ANSI B11.27–2020

American National Standard

Safety Requirements for Electro Discharge Machines

ANSI-Accredited Standards Developer and Secretariat:

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Houston, TX 77269, USA

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AMERICAN NATIONAL STANDARDS

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FOREWORD

(This Foreword is not part of the requirements of American National Standard B11.27-2020)

This American National Standard began using the ISO 28881-2013 standard as a 'template' document; that standard is an international type-C standard that deals with the safety requirements for electro discharge machines (EDMs).

The impetus to create a U.S. safety standard for EDMs was based primarily on the fact that while these machines are not currently manufactured in the U.S., they remain in wide use in the U.S., so the B11 SDC agreed to create a type-C standard for EDMs using the ISO standard as a starting point. Two very significant and substantial differences between ISO and ANSI B11 machine safety standards remain however:

- ISO standards *only* address manufacturer (supplier) requirements whereas ANSI B11 standards address *both* supplier *AND* user requirements;
- ISO standards *only* address machines made after the approval date of the standard whereas ANSI B11 standards address *both* new machines *AND* existing 'legacy' machines.

ANSI has rules and procedures regarding the national adoption of ISO standards as American National Standards. The adoption can be:

- **identical** (so noted by containing "IDT" in the alpha-numeric designation meaning that it is identical in technical content, structure and wording with only perhaps minimal editorial changes to the ISO standard, or;
- **modified** (so noted by containing "MOD" in the alpha-numeric designation meaning some changes beyond those above have been made to the ISO standard but is still maintains the "vice-versa" principle; or
- **not equivalent** which means the national standard is not equivalent to the ISO standard in technical content and structure and the changes have not been clearly identified.

Under these adoption rules, ANSI B11.27 would not qualify as either a "identical" or a "modified" adoption of ISO 28881, because this national standard contains many additional user requirements, as well as guidance on using risk assessment to address legacy (existing) machines. The "vice-versa" principle is not maintained in the sense that while compliance with ANSI B11.27 would automatically confer compliance with ISO 28881, however, compliance with ISO 28881 requirements would fall short of meeting the additional requirements for the North American market and that are contained in ANSI B11.27 since there are no "user requirements" in ISO 28881.

This standard is intended to be used by organizations using the subject equipment or undertaking the design, construction, installation and/or supply of such equipment. This standard also includes information to be provided by the supplier to the user.

DIFFERENCES BETWEEN ISO 28881 and ANSI B11.27

As noted above, ANSI B11.27 deals with user requirements and existing (legacy) machines. The structure of the document represents a sort of 'hybrid' structure between the typical ISO document structure and the typical (ANSI) B11 structure in order to better accommodate the changes by including additional requirements for the user and information on existing machines.

HISTORY

This is the first edition of this B11.27 standard, which is a type-C standard. It has been developed to integrate with the broader B11.0 (type-A) standard on general safety/risk assessment and the B11.19 (type-B) standard on risk reduction measures.

The B11 series of standards for machines began with safety requirements for power presses in 1922. Since that time, safety standards/requirements for a variety of machines have been developed and continually updated and revised to become a series of some three dozen B11 standards and technical reports. This series contains Type-A standards such as B11.0 and ANSI/ISO 12100 on broad/general safety requirements, Type-B standards such as B11.19 and all of the B11 technical reports dealing with broad safety aspects such

as risk reduction measures, ergonomics, lean/safety integration and noise, and Type-C standards addressing specific machine types or groups or like machines.

EFFECTIVE DATE

The following information on effective dates is informative guidance only, and not a normative part of this standard. The B11.27 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 B11.27 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 (risk reduction measures) for appropriate risk reduction.

Context (how to read/use this document)

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

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.

