse group of industry experts through the creation of the original standard in 1990, which was reaffirmed in 1997. The second revision, which was approved by ANSI in 2003, was a major rewrite that included updated Liberty Mutual anthropometric data and a new safety distance annex.

The 2010 version of ANSI B11.19 incorporated new requirements and information including: Protective Stops, Perimeter Guarding, Muting, Manual Suspension (Bypass), Emergency Stop including rope/cable pulls, three-position Enabling Devices, Hold-to-run Control, Guard Interlocking Switches with guard locking, and Presence-sensing Device Initiation (PSDI). Several informative annexes were added or expanded. Risk assessment was emphasized to maintain a high level of safety performance for safety functions, but also allow feasible risk reduction that can be reasonably justified through the process of a documented risk assessment that meets the required risk reduction.

The 2010 edition also incorporated some of the requirements previously contained in ANSI B15.1 *Safety Standard for Mechanical Power Transmission Apparatus* (formally withdrawn as an American National Standard in February 2011). The general risk reduction measure requirements for this equipment have been located in the ANSI B11.0 standard under "Mechanical Power Transmission." The specific guidelines to comply with those requirements are contained within this ANSI B11.19 standard (e.g., guards, safe-distance safeguarding, and safe-location safeguarding).

This 2019 revision of ANSI B11.19 contains substantial and significant changes from the 2010 edition, including:

- a change in title as well as a major organizational revision of the standard using the hazard control hierarchy as a general structure of this standard;
  Note: While the organization is based on the hazard control hierarchy found in ANSI B11.0, the reader is reminded that no order of preference, no level of risk reduction, or any relationship between risk reduction measure options are implied within this standard.
- removal of the concept of "complementary equipment and measures;"
- improved and harmonized definitions of terms used in the standard with ANSI B11.0 and applicable ISO and IEC standards;
- clarification of the responsibilities of the supplier, user, integrator/modifier/rebuilder, and personnel;
- enhanced and harmonized requirements throughout the standard (see **Harmonization** above);
- addition of requirements for Partial Guards, Nip Guards, and Trapped (Captive) Key;
- a segmentation of Perimeter Guards (barriers), Perimeter Risk Reduction Measures, and Whole body Access;
- addition of requirements for control functions, including safe conditions (safe motion, safe speed, etc.), safety-related reset, safety-related sensing field switching, whole body access and span of control;
- additional guidance in informative annexes including a significant addition to Safety distance and Reaching Distance for both protective structures and devices;
- additional content for risk reduction measures not previously included in prior versions of ANSI B11.19.

To minimize repetitive and duplicative language, the reader of this document must be aware of internal normative references within each of the major clauses and subclauses. As an example, clause 6 (and all internal references) applies to all risk reduction measures, 10.1 (and all internal references) applies to all engineering controls - devices, and 10.7.1 (and all internal references) applies to all presence-sensing devices. To facilitate use of this voluminous standard, hotlinks to intra-document references have been created.

As a guide to the changes from the 2010 revision to this revision, a separate annex has been created to identify the location of 2010 requirements within this standard. See Annex P.

Terminology

This 2019 revision of ANSI B11.19 uses the more inclusive term ***"risk reduction measures"*** to replace the historical term "**safeguarding**" in most instances. *Safeguarding* includes guards, safeguarding devices, awareness devices, and safeguarding methods. *Safeguarding* is actually a subset of the more comprehensive term *risk reduction measures*. Although the term *safeguarding* has been used in the U.S. for decades, there has been some confusion as to its use and specific technical meaning, particularly considering globalization and with the attendant increasing international commerce and industry. As a result, this version of ANSI B11.19 has been harmonized to use the new term ***"risk reduction measures"*** except in cases where "safeguarding" is an integral part of a named risk reduction measure or in cases where replacement may cause additional confusion.

In the effort to standardize on the term "risk reduction measures," the term "complementary equipment and measures" has also been removed. ANSI B11.19-2010 considered that the function of "complementary equipment or measures" was to ensure or augment the proper operation of the associated risk reduction measures (safeguarding). See P.1.1 of Annex P. This revision of ANSI B11.19 also updates the terminology to clarify technical meaning with the intent to achieve greater precision in the terms used.

