



Machine Functional Safety: Principles, Standards and Implementation

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Definition of Safety

Safety

Freedom from unacceptable risk

Functional Safety

Part of the safety of the machine and the machine control system which depends on the correct functioning of ---

- the safety related electrical control system
- other technology safety-related systems
- external risk reduction facilities



Top 10 OSHA Violations for 2017

1. Fall Protection - 6,072
2. Hazard Communication - 4,176
3. Scaffolding - 3,288
4. Respiratory Protection - 3,097
5. Lockout/Tagout - 2,877
6. Ladders - 2, 241
7. Powered Industrial Trucks - 2, 162
8. Machine Guarding - 1,933
9. Fall Protection Training Requirements - 1,523
10. Electrical Wiring Methods - 1,405



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Evolution of Safety



Properly designed safety never needs to be bypassed



As our relationship to machines has changed, so has society's emphasis for machine safety



Lock-Out Tag-Out is still relevant, but alternative methods can boost production without compromising safety



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Machinery Safety Legislation and Standards

- There are a variety of standards you can use when designing a safety system
- Legislation is specific to countries and regions
- The common themes of all new international machinery safety standards are...
 - risk assessments, risk quantification, life cycle design considerations and usage of electronic Safeguarding products



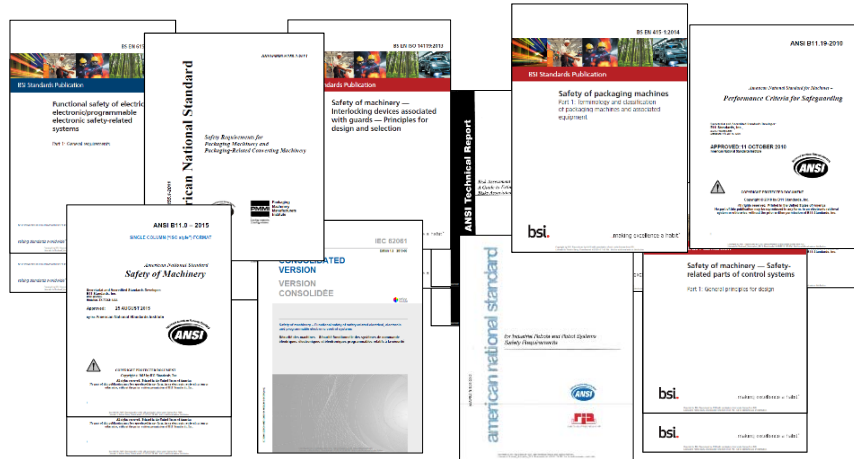
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Safety Organizations



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Why is So Many Standards?



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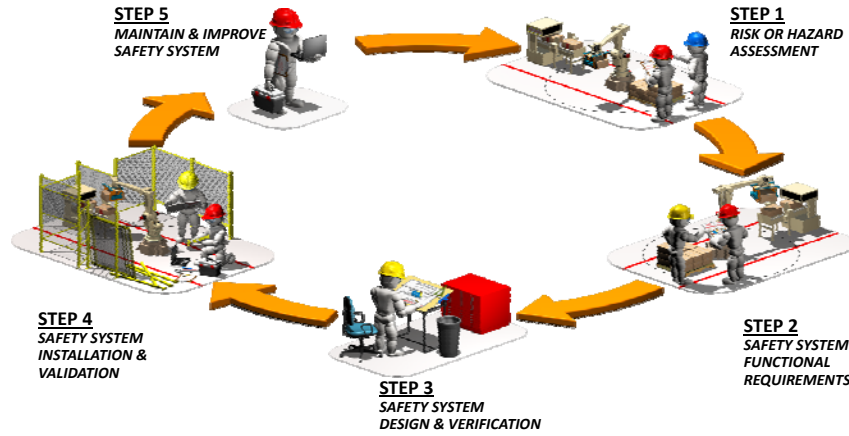
Safety Standards Overview

