ANSI B11 MACHINERY SAFETY STANDARDS PUBLISHED

By David Felinski, Bruce Main and Chris Soranno

Two significant and seminal American National Standards on machinery safety were recently revised and published: ANSI B11.0-2020, Safety of Machinery, and ANSI B11.19-2019, Performance Requirements for Risk Reduction Measures: Safeguarding and Other Means of Reducing Risk.

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Combined, these standards form the foundation for identifying hazards and assessing risks, and for reducing risks to an acceptable level. This article summarizes these new standards and highlights some of the many new additions made since the previous editions. Although written specifically for machinery, these standards can be applied to many different situations and applications, a few of which this article describes.

About ANSI B11

The first B11 standard, Safety Code for Power Presses and Foot and Hand Presses, was published in 1922, and the series now includes nearly three dozen machinery safety documents. Association for Manufacturing Technology assumed responsibility from National Safety Council in 1970 and administered the activity until 2010. B11 Standards Inc. is now the ANSI-accredited standards developing organization for the B11 series of safety standards for machines and is secretariat for the B11 Standards Development Committee. B11 Standards Inc. is also accredited by ANSI as the U.S. Technical Advisory Group (TAG) administrator to two International Organization for Standardization (ISO) technical committees (TC): ISO/TC 199 on machinery safety and ISO/TC 39/SC 10 on machine tool safety.

The B11 committee is comprised of organizations representing different stakeholder groups with substantial interest and competence in the overall scope of B11 standards, including ASSP. It is recognized by ANSI as the body that evaluates and votes on final draft standards or technical reports developed by B11 writing subcommittees for approval as American National Standards (or registration as technical reports) by ANSI's Board of Standards Review.

The scope of the B11 committee is standardization of concepts, general principles and requirements for safety of machinery incorporating terminology, methodology and risk-reduction measures for new, existing, modified or rebuilt power driven industrial and commercial machinery, not portable by hand while working. This includes associated equipment that may be used in the production system.

Organization & Application of B11 Documents

The B11 standards and technical reports can be associated with the ISO type A-B-C structure as shown in Figure 1 (p. 21; ANSI, 2019, 2020; Soranno, 2014). ANSI B11.0 is a type-A standard in that it applies to a broad array of machines and contains general requirements. However, in some sections, it also contains specific requirements. ANSI B11.19, B11.20, B11.21, B11.25, B11.26 and the entire B11 series of technical reports are all typical type-B documents that address general safety subjects or elements that can be used across a wide range of machinery (e.g., ANSI B11.19 on risk-reduction measures, ANSI B11.26 on functional safety or B11.TR1 on ergonomics) or as a standard when integrating machinery into a system (ANSI B11.20). The B11 series of technical reports are informative documents that may be generally applied to many different machines and, as such, would all fall in the type-B category. The machine-specific base (type C) B11 standards contain detailed safety requirements for a particular machine type or group of machines (see the machine and machinery system safety standards in Table 1, p. 20).

The safety of machinery depends on the practical application of the risk assessment process. The type-A (B11.0) and type-B standards are intended to be used concurrently with the type-C (machine-specific) standards during the risk assessment process by the supplier and user of machines (see Soranno, 2014, for further discussion).

U.S. & ISO Engagement/Harmonization Efforts

The B11 committee attempts to harmonize its standards internally across the series by adopting a common format and dealing with recurring topics consistently (e.g., supplier/user responsibilities and risk assessment). This can prove challenging when individual writing subcommittees meet to begin revisions and attempt to continuously improve on the work of those before them. As one can imagine, it does not take long for inconsistencies to develop.

The B11 committee remains committed to working closely with its European and other international colleagues at both ISO and International Electrotechnical Commission toward the close harmonization with European norms and international machinery safety and machine tool safety standards from ISO/TC 199 and ISO/TC 39/SC 10, respectively.

The Writing Community & Balance of Views

Although the B11 committee has its own unique set of ANSI-approved operating procedures, they are based on the ANSI essential requirements for developing American National Standards by applying, administering and enforcing the five cardinal

principles of standards development: balance, due process, openness, lack of dominance and a mechanism for appeals.

The New ANSI B11 Machinery Safety Standards

Following is a summary of key information from ANSI B11.0-2020, Safety of Machinery, and ANSI B11.19-2019, Performance Requirements for Risk Reduction Measures: Safeguarding and Other Means of Reducing Risk, including new elements of each standard.

ANSI B11.0-2020, Safety of Machinery

The concepts and principles contained in ANSI B11.0 can be applied broadly to a wide variety of systems and applications. The document sets the standard for machinery safety for a broad array of machinery by using the risk assessment process (Figure 2).

