Portage County Safety Council
Machine Safety Workshop Part 3 or 5
Risk Reduction Methods
and SFRS (Safety Functional Requirements Specification)

Sept. 15, 2021

Integrated Mill Systems

Mark Eitzman

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Integrated Mill Systems
Machine Safety Workshop handouts

- D+V+S>R notes
- *Goals and business outcomes of an investment in machine safety solutions*
- *IMS Machine Safety*
- *Previous presentations (parts 1 & 2)*
- *Today's presentation*

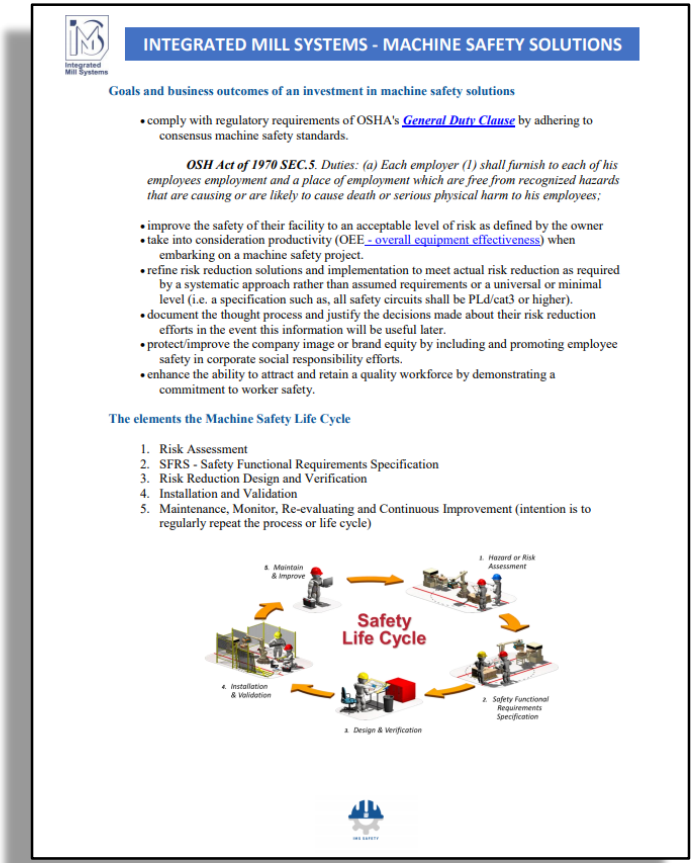

Integrated Mill Systems
Machine Safety Workshop

Leadership Driven Change - *Gleicher-Dannemiller Change Equation*

D + V + S > R

Dissatisfaction Vision Next Steps Resistance

Dissatisfaction	Vision	Next Steps	Resistance to Change


INTEGRATED MILL SYSTEMS - MACHINE SAFETY SOLUTIONS

Goals and business outcomes of an investment in machine safety solutions

- comply with regulatory requirements of OSHA's ***General Duty Clause*** by adhering to consensus machine safety standards.

OSH Act of 1970 SEC.5*. Duties: (a) Each employer (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;*

- improve the safety of their facility to an acceptable level of risk as defined by the owner
- take into consideration productivity (OEE - overall equipment effectiveness) when embarking on a machine safety project.
- refine risk reduction solutions and implementation to meet actual risk reduction as required by a systematic approach rather than assumed requirements or a universal or minimal level (i.e. a specification such as, all safety circuits shall be PLd/cat3 or higher).
- document the thought process and justify the decisions made about their risk reduction efforts in the event this information will be useful later.
- protect/improve the company image or brand equity by including and promoting employee safety in corporate social responsibility efforts.
- enhance the ability to attract and retain a quality workforce by demonstrating a commitment to worker safety.

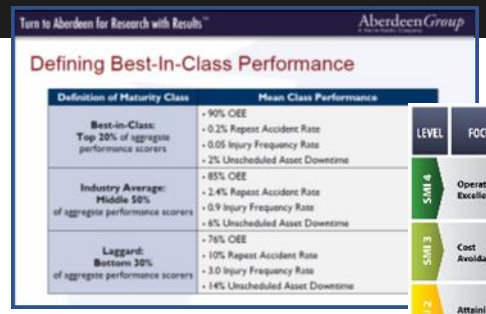
The elements the Machine Safety Life Cycle

1. Risk Assessment
2. SFRS - Safety Functional Requirements Specification
3. Risk Reduction Design and Verification
4. Installation and Validation
5. Maintenance, Monitor, Re-evaluating and Continuous Improvement (intention is to regularly repeat the process or life cycle)

5 part series on Manufacturing Safety

PORTAGE COUNTY SAFETY COUNCIL

A Forum For Workplace Safety



1. ✓ **Societal Demands for Safety and Productivity - Sept. 1**
2. ✓ **Regulatory Compliance (laws and standards) and Risk Assessments - Sept 8**
3. ★ **Risk Reduction Methods, Technologies and Techniques for Machinery Safety - Sept 15**
4. **Engineered Controls and Safety Circuits – Sept 22**
5. **Installation, Validation and Post Commissioning Management of Change – Sept 29**

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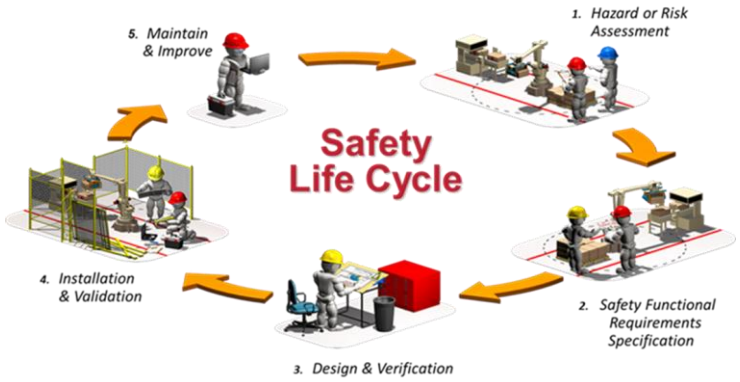
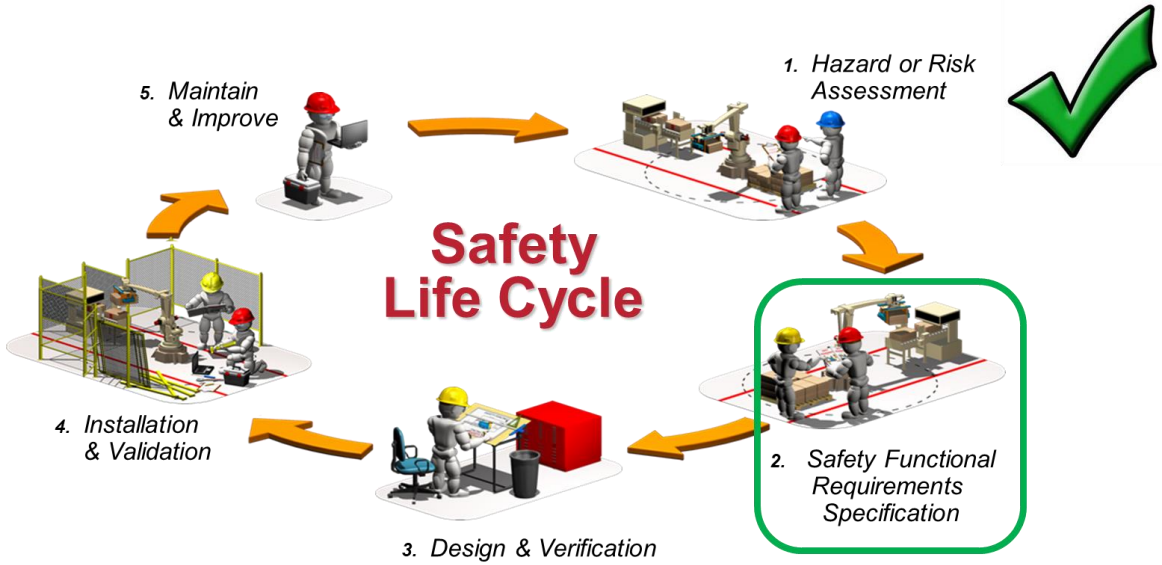


Portage County Safety Council
Machine Safety Workshop Part 3 or 5
Risk Reduction Methods and SFRS
Sept. 15, 2021 – Mark Eitzman

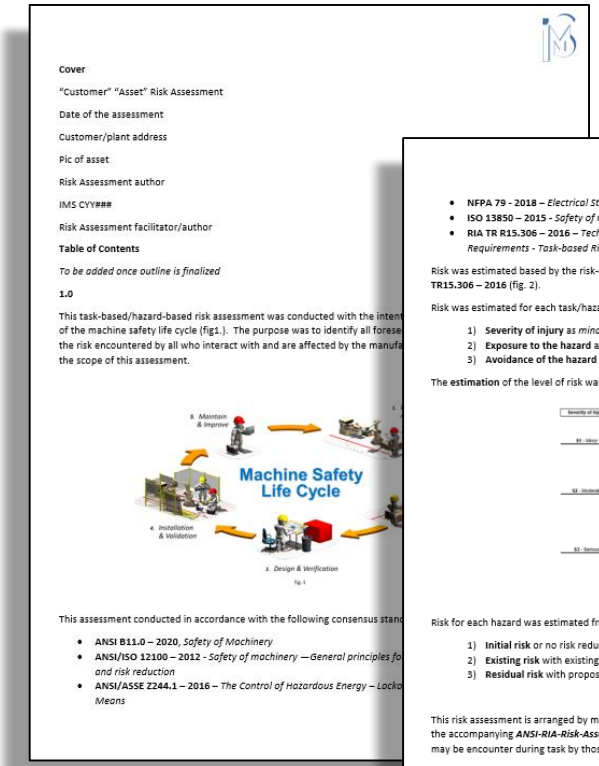
PORTAGE COUNTY SAFETY COUNCIL
A Forum For Workplace Safety

- Risk Reduction Methods & Technologies for Machine Safety
  - What are the various means of mitigating the risk of injury on machines?
  - Which are appropriate and most practical for your application based on the risk assessment?
  - The Safety Functional Requirements Specification (SFRS).

ISO, IEC, ANSI, RIA, etc.
Functional Safety Life Cycle



IMS Risk Assessment Documentation



Cover

"Customer" "Asset" Risk Assessment

Date of the assessment

Customer/plant address

Pic of asset

Risk Assessment author

IMS CYY###

Risk Assessment facilitator/author

Table of Contents

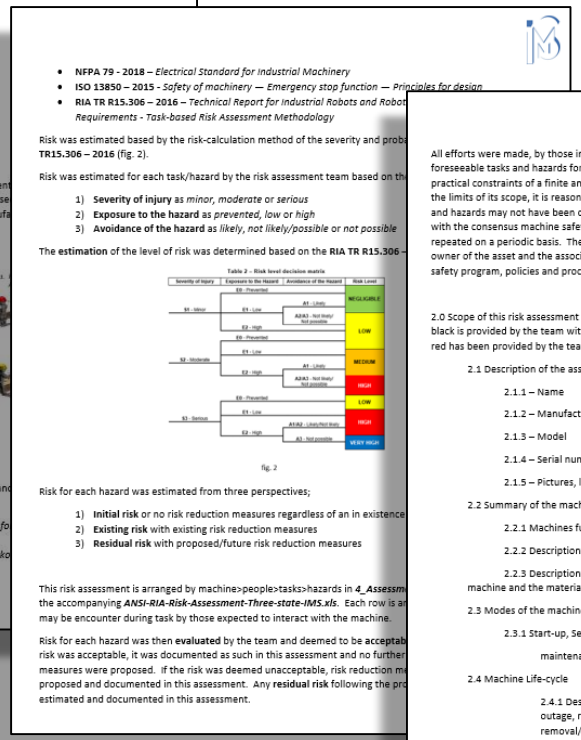
To be added once outline is finalized

1.0

This task-based/hazard-based risk assessment was conducted with the intent of the machine safety life cycle (fig1.). The purpose was to identify all foreseeable the risk encountered by all who interact with and are affected by the manufa the scope of this assessment.