Development

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 Felinski, Secretary

Organizations Represented	Name of Representative	
	Delegate	**Alternate**
AHT Insurance	John Russell, PE, CSP	George Forrester
Aluminum Extruders Council	Melvin Mitchell, CSP	Bradley Wyatt, CSP
American Society of Safety Professionals		Anne Mathias, PE
Association For Manufacturing Technology	Russell Bensman	Alan Metelsky, FS Eng
The Boeing Company	Jennifer Barber	Steven Thomas
Bridgestone	Kenji Furukawa, FS Eng	Joey Hinson, FS Eng
Canadian Standards Association	Andrea Holbeche, P.Eng.	Walter Vesnaver
Deere & Co.	Tony Beeth	Scott Winter
Euchner	Ron Yemmans	Brian Farrell, FS Eng
Exponent	Stephen Andrew, PE	Torsten Skujins
FDR Safety	Michael Taubitz	Jon Wolfsberger
General Motors Corporation	Michael Douglas	Stacey Brooks
Grantek	Adam Killian, ASP, FS Eng	Jeff Winter, CSP, FS Eng
Komatsu America Industries	George Schreck	James Landowski
Liberty Mutual	Stanford Brubaker, CSP	Julie Thompson, CSP
MAG Automotive	Erik Carrier	Doug Watts
Metal Powder Industries Federation	Dennis Cloutier, CSP	James Adams
National Institute for Occupational Safety & Health	Richard Current, PE	
Occupational Safety & Health Administration	Kenneth Stevanus	James McManus
Omron Scientific Technologies Incorporated	Tina Hull	Frank Webster
Packaging Machinery Manufacturers Institute	Bruce Main, PE, CSP	Tom Egan
Pilz Automation Safety, LP	Michael Peerman	Doug Sten, PhD
Plastics Industry Association	Jennifer Jones	Dale Bartholomew
Precision Metalforming Association	James Barrett, Jr. PhD	David Klotz
Presence-sensing Device Manufacturers Association	James Kirton	Michael Carlson
Robotic Industries Association	Carole Franklin	Jeff Fryman
Rockwell Automation	Michael Poynter, FS Eng	
Safe-T-Sense	Chris Gerges	Federico Badillo
SICK, Inc.	Chris Soranno, FS Exp	Nate Gose, FS Eng
Sheet Metal & Air Conditioning Contractors' Nat'l Assn.	Michael McCullion	Scott Lollar
Sub-Zero Group	Chad Pierce, CSP	Bill Lawrie
Toyota Motor Manufacturing North America	Chip Boertlein	

At the time this standard was approved, the ANSI B11.27 Electro-Discharge Machines Subcommittee had the following members who participated in the development of this standard:

Name	**Organization**
David Felinski, Chairman	B11 Standards
Chris Felinski, Secretary	B11 Standards
Jennifer Barber	Boeing
Tony Beeth	Deere
Tina Hull	Omron
Steven Thomas	Boeing

Explanation of the format, and ANSI B11 conventions

The 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.

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.

B11 conventions: 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 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

The main purpose of most every industrial machine is to process materials. Inadvertent interference with, or accidental misdirection of 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 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 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 engineering controls (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**.**

The 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, B11.21, B11.25, B11.26, as well as the entire B11 series of Technical Reports are all typical "Type-B" documents addressing general safety elements that can be used across a wide range of machinery (such as B11.19 and B11.20) 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 "Type-B" category. The machine-specific ("Type-C") B11 standards contain detailed safety requirements for a particular machine or group of machines. The Type-A B11.0 and the Type-C (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.

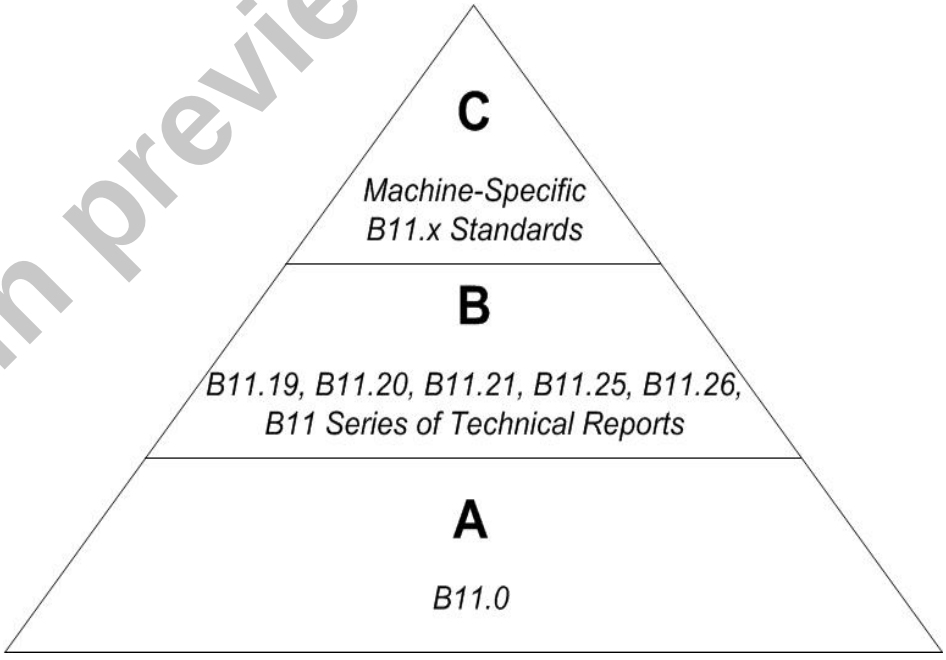

Figure 1 – Organization of the B11 series of documents

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 www.b11standards.org/current-standards or 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/store.