Purpose

ANSI B11.0 guides machinery suppliers and users through a risk assessment process designed to ensure that reasonably foreseeable hazards are

TABLE 1
ANSI B11 SERIES OF SAFETY STANDARDS & TECHNICAL REPORTS

Standard	Short title/topic	Year	Type
B11.0	Safety of Machinery	2020	A
B11.1	Mechanical Power Presses	2009 (R14)	C
B11.2	Hydraulic and 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 With or Without Auto Control	2001 (R12)	C
B11.7	Cold Headers and Cold Formers	1995 (R15)	C
B11.8	Manual Milling, Drilling and 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 and Multiple-Spindle Automatic Bar and Chucking Machines	1992 (R12)	C
B11.14	Coil Slitting Machines; combined into B11.18	Withdrawn	C
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 a System	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 and CNC Milling, Drilling and Boring Machines	2002 (R12)	C
B11.24	Transfer Machines	2002 (R12)	C
B11.25	Large Machines	2015	B
B11.26	Functional Safety for Equipment/Machine Control Systems	2018	B
B11.27	Electro-Discharge Machines	2020	C
B15.1	Mechanical Power Transmission Apparatus	Withdrawn	B
B11.TR1	Ergonomics	2016	B
B11.TR2	Metal Working Fluids	1997 (R16)	B
B11.TR3	Risk Assessment/Risk Reduction Guide	Withdrawn	B
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	Withdrawn	B
B11.TR7	Integration of Lean and Safety	2007 (R17)	B
B11.TR8	Sustainable Safety Systems Through Inspection of Risk Reduction Measures	202x	B
B11.TR9	Cybersecurity	2019	B
B11.TR10	Guidance on Artificial Intelligence Into Machinery Safety Applications	202x	B
ANSI/ISO 12100 Safety of Machinery (an identical adoption of ISO 12100-2010)		2012	A

Note. Adapted from "Performance Requirements for Risk Reduction Measures: Safeguarding and Other Means of Reducing Risk (ANSI B11.19-2019)," by ANSI, 2019; and "Safety of Machinery (ANSI B11.0-2020)," by ANSI, 2020.

identified and that corresponding risks are reduced to an acceptable level.

Scope

The standard applies to new, modified or rebuilt power-driven machines, not portable by hand, used to shape 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).

Objective

The standard's objective is to eliminate injuries to personnel from machinery or machinery systems by establishing requirements for the design, construction, reconstruction, modification, installation, setup, operation and maintenance of machinery or machine systems.

Responsibilities have been assigned to the supplier (i.e., manufacturer, the reconstructor and the modifier), the user and the user personnel (employees) to implement the standard.

The standard has been harmonized with international and European standards by the introduction the risk assessment process as the principal method for analyzing hazards to personnel to achieve a level of acceptable risk. The standard integrates the requirements of ISO 12100:2010, Safety of Machinery—General Principles for Design—Risk Assessment and Risk Reduction. Suppliers meeting the requirements of ANSI B11.0 may simultaneously meet the requirements of ISO 12100.

Responsibilities

The standard outlines responsibilities that machinery suppliers and users have for defining and achieving acceptable risk. According to the standard:

> The supplier and the 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 as described in this standard.
>
> Although the responsibilities of the supplier and the user differ over the life cycle of the machinery, each uses the risk assessment process.
>
> In general, the machinery supplier is responsible for the design, construction and information for operation and maintenance of the machine, while the user is responsible for the operation and maintenance of the machine. Responsibility for installation of the machinery usually depends on the terms of the purchase agreement. (ANSI, 2020, p. 29)

What's New

The new edition of the standard includes updates in the following areas:

- guidance on how to use ANSI B11.0 and type-C standards
- clarity on responsibilities for component suppliers, machine suppliers and machine users
- additional emphasis on the feasibility of risk reduction measures
- improved guidance on how to address existing (legacy) equipment
- additional guidance on prevention through design, achieving acceptable risk, and validating and verifying risk reduction measures
- new content on layout analysis for control zones, span of control, manual and special modes, and related to how to use alternative methods for controlling hazardous energy
- new requirements for machinery systems
- updates to injury and severity correlations
- updated outline for instruction handbook/manual
- information on correlating various safety standards and on defining terms for affected persons
- changes to terms to improve precision of meaning, as well as clarity of terms and definitions
- removal of unnecessary or redundant content