This assessment conducted in accordance with the following consensus stand

- **ANSI B11.0 – 2020**, *Safety of Machinery*
- **ANSI/ISO 12100 – 2012** - *Safety of machinery —General principles fo and risk reduction*
- **ANSI/ASSE Z244.1 – 2016 –** *The Control of Hazardous Energy – Locko Means*



- **NFPA 79 - 2018 –** *Electrical Standard for Industrial Machinery*
- **ISO 13850 – 2015 -** *Safety of machinery — Emergency stop function — Principles for design*
- **RIA TR R15.306 – 2016 –** *Technical Report for Industrial Robots and Robot Requirements - Task-based Risk Assessment Methodology*

Risk was estimated based by the risk-calculation method of the severity and proba **TR15.306 – 2016** (fig. 2).

Risk was estimated for each task/hazard by the risk assessment team based on th

1) **Severity of injury** as *minor, moderate or serious*
2) **Exposure to the hazard** as *prevented, low or high*
3) **Avoidance of the hazard** as *likely, not likely/possible or not possible*

The **estimation** of the level of risk was determined based on the **RIA TR R15.306 –**

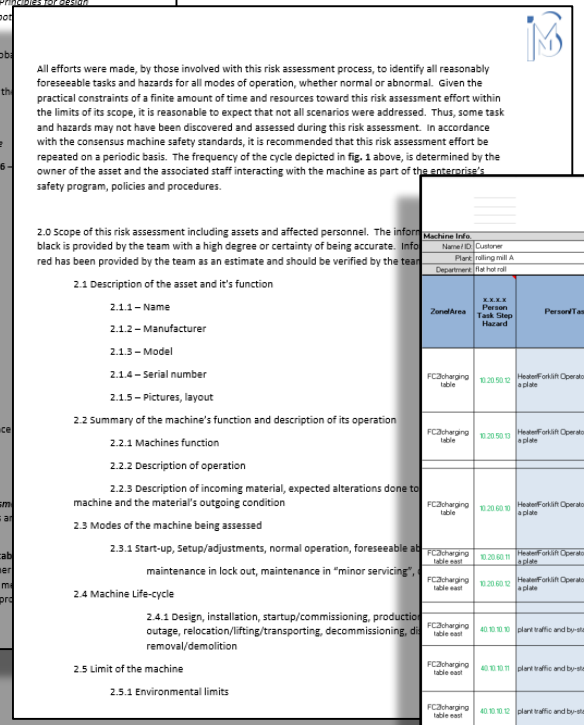
fig. 2

Risk for each hazard was estimated from three perspectives;

1) **Initial risk** or no risk reduction measures regardless of an in existence
2) **Existing risk** with existing risk reduction measures
3) **Residual risk** with proposed/future risk reduction measures

This risk assessment is arranged by machine>people>tasks>hazards in ***4_Assessm*** the accompanying ***ANSI-RIA-Risk-Assessment-Three-state-IMS.xls***. Each row is a may be encounter during task by those expected to interact with the machine.

Risk for each hazard was then **evaluated** by the team and deemed to be **acceptab** risk was acceptable, it was documented as such in this assessment and no further measures were proposed. If the risk was deemed unacceptable, risk reduction m proposed and documented in this assessment. Any **residual risk** following the pro estimated and documented in this assessment.



All efforts were made, by those involved with this risk assessment process, to identify all reasonably foreseeable tasks and hazards for all modes of operation, whether normal or abnormal. Given the practical constraints of a finite amount of time and resources toward this risk assessment effort within the limits of its scope, it is reasonable to expect that not all scenarios were addressed. Thus, some task and hazards may not have been discovered and assessed during this risk assessment. In accordance with the consensus machine safety standards, it is recommended that this risk assessment effort be repeated on a periodic basis. The frequency of the cycle depicted in **fig. 1** above, is determined by the owner of the asset and the associated staff interacting with the machine as part of the enterprise's safety program, policies and procedures.

2.0 Scope of this risk assessment including assets and affected personnel. The inform black is provided by the team with a high degree or certainty of being accurate. Info red has been provided by the team as an estimate and should be verified by the tea

2.1 Description of the asset and it's function

2.1.1 – Name

2.1.2 – Manufacturer

2.1.3 – Model

2.1.4 – Serial number

2.1.5 – Pictures, layout

2.2 Summary of the machine's function and description of its operation

2.2.1 Machines function

2.2.2 Description of operation

2.2.3 Description of incoming material, expected alterations done to machine and the material's outgoing condition

2.3 Modes of the machine being assessed

2.3.1 Start-up, Setup/adjustments, normal operation, foreseeable ab

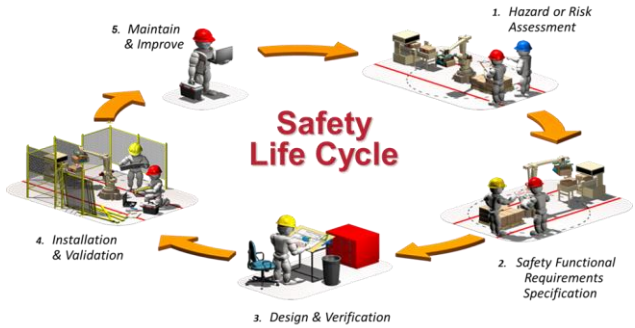
maintenance in lock out, maintenance in "minor servicing",

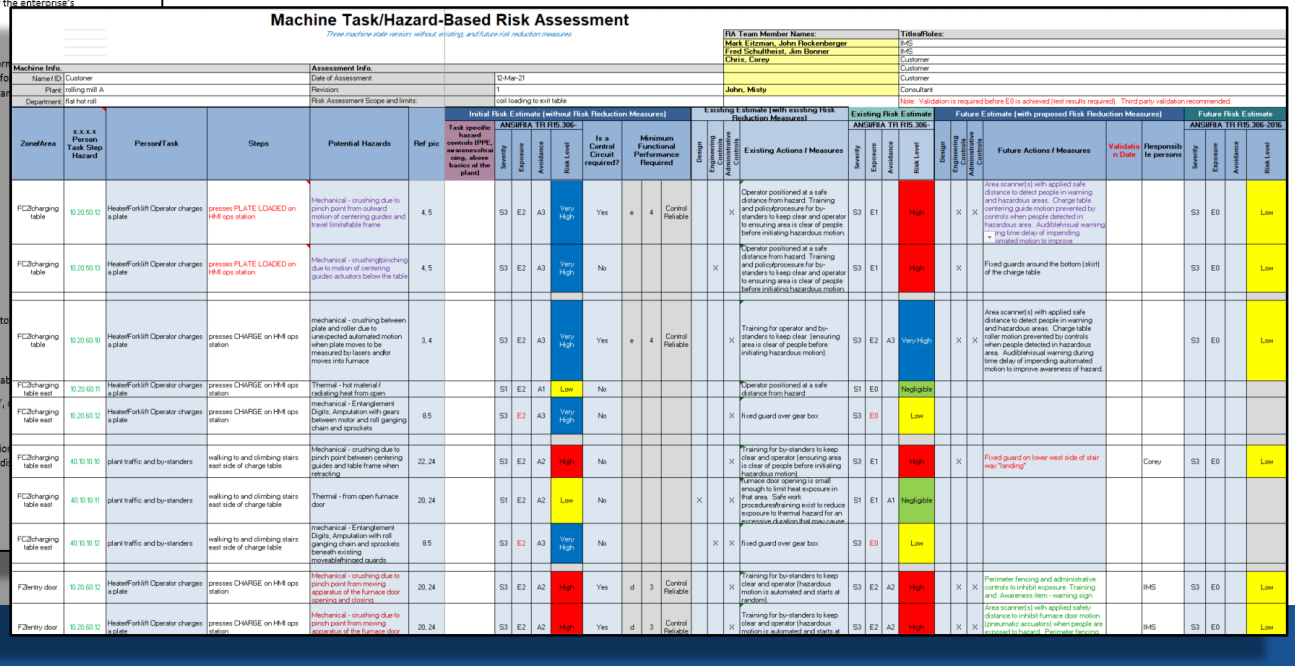
2.4 Machine Life-cycle

2.4.1 Design, installation, startup/commissioning, productio outage, relocation/lifting/transporting, decommissioning, di removal/demolition

2.5 Limit of the machine

2.5.1 Environmental limits





Machine Task/Hazard-Based Risk Assessment

Three machine state versions without, existing and future risk reduction measures

Machine Info.		Assessment Info.		RIA Team Member Names:	Title/Roles:
Name / ID	Customer	Date of Assessment	12-Mar-21	Mark Eitzman, John Reckenberger	IMS
Plant	rolling mill A	Revision:	1	Fred Schultheist, Jim Bonner	IMS
Department	flat hot roll	Risk Assessment Scope and limits:	coil loading to exit table	Chris, Corey	Customer
				John, Misty	Customer
					Customer
					Consultant

Note: Validation is required before E0 is achieved (test results required). Third party validation recommended.

Zone/Area	x.x.x.x Person Task Step Hazard	Person/Task	Steps	Potential Hazards	Ref pic	Initial Risk Estimate (without Risk Reduction Measures) — Task specific hazard controls (PPE, awareness/training, above basics of the plant)	ANSI/RIA TR R15.306- Severity	Exposure	Avoidance	Risk Level	Is a Control Circuit required?	Minimum Functional Performance Required			Existing Estimate (with existing Risk Reduction Measures) — Design	Engineering Controls	Administrative Controls	Existing Actions / Measures	Existing Risk Estimate ANSI/RIA TR R15.306- Severity	Exposure	Avoidance	Risk Level	Future Estimate (with proposed Risk Reduction Measures) — Design	Engineering Controls	Administrative Controls	Future Actions / Measures	Validation Date	Responsible persons	Future Risk Estimate ANSI/RIA TR R15.306-2016 Severity	Exposure	Avoidance	Risk Level
FC2/charging table	10.20.50.12	Heater/Forklift Operator charges a plate	presses PLATE LOADED on HMI ops station	Mechanical - crushing due to pinch point from outward motion of centering guides and travel limit/stable frame	4, 5		S3	E2	A3	Very High	Yes	e	4	Control Reliable			X	Operator positioned at a safe distance from hazard. Training and policy/procedure for by-standers to keep clear and operator to ensuring area is clear of people before initiating hazardous motion.	S3	E1		High		X	X	Area scanner(s) with applied safe distance to detect people in warning and hazardous areas. Charge table centering guide motion prevented by controls when people detected in hazardous area. Audible/visual warning ing time delay of impending imated motion to improve			S3	E0		Low
FC2/charging table	10.20.50.13	Heater/Forklift Operator charges a plate	presses PLATE LOADED on HMI ops station	Mechanical - crushing/pinching due to motion of centering guides actuators below the table	4, 5		S3	E2	A3	Very High	No						X	Operator positioned at a safe distance from hazard. Training and policy/procedure for by-standers to keep clear and operator to ensuring area is clear of people before initiating hazardous motion.	S3	E1		High		X		Fixed guards around the bottom (skirt) of the charge table			S3	E0		Low
FC2/charging table	10.20.60.10	Heater/Forklift Operator charges a plate	presses CHARGE on HMI ops station	mechanical - crushing between plate and roller due to unexpected automated motion when plate moves to be measured by lasers and/or moves into furnace	3, 4		S3	E2	A3	Very High	Yes	e	4	Control Reliable			X	Training for operator and by-standers to keep clear (ensuring area is clear of people before initiating hazardous motion).	S3	E2	A3	Very High		X	X	Area scanner(s) with applied safe distance to detect people in warning and hazardous areas. Charge table roller motion prevented by controls when people detected in hazardous area. Audible/visual warning during time delay of impending automated motion to improve awareness of hazard.			S3	E0		Low
FC2/charging table east	10.20.60.11	Heater/Forklift Operator charges a plate	presses CHARGE on HMI ops station	Thermal - hot material / radiating heat from open			S1	E2	A1	Low	No						X	Operator positioned at a safe distance from hazard	S1	E0		Negligible										
FC2/charging table east	10.20.60.12	Heater/Forklift Operator charges a plate	presses CHARGE on HMI ops station	mechanical - Entanglement Digits, Amputation with gears between motor and roll ganging chain and sprockets	8.5		S3	E2	A3	Very High	No						X	fixed guard over gear box	S3	E0		Low										
FC2/charging table east	40.10.10.10	plant traffic and by-standers	walking to and climbing stairs east side of charge table	Mechanical - crushing due to pinch point between centering guides and table frame when retracting	22, 24		S3	E2	A2	High	No						X	Training for by-standers to keep clear and operator (ensuring area is clear of people before initiating hazardous motion)	S3	E1		High		X		Fixed guard on lower west side of stair way "landing"		Corey	S3	E0		Low
FC2/charging table east	40.10.10.11	plant traffic and by-standers	walking to and climbing stairs east side of charge table	Thermal - from open furnace door	20, 24		S1	E2	A2	Low	No					X	X	Furnace door opening is small enough to limit heat exposure in that area. Safe work procedures/training exist to reduce exposure to thermal hazard for an excessive duration that may cause	S1	E1	A1	Negligible										
FC2/charging table east	40.10.10.12	plant traffic and by-standers	walking to and climbing stairs east side of charge table	mechanical - Entanglement Digits, Amputation with roll ganging chain and sprockets beneath existing moveable/hinged guards	8.5		S3	E2	A3	Very High	No					X	X	fixed guard over gear box	S3	E0		Low										
F2/entry door	10.20.60.12	Heater/Forklift Operator charges a plate	presses CHARGE on HMI ops station	Mechanical - crushing due to pinch point from moving apparatus of the furnace door opening and closing.	20, 24		S3	E2	A2	High	Yes	d	3	Control Reliable			X	Training for by-standers to keep clear and operator (hazardous motion is automated and starts at random).	S3	E2	A2	High		X	X	Perimeter fencing and administrative controls to inhibit exposure. Training and Awareness item - warning sign		IMS	S3	E0		Low
F2/entry door	10.20.60.12	Heater/Forklift Operator charges a plate	presses CHARGE on HMI ops station	Mechanical - crushing due to pinch point from moving apparatus of the furnace door	20, 24		S3	E2	A2	High	Yes	d	3	Control Reliable			X	Training for by-standers to keep clear and operator (hazardous motion is automated and starts at	S3	E2	A2	High		X	X	Area scanner(s) with applied safety distance to inhibit furnace door motion (pneumatic actuators) when people are exposed to hazard. Perimeter fencing		IMS	S3	E0		Low

