

## **Guide: Common machine safety standards, terms, violations: Terms you need to know**

Understanding machine safety standards and terms remains a challenging first step to spotting and reducing risks and increasing profitability. Sources for help are many. Standards organizations covering machine safety include American National Standards Institute (ANSI), National Fire Protection Association (NFPA), Robotics Industries Association (RIA), and U.S. Occupational Safety & Health Administration (OSHA), among others. Requirements are numerous; some are more obvious than others.

### **Watch for these common safety violations**

When doing any plant walk-through, open your eyes (behind safety glasses, of course) to the most common safety violations, which may include:

- E-Stop pushbutton: Must be red palm or mushroom head with yellow background;
- Non-inspected fire extinguishers: \$1,200 fine;
- Fan guard opening greater than 1/2-in.: \$1,500 fine;
- If a machine is modified, a new risk assessment is required; and
- When a Category 0 or Category 1 stop is used for the Emergency Stop function, final removal of power to the machine actuators shall be ensured by electromechanical components.

### **Agree to agree on standards and terms**

Safety terms commonly used within organizations can differ inside departments, within the facility, and across plants and organizations. Agreeing upfront on which standards apply and what things mean can save time and troubles later, helping to educate and ensure everyone's on the same page. Responsibilities of organizations and persons differ, as can requirements for devices, systems, and applications.

### **OSHA General Duties Clause Section 5: It's the LAW**

Each Employer:

- Shall furnish to each of his employees employment and a place of employment, which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees;
- Shall comply with occupational safety and health standards promulgated under this Act.

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Each Employee:

Shall comply with occupational safety and health standards and all rules, regulations and orders issued pursuant to this Act, which are applicable to his own actions and conduct.

**Cooperation between OSHA and ANSI**

The ANSI and OSHA memorandum of understanding allows ANSI to use its technical resources to assist OSHA in carrying out its responsibilities. Some applicable standards and guidance follow.

**ANSI B11.19 - 2003: Machine Tools Performance Criteria for Safety**

Standards below are referenced in and are intended to be used with "ANSI B11.19 - 2003: Machine Tools Performance Criteria for Safety." Standards always are subject to revision; investigate the possibility of applying the most recent editions of any standard referenced.

- ANSI / NFPA 79 - 2002: Electrical Standard for Industrial Machinery.
- ANSI / NFPA 70 - 2002: The National Electrical Code.

See the appropriate ANSI B11 machine tool safety standard for safeguarding selection requirements based on a specific application. (See examples below.) Selection of the safeguarding requires task and hazard identification, and the application of risk assessment and risk reduction of the total production system. (See ANSI B11.TR3 on risk assessment and risk reduction).

- ANSI B11.3 - 2002: Power Press Brakes
- ANSI/RIA 15.06: Safety Requirements for Industrial Robots and Robot Systems
- ANSI B20.1: Conveyors
- TR-3 - 2000: Risk Analysis
- TR-4 - 2005: Failsafe PLC Application
- ANSI B11.19 - 2003 - 4.2.3: The user shall ensure that when any change of the tooling, process or procedure occurs, the safeguarding continues to meet the requirements of the standard and the ANSI B11. "base" standard (the standard dealing with the specific machine tool) or meets the intent of ANSI B11-TR3. Changes in the production system that may affect the safeguarding include, but are not limited to tooling changes, addition or removal of auxiliary equipment, modification to the machine systems, operation method (program) change in operation personnel, adjustment location of safeguarding, and part configuration. Adjustments to the safeguarding or supplemental safeguarding may be necessary.

- ANSI B11.19 - 2003 - 5: Hazard Control: Hazards associated with the use of the safeguarding shall be identified and controlled as part of the overall risk reduction strategy. The over hazard identification and risk reduction strategy is identified in each ANSI B11 "base" standard or in B11.TR3. These documents are used to select safeguarding appropriate to the foreseeable tasks and identified hazards.
- NFPA 79 - 2002: Electrical Standard for Industrial Machinery

9.4.3\* Control Systems Incorporating Software and Firmware Based Controllers shall conform to all of the following. In the event of any single failure perform as follows:

- Lead to the shutdown of the system in a safe state;
- Prevent subsequent operation until the component failure has been corrected;
- Prevent unintended startup of equipment upon correction of the failure;
- Provide protection equivalent to that of control systems incorporating hardwired / hardware components; and
- Be designed in conformance with an approved standard that provides requirements for such systems.

11.3.4\* Use in Safety-Related Functions: Software and firmware based controllers to be used in safety-related functions shall be listed for such use.

A9.4.3 IEC 61508 provides requirements for the design of control systems incorporating the use of software and firmware-based controllers to performing safety related functions.

A.3.3.84 Risk: One reference to risk assessment is ANSI B11.TR3 - 2000

9.2.2\* Stop Functions: The three categories of stop functions shall be as follows:

- Category 0 is an uncontrolled stop by immediately removing power to the machine actuators;
- Category 1 is a controlled stop with power to the machine actuators available to achieve the stop then remove power when the stop is achieved; and
- Category 2 is controlled stop with power left available to the machine actuators.

#### **Categories of EN 954-1 (B, 1, 2, 3 and 4)**

This European standard allows the performance of the safety-related part of a control to be evaluated when faults occur.

- Category B: The control must be designed so that it can withstand the expected effects. System behavior: A fault can result in the loss of the safety function.
- Category 1: The requirements of Category B shall apply; well-tried components and well-tried safety principles shall be used. System behavior: the same as the system behavior of Category B, however with a higher safety-related reliability.
- Category 2: The requirements of Category B must be fulfilled; in addition the safety function shall be checked at suitable intervals. System behavior: The occurrence of a fault can lead to the loss of the safety function between checks.
- Category 3: The requirements of Category B must be fulfilled; a single fault may not lead to the loss of the safety function. Individual faults must be detected. System behavior: When a single fault occurs, the safety function is always performed.
- Category 4: The requirements of Category B must be fulfilled; a single fault must be detected at or before the next demand upon the safety function. System behavior: When faults occur, the safety function is always performed. The faults are detected in time.

