

ANSI B11.24–2002 (R2012)

American National Standard for Machines –

Safety Requirements for Transfer Machines

Secretariat and Accredited Standards Developer:
B11 Standards, Inc.
POB 690905
Houston, TX 77269

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American National Standards Institute



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Foreword (This Foreword is not part of the requirements of American National Standard B11.24-2002 R2012)

The primary objective of this standard is to eliminate or control hazards to personnel associated with transfer machines by establishing requirements for the construction, operation and maintenance of these machines. To accomplish this objective, responsibilities have been assigned to the supplier (e.g., manufacturer, rebuilder, reconstructor, installer, integrator), the user, and personnel in the working environment.

This standard began development in the late 1990's after recognition of the need for a safety standard to address the supplier and user needs involving these machines, and approved by ANSI in 2002. This American National Standard was reaffirmed by ANSI in 2007, and again in 2012.

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.

Transfer machines 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.

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.

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 77269-0905, Attention: B11 Secretariat.

This standard was prepared by the B11.24 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:

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Barry Boggs, Vice-Chairman
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Toyota Motor Manufacturing North America	Barry Boggs	Todd Mills
International United Automotive Workers	Tom Ford	

At the time this standard was approved, the ANSI B11 ASC **B11.24 Subcommittee** had the following members who participated in the development of this standard:

Name	Company	Title
Ronald K. Farleman, PE	Masco Machine	Chairman
John F. Bloodgood, PE	JFB Enterprises	Secretary
Anthony M. Bratkovich, PE	AMT	Administrator
Joe Ammond	Daimler Chrysler	
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Charles Hayes	Ford	
James Howe	UAW	
Joe Lovati	Cargill Detroit	
Warren Stanford	GM	
Stephen L. Stevens	Cross Hueller	
Gene Tkachuk	Lamb-Technicon	

Explanation of the format of this standard, and ANSI B11 conventions

This ANSI B11.24 – 2002 (R2012) American National Standard is divided into parts formerly referred to as sections or chapters and now referred to as clauses in line with the current ANSI style manual. Major divisions of clauses are referred to as subclauses and, when referenced by other text in the standard, are denoted by the subclause number (e.g., see 5.1).

The 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 clarify 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 AMT – POB 690905, Houston, TX 77269-0905 - 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):