Risk Estimation/Score in three states

Machine Task/Hazard-Based Risk Assessment

Three machine state version: without, existing, and future risk reduction measures

Machine Info.		Assessment Info.	
Name / ID:		Date of Assessment:	
Plant:		Revision:	
Department:		RA Scope and limits:	

Risk Assessment Team	Titles/Roles:

Note: Validation is required before E0 is achieved (test results required). Third party validation recommend

						Initial Risk Estimate (without Risk Reduction Measures)							Existing Estimate (with existing Risk Reduction Measures)				Existing Risk Estimate				Future Estimate (with proposed Risk Reduction Measures)				Future Risk Estimate			
						ANSI/RIA TR R15.306-											ANSI/RIA TR R15.306-								ANSI/RIA TR R15.306-2016			
Zone/Area	x.x.x.x Person Task Step Hazard	Person/Task	Steps	Potential Hazards	Ref pic	Severity	Exposure	Avoidance	Risk Level	Is a Control Circuit required ?	Minimum Functional Performance Required			Design	Engineering Controls	Administrative Controls	Existing Actions / Measures	Severity	Exposure	Avoidance	Risk Level	Design	Engineering Controls	Administrative Controls	Future Actions / Measures	Severity	Exposure	Avoidance	Risk Level
FC2/charging table north	1.1.1.4	Heater/Forklift Operator charges a plate	measures L x W of top/next plate on scissor lift to be loaded	Mechanical - crushing from plate moving north and failing to stop until contacting the hardstop barrier on the north side of the charge table (due to laser sensor failing to detect leading/upstream edge of plate	2	S3	E2	A2	High	Yes	d	3	Control Reliable			X	Blocking / rigging - hard stop/barrier on north side of charging table to stop a plate's northern travel in the event of a failure of the controls to perform a normal process stop	S3	E2	A2	High		X	X	prevent hazardous motion while people are detected when exposed to the hazard incorporating a safety function controlling the charge table rolls, awareness of impending automatic motion with horn/light	S3	E0		Low
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Person.Task.Steps.Hazards

Initial/No Risk Reduction

Existing Measures

Future Measures/Residual

Risk Estimation/Score in three states

Machine Task/Hazard-Based Risk Assessment

Three machine state version: without, existing, and future risk reduction measures

Machine Info.		Assessment Info.
Name / ID:		Date of Assessment:
Plant:		Revision:
Department:		RA Scope and limits:

Zone/Area	x.x.x.x Person Task Step Hazard	Person/Task	Steps	Potential Hazards	Ref pic	Initial Risk Estimate (without Risk Reduction Measures) ANSI/RIA TR R15.306-				Is a Control Circuit required ?	Minimum Functional Performance Required			Design	Engineering	Third party validation: Future Risk Estimate ANSI/RIA TR R15.306-2016		
						Severity	Exposure	Avoidance	Risk Level							Exposure	Avoidance	Risk Level
FC2/charging table north	1.1.1.4	Heater/Forklift Operator charges a plate	measures L x W of top/next plate on scissor lift to be loaded	Mechanical - crushing from plate moving north and failing to stop until contacting the hardstop barrier on the north side of the charge table (due to laser sensor failing to detect leading/upstream edge of plate	2	S3	E2	A2	High	Yes	d	3	Control Reliable			E0		Low
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Person.Task.Steps.Hazards

Initial/No Risk Reduction

Residual

Seq	Examples of Risk Reduction Measures
1	Alternative Method to Lockout
2	Area scanner with applied safety distance
3	Associate Training
4	Blocking / rigging
5	Bump cap
6	Current Operating Procedures
7	Cut resistant gloves and sleeves
8	Face shield
9	Hard Hat
10	Install hard stops
11	Install lift assist
12	Install tie-off points
13	Interlocked enabling device
14	Light curtain installed with applied safety distance
15	Lockout (zero energy)
16	Lockout (situational)
17	PPE
18	Robot limited to manual reduced speed
19	Safety Fence
20	Safety glasses with side shields
21	Safety harness
22	Safety mat
23	Utilize safety-rated safety axis
24	Wear NFPA 70E required apparel
-	**--- ANSI Standard Risk Reduction Measures Below ---**
25	Awareness devices - awareness barriers
26	Awareness devices - awareness signals
27	Awareness devices - awareness (safety) signs.
28	Safeguarding methods - safe-distance safeguarding
29	Safeguarding methods - safe-holding safeguarding
30	Safeguarding methods - safe-opening safeguarding
31	Safeguarding methods - safe-location safeguarding.
32	Complementary equipment and measures - emergency stop devices (palm / push buttons or rope / cable pulls)
33	Complementary equipment and measures - safety blocks, locking pins, limiting / blocking pins
34	Complementary equipment and measures - slide locks
35	Complementary equipment and measures - workholding equipment
36	Complementary equipment and measures - stopping performance monitor
37	Complementary equipment and measures - process malfunction, detection and monitoring equipment
38	Complementary equipment and measures - hand tools
39	Complementary equipment and measures - safety interface (safety relay) modules
40	Complementary equipment and measures - safety PES / PLC, safety controllers (including the safety-bus systems)
41	Complementary equipment and measures - shields
42	Complementary equipment and measures - enabling devices
43	Complementary equipment and measures - hold-to-run controls
44	Complementary equipment and measures - measures for the escape and rescue of trapped persons
45	Complementary equipment and measures - measures for isolation and energy dissipation
46	Complementary equipment and measures - provisions for easy and safe handling of machines and their heavy component parts
47	Complementary equipment and measures - measures for safe access to machinery.
48	Information for use - signage / awareness means
49	Information for use - instructions / manuals
50	Organizational - safe work procedures
51	Organizational - supervision
52	Organizational - permit-to-work systems.
53	Personal Protective Equipment
54	Training

Risk Reduction Measures

"*Hierarchy of Remediation*" – "*Hazard Control Hierarchy*"

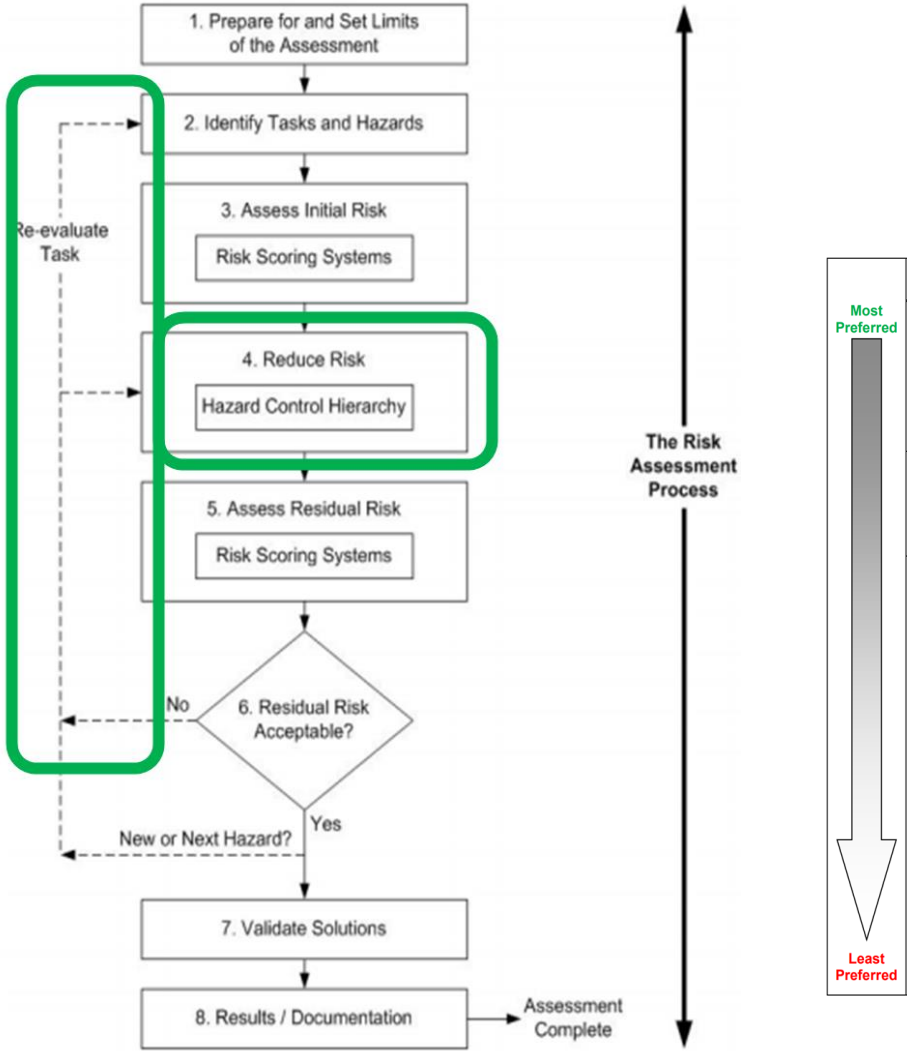


Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples		Probability				
Classification	Type		Severity	Exposure	Avoidance	Occurrence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

