2012

Region IV
VPPPA Conference
Chattanooga, TN

Global Machine Guarding Standards

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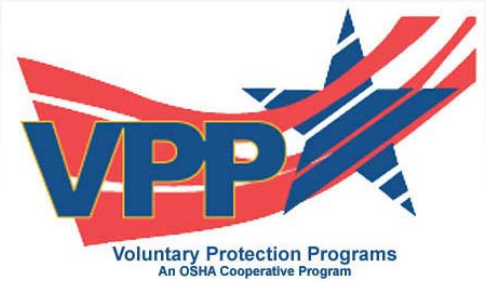
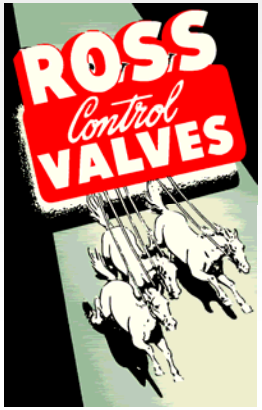
Agenda

- Ross Controls Introduction
- Global Machine Safety Standards Trends



The ROSS Controls Story

- Founded in 1921 by Charlie Ross
- Design, manufacture and sale or pneumatic valves and systems for industrial equipment
- 1954 – First double valve ever developed by ROSS
- 1962 – Developed first pneumatic energy isolation device
- 2005 – DM^2 ™



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Global Facilities

ROSS Controls - Madison Heights

ROSS Asia - Japan

ROSS Controls - Troy, MI

ROSS UK Ltd.

ROSS Controls - Lavonia, GA

ROSS Europa GmbH - Germany

ROSS South America

ROSS China

ROSS India

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Safety Industry

Current Committees with ROSS Representation

ANSI B11.19 Performance Criteria for Safeguarding
Published 2003. Updated 2010

ANSI B11.0 General Safety Requirements & Risk Assessment
Released 2008, updated 2010

ANSI Z244 Control of Hazardous Energy - Lockout Tagout
Published 2003, Re-affirmed 2008

ANSI TR6 Safety Control Systems for Machine Tools
Published 2010

ANSI B155.1 Packaging and Packaging Related Converting Machinery
Published 2011

ANSI B11.151 Plastics Machinery
Under revision

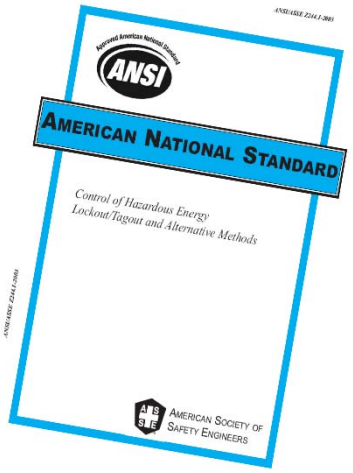
ANSI B11.1 Mechanical Power Press
Published 2009

ANSI B11.2 Hydraulic and Pneumatic Presses
Under revision, should release in 2012

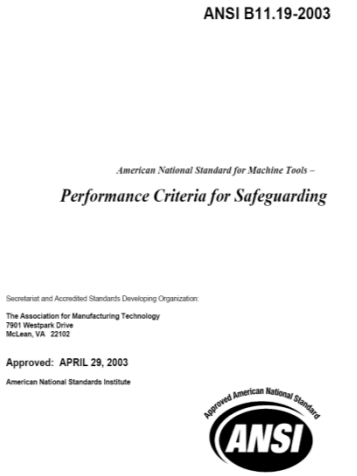
CSA Z432 Guarding of Machinery
Published 2004. Updated 2009

CSA Z460 Control of Hazardous Energy - Lockout - Tagout
Published 2005. Updated 2010

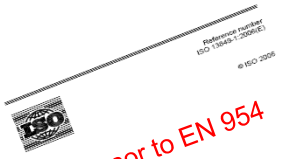
New! Machinery Directive 2006/42/EC
(December 29, 2009)



MIOSHA
Part 24
Mechanical Power Presses

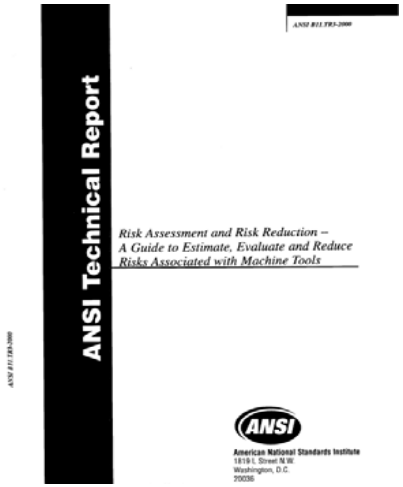


New! ANSI B11.GSR
General Safety Requirements



Successor to EN 954

OSHA Occupational Safety & Health Administration
U.S. Department of Labor



Global Standards
Machine Guarding *Trends*

Harmonization of Standards

- Standards are beginning to speak a similar language and have a similar structure
- Being copied with modifications
  - CSA Energy Isolation = ANSI Energy Isolation
- Robotics ISO 10218 will be the first global standard