Context

The writers of this document understand that the reader/user of this American National Standard is unlikely to read it cover-to-cover but instead (for example), might use the Table of Contents as a sort of 'roadmap' to find a very specific topic and then review only that topic. However, the reader/user of this standard is informed that the elements (clauses, subclauses, etc.) of these documents are sequenced and often interrelated in such a way as to state requirements that may very well be dependent on text in a section(s) that precedes the actual requirement. It therefore becomes vital and important for the reader/user of this standard to ensure they understand the depth, range and especially the context of the section or topic in which the actual requirement appears.

Inquiries with respect to the application or the substantive requirements of this standard, and suggestions for its improvement are welcomed, and should be sent to the B11 Standards, Inc. POB 690905, Houston, TX 77069 - Attention: B11 Secretariat.

This standard was processed and submitted for ANSI approval by the B11 Standards Development Committee (B11 SDC) 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 SDC was composed of the following member organizations:

Alan Metelsky, FS Eng, Chair / Anne Mathias, PE, Vice-Chair / David A. Felinski, Secretary

Organizations Represented	Names of Representatives (Delegates and Alternates)	
AHT Insurance	John Russell, PE, CSP, CPE	Alex Johanek
Aluminum Extruders Council	Mel Mitchell, CSP	Bradley Wyatt, CSP
American Society of Safety Professionals	Bruce Main, PE, CSP	Anne Mathias, PE (Vice-Chair)
Association For Manufacturing Technology	Russ Bensman	Alan Metelsky, FS Eng (Chair)
The Boeing Company	Jennifer Barber	Steven Thomas
Bridgestone	Kenji Furukawa, FS Eng	Joey Hinson
Canadian Standards Association	Andrea Holbeche, P.Eng	Walter Veugen
Deere & Co.	Tony Beeth	Scott Winter
Euchner	Mark Witherspoon	Henry Toal
Exponent	Stephen Andrew, PE	Torsten Skujins

FDR Safety	Mike Taubitz	Joe Wolfsberger
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Grantek	Jeff Winter, FS Eng, CSP	Patric Brown
Komatsu America Industries	George Schreck	James Landowski
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MAG Automotive	Erik Carrier	Doug Watts
Metal Powder Industries Federation	Dennis Cloutier, CSP	James Adams
National Institute for Occupational Safety & Health	Rick Current, PE	
Occupational Safety & Health Administration	Ken Stevanus	James McManus
Omron Scientific Technologies Incorporated	Tina Hull, FS Exp	Frank Webster
PMMI, Assn. for Packaging & Processing Technologies	Charles (Fred) Hayes	Tom Egan
Pilz Automation Safety, LP	Michael Beerman	Doug Sten, PhD, CSP
Plastics Industry Association	Jennifer Jones	Dale Bartholomew
Precision Metalforming Association	Jim Barrett, Jr. PhD	David Klotz
Presence-sensing Device Manufacturers Assoc.	Jim Kirton	Mike Carlson
Robotic Industries Association	Carole Franklin	Jeff Fryman
Rockwell Automation	Pat Barry, FS Exp	Michael Poynter, FS Eng
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Sub-Zero Group	Chad Pierce, CSP	Bill Lawrie
Toyota Motor Manufacturing North America	Earl Sowders	Chip Boertlein

At the time this standard was approved, the ANSI B11 ASC B11.19 Subcommittee had the following members who participated in the development of this revision:

Michael Carlson	Banner Engineering	Chairman
Heinz Knackstedt, FS Eng	Machine Control Safety Training	Vice-Chairman
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David Felinski	B11 Standards, Inc.	Secretary
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Mark Witherspoon	Euchner	
Paul Wozniczka	MTS Systems	

Explanation of the format, and ANSI B11 conventions

This 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 believed would help to clarify the requirements contained in 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.

Generally speaking, 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, however, the terms can often be used interchangeably.

B11 conventions:

The use of “hard” conversion between metric and English units does not imply a tolerance requirement.

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 conformance with the standard.

