

**ANSI B11.21-2006 (R2020)**

*American National Standard*

# ***Safety Requirements for Machine Tools Using a Laser for Processing Materials***

ANSI-Accredited Standards Developer and Secretariat:



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Houston, TX 77269, USA

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Board of Standards Review



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**FOREWORD (Informative and not part of American National Standard B11.21-2006 R2020)**

The initial subcommittee to draft this standard was established in November 1993, and the 1997 publication was the first issue. This limited revision of B11.21 standardizes the contents and requirements with common elements in the other B11 series of safety standards, and harmonizes with current requirements found in updated normative reference standards. The purpose of this standard is to reduce the risk or eliminate injuries to personnel as a result of the operation or maintenance of a machine tool using a laser for processing materials, and its associated equipment by establishing requirements for the machine's design, construction, safeguarding, operation and maintenance. To accomplish this objective, responsibilities have been assigned to both the supplier and user, as well as to personnel in the working environment.

The safeguarding of machine tools utilizing lasers for machining operations is complicated by the wide variety of operations and operating conditions, the variations in size, speed, and type of machine used; the size 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 material feeding and part and scrap removal. Because of these varying factors in the operations and in the workplace, a wide variety of safeguarding methods (guards and devices) have been covered in this standard.

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.

Suppliers of machine tools using a laser for processing materials must also comply with the *Manufacturer's Requirements for Laser Products* under Title 21 of the Code of Federal Regulations, section 1040.10 (Federal Laser Product Performance Standards -FLPPS), as well as the recordkeeping and reporting requirements of 21 CFR sections 1000 to 1005, 1010 and 1040. This is in addition to the responsibility of the actual laser device supplier (if different from the machine tool supplier) to do so.

The words "safe" and "safety" are not absolutes. Safety begins with good design. While the goal of this standard is to eliminate injuries, it is recognized that risk factors cannot be practically 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 safety factors that must be considered by the user.

**EFFECTIVE DATE**

The following 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 within 30 months of the approval of this standard.

For existing or modified machines, this Subcommittee recommends that users should confirm that the equipment / process has tolerable risk using generally recognized risk assessment methods within 30 months of the approval date of this standard. If the risk assessment shows that modification(s) is necessary, refer to the requirements of this standard to implement protective measures for appropriate risk reduction.

Suggestions for improvement of this standard will be welcome. They should be sent to B11 Standards, Inc., POB 690905, Houston, TX 77269 - Attention: B11 Standards, Inc.-B11 Secretariat.

This standard was prepared by the B11.21 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 reaffirmed as an American National Standard, the ANSI B11 Accredited Standards Committee was composed of the following member organizations:

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

Organizations Represented	Name of Representative	
	Delegate	Alternate
Aerospace Industries Association of America	Willard Wood	Lisa Goldberg / Chris Carnahan
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
The Boeing Company	Don Nelson	Lance Chandler, PE
Canadian Standards Association	Elizabeth Rankin, CRSP	Walter Veugen
Deere & Co.	Gary Kopps	Scott Fowler
FDR Safety	Michael Taubitz	Flavius Brown
General Motors Corporation	Michael Douglas	James Landowski
Komatsu America Industries	George Schreck	Teresa Stillman
Metal Powder Industries Federation	Dennis R. Cloutier, CSP	James Harris, PhD, PE
National Institute for Occupational Safety & Health	Richard Current, PE	Robert Bell
Occupational Safety & Health Administration	Kenneth Stevanus	Christopher Soranno
Omron Scientific Technologies Incorporated	Frank Webster	Maria Ferrante
Packaging Machinery Manufacturers Institute	Charles Hayes	Lee Burk
Pilz Automation Safety, LP	Michael Beerman	Bill Gaskin / Christen Carmigiano
Precision Metalforming Association	James Barrett, Jr. PhD	Michael Carlson
Presence-sensing Device Manufacturers Association	James V. Kirton	John Russell, PE, CSP
Property Casualty Insurers	Stanford Brubaker	Claude Dinsmoor
Robotic Industries Association	Jeffrey Fryman	Michael Miller
Rockwell Automation	Patrick Barry	Mark Witherspoon
Safe-T-Sense	Samuel Boytor	Roy Brown
Sheet Metal & Air Conditioning Contractors Nat'l. Assn.	Michael McCullion	Rod Simmons, PhD
System Safety Society	John Etherton, PhD, CSP	Todd Mills
Toyota Motor Manufacturing North America	Barry Boggs	
International United Automotive Workers	Tom Ford	