Keeping People Safe Around Machinery

OSHA Occupational Safety and Health Administration www.osha.gov

Rule #1:
If access to the machine is needed, turn it off

LOTO / Isolate Hazardous Energy

Rule #2:
If the machine is running, keep people away

Machine Guarding

Risk Reduction Methods

Hierarchy of remediation

Person.task.step.hazard

- Fundamental question…
  - *Is this a maintenance or minor servicing task?*

LOTO / Isolate Hazardous Energy

Machine Guarding

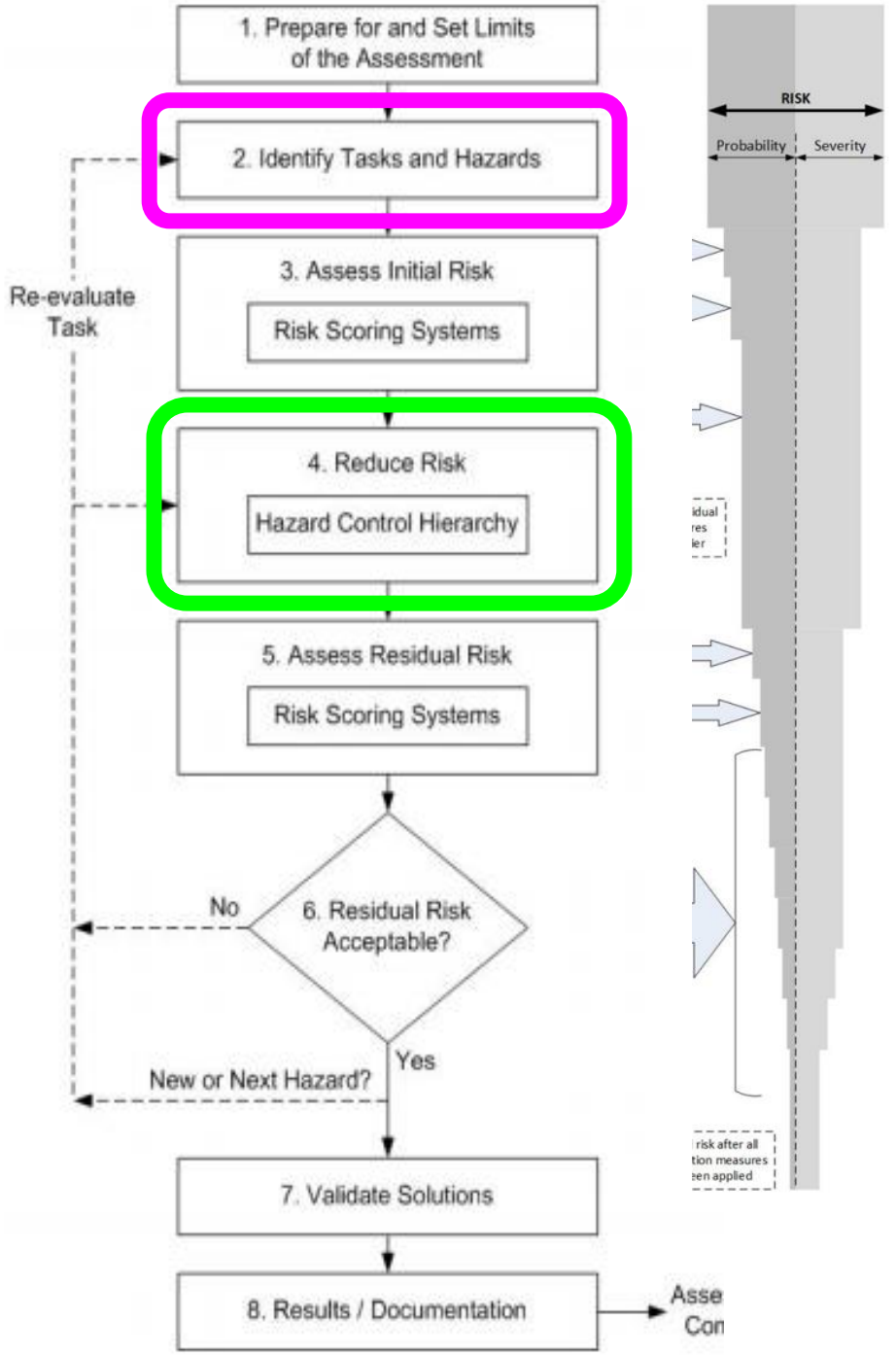
Minor servicing must be routine, repetitive and integral to the operation of the system.

Minor Service Exception to Lockout Tagout

Minor Servicing Exception - 29 CFR 1910.147 (a)(2)(ii)

- Regulation: Machine Guarding or alternative protection means minor jams, minor tool changes & adjustments, exchange
- Requirement: Protect operators from machine production hazards when performing minor servicing
- Tasks: Minor servicing such as clearing jams, loading parts, etc.

Must provide alternative measures that offer effective protection



Risk estimation/rating determines the recommended **primary** risk reduction measure

RIA TR R15.306-2016

Table 4 – Minimum risk reduction measures as a function of the risk level

	Risk Reduction Measure	Risk Level				
		VERY HIGH	HIGH	MEDIUM	LOW	NEGLIGIBLE
Most Preferred	Elimination	Use of one or a combination of these risk reduction measures are required as a primary means to reduce risks.			Any of the risk reduction measures that would reduce risks to an acceptable level may be used.	
	Substitution					
	Limit Interaction					
	Safeguarding/ SRP/CS					
	Complementary Protective Measures	Use of one or a combination of these risk reduction measures may be used in conjunction with the above risk reduction measures but shall not be used as the primary risk reduction measure.				
	Warnings and Awareness Means					
	Administrative Controls					
Least Preferred	PPE					

ANSI B11.0 2020

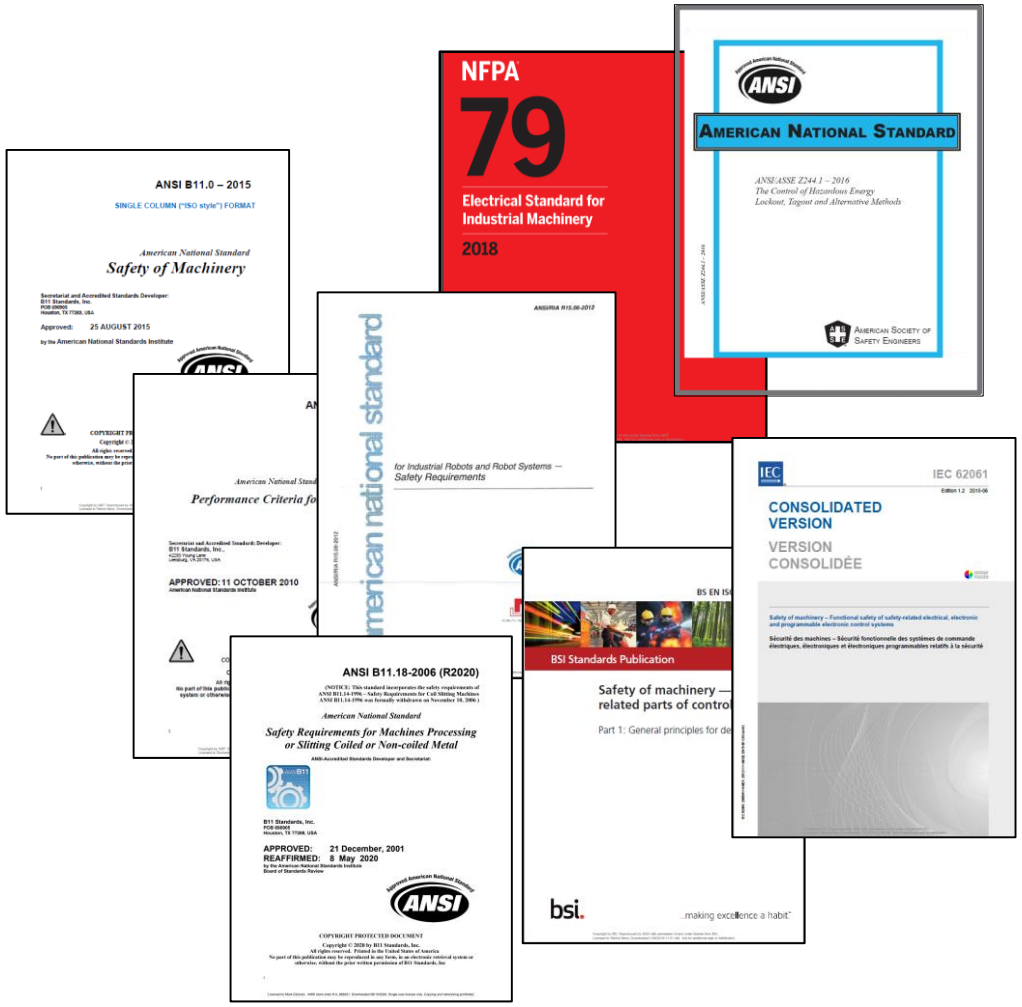
Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
				Probability				
Hierarchy Classification	Hierarchy Type	Examples	Severity	Exposure	Avoidance	Occurrence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

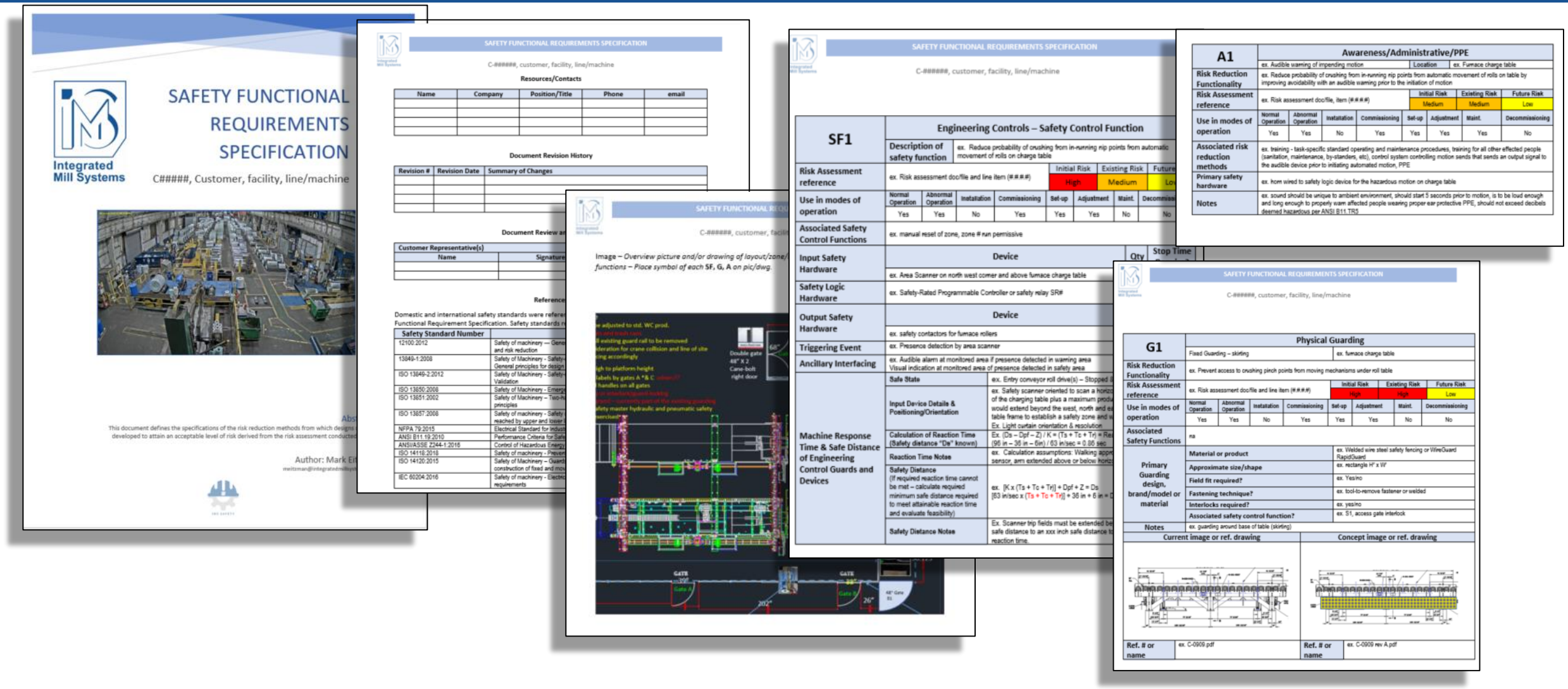
Note - Early 2023 published update to RIA TR R15.306 with further harmonization of ISO 10218-1,2 and ANSI B11