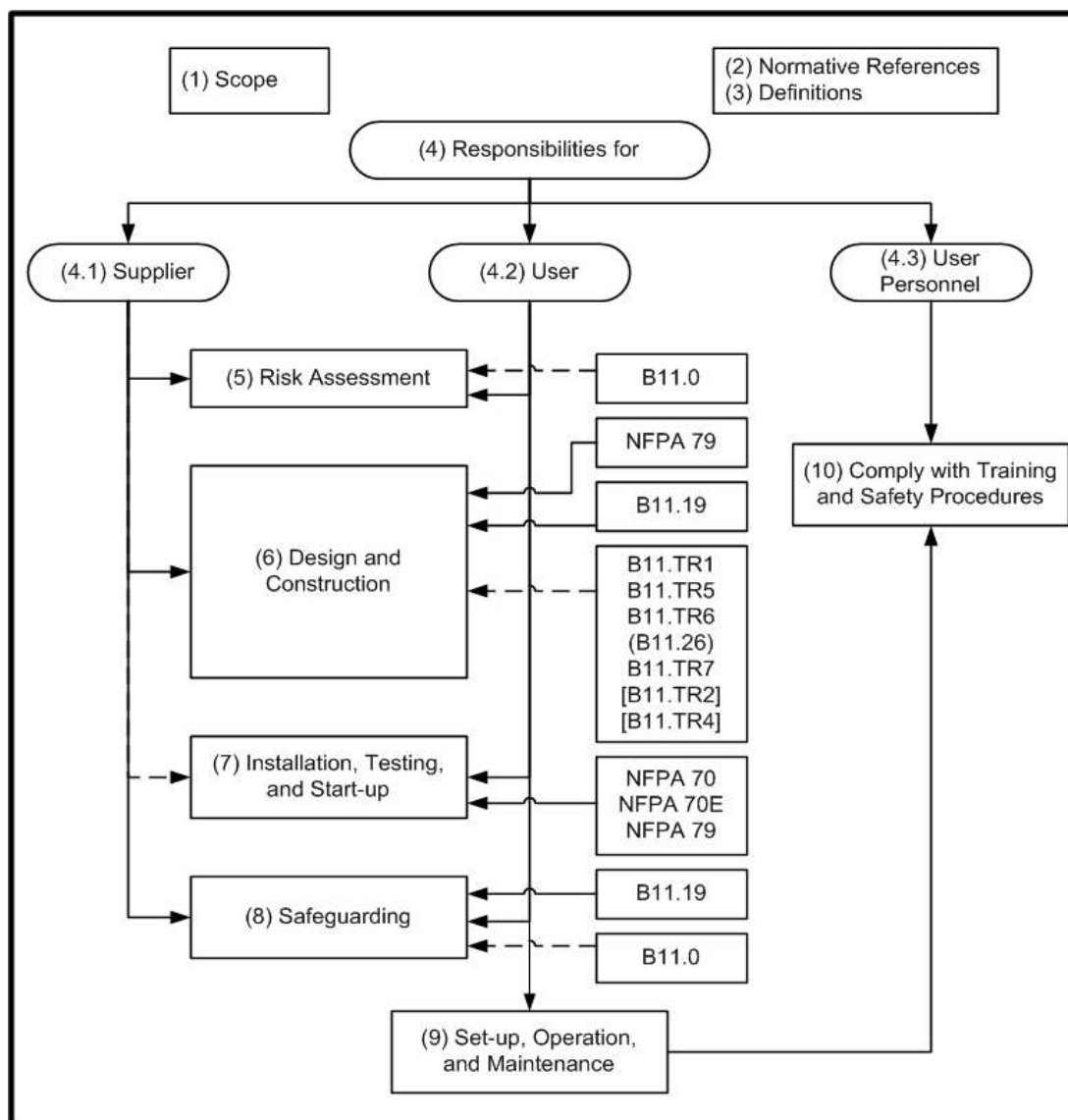


Figure 1 – Typical layout of B11 base standards showing the various responsibilities

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 Transfer Machines

STANDARD REQUIREMENTS

1 Scope

This standard specifies the safety requirements for the design, construction, operation and maintenance (including installation, dismantling and transport) of transfer machines.

1.1 General

A transfer machine is a machine with more than one station and one or more workpiece transport systems (e.g., transfer bar) designed to process (e.g., machine, assemble) only a pre-specified workpiece or a limited family of workpieces by means of a predetermined sequence of operations and process parameters (see Annex A, Figures 1 and 2).

The terms machine or machinery as used throughout this standard mean transfer machine.

NOTE -- The machine may include one or more of the following elements:

- stations;
- workpiece transport systems (e.g. transfer bars);
- workpiece clamping devices;
- coolant systems;
- swarf removal systems;
- tool storage and automatic tool change systems;
- measurement and test systems.

1.2 Exclusions

This standard is not intended to cover safety requirements of manufacturing systems/cells (integrated manufacturing systems; see ANSI B11.20), nor of transfer press lines.

2 Normative references

The following normative 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.

EXPLANATORY INFORMATION

(This column is not part of the requirements of this American National Standard for Machines – Safety Requirements for Transfer Machines, ANSI B11.24-2002 R2012).

E1

E1.1

Transfer machine can also include functions like gaging, leak-testing and other non-machining operations.

Types of transfer machines:

- metal cutting;
- assembly;
- inspection / testing;
- combination of the above.

Types of transfer means:

- in-line;
- shuttle;
- dial index;
- synchronous / non-synchronous.

E2 Informative references

All normative documents are subject to revision and users of this standard are encouraged to investigate applying the most recent revisions of the normative references listed in clause 2.