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 (R20)	C
B11.2	Hydraulic & Pneumatic Power Presses	2013	C
B11.3	Power Press Brakes	2012	C
B11.4	Shears	2003 (R20)	C
B11.5	Ironworkers	1988 (R2[illegible])	C
B11.6	Manual Turning Machines w/ or without Auto Control	2001 (R20)	C
B11.7	Cold Headers and Cold Formers	1995 (R2[illegible])	C
B11.8	Manual Milling, Drilling, & Boring Machines	20[illegible]1 ([illegible]20)	C
B11.9	Grinding Machines	20[illegible] (R2[illegible])	C
B11.10	Sawing Machines	2003 ([illegible]20)	C
B11.11	Gear and Spline Cutting Machines	2001 (R12)	C
B11.12	Roll Forming and Roll Bending Machines	[illegible]005 (R20)	C
B11.13	Single & Multiple-Spindle Automatic Bar and Chucking Machines	1[illegible]92 (R20)	C
B11.14	Withdrawn (Coil Slitting Machines; combined into B11.18)	(1996)	C
B11.15	Pipe, Tube and Shape Bending Machines	2001 (R20)	C
B11.16	Powder / Metal Compacting Presses	2014 (R20)	C
B11.17	Horizontal Hydraulic Extrusion Presses	2004 (R20)	C
B11.18	Machines Processing or Slitting Coiled or Non-Coiled Metal	2006 (R20)	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 (R20)	B
B11.22	Turning Centers and Automatic Numerically Controlled Turning Machines	2002 (R20)	C
B11.23	Machining Centers & CNC Milling, Drilling & Boring Machines	2002 (R20)	C
B11.24	Transfer Machines	2002 (R20)	C
B11.25	Large Machines	2015 (R20)	B
B11.26	Functional Safety for Equipment / Machine Control Systems	2018	B
B11.27	Electro-Discharge Machines	2020	C
B11.TR1	Ergonomics	2016	B
B11.TR2	Metal Working Fluids	1997 (R16)	B
B11.TR3	Withdrawn (Risk Assessment / Risk Reduction Guide)	(2000 R15)	B
B11.TR4	Selection of Programmable Electronic Systems (PES/PLC)	2004 (R15)	B
B11.TR5	Noise Measurement	2006	B
B11.TR6	Withdrawn (Safety Control Systems for Machines)	(2010)	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	2020	B
ANSI/ISO 12100	Safety of machinery (identical adoption of ISO 12100-2010)	2012	A

STANDARD REQUIREMENTS EXPLANATORY INFORMATION

American National Standard for Machines –

Safety Requirements for Electro Discharge Machines

(This column is not part of the requirements of this American National Standard for Machines – Safety Requirements for Electro Discharge Machines, ANSI B11.27-2020).

1 Scope

This standard specifies safety requirements and/or risk reduction measures, applicable to Electro Discharge Machine (EDM) equipment and EDM systems, such as:

a) manually controlled
   - die sinking;
   - drilling machines.

b) numerically controlled
   - die sinking;
   - drilling machines;
   - wire cutting machines.

This standard addresses hazardous conditions during the use and foreseeable misuse in normal environments and non-explosive atmospheres and associated machine tasks including transportation, installation, maintenance, repair and dismantling for removal or disposal.

This standard is also applicable to auxiliary devices essential for EDM processing and includes information to be provided by the supplier to the user.

This standard is not applicable to arc eroding and electro-chemical machining equipment.

E1

Electrical discharge machining is a machining method primarily used for hard metals or those that would be very difficult to machine with traditional techniques.

EDM typically works with materials that are electrically conductive, although methods for machining insulating ceramics with EDM have also been proposed.

EDM can cut intricate contours or cavities in pre-hardened steel without the need for heat treatment to soften and re-harden them. This method can be used with any other metal or metal alloy such as titanium, hastelloy, kovar and inconel. Also, applications of this process to shape poly-crystalline diamond tools have been reported.

EDM is often included in the "non-traditional" or "non-conventional" group of machining methods together with processes such as electrochemical machining (ECM), water jet cutting (WJ, AWJ), laser cutting and opposite to the "conventional" group (turning, milling, grinding, drilling and any other process whose material removal mechanism is essentially based on mechanical forces).

Ideally, EDM can be seen as a series of breakdown and restoration of the liquid dielectric in-between the electrodes.

See also, Annex A for several examples of EDMs.