Recommended Voluntary Standards for Machine Safety Design and Integrations

- **ANSI B11.0-2020** Safety of Machinery
- **RIA TR R15.306-2016** – Safety Requirements – Task-based Risk Assessment Methodology
- **ANSI B11.19-2019** Performance Requirements for Risk Reduction Measures
- **ANSI/ASSE Z244.1 – 2016** The Control of Hazardous Energy Lockout, Tagout and Alternative Methods
- **ANSI B11.20-2017** Safety Requirements for Integrated Manufacturing Systems
- **ANSI/RIA15.06-2012** – Safety Requirements for Industrial Robots and Robot Systems
- **NFPA79-2018** Electrical Standards for Industrial Machines
- **NFPA70e-2021** Standard for Electrical Safety in the Workplace
- **ANSI B11.26-2018** (Machines - Functional Safety For Equipment: General Principles For The Design Of Safety Control Systems Using ISO 13849-1)
- **ISO 13849-1-2008** Safety of machinery — Safety-related parts of control systems Part 1: General principles for design
- **ISO 13849-2-2012** Safety of machinery — Safety-related parts of control systems Part 2: Validation
- **IEC 62061-2005** Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
- **ISO 14120-2015** General Requirements for the design and Construction of Fix and Moveable Guards



Safety Functional Requirement Specification - SFRS



SAFETY FUNCTIONAL REQUIREMENTS SPECIFICATION

Integrated Mill Systems

C#####, Customer, facility, line/machine

SAFETY FUNCTIONAL REQUIREMENTS SPECIFICATION

C-######, customer, facility, line/machine

Resources/Contacts

Name	Company	Position/Title	Phone	email

Document Revision History

Revision #	Revision Date	Summary of Changes

Customer Representative(s)

Name	Signature

Safety Standard Number	
12100:2012	Safety of machinery — General principles for design — Risk assessment and risk reduction
13849-1:2008	Safety of Machinery - Safety-related parts of control systems - Part 1: General principles for design
ISO 13849-2:2012	Safety of Machinery - Safety-related parts of control systems - Part 2: Validation
ISO 13850:2008	Safety of Machinery - Emergency stop - Principles for design
ISO 13851:2002	Safety of Machinery – Two-hand control devices – Functional aspects and principles
ISO 13857:2008	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
NFPA 79:2015	Electrical Standard for Industrial Machinery
ANSI B11.19:2010	Performance Criteria for Safeguarding
ANSI/ASSE Z244-1:2016	Control of Hazardous Energy - Lockout, Tagout and Alternative Methods
ISO 14118:2018	Safety of machinery - Prevention of unexpected start-up
ISO 14120:2015	Safety of Machinery – Guards – General requirements for the design and construction of fixed and movable guards
IEC 60204:2016	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Image – *Overview picture and/or drawing of layout/zone/functions – Place symbol of each* **SF, G, A** *on pic/dwg.*

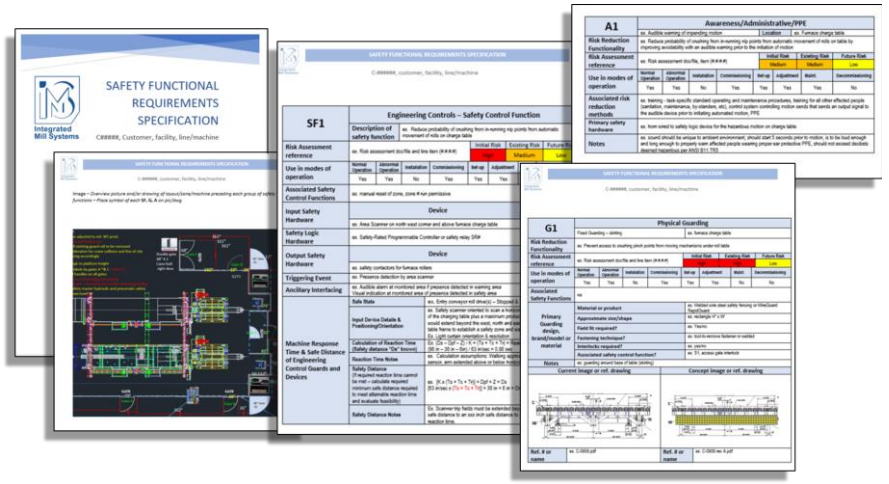
SF1	Engineering Controls – Safety Control Function							
Description of safety function	ex. Reduce probability of crushing from in-running nip points from automatic movement of rolls on charge table							
Risk Assessment reference	ex. Risk assessment doc/file and line item (####)				Initial Risk: High	Existing Risk: Medium	Future: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: No	Decommissioning: No
Associated Safety Control Functions	ex. manual reset of zone, zone # run permissive							
Input Safety Hardware	Device						Qty	Stop Time
	ex. Area Scanner on north west corner and above furnace charge table							
Safety Logic Hardware	ex. Safety-Rated Programmable Controller or safety relay SR#							
Output Safety Hardware	Device							
	ex. safety contactors for furnace rollers							
Triggering Event	ex. Presence detection by area scanner							
Ancillary Interfacing	ex. Audible alarm at monitored area if presence detected in warning area Visual indication at monitored area of presence detected in safety area							
Machine Response Time & Safe Distance of Engineering Control Guards and Devices	Safe State	ex. Entry conveyor roll drive(s) – Stopped						
	Input Device Details & Positioning/Orientation	ex. Safety scanner oriented to scan a horiz... of the charging table plus a maximum produ... would extend beyond the west, north and e... table frame to establish a safety zone and w... Ex. Light curtain orientation & resolution						
	Calculation of Reaction Time (Safety distance "Dx" known)	Ex. (Ds – Dpf – Z) / K = (Ts + Tc + Tr) = Re... (96 in – 36 in – 6in) / 63 in/sec = 0.86 sec						
	Reaction Time Notes	ex. Calculation assumptions: Walking appr... sensor, arm extended above or below horiz...						
	Safety Distance (If required reaction time cannot be met – calculate required minimum safe distance required to meet attainable reaction time and evaluate feasibility)	ex. [K x (Ts + Tc + Tr)] + Dpf + Z = Ds [63 in/sec x (Ts + Tc + Tr)] + 36 in + 6 in = D						
	Safety Distance Notes	Ex. Scanner trip fields must be extended be... safe distance to an xxx inch safe distance t... reaction time.						

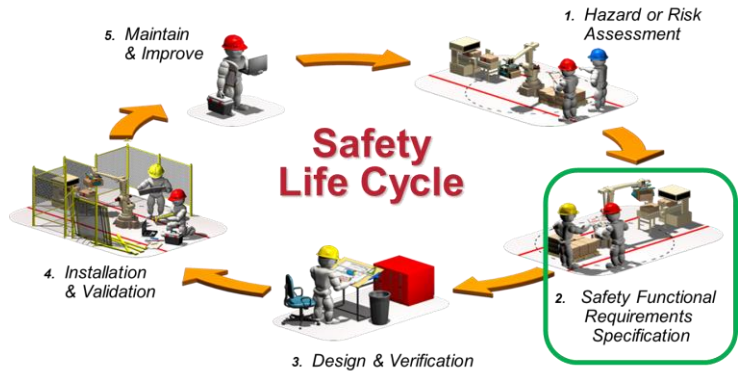
A1	Awareness/Administrative/PPE							
	ex. Audible warning of impending motion			Location: ex. Furnace charge table				
Risk Reduction Functionality	ex. Reduce probability of crushing from in-running nip points from automatic movement of rolls on table by improving avoidability with an audible warning prior to the initiation of motion							
Risk Assessment reference	ex. Risk assessment doc/file, item (####)				Initial Risk: Medium	Existing Risk: Medium	Future Risk: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: Yes	Decommissioning: No
Associated risk reduction methods	ex. training - task-specific standard operating and maintenance procedures, training for all other effected people (sanitation, maintenance, by-standers, etc), control system controlling motion sends that sends an output signal to the audible device prior to initiating automated motion, PPE							
Primary safety hardware	ex. horn wired to safety logic device for the hazardous motion on charge table							
Notes	ex. sound should be unique to ambient environment, should start 5 seconds prior to motion, is to be loud enough and long enough to properly warn affected people wearing proper ear protective PPE, should not exceed decibels deemed hazardous per ANSI B11.TR5							

G1	Physical Guarding							
	Fixed Guarding – skirting			ex. furnace charge table				
Risk Reduction Functionality	ex. Prevent access to crushing pinch points from moving mechanisms under roll table							
Risk Assessment reference	ex. Risk assessment doc/file and line item (####)				Initial Risk: High	Existing Risk: High	Future Risk: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: No	Decommissioning: No
Associated Safety Functions	na							
Primary Guarding design, brand/model or material	Material or product	ex. Welded wire steel safety fencing or WireGuard RapidGuard						
	Approximate size/shape	ex. rectangle H' x W'						
	Field fit required?	ex. Yes/no						
	Fastening technique?	ex. tool-to-remove fastener or welded						
	Interlocks required?	ex. yes/no						
	Associated safety control function?	ex. S1, access gate interlock						
Notes	ex. guarding around base of table (skirting)							
Current image or ref. drawing				Concept image or ref. drawing				
Ref. # or name	ex. C-0909.pdf			Ref. # or name	ex. C-0909 rev A.pdf			

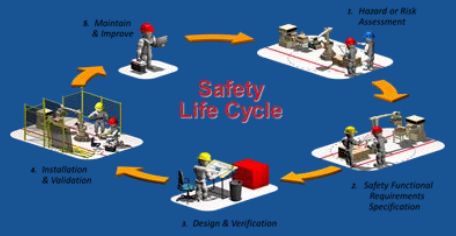
Safety Functional Requirement Specification - SFRS

- Engineering study of the application before the design of the solution;
  - Feasibility of the proposed measures
  - Requirements to ensure compliance with;
    - Regulatory requirements (laws)
    - Voluntary standards for the designs
- Create a common bid to design document
  - Integral to Ts & Cs of a contract
- Used in the validation plan/task following commissioning
- Documents decisions made with the information available at the time





Safety Functional Requirement Specification - SFRS



Details on a controls solution

- Triggering event
- Safe state
- Reaction/stop time
- Diagnostics
- Circuit performance
- Reset
- Standards followed

SF1	Engineering Controls – Safety Control Function							
	Description of safety function	ex. Reduce probability of crushing from in-running nip points from automatic movement of rolls on charge table						
Risk Assessment reference	ex. Risk assessment doc/file and line item (#.#.#.#)				Initial Risk: High	Existing Risk: Medium	Future Risk: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: No	Decommissioning: No
Associated Safety Control Functions	ex. manual reset of zone, zone # run permissive							
Input Safety Hardware	Device						Qty	Stop Time Require?
	ex. Area Scanner on north west corner and above furnace charge table						1	yes
Safety Logic Hardware	ex. Safety-Rated Programmable Controller or safety relay SR#							
Output Safety Hardware	Device						PLr	Stop Category
	ex. safety contactors for furnace rollers						PLd	1
Triggering Event	ex. Presence detection by area scanner							
Ancillary Interfacing	ex. Audible alarm at monitored area if presence detected in warning area Visual indication at monitored area of presence detected in safety area							
Machine Response Time & Safe Distance of Engineering Control Guards and Devices	Safe State	ex. Entry conveyor roll drive(s) – Stopped & STO by AC drives active						
	Input Device Details & Positioning/Orientation	ex. Safety scanner oriented to scan a horizontal plane above the height of the charging table plus a maximum product thickness. Scanning would extend beyond the west, north and east edges of the charge table frame to establish a safety zone and warning zone. Ex. Light curtain orientation & resolution						
	Calculation of Reaction Time (Safety distance "Ds" known)	Ex. (Ds – Dpf – Z) / K = (Ta + Tc + Tx) = Reaction Time (96 in – 36 in – 6in) / 63 in/sec = 0.86 sec						
	Reaction Time Notes	ex. Calculation assumptions: Walking approach at right angle to sensor, arm extended above or below horizontal plane of scanner						
	Safety Distance (If required reaction time cannot be met – calculate required minimum safe distance required to meet attainable reaction time and evaluate feasibility)	ex. [K x (Ta + Tc + Tx)] + Dpf + Z = Ds [63 in/sec x (Ta + Tc + Tx)] + 36 in + 6 in = Ds						
	Safety Distance Notes	Ex. Scanner trip fields must be extended beyond the anticipated 96 inch safe distance to an xxx inch safe distance to accommodate system reaction time						