At the time this standard was approved, the ANSI B11 ASC **B11.21 Subcommittee** had the following members who participated in the development of this revision:

Chairman: Ancel Thompson, Preco Laser Systems (formerly with Amada)	Dennis Cloutier Scott Filzen Peter Keller	Cloutier Consulting W.A. Whitney Trumpf, Inc.
Secretary: David Felinski, AMT	Karl Oberjohn Thomas Lieb	Cincinnati, Inc. LAI International

## Explanation of the format, and ANSI B11 conventions

This ANSI B11.21 – 2006 (R2020) standard uses a two-column format to provide supporting information for requirements. The material in the left column is confined to “Standard 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.

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 compliance with the standard. The B11 standards do not use the term “and/or” but instead, the term “OR” is used as an inclusive disjunction, meaning *one or the other or both*. 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.). Gauge refers to a measuring or testing instrument; gage refers to limiting device (e.g., backgage).

Suggestions for improvement of this standard will be welcome. They should be sent to B11 Standards, Inc., POB 690905, Houston, TX 77269 - Attention: B11 Secretariat.

## Introduction

The primary purpose of every machine tool is to process parts. This is accomplished by the machine imparting process energy onto the workpiece. Inadvertent interference with, or accidental misdirection of the released energy during production, maintenance, commissioning and de-commissioning may result in injury.

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

The responsibility for the alleviation of these risks is divided between the equipment supplier, its user and its operating personnel, as follows (numbers in parentheses refer to the clause numbers in these standards which address that responsibility):

