

Preventa™ Machine Safety Products

Catalog
2014

Chapter 8

US Safety Standards

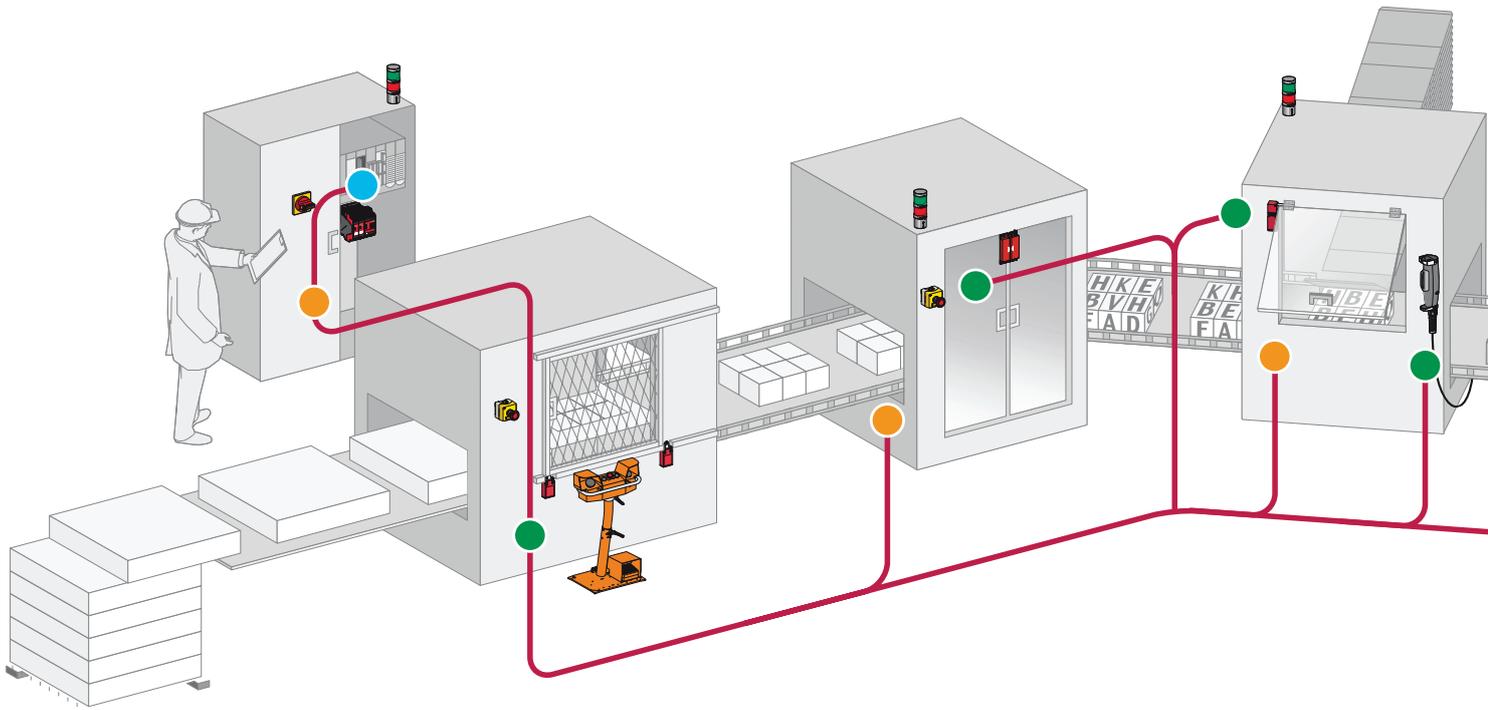


Schneider
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Save time and money with our Preventa™ machine safety solutions offer



Safety-related signal transmission

Acquiring information...

- > Safety interlock devices used as part of safeguarding systems to control access, under specific conditions of reduced risk.
- > Light curtains to detect approach to dangerous and limited areas.
- > Emergency stop buttons and cable pull switches for emergency shut down.



Safety interlocks

Monitoring and processing...

- > Safety relay modules with specific safety functions – to monitor input signals from safety-related devices, and to interface with contactors and drives – by switching off output safety contacts.
- > Safety Controller: configurable safety device capable of centralizing a range of safety monitoring functions.
- > Safety PLCs: programmable electronic systems to carry out safety or non-safety related tasks for machinery and equipment.
- > “As-interface safety at work”: safety field bus network certified to work with safety-related devices to provide safety functions.