Safe-state of associated SFs	ex. All motion on charge table is stopped ex. Safety contactors are de-energized/opened preventing mill feed rolls from rotating ex. Safety pneumatic valves are in their safe state position preventing C-frame travel in or out ex Safety hydraulic valves are in their safe state position preventing lift table motion up or down
Means of reset	ex. after closing gate, press blue *Reset* pushbutton on outside of gate to indicate to the safety logic device to put system into ready-to-run state.
Conditions to Permit Reset	ex. output device free of faults, safety logic device receives appropriate simultaneous dual channel input transitions from device on gate, all e-stop actuators in non-estop position, trapped-key for exclusive control is in interlocked device on gate and in locked position
Description of functional safety sequence from trigger to safety state to reset	ex. Depress white *Request Access* pushbutton on guard-locking gate device. The safety logic controller issues commands to the safety output devices and actuators to go to their safety-state. The safety contactors open, the hydraulic vales transition to blocked position, the pneumatic valves go to closed/blocked position and the water valves go to safe state. As machine transitions to safe-state, green *Access* indicator on guard-locking gate device flashed and then illuminates solid when safe-state is achieved and the red *Locked* illuminated indicator turns off. Upon reaching safe-state, the safety logic controller issues a command to unlock gate's guard-lock allowing the operator to turn the handle and open the gate. The PLC monitors the state of the output/actuators for faults while access is granted and the open/unlocked state of the gate. Upon closing the gate, machine motion will not resume. The operator pressed and releases the blue *Reset* button on the guard-locking gate device that signals to the safety logic device to allow for the normal start of the machine operation. The green *Access* indicator on the gate guard-locking device turns off and the red *Locked* indicator illuminates solid. The operator can start the machine with a *Start* button on the ops. station. The output safety devices return to normal run position. The safety logic device monitors the state of all output devices for faults and if none are present, allows the machine to return to operation.
Notes	ex. Emergency stop pushbuttons shall be installed at all operator station locations and areas where tasks are performed. Quantity to be determined as operator stations have not yet been defined. Safety function shall be verified and validated in accordance with ISO 13849-1 & -2.

Machine Guarding

Minor Servicing Exception

E-stop

Lockout/Tagout

Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Exposure	Avoidance	Occurrence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

When *should safety be addressed?*

- ANSI B11.0-2020 ***(Safety of Machinery)***
  - Collaboration of Supplier/User of Equipment/Machine
  - Risk assessed & mitigated at each stage
- Inherently by design
- Suggest that this in contractual layout (Ts & Cs)

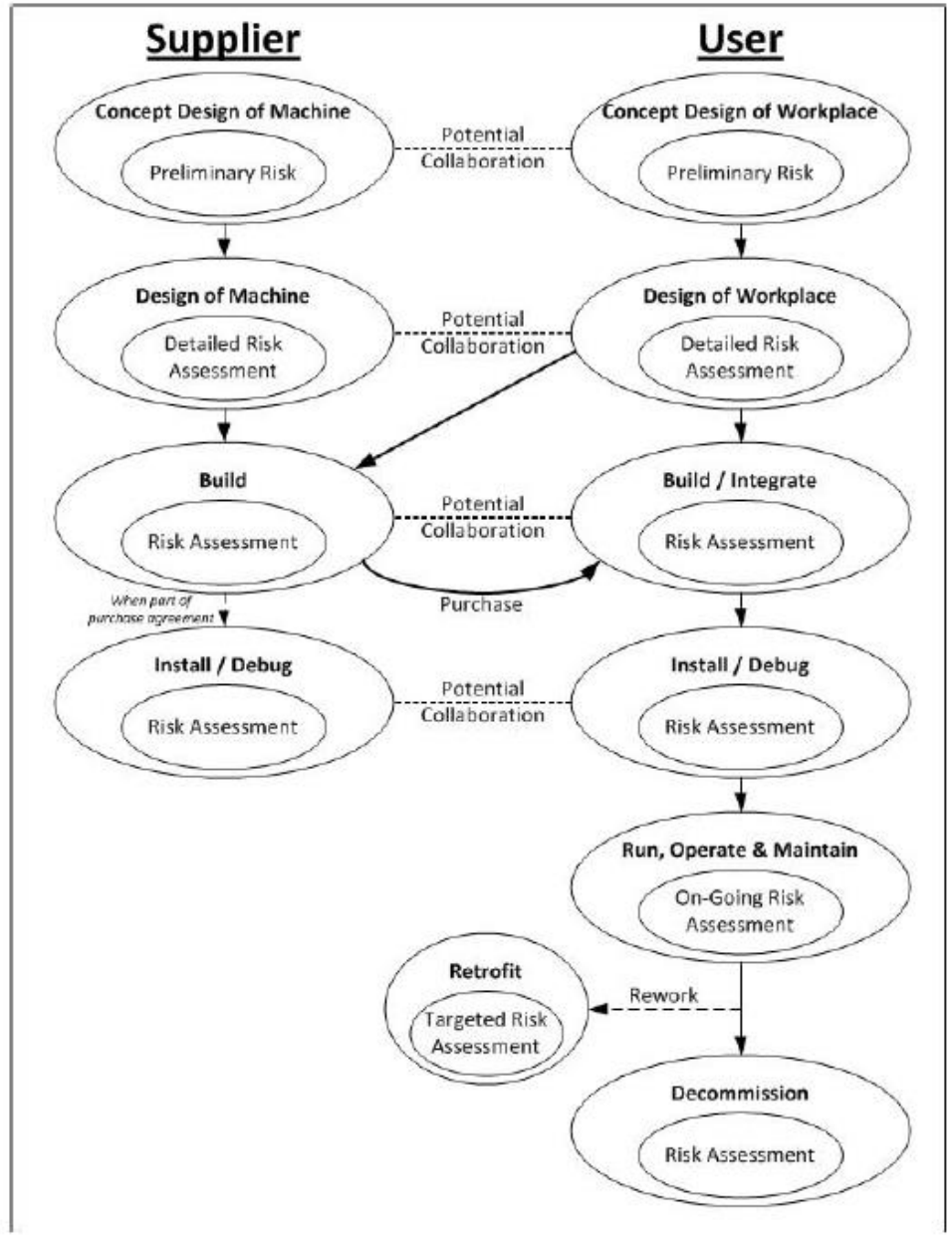
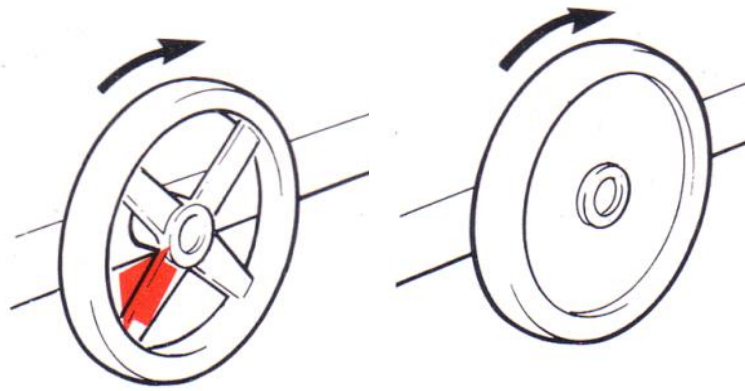


Figure 5 — Example of Machinery Lifecycle Responsibilities

Safety by Design/Redesign
Elimination of the hazard or risk

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Expo-sure	Avoid-ance	Occur-rence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			

- often a mechanical or process alteration
  - modify the machine, ex. – location of lube line and zerk fittings
  - use a robot/automation
- product substitution
  - raw direct material or secondary product like lubricant

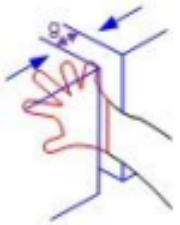


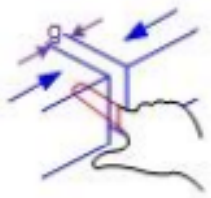
Safety by Design/Redesign
Elimination of the hazard or risk
- *ANSI B11.19-2019*

- Location of where personnel perform work
- Modifying, containing or redirecting how and/or where energy is released (pressure/steam safety relief valve)
- Reducing the energy available/accumulated
  - kinetic
  - potential
  - electrical
- Rerouting processes or hazards
- Locating inside an inaccessible, permanent and substantial section of the machine; locating in an elevated area or on an inaccessible balcony.
- Combining risk reduction measures to achieve acceptable risk for a given task;
  - redesigning or automating of tasks to eliminate human interaction or direct handling;
- Re-configuring or modifying machinery or equipment:
  - elimination of pinch or nip points by increasing clearances
- Elimination of shear points or offset edges

Inherently Safety by Design
ANSI B11.19-2019

- **Inherently safe by design**: A design measure that reduces risk, which is not susceptible to a malfunction that will increase the risk of harm.
- Prevention though design
  - **Safe-opening safeguarding method**
    - When work piece is in place, no room for human (in part or whole)
    - Typically includes an engineered control (guard)
  - **Safe-location safeguarding method**
    - Put hazard out of normal reach (horizontal/vertical)
    - Separate area/room/vault
  - **Minimum gaps to avoid crushing of parts of the human body**
    - ANSI B11.19-2019 Table 1
  - **Maximum gaps to avoid exposure to hazards**
    - ANSI - US = 1/4” (~6mm)
    - ISO – EU = 4mm (~5/32”)





When *should safety be addressed?*

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  - Risk assessed & mitigated at each stage
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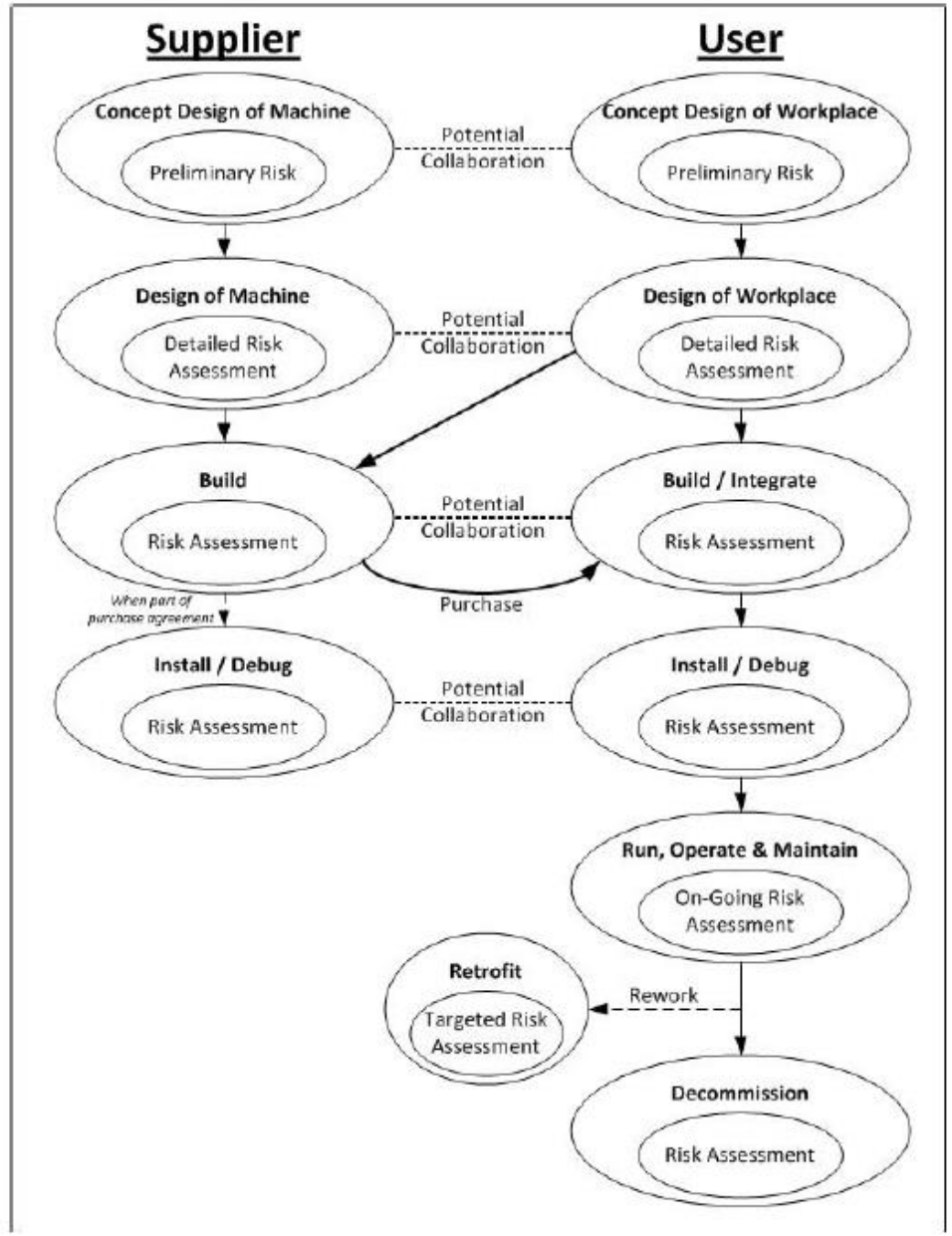