Global Standards
Machine Guarding *Trends*

"The New Directive"

- Does not apply to US Machines but ...
  - Global users and OEMs
    - Like to standardize
    - Different machines can affect liability
    - Driving the current global manufacturing market

CE

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Global Standards
Machine Guarding *Trends*

European Certification and Documentation

CE

EQUALS

“YOUR PASSPORT TO EUROPE”

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Global Standards
Machine Guarding *Trends*

The Machinery Directive 98/37/EC was replaced with 2006/42/EC on December 29, 2009

- "The New Directive"
  - Requires CE mark on machinery & safety components
  - Compiling the technical construction file (Mtce. Manual, spare parts, risk assessment etc.)
  - Meet the EHSR's
  - Includes safety valves with diagnostics

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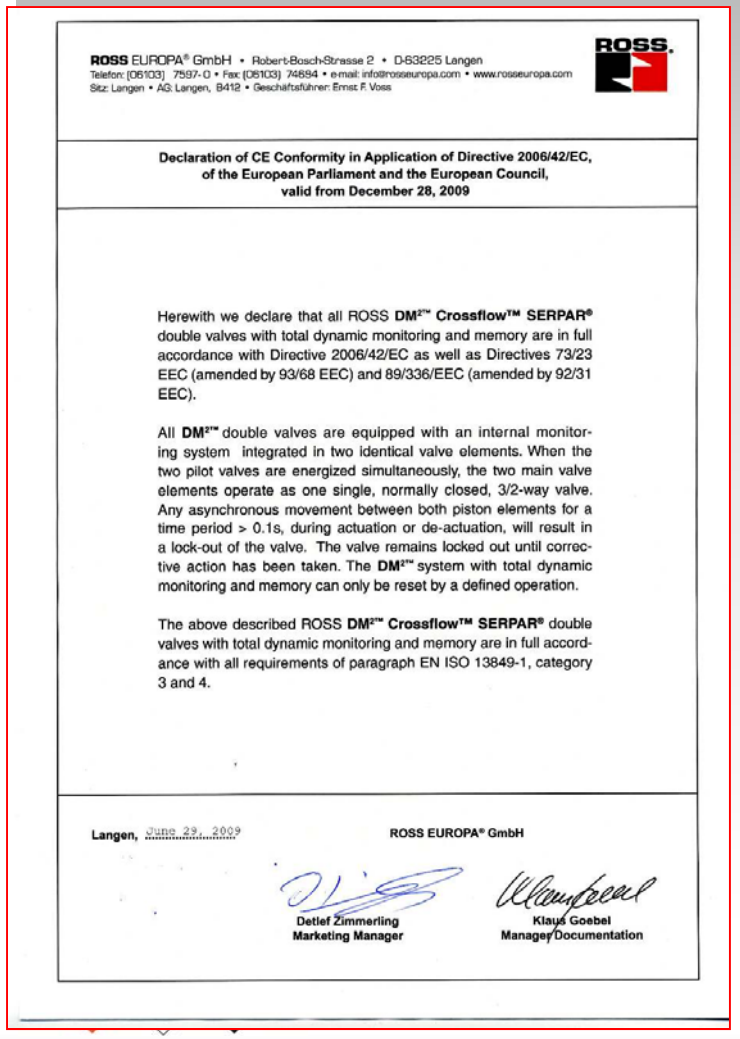
Global Standards
Machine Guarding *Trends*



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Declaration of CE Conformity in Application of Directive 2006/42/EC, of the European Parliament and the European Council, valid from December 28, 2009

Herewith we declare that all ROSS **DM²™ Crossflow™ SERPAR®** double valves with total dynamic monitoring and memory are in full accordance with Directive 2006/42/EC as well as Directives 73/23 EEC (amended by 93/68 EEC) and 89/336/EEC (amended by 92/31 EEC).