Light curtains



Emergency stop



Cable pull switch



Safety relays



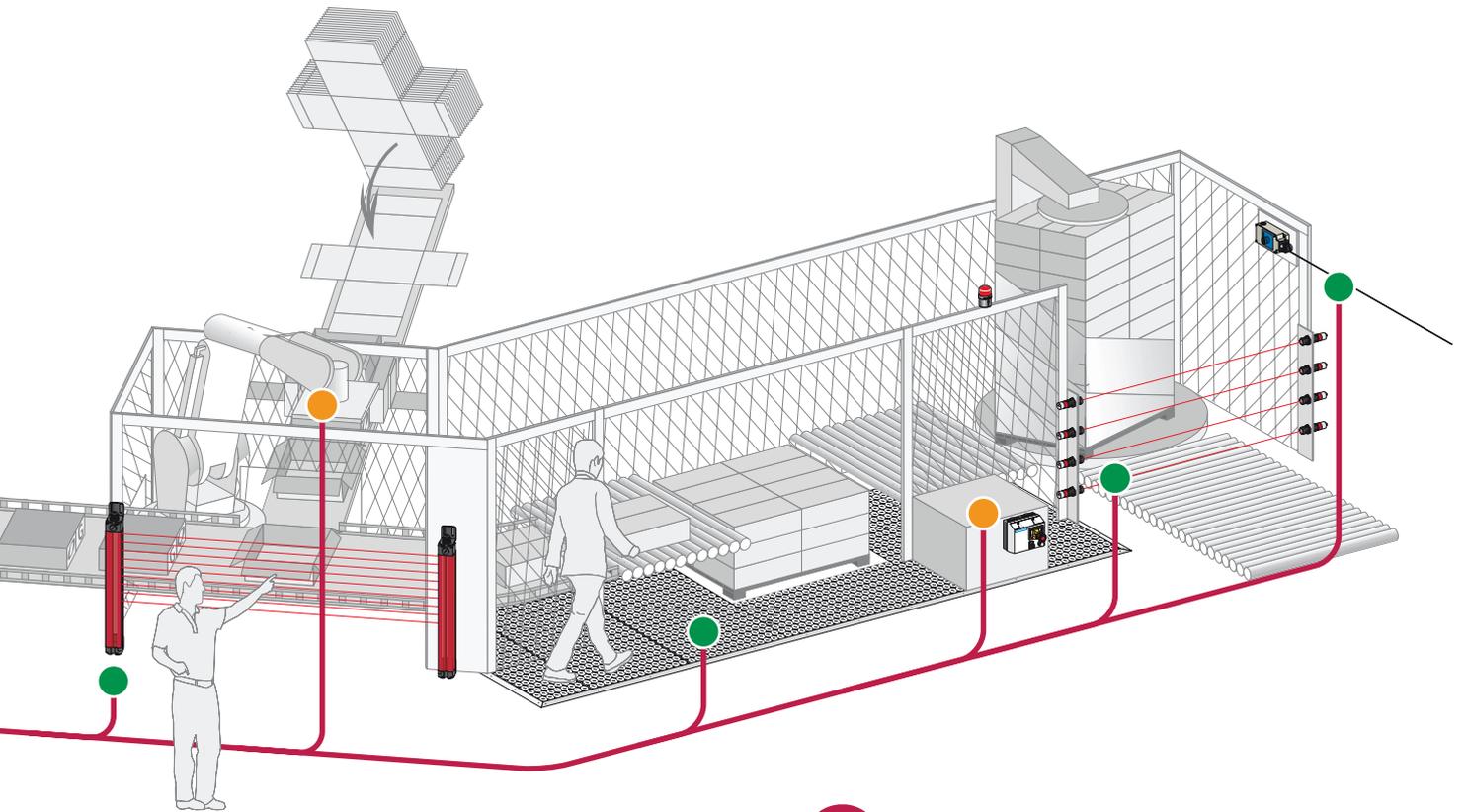
Safety Controller



Safety PLCs



As-interface safety at work



Stopping the machine...

- > Contactors to cut-off the electrical power supply to motors – with mechanically linked or mirrored auxiliary contacts – integrated for feedback loop diagnosis of safety relay modules, safety controllers, or safety PLCs.
- > Variable speed drives and servo drives with integrated safety functions...control stopping of dangerous movements.