Figure 5 — Example of Machinery Lifecycle Responsibilities

Machine Guarding

Minor Servicing Exception

E-stop

Lockout/Tagout

Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Exposure	Avoidance	Occurrence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	Eliminated the hazard or reduced the severity of consequences		•		•		•
	Elimination		•	•				
			•			•	•	
	Substitution		•	•	•	•	•	•
			•			•		•
			•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

Machine Guarding

Minor Servicing Exception

E-stop

Lockout/Tagout

Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
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Classification	Type			Expo-sure	Avoid-ance	Occur-rence		
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

Keeping People Safe Around Machinery

OSHA Occupational Safety and Health Administration www.osha.gov

Rule #1:
If access to the machine is needed, turn it off

LOTO / Isolate Hazardous Energy

Rule #2:
If the machine is running, keep people away

Machine Guarding

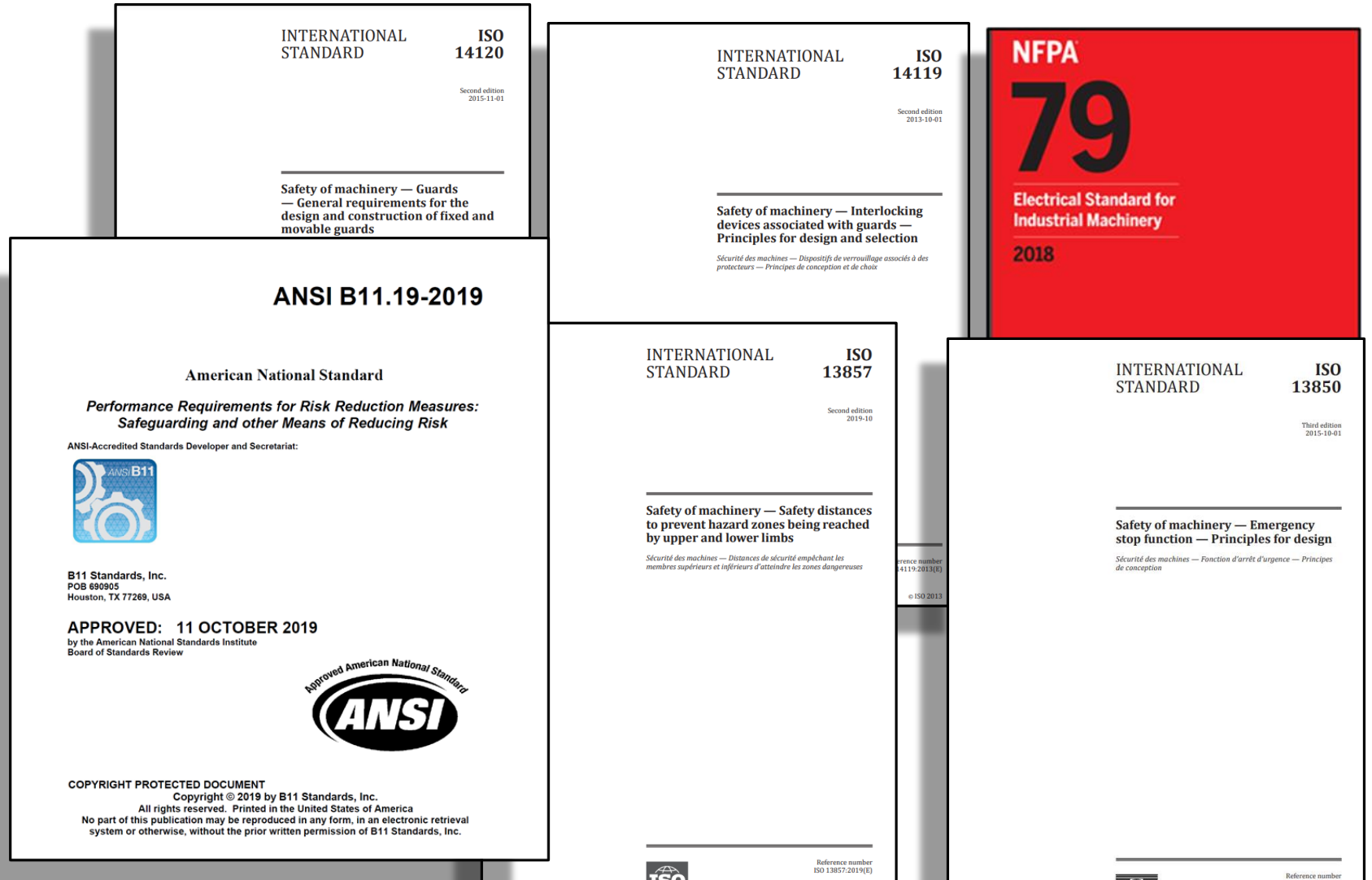
Engineering Controls

Machine Guarding

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Expo-sure	Avoid-ance	Occur-rence	Failure	Error / Misuse
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	

Machine Guarding (separating)

- Fixed Guards
- Movable Guards
  - Switches & Interlocking Devices
  - Control Functions
  - Safety Distance & Stop Time Calculations



Purpose of a fixed guard/shield (separating guard)

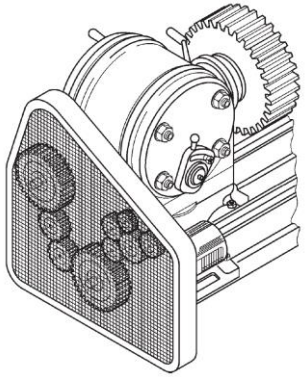
- **Prevent contact** – the safeguard must prevent bodily parts from coming in contact with moving parts
- **Secure** – safeguards must not be easily removed or tampered with to prevent bypassing (tool required to remove)
- **Protect from falling or discharged objects** – must ensure that objects do not fall into or be discharged from the machine
- **Create no new hazard** – any safeguard that impedes the worker from performing their job quickly and comfortably may soon be overridden or removed.
- **Maintain visibility** – The guard shall not obscure necessary view of work area

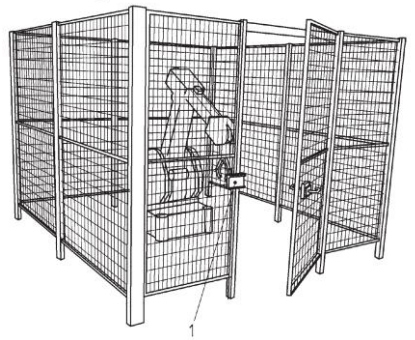
AND

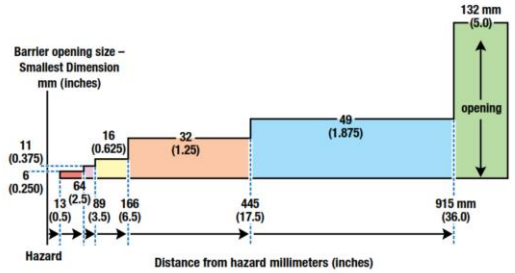
- **Allow safe operation of the machine** – all workers on the machine should be able to perform their assigned task quickly and safely without the need to remove, modify or bypass the safeguarding functions.

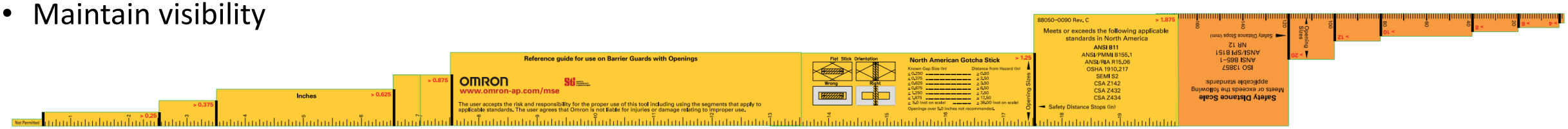
Fixed Guards / Shields

- Permanent part of the machine
- Perimeter (distance guard) or on-machine
- **ANSI B11.19 – 2019** *-Performance Requirements for Risk Reduction Measures*
- **ISO 14120-2015** *General requirements for the design and construction of fixed and movable guards*
  - Captive fastener's that require a tool to operate
  - Must be able to withstand calculated impact forces
  - Must comply with the Depth of Penetration Test (gotcha stick)
  - Must meet the <u>AUTO test</u>
    - Must not be able to reach the hazard by reaching **A**round, **U**nder, **T**hrough or **O**ver
    - Not only for fixed guarding but all safety functions
  - Take into account reasonably foreseeable misuse (removing the guard and allowing the machine to be run)
  - Maintain visibility









Machine Guarding

Minor Servicing Exception

E-stop

Lockout/Tagout

Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Exposure	Avoidance	Occurrence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

Keeping People Safe Around Machinery

OSHA Occupational Safety and Health Administration www.osha.gov

Rule #1:
If access to the machine is needed, turn it off

LOTO / Isolate Hazardous Energy

Rule #2:
If the machine is running, keep people away

Machine Guarding

Administrative Controls

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Exposure	Avoidance	Occurrence	Failure	Error / Misuse
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
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	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

The rest

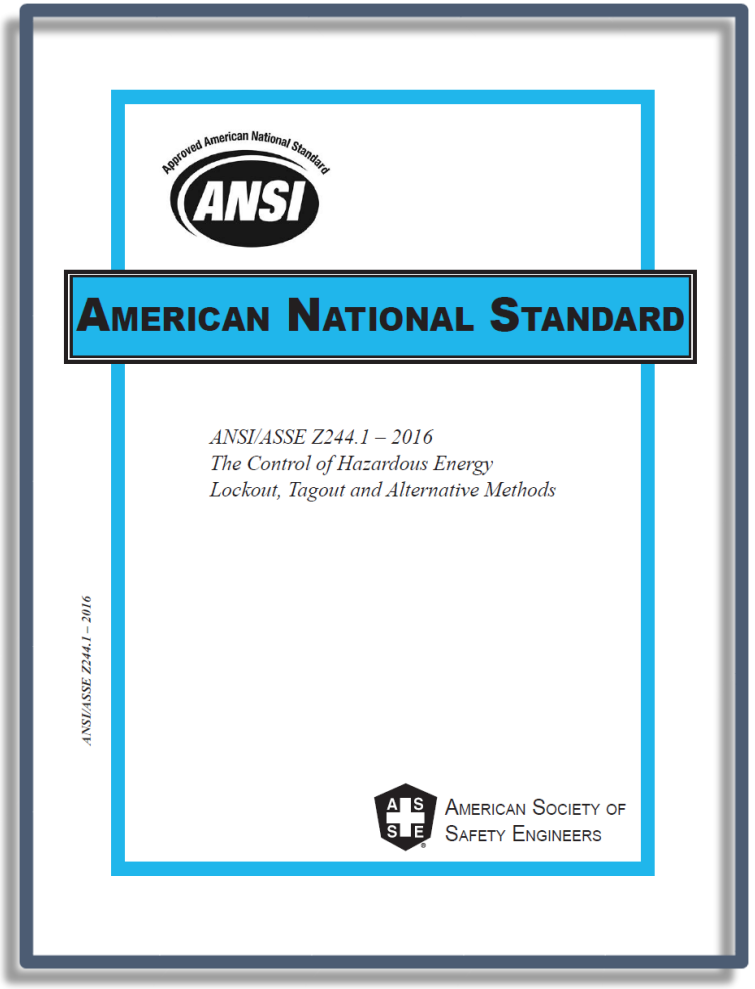
Lockout/Tagout

The rest

ANSI/ASSE Z244.1-2016

The Control of Hazardous Energy Lockout, Tagout and Alternative Methods

- March 1973 First meeting of Accredited Standards Committee Z244. First published March 1982
- Sept. 1989 OSHA promulgated 29 CFR1910.147 and used Z244.1 as a principle reference
- Alternative methods and risk assessment have received additional attention to emphasize their importance in the energy control process



Requirements of a Lockout/Tagout Program

Machine-Specific Procedures

Employee Training

Audit Program

Overall LOTO Policy

Proper LOTO Devices

OSHA's *Control of Hazardous Energy* regulation mandates:

- A machine must be locked out any time one of the following conditions occur:
  - An employee must remove machine guarding.
  - An employee bypasses a guard, interlock, or other safety device.
  - An employee places part of their body in harm's way.
- An employee performs any servicing or maintenance work
  - Repairing a machine
  - Lubricating parts inside the machine
  - Making machine adjustments or major tool changes
  - Inspecting and addressing a machine for errors, jams, or other problems

When LOTO is NOT required

- Cord and plug equipment where <u>all</u> of the following are true
  - Electrical energy is the only hazardous source
  - Electrical energy is under the exclusive control of the employee performing the work.
  - Disconnect must be a plug
    - located near enough to the equipment that it cannot be energized without the authorized employees knowledge.