All **DM²™** double valves are equipped with an internal monitoring system integrated in two identical valve elements. When the two pilot valves are energized simultaneously, the two main valve elements operate as one single, normally closed, 3/2-way valve. Any asynchronous movement between both piston elements for a time period > 0.1s, during actuation or de-actuation, will result in a lock-out of the valve. The valve remains locked out until corrective action has been taken. The **DM²™** system with total dynamic monitoring and memory can only be reset by a defined operation.

The above described ROSS **DM²™ Crossflow™ SERPAR®** double valves with total dynamic monitoring and memory are in full accordance with all requirements of paragraph EN ISO 13849-1, category 3 and 4.

Langen, June 29, 2009 — ROSS EUROPA® GmbH

Detlef Zimmerling, Marketing Manager — Klaus Goebel, Manager Documentation

CE

The CE Mark denotes that the manufacturer has declared his product in compliance with all the pertinent Directives.

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Global Standards
Machine Guarding *Trends*

International Electrotechnical Commission (IEC)
International Organization for Standardization (ISO)

Member Countries of WTO

Global Standards
Machine Guarding *Trends*

- Type A
  - Basic safety standards and terminology
- Type B
  - B1 – Standards on safety aspects
  - B2 – Standards on safety components
- Type C
  - Specific machine requirements

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Global Standards
Machine Guarding *Trends*

STANDARD	USA	Canada	Europe	Brazil	Australia	China	Japan	India
Electrically Operated Valves	UL 429	CSA 22.2 No 139						
Control Of Hazardous Energy (Lockout)	ANSI Z244	CSA Z460	ISO 14118	NR 12	AS 4024			
Safeguarding of Machinery	ANSI B11.19	CSA Z432	ISO 13849			GB 17957	JIS B9700	
Safety Reqs and Risk Assessment	ANSI B11.0		ISO 12100				Article 18	IS 11016
Power Press Safety Regulation	ANSI B11.1	CSA Z142	EN 692				No 116	
Cylinder Press Regulation	ANSI B11.2	CSA Z142	EN 13736					
Robots	ANSI 15.06	CSA Z434	ISO 10218					
Packaging Machinery	ANSI B155.1		EN 415 1-9					
Plastics Machinery	ANSI B151.1		EN 422					
Hollow glass			EN 13042					
Safety Control Systems	ANSI B11.TR6		BG					
Pneumatic Systems	ISO 4414		ISO 4414			ISO 4414		
Two Hand Control			ISO 13851					
Pneumatic Fluid Power Testing			ISO 19973					

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Global Standards
Machine Guarding *Trends*

Emergency Stop:

- ANSI B11.19
- ANSI/NFPA 79
- ISO 13850

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Global Standards
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Risk Assessment Required:

- ANSI B11.0
- ANSI B155.1
- ANSI Z244
- ISO 12100
- ISO 13849
- ISO 10218
- RIA 15.06
- CSA 432
- CSA 434
- CSA 460

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Global Standards
Machine Guarding *Trends*

Risk Assessment Requirements:

Performed by:

- OEM
- Integrator
- End User

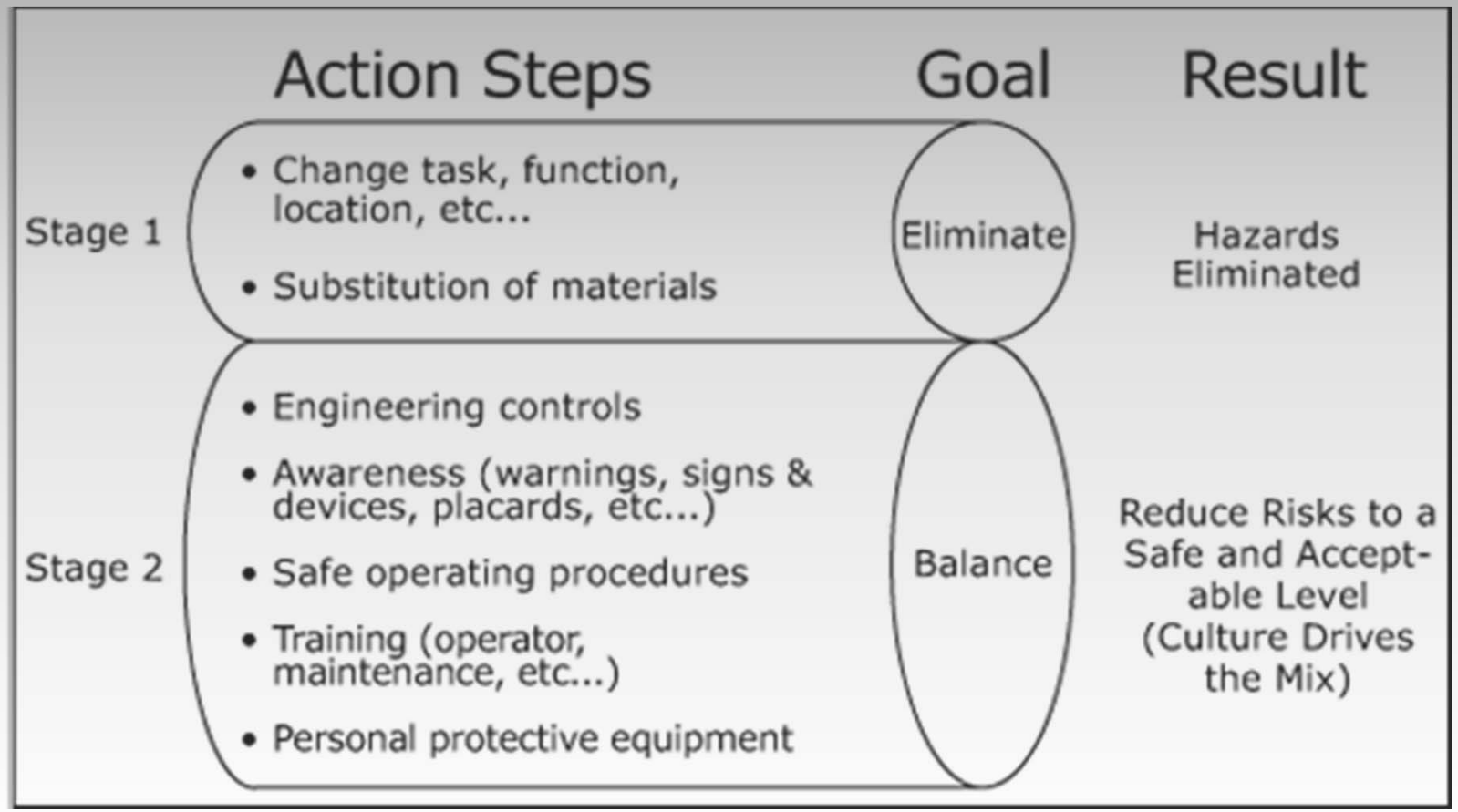
Must consider:

- Foreseeable misuse
- Failure Modes

Risk Assessment

- Risk Assessment
  - Task based process
  - Consider severity, frequency, & probability
  - Consider foreseeable misuse & failure modes

Machine Guarding Hierarchy



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Risk Assessment – EN 954

S - Severity of Injury

S1 — *Slight (reversible)*

S2 — *Serious (non-reversible)*

Take the worst case injury into account. If this is no more than a slight cut or bruise, then select S1. If the consequences are more severe, up to and including death, then select S2.

F - Frequency & Duration of Exposure

F1 — *Seldom*

F2 — *Frequent to continuous and/or long exposure*

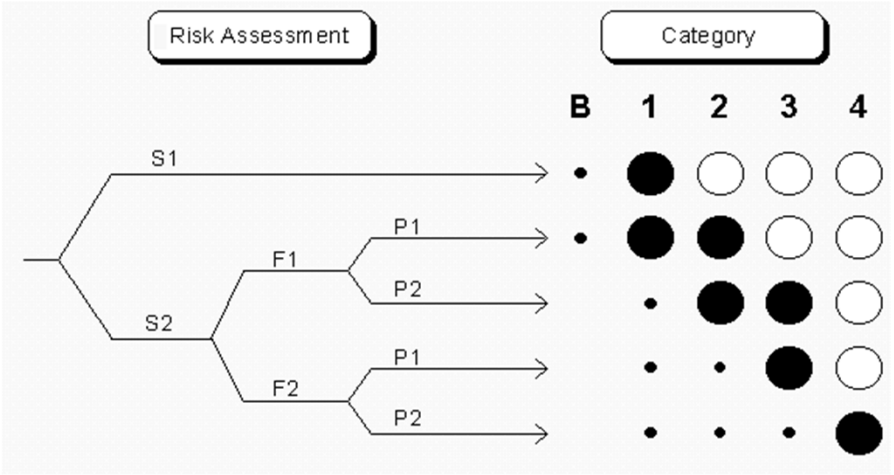
Select F2 if a person is exposed to the hazard frequently. It is irrelevant whether it is the same person or a different person. Select F1 if access is only required from time to time and the exposure time is short.