The ANSI B11 standards generally use the term “OR” as an inclusive disjunction, meaning *one or the other or both,* but on occasion will use the term “and/or” to emphasize the fact that both are fully intended in cases where the Subcommittee believed it was imperative to make that clear.

A distinction between the terms “*individual*” and “*personnel*” is drawn. Individual includes personnel (employees, subcontractors, consultants, or other contract workers under the indirect control of the supplier or user) but also encompasses persons who are not under the direct or indirect control of the supplier or user (e.g., visitors, vendors, etc.).

Introduction

A main purpose of every ANSI B11 machine is to process materials. 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 can result in injury.

The purpose of the ANSI B11 series of machinery safety standards is to devise and propose ways to eliminate or minimize risks of the potential hazards associated with the required tasks. 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. 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.

Organization and Application of B11 Documents

The ANSI B11 standards and technical reports can be associated with the ISO "type A-B-C" structure as described immediately below, and as shown in Figure 1.

- **Type-A standards** ('basis' or 'foundational' standards) give basic concepts, principles for design, and general 'foundational' aspects that can be applied broadly across different types of machinery;
- **Type-B standards** (generic safety standards) deal with one or more safety aspects (type B-1)or one or more types of safety devices (type B-2) 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 B11.19 standard on risk reduction measures is primarily a "type – B" standard in that it addresses the overall concept of risk reduction measures as they apply to a broad array of machines, and contains very general requirements. However, in some areas, it also contains very specific requirements. ANSI B11.19, B11.20, B11.21, B11.25, B11.26 and the entire B11 series of Technical Reports are all "type-B" documents addressing general safety elements or concepts/constructs that can be used across a wide range of machinery, or as a document addressing safety considerations when combining machines (ANSI B11.20). The ANSI B11 series of Technical Reports are informative documents that may be generally applied to many different machines, and as such would fall into the "type-B" category. The machine-specific ("base" or "type-C") ANSI B11 safety standards contain detailed safety requirements for a particular machine or group of machines.

The type-A ANSI B11.0 and the type-B ANSI B11.19 are intended to be used concurrently with the type-C (machine-specific) standard 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 another type-B or type-A 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 using feasible risk reduction to achieve acceptable risk.

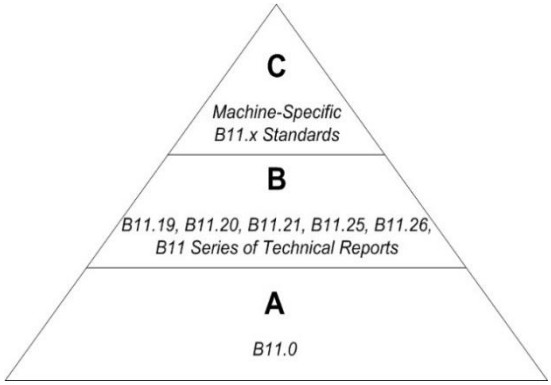

Figure 1 — Organization of the B11 Series of Documents

The responsibility for reducing these risks to an acceptable level is divided between the machine supplier, the machine modifier, the machine user and its operating personnel, as addressed in Annex A.

As of the date of approval of this standard, the ANSI B11 series of American National Standards and Technical Reports on machinery safety consisted of the following documents shown in the list below. The user should check a licensed reseller such as ANSI (www.ansi.org) for the current versions of any of these documents. All archival / historical versions of the documents are available at www.b11standards.org.