The following documents (this column, below) are listed for information only, and are not essential for the completion of the requirements of this standard:

Standard Requirements

Explanatory Information

ANSI Z 244.1-1982, *Safety Requirements for the Lock Out/Tag Out of Energy Sources*

NFPA/T2.24.1 R1-2000, *Hydraulic Fluid Power – Systems Standard for Stationary Industrial Machinery-Supplement to ISO 4413: 1998, Hydraulic fluid power – General rules relating to systems*

ANSI B93.114M-1987, *Pneumatic Fluid Power - Systems Standard for Industrial Machinery*

ANSI B11.19-1990, *Performance criteria for the design, construction, care and operation of safeguarding when referenced by other B11 machine tool safety standards*

ANSI B11.TR3 – 2000 *Risk Assessment and Risk Reduction – A Guide to Estimate, Evaluate and Reduce Risks Associated with Machine Tools*

ANSI A14.3-1984, *Safety requirements for fixed ladders*

ANSI B11.TR1 – 1994 *Ergonomic Guidelines for the Design and Installation of Machine Tools*

ANSI / ASME-2001, *Boiler and Pressure Vessel Code; Division 1, Section VIII*

ANSI B11.TR2 – 1997 *Mist Control Considerations for the Design, Installation and Use of Machine Tools Using Metalworking Fluids*

ANSI / ASME B15.1-1992, *Mechanical Power Transmission Apparatus*

NFPA 70-2002, *National Electrical Code*

ANSI / NPFA-70E-1994, *Electrical Safety Requirements for Employee Workplaces*

NFPA 79-2002, *Electrical Standard for Industrial Machinery*

ANSI / IEEE Std. 518: 1982, *IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources*

ANSI / IES-RP-7-1991, *Industrial Lighting*.

NMTBA (AMT) *Noise Measurement Techniques* (1976)

Organization Resources Counselors (ORC) *Management of the Metal Removal Fluid Environment: A Guide to the Safe and Efficient Use of Metal Removal Fluids* (www.orc-dc.org)

Metalworking Fluids: Safety and Health Best Practices Manual (OSHA) (www.osha-slc.gov/SLTC/metalworkingfluids).

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 automatic operation: continuous operation of the machine in accordance with the control data until stopped by the program or the operator.

3.2 awareness device: An attachment that by physical contact warns personnel of an approaching or present hazard.

3.3 awareness signal: A signal that, by means of audible sound or visible light, warns of a present or approaching hazard.

3.4 control reliability: The capability of the machine control system, the safeguarding, other control components and related interfacing to achieve a safe state in the event of a failure within their safety-related functions.

E3.4 See also, *safety-related function*.

3.5 fixture: A means used to locate or support material or workpieces or tools (tooling) during operation.

E3.5 Examples of fixtures are universal tables, angle plates, trunnions, rotating tables, and other removable workholding equipment.

3.6 guard: A barrier that prevents entry into the work zone or other hazard area zone.

3.7 hazard: A condition or set of circumstances that can cause physical harm to exposed personnel.

3.8 helper: An individual who assists another in the operation, maintenance or repair of the machine.

3.9 hold-to-run control device: Control device that initiates and maintains operation of machine elements only as long as the manual control (actuator) is actuated.

3.10 immediate stop command: A command that initiates an action(s) to stop hazardous motion (situation) at any point in the machine cycle.

3.11 installer: An individual, partnership or corporation responsible for placement and preparation for use of a machine.

3.12 integrator: Any supplier that designs, provides, manufactures or assembles a [machine], its associated machines or equipment, the safeguarding, control interfaces, interconnections or the control system into a machine production system. See also *supplier*.

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3.13 jog: To impart motion by momentary manual operation of the jog control device.

3.14 manufacturer: Any supplier that designs, manufactures or assembles machines or systems (see also, *supplier*).