ISO 12100 (TYPE-A STANDARD) GENERAL PRINCIPLES FOR DESIGN – RISK ASSESSMENT AND RISK REDUCTION					
TYPE-B STANDARDS RELATED TO HAZARDS			TYPE-B STANDARDS RELATED TO ASPECTS AND TECHNOLOGY		
NOISE	SUBSTANCES	VIBRATION & SHOCK	DIMENSIONS & DISTANCES	POWER SOURCE	SAFETY DEVICES
Determination of emission sound pressure levels at a workstation ISO 11300, ISO 11301 to ISO 11305	Evaluation of emission of airborne hazardous substances ISO 23042 series	Whole body vibration ISO 2631 series	Gaps to avoid crushing ISO 13854	Electrical equipment IEC 60304-1	Guards ISO 14120
Determination of sound power and energy levels ISO 3741, ISO 3743-1, ISO 3744, ISO 3745, ISO 3746, ISO 3747	Reduction of risks to health from hazardous substances ISO 14123-1, ISO 14123-2	Hand-arm vibration ISO 13753	Minimum distances ISO 13855	Pneumatic equipment ISO 4414	Interlocking devices ISO 14119
Determination of sound power levels by sound intensity ISO 9614 series	Hygiene requirements ISO 14159	Hand-held and hand-guided machinery ISO 20643	Safety distances ISO 13857	Hydraulic equipment ISO 4413	Two-hand control devices ISO 13851
Insulation performances of enclosures ISO 11546 series	THERMAL HAZARDS Human responses to contact with hot surfaces ISO 13732-1	ERGONOMICS Access openings ISO 15534	Permanent means of access ISO 14122 series	CONTROL SYSTEMS Avoidance of unexpected start-up ISO 14118	Electro-sensitive protective equipment IEC 61496 series
Insulation performances of cabins ISO 11546 series	FIRE HAZARDS Fire prevention and protection ISO 13953	Anthropometric requirements for workstations ISO 14738	ALARMS & WARNINGS Design principles for safety signs ISO 3864-1	Design of safety-related parts of control systems ISO 13849-1	Pressure-sensitive protective devices ISO 13859 series
Declaration and verification of noise emission ISO 4871	ELECTRICAL HAZARDS Protection against electric shock IEC 60204-1	Computer manikins and body templates ISO 15536-1	Registered safety signs ISO 7010	Validation of safety-related parts of control systems ISO 13849-2	ASSEMBLY OF MACHINERY Integrated manufacturing systems ISO 11161
		RADIATION HAZARDS Lasers and laser-related equipment – Generals ISO 11145	Auditory danger signals ISO 7731	Emergency stop function ISO 18550	

TYPE-C STANDARDS
 THERE ARE MANY STANDARDS THAT ARE CREATED FOR SPECIFIC MACHINERY OR EQUIPMENT TYPES. THESE ARE TYPE-C STANDARDS. A LIST OF THESE SPECIFIC STANDARDS CAN BE FOUND ON ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/machinery/index_en.htm

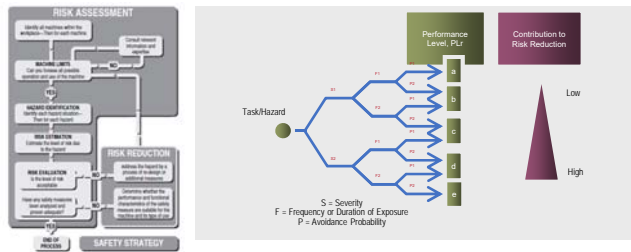
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Machine Safety Lifecycle



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Risk Assessment



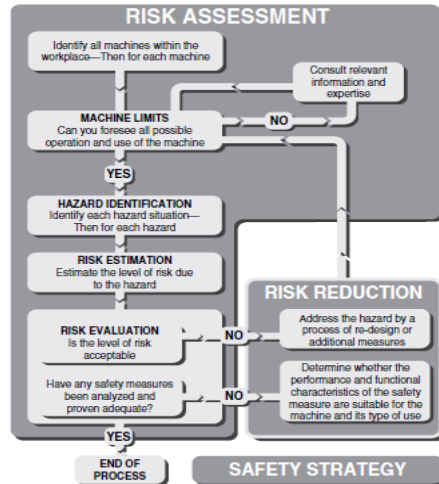
- Provides Safety Performance Level – Design Target
- Creates the Foundation of the Safety System Functional Requirements, System Design & Validation Protocol
- Shows “Due Diligence” & Compliance to Industry Standards
- Incorporates input from the people that actually use the machine and considers how they use it
- Output - safeguarding concept that answers several questions