**Up to 50%
better space
optimization**

Compact components
have smaller footprint

**Save up
to 30%
on installation
time**

Reduce installation
time with quick and
easy wiring



Variable
speed drives



Servo drives



Contactors

Introduction

There are many organizations and standards that affect safety in the United States. Some are legally required (such as OSHA regulations) and others are consensus standards guidelines by various associations. The most significant of the legally required standards are OSHA and the related ANSI standards. The OSHA standards, however, are the minimum legally required standards in the United States. Many companies have adopted ANSI and NFPA (as well as others) as part of their corporate standards, and this trend is increasing as interest in improved safety is growing. The most pertinent standards dealing with machinery and machine safety are listed below. We have not attempted to provide details on these standards since there are volumes of additional information available from OSHA, ANSI, and NFPA as well as other sources. There are other codes and standards that also need to be referenced and followed such as the National Electrical Code (NEC - NFPA 70), as well as regional and local requirements.

This section provides information from the referenced standards from OSHA, ANSI and NFPA. This material is provided to help users better understand some of the issues that need to be taken into consideration when designing new applications or upgrading current applications when the safety of personnel is concerned. The complete versions of the referenced standards must be used, read, and referenced whenever designing safety solutions, as more detailed information and additional information is provided in the complete versions of these standards.

Hazards to Personnel

When considering potential safety hazards for personnel, it is easy for everyone to recognize examples of some safety hazards, such as presses or saws, because they are easy to visualize. Some hazards that are often overlooked but are no less dangerous to personnel are:

- Chemical
- Thermal - both heat and cold
- Electrical and shock
- Magnetic
- Toxicity
- Hydraulic
- Pneumatic
- Mechanical
- Kinetic
- Movement of mechanical components, whether related to the equipment under consideration or not
- Plus many more

OSHA 29 CFR1910 Occupational Safety and Health Standards

OSHA began as the Occupational Safety and Health Act of 1970, passed as an act of Congress "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our national resources." This act is mandatory and legally binding in the United States.

The Occupational Safety and Health Administration (OSHA) standards cover a number of topics regarding safety and health, from A to Z, including Work Surfaces, Hazardous Materials, Personal Protective Equipment, as well as many others.

While OSHA does cover a great deal of topics and areas of safety, there are other organizations that are not government agencies that have developed standards for various industries or situations. OSHA has, in many cases, chosen to use existing consensus standards instead of developing new ones. Many of these existing standards are referenced in OSHA 1910, and according to 1910.6, these "organizations which are not agencies of the U.S. Government which are incorporated by reference in this part, have the same force and effect as other standards in this part". OSHA has incorporated the standards of two primary standards groups, the American National Standards Institute (ANSI) and the National Fire Protection Association (NFPA), into its set of standards.

Subpart O of 1910 deals with Machinery and Machinery Guarding. Subpart R deals with Special Industries. The topics for Subpart O and R are listed below; followed by Subparts J and S which are of interest to anyone involved with machinery.

OSHA 29 CFR1910 Occupational Safety and Health Standards (continued)

OSHA 1910, Subpart O, Machinery and Machine Guarding

- 1910.211 Definitions
- 1910.212 General Requirements for all Machines
- 1910.213 Woodworking Machinery Requirements
- 1910.214 Cooperage Machinery
- 1910.215 Abrasive Wheel Machinery
- 1910.216 Mills and Calenders in the Rubber and Plastics Industries
- 1910.217 Mechanical Power Presses
- 1910.218 Forging Machines
- 1910.219 Mechanical Power Transmission Apparatus
- 1910.220 Effective Dates
- 1910.221 Source of Standards
- 1910.222 Standards Organizations

OSHA 1910, Subpart R, Special Industries

- 1910.261 Pulp, Paper, and Paperboard Mills
- 1910.262 Textiles
- 1910.263 Bakery Equipment
- 1910.264 Laundry Machinery and Operations
- 1910.265 Sawmills
- 1910.266 Logging Operations
- 1910.267 Agricultural Operations
- 1910.268 Telecommunications
- 1910.269 Electric Power Generation, Transmission, and Distribution
- 1910.272 Grain Handling Facilities



OSHA 1910 Subpart J, General Environmental Controls

- 1910.147 Control of Hazardous Energy (also known as Lockout/Tagout)

This standard was effective as of January 2, 1990. It was adopted to help safeguard personnel from hazardous energy while maintaining or servicing equipment. Before maintenance is performed, the hazardous energy must be turned off to the machine, and an energy-isolating device must be used to either lockout or tagout the machine.

This energy source can be electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other forms of energy. Multiple energy sources may need to be locked out/tagged out before service or maintenance can be performed on the equipment. Section (b) of this standard states "Push buttons, selector switches, and other control circuit type devices are not energy isolating devices." This would include limit switches, safety interlock switches, cable pull switches, and other types of control equipment. 1910.147 may be the most far reaching standard OSHA has adopted, covering virtually all equipment in use today.

The lockout/tagout is similar in principle to the European Machinery Directive 98/37/EC, Annex 1, Isolation of Energy Sources.