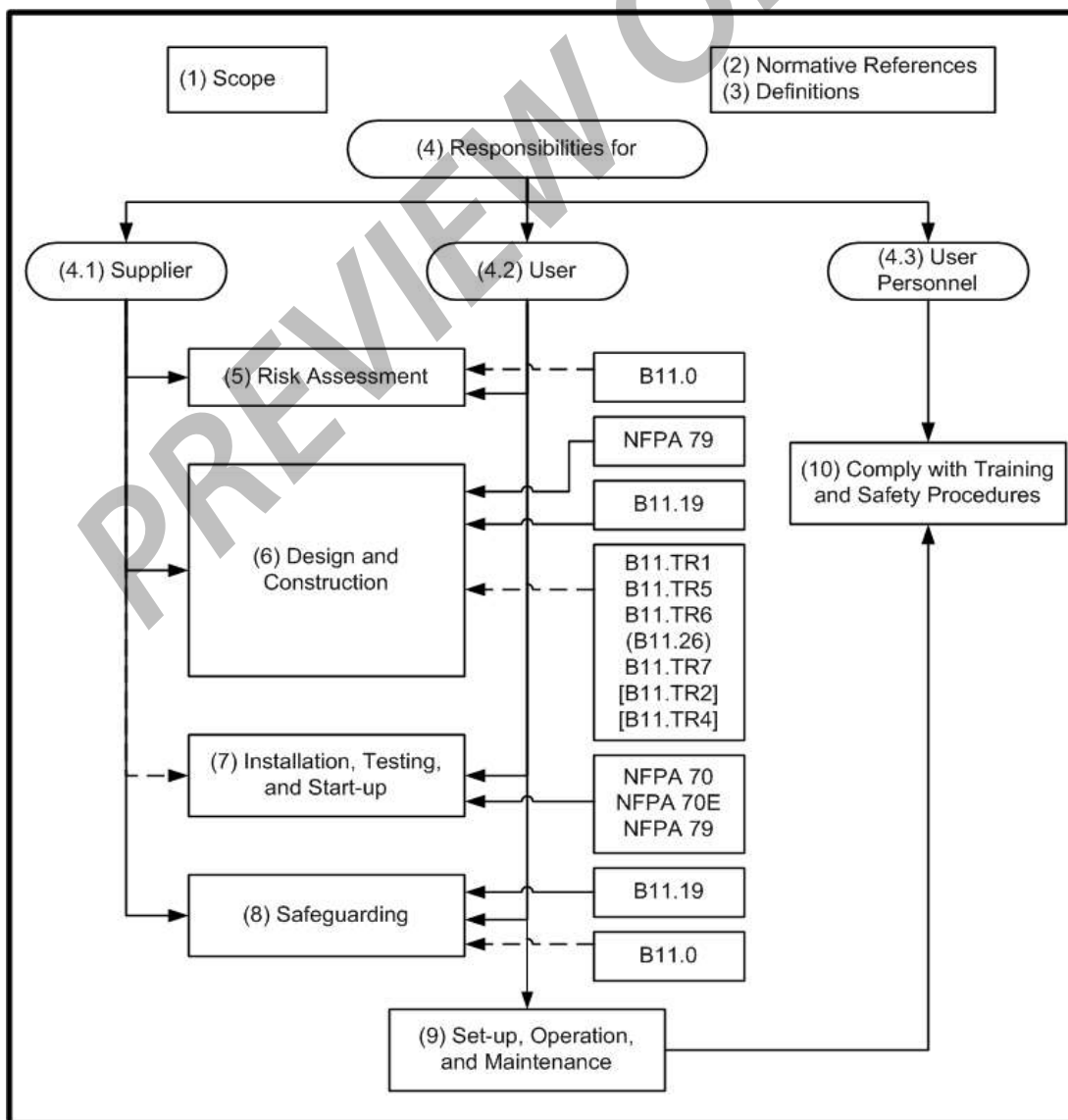


Figure 1 – Typical layout of B11 base standards showing the various responsibilities

Figure 1 (previous page) provides an overview of this standard and in particular, the responsibilities of and requirements for the supplier and user, including the user personnel. Numbers in parentheses denote the particular clause or subclause of the standard. A solid line between a block showing reference standard(s) and a block showing a normative clause denotes part of the requirements. A dashed line denotes an informative reference.

**Notes for Figure 1:**

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



# American National Standard for Machines – Safety Requirements for Machine Tools Using a Laser for Processing Materials

## STANDARD REQUIREMENTS

### 1 Scope

#### 1.1 Scope

This standard applies to machine tools using a laser for processing materials, and its associated equipment. It describes the hazards generated by such machines and states the protective measures to be incorporated into such machines.

The standard also contains requirements for the information provided with such machines.

#### 1.2 Inclusions

Laser material processing includes, but is not limited to, such applications as:

- drilling;
- cutting;
- welding;
- cladding;
- surface melting;
- transformation hardening;
- marking;
- engraving;
- curing;
- ablation;
- laser-shock hardening;
- scribing;
- sintering;
- rapid prototyping;
- stereolithography.

#### 1.3 Exclusions

This standard is not applicable to laser products or equipment containing such products which are manufactured solely for the following applications:

## EXPLANATORY INFORMATION

(Not part of American National Standard – Safety Requirements for Machine Tools Using a Laser for Processing Materials, ANSI B11.21-2006 R2020)

#### E1.1

A machine tool using a laser for processing materials, and its associated equipment using laser radiation is a machine in which a laser(s) provides sufficient energy/power to melt, evaporate, or cause a phase transition in at least a portion of the workpiece.

A machine tool using a laser for processing materials, and its associated equipment is complete and operational when connected to appropriate exhaust/filtration equipment and other utilities (such as gas, electric, coolant, etc.).

This definition differs slightly from the European definition of a complete machine per ISO 12100-1 and 2. Only complete machines may certify compliance to the European Machinery Safety Directive.

- photolithography;
- holography;
- equipment used in medical applications;
- computer data storage;
- laser printers and copiers.

## 2 References

### 2.1 Normative References

#### E2.1

The following documents contain provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All documents are subject to revision, and parties to agreements subject to this American National Standard should apply the most recent editions of the documents listed below.

In addition to these listed normative standards, designers and builders of machine tools using a laser for processing materials, and its associated equipment must comply with 21 CFR §§ 1000-1005, §1010 and §§1040.10-11. The reader should also investigate the existence of any additional mandatory codes, specifications or regulatory standards, e.g., those standards found at 29 CFR Part 1910 (OSHA standards – see also [www.osha.gov](http://www.osha.gov)).

ANSI B11.19-2003, Performance criteria for safeguarding.

ANSI / ASSE Z244.1-2003, American National Standard for Personnel Protection - Lockout/Tagout of Energy Sources - Minimum Safety Requirements.

NFPA 70-2005, National Electrical Code.

NPFA 70E-2004, Electrical Safety Requirements for Employee Workplaces.

NFPA 79-2002, Electrical Standard for Industrial Machinery.

ANSI Z136.1-2000, Standard for Safe Use of Lasers.

### 2.2 Informative References

#### E2.2

The documents in E2.2 are not normative references, but may be helpful in conforming to the requirements of this standard.

29 CFR 1910.147, The control of hazardous energy (lockout/tagout).