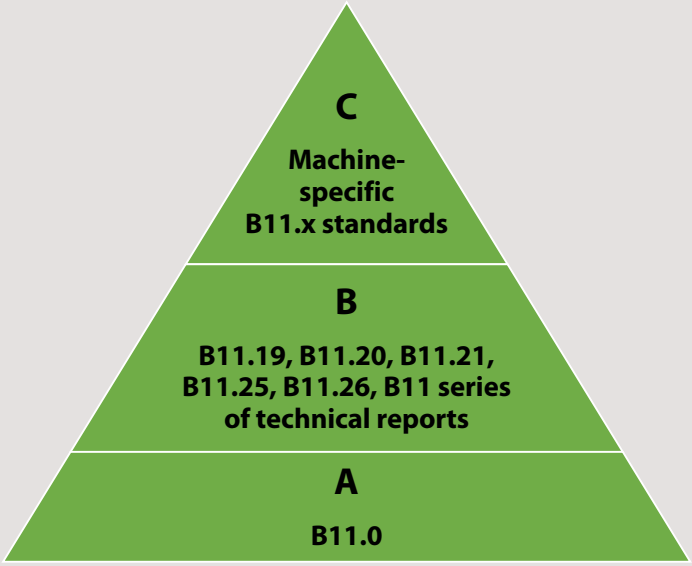
ANSI B11.19-2019

The B11.19 standard is organized around the hazard control hierarchy. The selection of which risk reduction measure(s) should be used is based on risk as determined in a risk assessment per ANSI

FIGURE 1

ORGANIZATION OF THE B11 SERIES OF DOCUMENTS

Type-A standards (basic safety 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 or one or more types of risk reduction measure that can be used or applied across a wide range of machinery; and Type-C standards (machine safety standards) deal with detailed safety requirements for a particular machine or group of machines.



Note. Adapted from "Performance Requirements for Risk Reduction Measures: Safeguarding and Other Means of Reducing Risk (ANSI B11.19-2019)," by ANSI, 2019; and "Safety of Machinery (ANSI B11.0-2020)," by ANSI, 2020.

B11.0. ANSI B11.19 addresses how to apply different risk-reduction measures once a measure has been selected. As a result, the standard applies broadly to machinery, equipment and facilities where risk-reduction measures are used (see Soranno, 2020, for a more detailed discussion).

The standard's length (roughly 250 pages) can be daunting to the reader. The standard's electronic version contains hyperlinks for easy navigation when other clauses are referenced. Readers familiar with the standard's 2010 version will find a table in Annex P cross-referencing the prior subclause topic location with its corresponding new location in the 2019 revision.

General

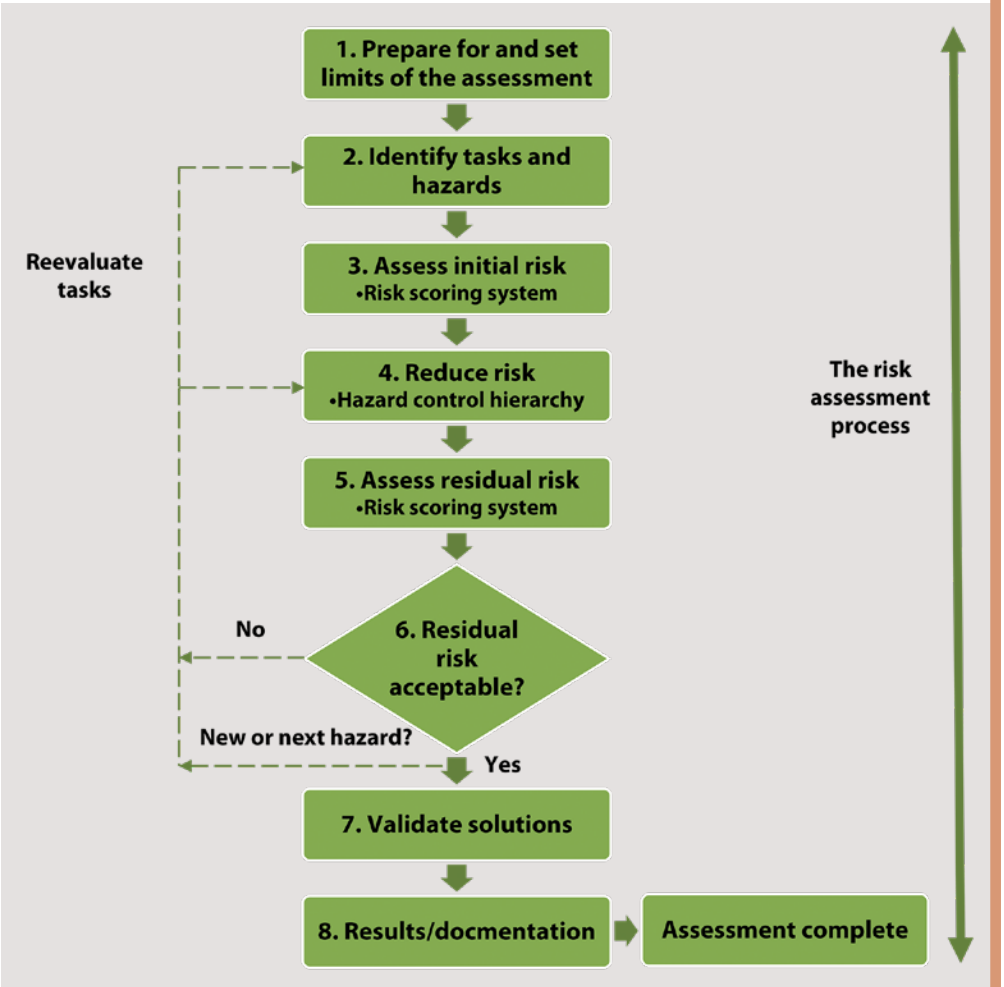
The standard's primary objective is to establish the requirements for the design, construction, installation, operation and maintenance of the risk-reduction measures used to eliminate or control hazards to individuals associated with machines. It relies on other standards to determine which risk-reduction measures are required or allowed to control identified hazards or hazardous situations, and is intended to be used in conjunction with B11.0. The standard establishes responsibilities for the supplier (e.g., manufacturer, rebuilder, installer, integrator, 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