OSHA 1910 Subpart S, Electrical

This subpart addresses electrical safety requirements that are necessary for the practical safeguarding of employees in their workplaces.

The American National Standards Institute (ANSI)

The American National Standards Institute (ANSI) is a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations, founded in 1918. ANSI does not develop standards, but acts as a facilitator in establishing voluntary consensus standards with various groups. They promote US standards internationally and encourage the adoption of international standards as national standards. ANSI was a founding member of the ISO, and is still active in governing it. They are also strong members of the IEC.

ANSI B11.19, Performance Criteria for Safeguarding

Of the many ANSI standards available, the ANSI B11 Series standards are the most pertinent to machines and machine safety. One of the most pertinent of these standards for general industrial use is: "ANSI B11.19, Performance Criteria for Safeguarding"

- B11.1 Mechanical Power Presses – Safety Requirements for Construction, Care and Use
- B11.2 Hydraulic Power Presses – Safety Requirements for Construction, Care and Use
- B11.3 Safety Requirements for Power Press Brakes
- B11.4 Safety Requirements for Shears
- B11.5 Iron Workers - Safety Requirements for Construction, Care and Use
- B11.6 Safety Requirements for Manual Turning Machines
- B11.7 Cold Headers and Cold Formers - Safety Requirements for Construction, Care and Use
- B11.8 Safety Requirements for Manual Milling, Drilling and Boring Machines
- B11.9 Safety Requirements for Construction, Care and Use of Grinding Machines
- B11.10 Safety Requirements for Metal Sawing Machines
- B11.11 Safety Requirements for Gear and Spline Cutting Machines
- B11.12 Safety Requirements for Roll Forming and Roll Bending Machines
- B11.13 Automatic Screw/Bar and Chucking Machines – Safety Requirements for Construction, Care and Use
- B11.14 Coil Slitting Machines – Safety Requirements for Construction, Care and Use
- B11.15 Safety Requirements for Pipe, Tube, and Shape Bending Machines
- B11.16 Safety Requirements for Powder/Metal Compacting Presses
- B11.17 Safety Requirements for Horizontal Hydraulic Extrusion Presses
- B11.18 Safety Requirements for Machines Processing or Slitting Coiled or Non-Coiled Metal
- B11.19 Performance Criteria for Safeguarding
- B11.20 Safety Requirements for Integrated Manufacturing Systems
- B11.21 Safety Requirements for Machine Tools Using Lasers for Processing Materials
- B11.22 Safety Requirements for Turning Centers and Automatic, Numerically Controlled Turning Machines
- B11.23 Safety Requirements for Machining Centers and Automatic, Numerically Controlled Milling, Drilling and Boring Machines
- B11.24 Safety Requirements for Transfer Machines.

Technical Reports and Explanatory Information

- B11.TR1 Ergonomic Guidelines for the Design, Installation and Use of Machine Tools
- B11.TR2 Mist Control Considerations for the Design, Installation and Use of Machine Tools Using Metalworking Fluids
- B11.TR3 Risk Assessment and Risk Reduction – A guide to estimate, evaluate and reduce risks associated with machine tools
- B11.TR4 Selection of Programmable Electronic Systems (PES/PLC) for Machine Tools
- B11.TR5 Sound Level Measurement Guidelines – A guide for measuring, evaluating, documenting and reporting sound levels emitted by machinery
- B11.TR6 Safety Control Systems for Machine Tools
- B11.TR7 Designing for Safety and Lean Manufacturing – A guide on integrating safety and lean manufacturing principles in the use of machinery

Additional Standards

Industrial Robots and Robot System Safety

OSHA has recommended

- That robots comply with ANSI/RIA R15.06 (1999), Manufacturing, Remanufacture and Rebuild of Robots. Some of the sections of this standard deal with: manufacture, remanufacture, and rebuild of robots (section 4), performance requirements of safeguarding devices (section 5), installation of robots and robot systems (section 6), safeguarding of personnel (section 7, 8, and 9). In addition, robots and robot systems must comply with OSHA 1910.333 and 1910.147.
- This recommendation is a part of OSHA instruction TED 1.15, September 1995, from the Office of Science and Technology Assessment.

National Fire Protection Association (NFPA)

The NFPA has developed many standards covering a wide variety of subjects over the past 100 years. While they began out of a need to standardize on automatic sprinkler system standards, they grew to become the major recognized group in fire protection in the United States, and are recognized internationally as well.