List of the ANSI B11 Series of Safety Standards and Technical Reports

#	SHORT TITLE / TOPIC	YEAR	TYPE
B11.0	Safety of Machinery	2020	A
B11.1	Mechanical Power Presses	2009 (R14)	C
B11.2	Hydraulic & Pneumatic Power Presses	2013	C
B11.3	Power Press Brakes	2012	C
B11.4	Shears	2003 (R13)	C
B11.5	Ironworkers	1988 (R13)	C
B11.6	Manual Turning Machines w/ or without Auto Control	2001 (R12)	C
B11.7	Cold Headers and Cold Formers	1995 (R15)	C
B11.8	Manual Milling, Drilling, & Boring Machines	2001 (R12)	C
B11.9	Grinding Machines	2010 (R15)	C
B11.10	Sawing Machines	2003 (R15)	C
B11.11	Gear and Spline Cutting Machines	2001 (R12)	C
B11.12	Roll Forming and Roll Bending Machines	2005 (R15)	C
B11.13	Single & Multiple-Spindle Automatic Bar and Chucking Machines	1992 (R12)	C
B11.14	Coil Slitting Machines (Withdrawn; content combined into B11.18)	Withdrawn	---
B11.15	Pipe, Tube and Shape Bending Machines	2001 (R12)	C
B11.16	Powder / Metal Compacting Presses	2014 (R20)	C
B11.17	Horizontal Hydraulic Extrusion Presses	2004 (R15)	C
B11.18	Machines Processing or Slitting Coiled or Non-Coiled Metal	2006 (R12)	C
B11.19	Performance Requirements for Risk Reduction Measures (Safeguarding)	2019	B
B11.20	Integration of Machinery into Systems	2017	B
B11.21	Machine Tools Using Lasers for Processing Materials	2006 (R12)	B
B11.22	Turning Centers and Automatic Numerically Controlled Turning Machines	2002 (R12)	C
B11.23	Machining Centers & CNC Milling, Drilling & Boring Machines	2002 (R12)	C
B11.24	Transfer Machines	2002 (R12)	C
B11.25	Large Machines	2015	B
B11.26	Functional Safety for Machinery/Equipment	2018	B
B11.27	Electro-Discharge Machines	201x	C
B11.TR1	Ergonomics	2016	B
B11.TR2	Metal Working Fluids	1997 (R16)	B
B11.TR3	Risk Assessment / Risk Reduction (Withdrawn; contained in B11.0)	Withdrawn	---
B11.TR4	Selection of Programmable Electronic Systems (PES/PLC)	2004 (R15)	B
B11.TR5	Noise Measurement	2006	B
B11.TR6	Safety Control Systems for Machines	2010	B
B11.TR7	Integration of Lean and Safety	2007 (R17)	B
B11.TR8	Inspection and Maintenance of Risk Reduction Measures	202x	B
B11.TR9	Guidance on Machinery Safety Cybersecurity Aspects	2019	B
B11.TR10	Guidance on Artificial Intelligence into Machinery Safety Applications	202x	B
ANSI/ISO 12100	Safety of machinery (identical adoption of ISO 12100-2010)	2012	A

Performance Requirements for Risk Reduction Measures: Safeguarding and other Means of Reducing Risk

STANDARD REQUIREMENTS	EXPLANATORY INFORMATION
	(This column is not a normative part of the requirements of this ANSI B11.19-2019 American National Standard for Machines)
1 Scope	***E1***
This standard provides performance requirements for the design, construction, installation, operation, and maintenance of the risk reduction measures listed below when applied to machines. • inherently safe by design (see clause 7); • engineering controls – guards (see clause 8); • engineering controls – control functions (see clause 9); • engineering controls – devices (see clause 10); • administrative controls (see clause 11).	The manufacturer or supplier referred to in this standard is the manufacturer or supplier of the risk reduction measures (see clause 3 definitions of *manufacturer* and *supplier*).
This standard does not provide the requirements for the selection of the risk reduction measure for a particular application.	See the appropriate ANSI B11 machine-specific "base" (type-C) safety standard or any other related machinery safety standard(s) for the requirements for the selection of the risk reduction measure(s) based on specific applications. Selection of the risk reduction measure(s) requires task and hazard identification, and the application of documented risk assessment and risk reduction of the total production system. See also, ANSI B11.0 for additional information and guidance on risk assessment and risk reduction.
Any deviation in conforming to a requirement of this standard shall be carefully considered and based on a documented risk assessment to achieve acceptable risk. The reasoning and information concerning any deviation shall be included in the information for operation and maintenance of the machinery.	Alternative solutions or a combination of risk reduction measures can provide a best practical solution for a specific application. The user should evaluate the reasoning and the information concerning the deviation to achieve acceptable risk for the specific application. See also, ANSI B11.0. Risk reduction measures and associated equipment technologies are 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. See also, Annex O.