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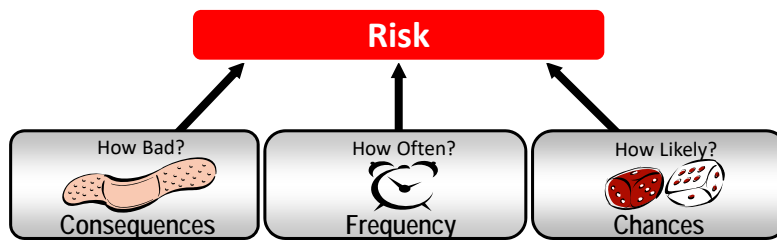
Principles of Risk Assessments

Risk Reduction

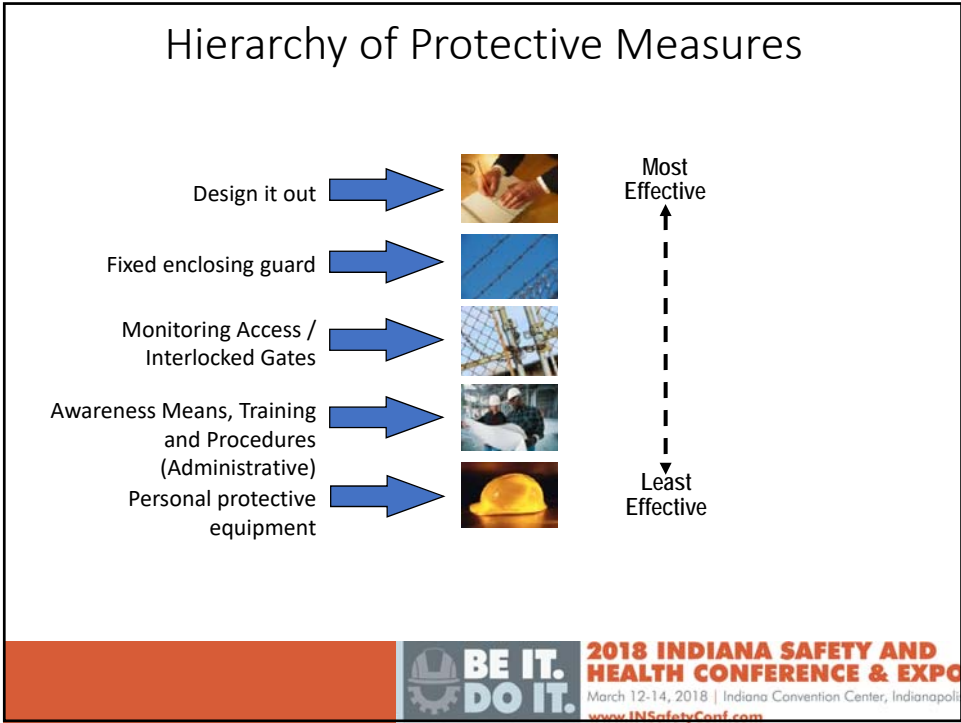


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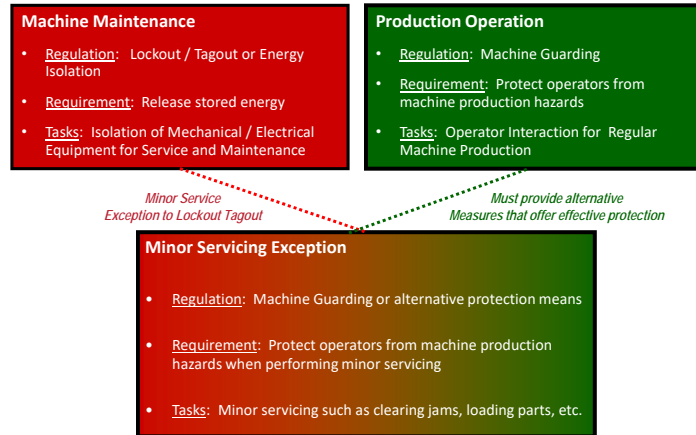
Performing Risk Assessments



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Energy Isolation vs Machine Guarding



Minor servicing must be **routine**, **repetitive** and **integral** to the operation of the system



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How do I Know a Product is Safe?

All safety rated products are developed to meet specific standards for safety

Most safety rated products are certified by professional 3rd party organizations to demonstrate compliance to specific safety standards

- Examples of third party certification organizations include TUV Rheinland, TUV Nord and BG



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Questions?



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