NFPA 79 began in 1941, with an NFPA subcommittee. It appeared as a supplement to the 1940 NEC in Article 670 - Machine Tools, and remained in Article 670 through the 1959 edition of the NEC. It was officially adopted as a stand alone standard in 1962, but continues to be referenced in Article 670 of the NEC. NFPA 79 – Electrical Standard for Industrial Machinery, as its title indicates, covers all industrial machinery in the US and should be a frequently referred to standard in all industrial facilities.

Topics of interest

Several topics on safety have generated significant interest over the past few years, and these topics are discussed below for general industrial applications. There are standards specific to particular industries in the various standards, and these need to be consulted separately. There are also standards specific to certain types of machinery, and these need to be consulted separately as well. Below are topics that are of the most interest for general industrial machinery.

Similarities between the US standards are noted, as well as similarities to European EN and IEC standards. There has been significant interest in the European and IEC standards recently, and it is interesting to note the similarities between the European standards and US nationally accepted consensus standards and OSHA. As many of the various standards evolve, the US, IEC, and EN standards are becoming more similar, resulting in fewer differences than just a decade ago. Companies doing business globally are already familiar with the EN and IEC standards and their requirements.

References to these standards are provided in the sections below for reference only. The complete versions of the referenced standards must be used, read, and referenced whenever designing safety solutions, as more detailed information and additional information is provided in the complete versions of these standards.

Safety systems and qualified persons

Safety systems are comprised of many components. No one safety component will insure the safety of the system. The design of the complete safety system should be considered before you begin. It is very important to follow applicable safety standards when installing and wiring these components. OSHA has a similar definition of safety systems in their standards. OSHA and ANSI have also defined an “authorized (qualified) person” to perform tasks, and that the authority is given by the employer to this person. This person has also received training on the hazards involved in the tasks they are to perform. It is important that appropriately trained and qualified personnel design, develop and maintain safety equipment and systems to provide an appropriate safety level for all personnel.

OSHA 1910.211 Definitions - Safety System

(d) (60) (d) (62) “Safety system” means the integrated total system, including the pertinent elements of the press, the controls, the safeguarding, and any required supplemental safeguarding, and their interfaces with the operator, and the environment, designed, constructed, and arranged to operate together as a unit, such that a single failure or single operating error will not cause injury to personnel due to point of operation hazards.

OSHA 1910.211 Definitions – Authorized Person

(d) (63) “Authorized person” means one to whom the authority and responsibility to perform a specific assignment has been given by the employer.

NFPA 79 – Definitions: Qualified Person.

One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.

Topics of interest (continued)

User's Responsibilities

The user (employer) is responsible for ensuring the safeguarding equipment is installed and maintained correctly, and that the various personnel are trained in the operation and maintenance of the safeguarding

ANSI B11.19 defines a user as:

- An entity that utilizes machines, systems, and related equipment.
- An individual, corporation, partnership, or other legal entity or form of business that employs individuals to operate and maintain manufacturing systems/cells.

ANSI B11.19 states the user's responsibilities include:

- The user shall be responsible for ensuring that safeguarding is provided, integrated, installed, maintained, and used in accordance with the requirements of this standard.
- The user shall be responsible for ensuring that supervisors, operators, maintenance and service personnel are trained in the proper installation, adjustment, operation and maintenance of the safeguarding, within the scope of their work activity.

Control Reliability

The sections identified below for control reliability are very similar to the intent of Category 3 and 4 as defined in European Harmonized Standard EN/ISO 13849-1. In all cases, if a single component fails, it shall not prevent the normal stopping action of the machine, and it does prevent the machine from re-starting.

It stands to reason that if a single component fails, there must be a similar component available to complete the stopping action, and that there must be some type of checking circuit to acknowledge that single component failure and prevent a re-start of the machine. This would suggest some type of redundancy of the various components and self checking circuitry would be required if a circuit is to be control reliable.

OSHA 1910.217 (b) (13) Control Reliability

The control system shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent initiation of a successive stroke until the failure is corrected. The failure shall be detectable by a simple test, or indicated by the control system. This requirement does not apply to those elements of the control system which have no effect on the protection against point of operation injuries.

ANSI B11.19 and ANSI/RIA 15.06 both provide a definition of Control Reliability similar to the one below:

The control system shall be designed, constructed, and installed such that a single control component failure within the system does not prevent stopping action from taking place but will prevent successive system cycles until the failure has been corrected.

Electrical Equipment

Many standards require conformance to NFPA 79 for electrical equipment and emergency stop devices. Two such standards are ANSI B11.19 and ANSI B11.20.