3.15 monitoring: The checking of system components to detect a failure of a component, subassembly or module that affects the performance of the safety-related functions.

3.16 normal stop command: A command that initiates an action(s) to stop motion(s) or situation(s) at the end of a machine cycle or at other points required by the machine functions.

3.17 numerical control (computer numerical control) (NC, CNC): Automatic control of a process performed by a device that makes use of numeric data introduced while the operation is in progress.

3.18 operator: An individual who performs production work and who controls the machine.

3.19 operator control station: The complement of controls used by the operator to operate the transfer machine.

3.20 pinch point: An area, excluding the work zone or trapping space that poses a hazard by exposure to moving parts of the machine, its related machines or equipment or the material or workpieces.

3.21 programmable electronic system (PES): An electronic system that performs logical, decision-making or arithmetic functions by executing instructions in a specific manner. A PES usually includes input and output elements (ports) and is usually re-programmable.

3.22 redundancy: The use of multiple means to perform the same function.

3.23 safety-related function: That portion of the control system or safeguarding device that eliminates exposure to a hazardous situation or reduces exposure to a tolerable level.

3.24 safeguarding: methods for protection of personnel from hazards using guards, safety devices or safe work procedures.

E3.20 The term "pinch point," as used in this standard, refers only to hazards that may exist as a part of the machine or its associated parts. The expression is not used to describe hazards caused by the tooling at the trapping space, since these hazards are a different problem and require different treatment.

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3.25 set-up: The process of adjusting the machine and the installation and adjustment of workholding devices or tooling and appropriate safeguarding to ensure proper and safe operation of the machine.

3.26 shield:

- 1) A barrier used to keep chips or coolant(s) within the machine.
- 2) A barrier used to reduce the potential of tooling parts or workpieces from being ejected from the machine.

3.27 station: The term applies to the fixed positions within a machine at which workpieces are located during the processing portion of the machine working cycle. Stations are normally identified by sequential numbering (see Annex A, Figures 3 and 4), for example:

- | | | |
|--------------|---|--------------------|
| Station 1 | - | Load station |
| Station 2, 4 | - | Machining stations |
| Station 3, 5 | - | Idle stations |
| Station 6 | - | Gaging station |
| Station 7 | - | Unload station |

E3.27 See also, Annex A, Figure 5.

The term station also covers the fixtures, units, heads and other mechanisms associated with the process performed at a particular station.

3.28 stop: Immediate or controlled cessation of machine motion.

3.29 stop command: An action to cause cessation of machine motion either automatically or through human intervention. The stop command can be immediate or normal.

3.30 stop control: An operator control used to initiate a machine stop.

3.31 supplier: An individual, corporation, partnership or other legal entity or form of business that provides or makes available for use all or part of the machine.

E3.31 For the purpose of this standard, a supplier provides or makes available for use all or part of the machine.

NOTE – When the user provides any of the above services, the user is considered to be the supplier within the scope of that work activity.

Besides the manufacturer, the supplier can include the manufacturer's agent, representative, or distributor, reseller, installer, modifier, rebuilder or integrator who provides equipment or services associated with the machine.

3.32 tool [tooling]: Instrument [instrumentation] used in a machine tool to cut or shape material.

3.33 tool trapping space: The space where it is possible to trap body parts between the tooling or its mounting and the workpiece or workholding equipment.

Standard Requirements

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3.34 unit: A single axis or multi-axis module located at a station to carry the tooling, device or mechanism that performs the process on the workpiece (see Annex A, Figure 6).

3.35 user: An entity that utilizes machines and related equipment.

3.36 warning [warning device/signal]: A means used to call attention to a hazard or unsafe work practice.

3.37 work zone: The space within the machine where the metal cutting process takes place.

4 Responsibility

4.1 Supplier's responsibility

It shall be the responsibility of the supplier (e.g., manufacturer, reconstructor, modifier, installer, integrator) to design and construct the machine in accordance with clauses 5, 6, and 8 of this standard.

The supplier shall identify the sources of hazards (see 5.1).