According to the 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. (ANSI, 2019)

FIGURE 2
RISK ASSESSMENT PROCESS



Note. Adapted from "Safety of Machinery (ANSI B11.0-2020)," by ANSI, 2020, Figure 6, p. 38.

Harmonization

The requirements of the standard were harmonized with similar requirements in several international and European standards. This does not mean duplication of exact requirements. Rather, it means that the requirements have been aligned in essence to achieve a similar level of risk reduction.

While international standards tend toward individual documents for each type of risk-reduction measure (e.g., light curtains, emergency stop controls, prevention of unexpected start-up), ANSI B11.19 combines the various requirements into a single standard, thereby allowing readers to understand and compare the requirements for different approaches to reducing risk. The standard's annexes help readers identify and understand the correlation of the various national and international standards.

Scope

The standard provides performance requirements for the design, construction, installation, operation and maintenance of the following risk reduction measures when applied to machines:

•inherently safe by design
•engineering controls—guards
•engineering controls—control functions
•engineering controls—devices
•administrative controls

Standards often include responsibilities for different stakeholders involved; ANSI B11.19 is no different. Clarification has been given to the responsibilities of the supplier, user, integrator/modifier/rebuilder and personnel. User responsibilities are not addressed in ISO standards; therefore, it is important for companies selling and using machines in different countries to note the different responsibilities.

What's New

The 2019 revision of the standard contains substantial and significant changes from the 2010 edition:

•title change and major organizational revision of the standard using the hazard control hierarchy as a general structure of the standard
•addition of requirements for partial guards, nip guards, and trapped (captive) key
•segmentation of perimeter guards (barriers), perimeter risk-reduction measures and whole-body access
•additional requirements for control functions, including safe conditions (e.g., safe motion, safe speed), 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
•removal of the complementary equipment and measures concept
•improved and harmonized definitions of terms and requirements

The revision also updates the terminology to clarify technical meaning for greater precision in the terms used.

Applications

ANSI B11.0 and ANSI B11.19 can be and have been applied to various applications. Obviously, the list of machines and machinery in Table 1 (p. 20) all apply. However, the general applicability of these standards has been used for a wide variety of additional situations such as:

•longshoring automation of transferring cargo containers from ship to shore to rail/truck delivery
•consumer products
•industrial fixed and mobile robots
•airport baggage handling systems
•glass making operations
•insulation operations
•industrial furnaces
•wire wrapping
•semiconductor manufacturing
•pharmaceutical applications
•food and beverage processes
•packaging and processing equipment
•bulk material handling
•wind turbines

The approach and terminology used in the B11 series is common for machinery, and closely aligned with the content in ANSI/ASSP Z590.3, Prevention through Design, and ANSI/ASSP Z244.1, Control of Hazardous Energy. There are some differences from the approaches and terminology used in the ISO 45001 standard and related standards approaches for risk management.

Machinery manufacturers and users should obtain and start to use the new ANSI B11.0 and B11.19 standards. **PSJ**

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Learn more about the B11 standards at www.b11standards.org/standards.