### **Definitions**

For a list of related machine safety terms, from actuating controls through verification, [click here](#).

### **Additional organizations and links:**

For more information on these topics, reference the following links.

Siemens [www.siemens.com/safety](http://www.siemens.com/safety)

American National Standards Institute (ANSI) [www.ansi.org](http://www.ansi.org)

European Norm (EN) [www.cenelec.org](http://www.cenelec.org)

International Electrotechnical Commission (IEC) [www.iec.ch](http://www.iec.ch)

National Fire Protection Association (NFPA) [www.nfpa.org](http://www.nfpa.org)

Occupational Safety and Health Administration (OSHA) [www.osha.gov](http://www.osha.gov)

Robotics Industries Association (RIA) [www.robotics.org](http://www.robotics.org)

The Instrumentation, Systems, and Automation Society (ISA) [www.isa.org](http://www.isa.org)

### **More Online: Machine safety definitions**

- Actuating Control(s): An operator control(s) used to initiate or maintain machine motion(s) or other machine function(s).
- Adjustable Barrier Guard: A guard with provisions for adjustment to accommodate various jobs or tooling set-ups.
- Anti-Repeat: A function of the control system or device that limits the machine to a single cycle.

- Awareness Device: A barrier, signal, or sign that warns individuals of an impending, approaching or present hazard.
- Barrier: A device or object that provides a physical boundary to a hazard.
- Blanking: Bypassing a portion of the sensing field of a presence-sensing safeguarding device (light curtain).
- Cable-Operated Switch: This is mainly used in EMERGENCY STOP protective safety devices and is a signal transmitter whose switching state changes if a cable / line - connected to the switch - is pulled or the line / cable breaks. This device is used to monitor long lengths (for example, along conveyor belts).
- Cascading Input - Safety Relay: Safety, single-channel input of a safety relay that is internally evaluated just like a sensor signal; logical and operational with the other signal transmitter / sensor inputs. If a voltage is not connected, the safety relay safely disables the enable circuits (outputs).
- CCF (Common Cause Failure): Failure with a common cause (short-circuit).
- CEN CENELEC Committee European de Normalization; European Committed for Standardization; Committee European de Normalization Electro technique; European Standards Committee for electrical engineering.
- Emergency Stop: A manually actuated control device that can be used to initiate an EMERGENCY STOP function (red mushroom button with yellow background).
- Contact less Electro-Sensitive Protective Device (laser scanners, light grids, and light curtains). Contact less / electro-sensitive protective devices that essentially comprise the sensor function and the associated control / monitoring function with output switching element - also known as OSSD (output safe switching device).
- 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.
- Diversity: The use of different means, such as use of different processors or other hardware such as relays, storage media, programming languages and software to perform the same function.
- Energy Source: Any electrical, mechanical, hydraulic, pneumatic, chemical, thermal, potential, kinetic or other sources of power / movement.
- Guard: A barrier that prevents exposure to an identified hazard.
- Hand Control: A hand-operated mechanism or device used as an actuation control.
- Hand Tool: Any device used for manual feeding or removal or a work piece, freeing of a jammed work piece or removal of scrap.
- Hazard: A potential source of harm to individuals.
- Interlocked Barrier Guard: A barrier, or section of barrier, interfaced with the machine control system in such a manner as to prevent inadvertent access to the hazard.

- Life Cycle of a Machine: The phases of a machine including design and construction, transport and commissioning, re-assembly, installation, initial adjustment, relocation, use (such as setting, teaching / programming or process changeover, operation) and care (cleaning, trouble shooting, maintenance (planned or unplanned) de-commissioning, dismantling and, as far as safety is concerned, disposal.
- Listed for use: Equipment, materials or services included in a list published by a Nationally Recognized Testing Laboratory (NRTL) and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material or services meets identified standards or has been tested and found suitable for a specified purpose.
- Muting: The automatic temporary bypassing of any safety-related function(s) of the control system or safeguarding device.
- PES (Programmable Electronic System): A system for control or monitoring using one or more programmable electronic devices, including all elements of the system, such as power supplies, sensors and other input devices, data links and other communication paths, and actuators, and other output devices.
- Presence-Sensing Device: A device that creates a sensing field, area or plane to detect the presence of an individual or project.
- Protective Device: Device (other than a guard), which reduces a risk, either alone or associated with a guard (does not include personal protective equipment).
- Residual Risk: That risk that remains after safeguarding devices have been applied and a risk assessment performed.
- Risk: A combination of the probability and the degree of the possible injury or damage to health in a hazardous situation in order to select appropriate safeguards.
- Risk Assessment: The process by which the intended use of the machine, the tasks and hazards, and the level of risk are performed.
- Safeguarding: Guards, safeguarding devices, awareness devices, safeguarding methods and safe work procedures.
- Safety Distance: The calculated distance between a hazard and its associated safeguard.
- Safety Function: Function of a machine, the malfunction of which would increase the risk of harm.
- Tolerable Risk: Risk that is accepted for a given task and hazard combination (hazardous situation).
- Two Hand Control Device: An actuating control that requires the concurrent use of the operators hands to initiate machine motion during the hazardous portion of the machine cycle.
- Validation: Confirmation by examination and testing that the particular requirements for a specific intended use are met.

- Verification: The process or act of confirming that a device or function conforms or performs to its design.