The supplier shall eliminate or provide the means for controlling the identified hazards by implementing a risk reduction (see 5.2).

The supplier shall provide instructional material for installation, testing, start-up, operation, safeguarding, and maintenance.

E4.1

The supplier should refer to clause 2 for applicable standards relative to the product or service provided by that supplier. When safety standards are not provided, safeguarding techniques used on similar equipment should be applied to this type of equipment, where applicable.

The machine documentation should contain the following:

- a) a clear, comprehensive description of the machine and its installation including:
 - foundation requirements (e.g., space allocation, dynamic loading);
 - power consumption requirements;
 - equipment layout;
 - major component weights;
 - work area safeguarding;
 - preparation prior to start-up;
 - energy sources;
 - procedures for transporting and lifting, erection, commissioning and decommissioning;
 - the system performance specifications;
 - physical environment requirements (e.g. lighting, vibration, noise levels, airborne contaminants).

Standard Requirements**Explanatory Information**

The supplier shall provide an operator's manual and a maintenance manual with each machine.

b) information on the:

- programming;
- operation;
- frequency of inspection;
- frequency and method of functional testing;
- guidance on the repair and maintenance of the machine and its safeguards.

These manuals should include the following information:

- function and location of all controls;
- spindle speeds; horsepower; table speeds; length of travel of the slide, spindle, etc.;
- lubrication specification, including recommended lubricants, frequency of lubrication, and locations to be lubricated;
- electrical, hydraulic, lubrication, and pneumatic diagrams;
- periodic maintenance instructions;
- safety instructions for operators, helpers, set-up and maintenance personnel.

Due to the wide variety of machines covered in this standard, specific machines may require additional information.

The supplier shall equip each machine with safeguards (e.g., guards, safeguarding (protective) devices) as appropriate.

The supplier shall be responsible for providing means of isolating or dissipating stored energy associated with the machine.

The supplier shall furnish, in writing or by diagram, the clearances needed by personnel for lubrication, adjustment, chip removal, coolant reservoir cleaning and similar routine maintenance activities.

4.2 User's responsibility

The user shall be responsible for the overall workplace safety of personnel. The user shall review the machine and its associated equipment including installation and set-up and any modifications as provided by the supplier(s) to ensure their compliance with clauses 5, 7, 8 and 9 of this standard.

E4.2

The user should provide, or require others to provide the necessary safeguarding.

The user shall ensure that:

- a) The recognized hazards for the tasks to be implemented on the machine are identified (see 5.1);
- b) The protective measures required for the tasks identified in 4.2 (a) are provided and used in accordance with clause 8 (see 5.2);

One method that may be used to identify hazards and establish a risk reduction strategy is to form a team of individuals from the various disciplines involved with the design, construction, operation and maintenance of the machine.

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- c) The safeguarding required to eliminate or control the identified hazards as provided by the supplier is used and maintained in accordance with clause 8 of this standard (see 5.2);
- d) A procedure for the inspection and maintenance of the machine is established to ensure that its parts, safeguarding, and other safeguarding (protective) devices are in safe operating condition and adjustment;
- e) Correct and safe working procedures are being followed.

The user should consult the supplier's instructional material regarding the unpacking, handling, installation, and operation including safeguarding and maintenance of the machine.

The user shall ensure that the machine operator, helper, or set-up person follows the instructions and directions set forth by the user to meet the requirements of this standard.

The user shall ensure that all set-up and maintenance personnel and operators are trained to perform the functions for which they are responsible. The training shall include familiarizing the employees with the portions of this standard related to their work (see clause 9).

For examples of the machine operator's, helper's or set-up person's responsibilities, see E4.3.

The following shall be considered as minimum and shall be expanded as it applies to a particular condition:

- a) the function, location and use of all controls;
- b) a safe method for installing, removing, and adjusting tooling;
- c) the location and method for installation and adjustment of all safeguarding (protective) devices and guards, and the use of safe working procedures;
- d) the risk reduction strategy designed to eliminate or reduce the identified hazards.