Requirements for individual products

There are many products used in control systems for safety, and each of these products perform different functions in their application, either as emergency stopping or for guarding personnel. The various safety standards have specific requirements for each of these devices, and a summary of some of these requirements are listed in the following sections. Some of the requirements listed here have been in the US standards for a long time, while many of the requirements have changed over the past few years. As these standards evolve, it is important to keep up to date on the changes as they will affect the design of your equipment.

The information listed here is intended to help make the reader aware of some of the US safety requirements. The complete versions of the referenced standards must be used, read, and referenced whenever designing safety solutions, as more detailed information and additional information is provided in the complete versions of these standards.

Emergency Stop

This section is divided into 5 different groups, due to the amount of information available and to make it easier to locate the information required. Most of the references in this section are from NFPA 79, since ANSI B11.19 states that Stop and emergency stop devices shall meet the requirements of NFPA 79.

General Emergency Stop Requirements

Listed below are highlights of the requirements for emergency stop devices per NFPA 79. For full details, please refer to NFPA 79.

- Emergency stop devices must have absolute priority over all other functions.
- Must have stop or emergency stop capability at each operator workstation and other locations where emergency stop is required.
- Every machine must have a category 0 emergency stop or category 1 emergency stop.
- Emergency stop devices shall include push button, pull-cord (cable pull) or foot switch (without cover).
- Emergency stop switches shall not be flat switches or graphic representations based on software applications.
- Must have self latching means (i.e.: pull to release or rotate).
- Shall be initiated by a single human action.
- Must be manually reset.
- Resetting of the e-stop shall not restart the machinery but only permit restarting.
- Must have positive/direct opening contacts.
- RED actuator with a YELLOW background.
- The emergency stop devices must be continuously operable and readily accessible.

ANSI has some additional information on emergency stops as follows:

ANSI B11.19: STOP AND EMERGENCY STOP DEVICES

Stop and emergency stop devices are not safeguarding devices. They are complimentary to the guards, safeguarding devices, awareness barriers, signals and signs, safeguarding methods and safeguarding procedures.

Stop and emergency stop devices must meet the requirements of ANSI/ NFPA 79.

ANSI/RIA R15.06 also states that the emergency stop shall be fully compliant to NFPA 79.

Emergency Stop (continued)

1. Emergency Stop Color

Actuators of emergency stop devices shall be red and the background around these devices shall be yellow. Visibility and recognition of emergency stop devices is the primary concern. The red and yellow color combination shall only be used for emergency stop applications.

OSHA 1910.144: Safety color code for marking physical hazards.

(a)(1)(iii) Stop. Emergency stop bars on hazardous machines such as rubber mills, wire blocks, flat work ironers, etc., shall be red. Stop buttons or electrical switches which letters or other markings appear, used for emergency stopping of machinery shall be red.



2. Emergency Stop Device Types

Emergency stop devices include mushroom head push buttons, pull cord (cable pull), push bar (bumper guards), and foot switches (without mechanical guards). Mushroom head push buttons shall be self latching and have positive opening contacts.

Push button-type devices for emergency stop shall be of the self-latching type and shall have direct opening operation.

Emergency stop switches shall not be flat switches or graphic representations based on software applications.



3. Emergency Stop Function

- Emergency stop devices shall override all other controls.
- They shall be hard wired into the emergency stop circuit.
- Where emergency stop or emergency switching off is used, it shall be initiated by a single human action, and must be manually re-set.
- Resetting of the emergency stop device shall not start, restart, nor cause any hazardous motion or condition.



4. Emergency Stop Location

Emergency stop devices shall be at every operator workstation and other locations where required; continuously operable; readily accessible; and easily distinguishable from other controls.

US safety standards

Stop categories, safety relays, safety controllers and PLCs

Stop Categories

The NFPA 79 Stop Category 0, 1 and 2 identified below are very similar to the same Stop Categories in IEC/EN 60204-1. There are no similar stop categories identified in OSHA 1910. The choice of stop category to use is determined by the type of machine and control circuit used, plus the hazards available to personnel.

The three categories of stop functions shall be as follows:

1. Category 0 is an uncontrolled stop by immediately removing power to the machine actuators.
2. 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.
3. Category 2 is a controlled stop with power left available to the machine actuators.

All machines shall have a Category 0 stop.



Safety Relays

Safety relays and their use are now referenced as such in US standards (i.e.: ANSI B11.9).

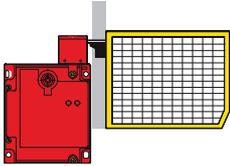
ANSI B11 also states: A safety (relay) interface module usually consists of monitored, multiple, force-guided captive contact relays, or other devices. A single discrete force-guided captive contact relay does not meet the requirements of this standard.

Safety Controllers and Safety PLCs

Control Systems Incorporating Software and Firmware based Controllers are referenced in NFPA 79.