P – Possibility of Avoiding the Hazard

P1 — *Possible under specific conditions*

P2 — *Less possible*

Determine the possibility of avoiding the hazard if the monitoring & control devices used (such as light curtains) failed. This is generally related to the speed at which the hazard moves, proximity to the hazard, level of training, and expertise of operators. If, in your opinion, the operator could recognize the hazard and avoid injury, select P1. Otherwise, select P2



Legend

Preferred Category. Some risk levels offer two selection possibilities. If the equipment is clean and dry and the levels of maintenance and inspection of the safety related system are high, select the lower category. Otherwise, select the higher.

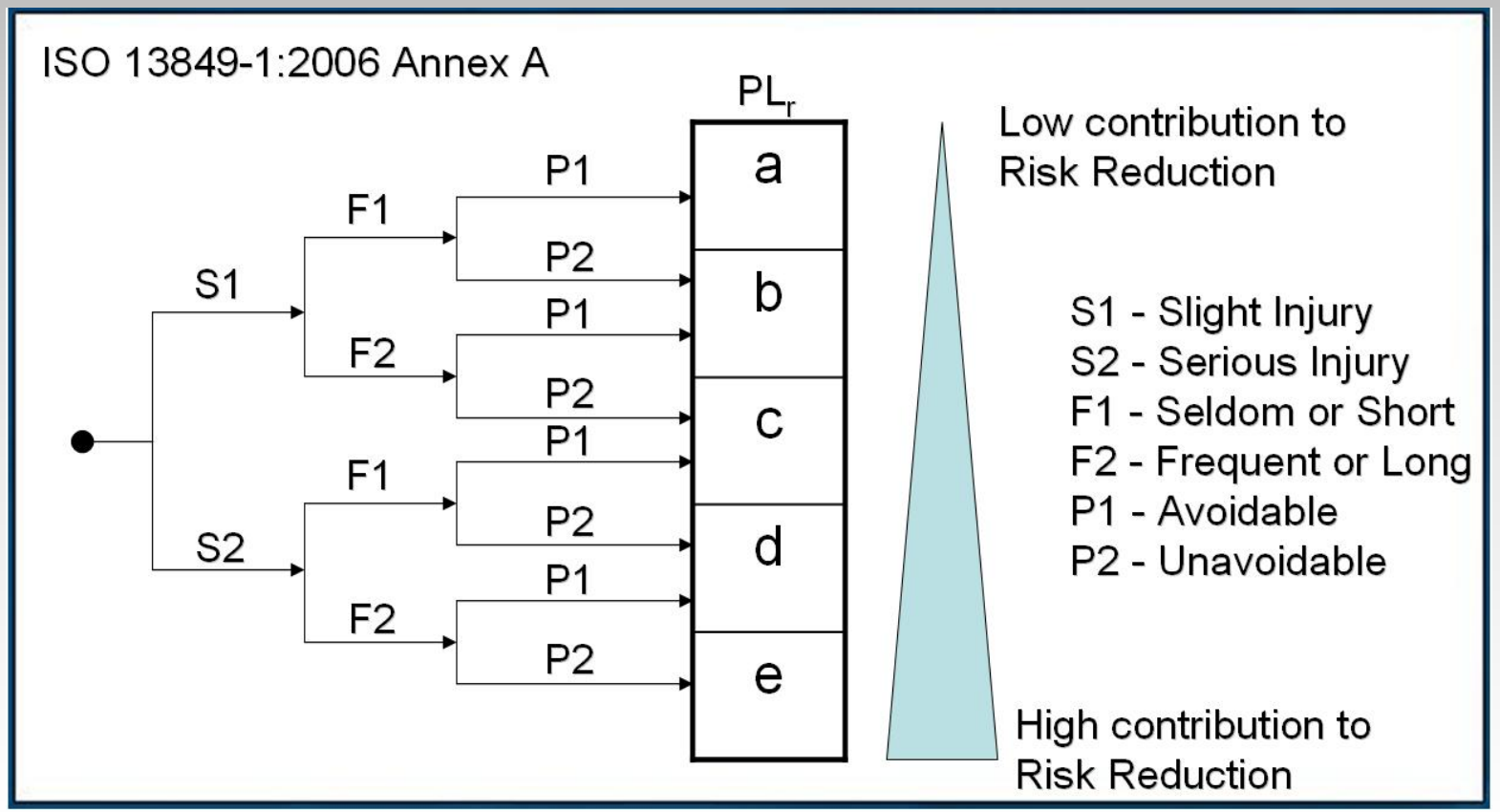
Possible Lower Category. In some applications the designer can select a lower category by using other safeguard measures, such as hard guarding.