The user shall designate, provide, and ensure the use of at least one of the following methods of safeguarding that affords protection for the operator, consistent with the requirements of the task:

- 1) guard(s) (see 8.2)
- 2) safeguarding device(s) (see 8.3);
- 3) awareness barrier(s) or awareness device(s) (see 8.4);
- 4) safe work procedure(s) (see 8.6).

The user shall be responsible for:

- availability and use of tools suited to the particular operation being performed;
- availability and use of proper tool holder(s) or adapter(s) for the machine and operation being performed;
- ensuring that tool holders or adapters are securely held by the machine and securely hold the tool;

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- providing a safe method of handling tools (e.g., safe working procedure – see 8.6);
- ensuring that the workholding device is properly set.

The user shall determine what personal protective equipment is required and shall train personnel and enforce the use of the equipment.

The user shall establish and follow a lockout/tagout procedure that will limit personnel to exposure from unintended machine motion that can cause injury during repair, servicing, set-up, or adjustment of machines (see ANSI Z 244.1).

4.3 Personnel responsibility

The operator shall comply with the instructions of the user concerning safe methods of operation of the machine.

Explanatory Information**E4.3**

Examples of the machine operator's, helper's, or set-up person's responsibilities:

- Follow all safety practices and procedures given in this standard that apply to his/her actions and conduct;
- Notify their supervisor when they observe an unsafe practice or condition;
- Properly use all personal protective equipment as specified by their user;
- Install, position, or adjust safety devices as instructed by the user under the provisions of this standard;
- Do not alter, remove, or disable any safety equipment without the approval of the user;
- Make a visual safety check of the set-up during each shift. Severe operating conditions should require more frequent checking;
- Do not wear clothing or jewelry that will present a hazard to their personal safety;
- Maintain an orderly work area. Particular attention should be given to the storage of tools or parts that could be dislodged and fall, or roll;
- Never slow or stop the spindle or workpiece by hand gripping of the spindle, workholding device or workpiece. Never use an improvised braking device (e.g., pry bar);
- Keep work areas free of spillage of lubricants and coolants to prevent slipping hazards.

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5 Hazard control

5.1 Task and hazard identification

Reasonably foreseeable tasks and associated hazards shall be identified throughout the lifecycle (design, installation, set-up, operation and maintenance) of the transfer machine.

E5.1

Task identification should take into account, but not be limited to the following task categories:

- packing and transportation;
- unloading/unpacking;
- systems installation;
- startup/commissioning;
- set-up and tryout (debug);
- operation (all modes);
- tool change;
- planned maintenance;
- unplanned maintenance;
- major repair;
- recovery from control failure;
- recovery from jam;
- troubleshooting;
- housekeeping;
- decommissioning;
- disposal.

For each of the task categories there may be many tasks. Tasks are specific activities that relate to the task category. Each task category may have numerous tasks associated with it, such as:

- changing a mill cutter at station 25;
- replacing a drive chain on motor 2;
- replacing an oil filter on HPU # 14;
- troubleshooting a ram repeatability;
- clearing jammed part in conveyor #5.

For each of the above tasks, there may be numerous hazards. Examples of hazards and hazardous situations addressed within this standard (design/construction, installation, set-up, operation and maintenance) are contained in Annex B.

In addition, reasonably foreseeable hazards not directly related to tasks shall be identified.

Following are some examples of reasonably foreseeable hazards not related to tasks:

- power failure;
- failure of a high-pressure hydraulic line;
- bearing failure or bearing seizure;
- failure of the structural components of the machine.

Tasks and associated hazards shall be identified and reassessed when necessary or whenever the machine is modified or its typical use is changed (see 5.2).

Each time a machine is modified or its use is changed, the tasks/hazards associated with the modification or change should be identified and re-assessed. For a more detailed discussion on task/hazard combination identification, refer to ANSI B11.TR3.