Guards, Barriers and Interlocking



There are many ways to protect personnel: guards and barriers, two hand controls, light curtains, and sometimes distance. These methods are discussed in this section. Guards will be discussed first.

Guards need to prevent personnel from being in the hazardous zones when the machine is operating, and machinery cannot be operated with the guards open. It is clear that the responsibility for these guards falls on the employer per OSHA.

General Requirements

Some of the requirements of guards and interlocks are as follows:

- Guards or interlocks shall be difficult to defeat.
- Devices used in safety related functions shall have positive (direct) opening contacts.
- Closing of the guard or interlock shall not initiate machine motion or any hazardous condition
- When doors or guards are opened and open, no hazardous motion or condition can exist
- Machinery is allowed to start and run only when gates and guards are closed.
- Switches and interlocks shall be installed so they will not be damaged on over-travel.
- Guards and safeguarding devices must be positioned so that personnel cannot reach the hazard prior to the hazardous condition being eliminated (i.e.: hazardous motion stopped)
- The guard shall be designed and installed so that personnel cannot reach over, under, around, or through the guard.

When guards, barriers, light curtains or other safeguarding is used to protect personnel, there is always a minimum safety distance required to protect personnel from harm. With hard guards or barriers, this distance may be determined by the size of the openings in the guard and using a table or chart for the correct minimum safety distance, i.e.: OSHA 1910.217 Table O-10. Other safeguarding devices, such as light curtains or two hand control devices, need to be located a minimum distance away from the hazard such that the hazardous situation can be eliminated before an individual can be injured. ANSI B11.19, Annex on Safety Distance is an excellent resource for determining these minimum safety distances. It covers a wide variety of safeguarding techniques and methods to determine the minimum safety distances and the factors that need to be considered.

Standards References

OSHA 1910.212 General Requirements for all Machines

(a) (1) Types of guarding. One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips, and sparks. Examples of guarding methods are: barrier guards, two-hand tripping devices, and electronic safety devices.

OSHA 1910.212 General Requirements for all Machines

(a) (3) (ii) The point of operation of machines whose operation exposes an employee to injury, shall be guarded. The guarding device shall be in conformity with any appropriate standards therefore, or, in the absence of applicable specific standards, shall be so designed and constructed as to prevent the operator from having any part of his body in the danger zone during the operating cycle.

OSHA 1910.217 Mechanical Power presses

(c) (1) (i) It shall be the responsibility of the employer to provide and ensure the usage of "point of operation guards" or properly applied and adjusted point of operation devices on every operation performed on a mechanical power press. See Table O-10.

OSHA 1910.217 Table O-10 identifies the minimum distance from the barrier or guard to the point of operation hazard based on the size of the opening. If there are any openings in the guard, such as holes or openings in a mesh guard, the maximum dimensions of these openings are used as the basis for use with Table O-10



Light Curtains

The application, use, and installation of light curtains is covered in much greater detail in Chapter 5 of this catalog. The safety distance formulas in Chapter 5 must be used to determine the minimum safety distance a light curtain must be mounted away from the hazardous activity, based on the particular machine and light curtain used. Listed below are some highlights from ANSI B11.19 regarding light curtains.

The presence sensing device shall incorporate visual means to indicate that the device is detecting an individual within the sensing field of the device.

Exposure to the hazard(s) shall not be possible by reaching over, under or around the sensing field of the device. Additional guards or safeguarding devices shall be provided to protect these areas.

The effective sensing field shall be of adequate height, width and depth so that entry of the individual into the hazard area is detected.

If individuals can place themselves between the sensing field and the hazard area, additional safeguarding should be used in conjunction with the device to prevent the individual from exposure to the hazard.

The presence sensing device shall be installed at a location so that the effective sensing field prevents individuals from reaching the hazard(s) during the hazardous portion of the machine cycle

The presence-sensing device shall protect individuals from hazards by initiating an immediate stop command to the machine control system when the sensing field of the device is interrupted during the hazardous portion of the machine cycle. It shall require re-initiation of the normal actuating means prior to the start or continuation of the motion of the machine

When an individual can pass through the sensing field of the presence-sensing device, the device shall initiate an immediate stop command to the machine control system and shall require that the device be manually reset before hazardous motion can occur.

The reset device shall be located outside of the safeguarded area such that it cannot be reached from the safeguarded area. Reset of the device or machine control shall not occur until verification that the safeguarded area is clear of individuals.

The operator should ensure that no individual is in the safeguarded area before re-setting the device or machine control and initiating hazardous motion.