More than required for the relevant risk

Risk Assessment – ANSI B11.0

Probability of occurrence of harm	Severity of harm: Catastrophic	Serious	Moderate	Minor
Very Likely	High	High	High	Medium
Likely	High	High	Medium	Low
Unlikely	Medium	Medium	Low	Negligible
Remote	Low	Low	Negligible	Negligible

Risk Assessment – ISO 13849



Machine Guarding Hierarchy

Table 3 — The Hazard Control Hierarchy

Most Preferred

Least Preferred

Protective Measure	Examples	Influence on Risk Factors	Classification
Elimination or Substitution	• Eliminate pinch points (increase clearance) • Intrinsically safe (energy containment) • Automated material handling (robots, conveyors, etc.) • Redesign the process to eliminate or reduce human interaction • Reduced energy • Substitute less hazardous chemicals	• Impact on overall risk (elimination) by affecting severity and probability of harm • May affect severity of harm, frequency of exposure to the hazard under consideration, and/or the possibility of avoiding or limiting harm depending on which method of substitution is applied.	Design Out
Guards and Safeguarding Devices	• Barriers • Interlocks • Presence sensing devices (light curtains, safety mats, area scanners, etc.) • Two hand control and two-hand trip devices	• Greatest impact on the probability of harm (Occurrence of hazardous events under certain circumstance) • Minimal if any impact on severity of harm	Engineering Controls
Awareness Devices	• Lights, beacons, and strobes • Computer warnings • Signs and labels • Beepers, horns, and sirens	• Potential impact on the probability of harm (avoidance) • No impact on severity of harm	Administrative Controls
Training and Procedures	• Safe work procedures • Safety equipment inspections • Training • Lockout / Tagout / Tryout	• Potential impact on the probability of harm (avoidance and/or exposure) • No impact on severity of harm	
Personal Protective Equipment (PPE)	• Safety glasses and face shields • Ear plugs • Gloves • Protective footwear • Respirators	• Potential impact on the probability of harm (avoidance) • No impact on severity of harm	

Control Integrity

Table 4 — Approximate Relationships Between Levels in ANSI B11.TR6 and Other Relevant Standards

Risk Reduction	System Architecture				
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
ANSI B11.TR6 (ISO 13849-1:1999)	ANSI B11.0	Robotics Industry (RIA R15.06 / CSA Z434)	CATEGORY (ISO 13849-1:1999)	SIL (IEC 61508)	Performance Level (ISO 13849-1: 2006
Highest: Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that a single fault in any of these parts does not lead to a loss of the safety function, and the single fault is detected at or before the next demand upon the safety function, but that if this detection is not possible, an accumulation of undetected faults shall not lead to loss of the safety function.	Highest: Redundancy w/ continuous self-checking (e.g., Dual channel w/ continuous monitoring)	R1 / R2A (Control reliable)	4	3	e
Intermediate / High: Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that a single fault in any of these parts does not lead to the loss of the safety function, and whenever reasonably practicable, the single fault is detected.	Intermediate / High: Redundancy w/ self-checking upon start-up (e.g., Dual channel w/ monitoring at cycle/start-up)	R2A / R2B (Control reliable / Single channel with monitoring)	3	3 to 2	d or c
Low / Intermediate: Requirements of B and the use of well-tried safety principles shall apply. Safety function shall be checked at suitable intervals by the machine control system.	Low / Intermediate: Redundancy that may be manually checked (e.g., Dual channel w/ optional manual monitoring)	R2B / R2C (Single channel with monitoring / Single channel)	2	2 to 1	b
Lowest: Requirements of B shall apply. Well-tried components and well-tried safety principles shall be used.	Lowest: Single channel	R3A (Single channel)	1	0	a
B: SRP/CS and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards so that they can withstand the expected influence. Basic safety principles shall be used.		R3B / R4 (Simple)	B		a

Global Standards
Machine Guarding *Trends*

- Global users choose the “highest” standard


INTERNATIONAL STANDARD

ISO 13849-1

Second edition
2006-11-01

Safety of machinery — Safety-related parts of control systems —
Part 1:
General principles for design

Sécurité des machines — Parties des systèmes de commande relatives à la sécurité —
Partie 1: Principes généraux de conception

Reference number
ISO 13849-1:2006(E)

© ISO 2006

  - o Tend to be ISO due to legal requirements
  - o Desire one machine globally
  - o Should not have lesser safety requirements depending upon country
  - o Allows for global design standards

- OEMs design to customer specs

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Global Standards
Machine Guarding *Trends*

User Customer Demand

OEM Special

Standard requirements

OEM Standard Design

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Lockout Tagout

OSHA 1910.147 The control of Hazardous energy

ANSI Z244 Lockout/Tagout

- Lockout whenever a body part is put into a point of operation
- Production related issues may be performed using “alternative measures which provide effective protection”.