An additional item of interest regarding light curtains is the Presence Sensing Device Initiation (PSDI): See OSHA 1910.217 (h)





Foot Switches

Foot switches are not considered to be safety products, but they have been used to keep personnel out of reach of a hazard. An example is the operator of a machine using the foot switch to start and run the machine. When an operator removes their foot from the foot switch, the machine stops. The foot switch needs to be located a sufficient distance away from the machine to keep the operator out of harm's way.

The references below indicate that foot switches need to be protected from accidental operation from falling objects and unintended operation. Foot switches used for emergency stop need to be unguarded.

OSHA 1910.217(b)(7)(x) MECHANICAL POWER PRESSES

Foot operated tripping controls, if used, shall be protected so as to prevent operation from falling or moving objects, or from unintended operation by accidental stepping onto the foot control.

OSHA 1910.218(b)(2) MECHANICAL POWER PRESSES

Foot operated devices. All foot operated devices (i.e., treadles, pedals, bars, valves, and switches) shall be substantially and effectively protected from unintended operation.

Summary

Safety systems are comprised of many components. No one safety component will insure the safety of the system. The design of the complete safety system should be considered before you begin. It is very important to follow applicable safety standards when installing and wiring these components.

This appendix provides portions of the referenced standards from OSHA, ANSI and NFPA. This material is provided to help users better understand some of the issues that need to be taken into consideration when designing new applications or upgrading current applications when the safety of personnel is concerned. The complete versions of the referenced standards must be used, read, and referenced whenever designing safety solutions, as more detailed information and additional information is provided in the complete versions of these standards.

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Additional information on US Safety Standards

There are many sources of information on US safety standards, and below is a partial list of these sources. This information was taken from literature, personal contacts, and from the internet. While we believe this information to be correct, there may have been changes in phone numbers and addresses from when we acquired this information. If you need any additional information regarding the US safety standards, please contact any of the sources listed below:

American National Standards Institute (ANSI)

1899 L Street, NW, 11th Floor, Washington, DC 20036
Phone: 202-293-8020
Fax: 202-293-9287
<http://web.ansi.org>

American Society of Mechanical Engineers (ASME)

Two Park Avenue, New York, NY 10016-5990
Phone: 800-843-2763 (U.S./Canada)
<http://www.asme.org>

American Society for Testing and Materials (ASTM)

100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA 19428-2959
<http://www.astm.org>

Association for Manufacturing Technology (AMT)

7901 Westpark Dr., McLean, VA 22102-4206
Phone: 703-893-2900
Fax: 703-893-1151
<http://www.mfgtech.org>

IHS

15 Inverness Way East, Englewood, Colorado 80112
Phone: 800-854-7179
Fax: 303-397-2740
<http://global.ihs.com>

Institute of Electrical and Electronics Engineers (IEEE)

Operations Center, 445 Hoes Lane, Piscataway, New Jersey 08854-5997
Phone: 732-981-0060
<http://www.ieee.org>

National Fire Protection Association (NFPA)

1 Batterymarch Park, Quincy, MA 02169-7471
Phone: 617-770-3000
Fax: 617-770-0700
<http://www.nfpa.org>

National Institute for Occupational Safety and Health (NIOSH)

1600 Clifton Rd. Atlanta, GA 30333
Phone: 800-232-4636
<http://www.cdc.gov/niosh/>

National Safety Council

1121 Spring Lake Dr., Itasca, IL 60143-3201
Phone: 800-621-7615
<http://www.nsc.org>

NEMA

1300 N. 17th Street, Suite 900, Arlington, VA, 22209.
Phone: 703-841-3200
Fax: 703-841-5900,
<http://www.nema.org>

Additional information on US Safety Standards (continued)

NIST (National Institute of Standards and Technology)

100 Bureau Drive, Stop 2100, Gaithersburg, MD 20899-2100
Phone: 301-975-2020
<http://www.nist.gov/>

Occupational Safety and Health Administration (OSHA)

<http://www.osha.gov>

Precision Metalforming Association (PMA)

6363 Oak Tree Blvd., Independence, Ohio 44131-2500
Phone: 216-901-8800 ---- Fax: 216-901-9190
<http://www.pma.org>

Robotic Industries Association

900 Victors Way, Suite 140, Ann Arbor, Michigan 48106
Phone: 313-994-6088
<http://www.robotics.org>

Society of Automotive Engineers (SAE)

400 Commonwealth Drive, Warrendale, PA 15096-0001
Phone: 724-776-4841
<http://www.sae.org>

Underwriters Laboratories Inc.

333 Pfingsten Rd., Northbrook, IL 60062
Phone: 847-272-8800
<http://www.ul.com>



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