Lockout/Tagout OSHA

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Alternative Measures

May only be used for tasks that are part of the normal production and operation

- Routine
- Repetitive
- Integral to the manufacturing process

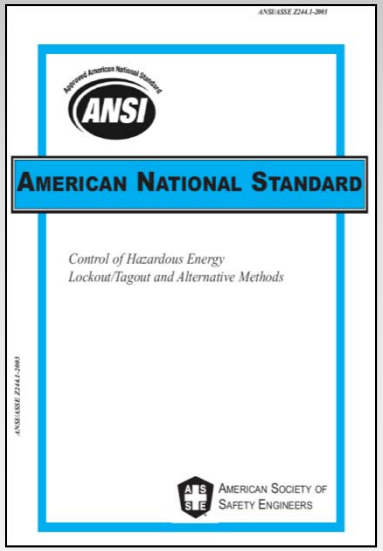
Examples: jam clearing, tool changes, lubrication, roll polishing

Alternative Measures

- Allows for rapid access
- Maintains safety of employees
- ANSI Z244 provides specific process

Alternative Measures

- Process Requirements (3 steps)
  - Risk assessment
  - Hierarchy of control defined
  - Control circuit integrity defined



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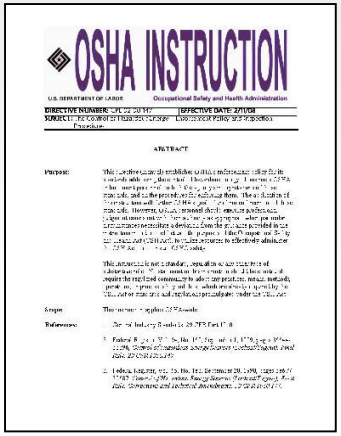
Alternative Measures

OSHA Instruction CPL 02-00-147 (Highlights)

- Directive to inspectors to address ANSI Z244.1
- Machine guarding becomes an important economical alternative to LOTO
- Hazardous energy that is present must be released
- Apply this safeguard through a risk assessment process
- Control reliability would provide alternative safeguarding measures


OSHA INSTRUCTION

Occupational Safety and Health Administration

ABSTRACT

Purpose:

Scope:

References:

Consider it DONE!

Risk Reduction

ANSI B11.19 Hierarchy

a) Guards

b) Safeguarding devices

Only methods recognized by OSHA

c) Awareness devices

d) Safeguarding (work) methods

e) Safe work procedures

Risk Reduction

Control circuit integrity (Z244)

a) Negligible Risk Potential - Infrequent exposure, low injury severity
  – Single channel hardwired circuit

b) Low Risk Potential – Frequent exposure and low injury severity
  – Dual channel hardwired circuit

c) Medium Risk Potential – ANY exposure to serious injury
  – Dual channel hardwired circuits that are redundant and monitored

d) High risk potential – ANY exposure to catastrophic injury
  – Requires control reliable components”

Alternative Measures

- Must use traditional lockout for maintenance
- Alternative lockout for production (routine, repetitive, & integral)
  - Requires risk assessment
  - Concerned with hazardous energy
  - Control reliable systems can be an effective means
  - Exclusive control by the employee

Alternative Measures

Lockout costs (time related):

- Initial problem occurs
- Troubleshooting the true problem
- Locating repair parts
- Lockout all energy sources
- Repair installation
- Restart

Alternative Measures

Alternative lockout reduces the risk of an operator missing a LOTO for one energy source when he is rushed.

Alternative lockout reduces the time required to put the machine into a safe mode.

TIME = MONEY

SAFETY + PRODUCTIVITY

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Wh

Table 1 — Recommended application of IEC 62061 and ISO 13849-1

	Technology implementing the safety-related control function(s)	ISO 13849-1	IEC 62061
A	non electrical, e.g. hydraulics	X	not covered
B	electromechanical, e.g. relays, and/or non complex electronics	restricted to designated architectures (see Note 1) and up to PL = e	all architectures and up to SIL 3
C	complex electronics, e.g. programmable	restricted to designated architectures (see Note 1) and up to PL = d	all architectures and up to SIL 3
D	A combined with B	restricted to designated architectures (see Note 1) and up to PL = e	X see Note 3
E	C combined with B	restricted to designated architectures (see Note 1) and up to PL = d	all architectures and up to SIL 3
F	C combined with A, or C combined with A and B	X see Note 2	X see Note 3

X indicates that this item is dealt with by the standard shown in the column heading.

NOTE 1 Designated architectures are defined in 6.2 of ISO 13849-1 to give simplified approach for quantification of performance level.

NOTE 2 For complex electronics: Use designated architectures according to ISO 13849-1 up to PL = d or any architecture according to IEC 62061.

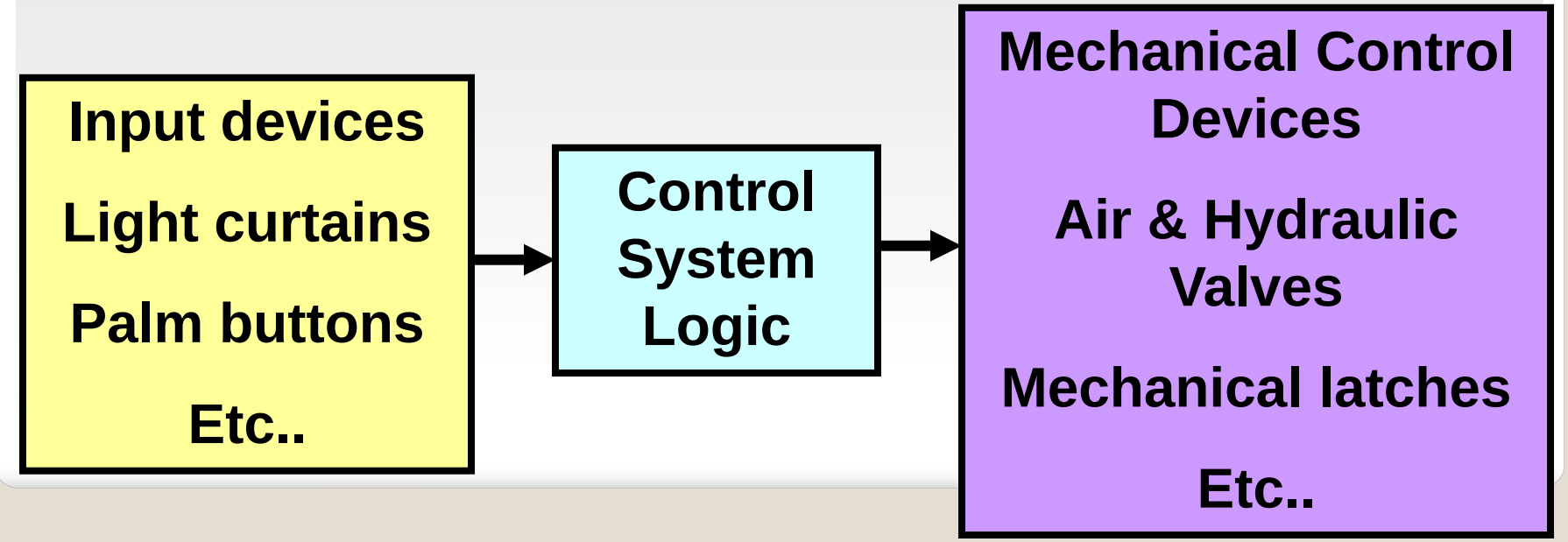
NOTE 3 For non-electrical technology use parts according to ISO 13849-1 as subsystems.

Complex equipment must comply with IEC61508, regardless of which standard above is used. This falls under the responsibility of the component manufacturer, not the system designer.

Control System

The Control system does NOT END with the wire!

It includes all components involved in performing the safety function; sensors, manual input, and mode selection elements, interlocking and decision-making circuitry, and output elements that control machine operating devices or mechanisms.



Machine Guarding

B11.19 Highlights

Section 6 General Safeguarding Requirements:

Requires monitoring of all safety circuit applications involving stopping distances where the **stopping time** might change based on the systems components (sticky valve, worn spring on a switch, etc.)

Safety Valves

ANSI B155.1 Packaging Machinery Standard

7.2.9.2 Stop functions

- When pneumatic or hydraulic elements are incorporated into a safety stopping function, the circuit design and component selection shall be appropriate for the required level of safety performance. Devices that produce a hazard shall have power removed during a stop function, provided a greater hazard is not created in the process.

Global Standards
Machine Guarding *Trends*

- Introduction of Functional Safety
  - TR6 Revision
  - Export OEMs
- Harmonizing IEC 62061 & ISO 13849
  - Equate SIL & PL
- ANSI harmonization

Global Machine Guarding Standards

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