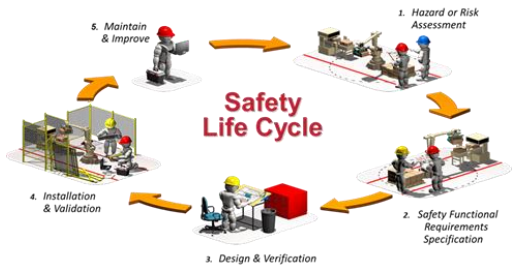
- LOTO is not needed for minor servicing activities if:
  - The activity must be conducted during the equipment's normal operations
  - The activity must be routine, repetitive, and integral
  - Alternative measures must be used to provide effective protection equal to or beyond LOTO
  - Shall provide justification and team-based risk assessment

Minor Servicing Exception

What is hazardous energy?

- *Any source of energy associated with a hazard identified by a cross-functional team-based audit*
  - Electrical
  - Mechanical
  - Hydraulic
  - Pneumatic
  - Chemical
  - Thermal
  - Other energy

Lockable and non-lockable



Lockable Energy Sources

- Electrical
- Pneumatic
- Water
- Gas
- Steam
- Other liquids (fuels, chemicals, product)

(WAGES)

Non-Lockable Energy Sources

- Documented for employee to dissipate and control – awareness and administrative controls

Potential Energy Capacitance		Verify all capacitors have discharged before service. If service is required on the capacitors an additional 5 minute wait is required after removing all sources.
Potential Energy Gravity		Be sure to lower all parts to lowest position or install blocks in raised position before attempting to service machine.
Potential Energy Spring		Springs can store energy. Be sure to release spring tension before attempting to service machine.
Hydraulic Energy		Hydraulic equipment can store energy. Check to ensure all hydraulic pressure gauges read zero pressure before proceeding.
Thermal Energy		Be sure to wait until heat has dissipated from machine until cool to touch before servicing. Wear proper PPE before beginning work.
Kinetic Energy		Be sure to wait until all moving parts have come to a complete stop. If necessary, use a block or chain to prevent equipment from moving while servicing.

Written LOTO Procedure
Sequence of Lockout (8 steps)

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out.
2. The ***authorized employee*** shall refer to and understand [the LOTO procedure]
3. If the machine or equipment is operating, shut it down by the normal stopping procedure
4. De-activate the energy isolating device(s) so that the machine or equipment is isolated from ALL of the energy source(s).

Written LOTO Procedure
Sequence of Lockout (8 steps)

5. Lock out the energy isolating device(s) with assigned individual lock(s) & devices.
6. Stored or residual energy must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down, etc.
7. Test to ensure that the equipment is disconnected from the energy source(s).
8. Return operating control(s) to neutral or "off" position after verifying the isolation of the equipment.

The machine or equipment is now locked out

Written LOTO Procedure Sequence for *Restoring Equipment to Service (5 steps)*

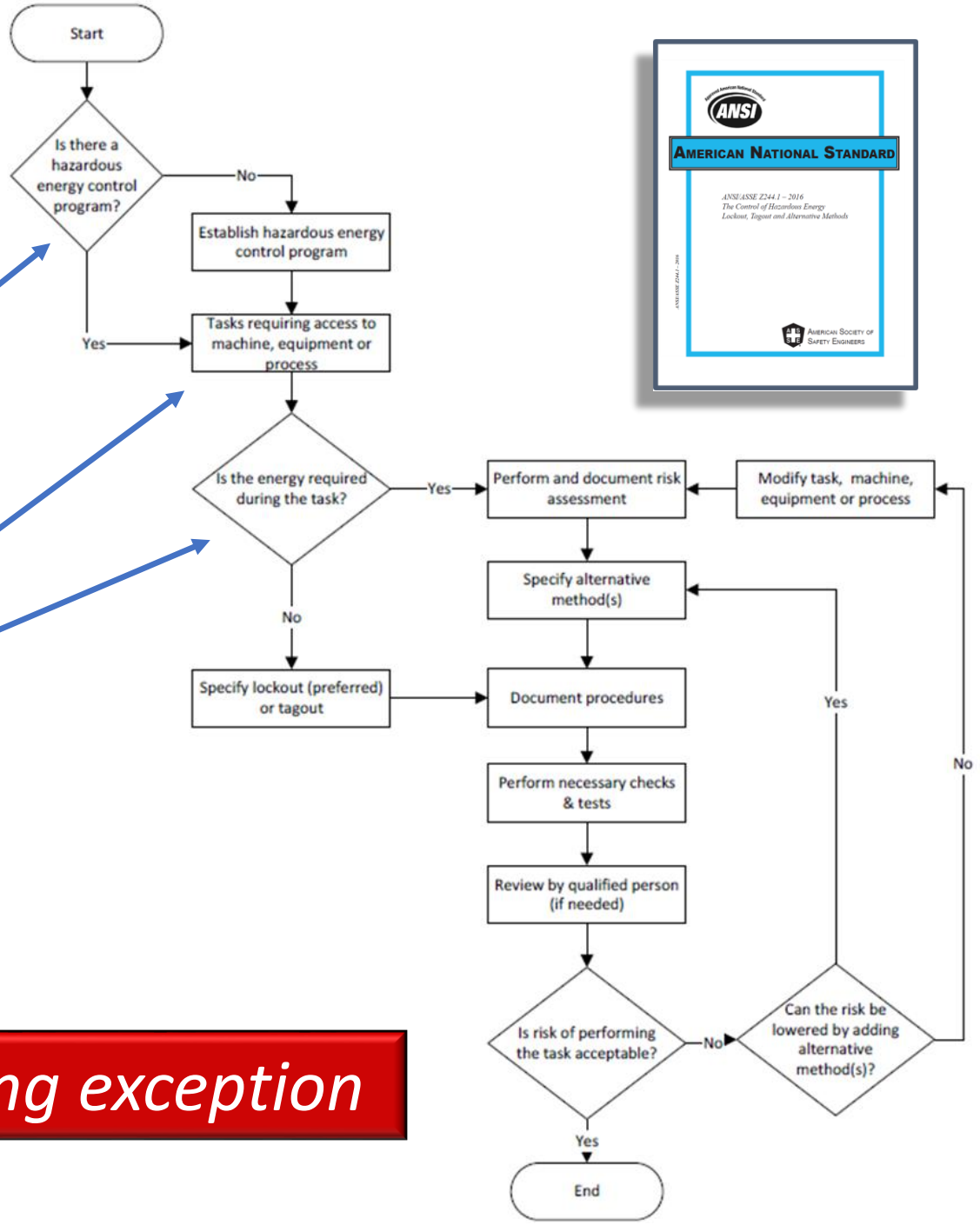
1. Check the machine or equipment and the immediate area around the machine to ensure that nonessential items have been removed and that the machine or equipment components are operationally intact.
2. Check the work area to ensure that all employees have been safely positioned or removed from the area.
3. Verify that the controls are in neutral.
4. Remove the lockout and/or blocking devices and reenergize the machine or equipment.
5. Notify affected employees that the servicing or maintenance is completed and the machine or equipment is ready for use.

- Return LOTO devices to their authorized storage location

ANSI/ASSE Z244.1-2016

The Control of Hazardous Energy

Lockout, Tagout and Alternative Methods



- An established LOTO program?
- Does task require access to machine?
- Is energy <u>required</u> during the task?
- If yes <u>to all</u> document the thought process and justification.

Alternative Methods = *minor servicing exception*

Machine Guarding

Minor Servicing Exception

E-stop

Lockout/Tagout

Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Expo-sure	Avoid-ance	Occur-rence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

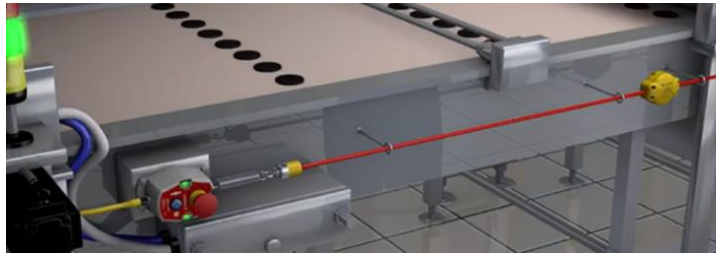
Emergency Stop Function – General Requirements

ISO 13850:2015(E) 4.1.1

- The purpose is to avert actual or impending emergency situations arising from the behavior of persons or from an unexpected hazardous event.
- Is to be initiated by a single human action.
  - does not require the consideration of the resultant effects
- Shall be available and operational at all times.
  - Shall override all other functions and operations in all operating modes of the machine without impairing other protective functions
- It shall be maintained until it is manually reset
- Hazardous movements and operations of the machine are stopped in an appropriate manner
  - Can initiate other functions other than stopping to minimize the risk of harm
    - Reversal or limitation of motion, rate of braking, etc
- Actuation shall not create any new hazards

Emergency Stop - locations

- ISO 13850:2015(E) 4.3.2 *An emergency stop device shall be located:*
  - *at each operator control station*
    - *except where the risk assessment indicates that this is not necessary;*
  - *at other locations, as determined by the risk assessment, e.g.:*
    - *at entrance and exit locations;*
    - *at locations where intervention to the machinery is needed, e.g. operations with a hold-to-run control function;*
    - *at all places where a man / machine interaction is expected by design (loading / unloading zone for example).*



Stops - *cessation of machine motion*

- **Normal stop** - The stopping of a machine, initiated by the control system, at the completion of a cycle.
- **Emergency stop** - The stopping of a machine, manually initiated, for emergency purposes.
- **Protective or safety stop** - The stopping of a machine initiated by an engineering controls device for risk reduction purposes.

- These definitions are harmonized across all of the standards

9.4.4 Comparison of Stop Functions

B11.19–2019

Table 2 offers an explanatory comparison of the different types of stop functions.

Table 2 — Comparison of stop, emergency stop, and protective stops (Informative)

	Normal Stop	Emergency Stop	Protective Stop
ANSI B11.19 reference	3.101.3; 9.4.1	3.101.2; 9.4.2; 10.12	3.101.4; 9.4.3
Location	Personnel have quick, unobstructed access. Required on all operator stations	Personnel have quick, unobstructed access. Required on all operator stations and other locations as determined by a risk assessment	Located such that an individual cannot access the hazard. Determined by the safety distance formula (see also, 9.6 and Annex H).
Initiation of stop signal	Manual or automatic	Manual only	Manual or automatic
Stop category**	0, 1 or 2	0 or 1 only	0, 1, or 2
Circuit performance	As determined by a documented risk assessment		
	Typically single channel (non safety-rated)	Minimum single channel safety rated controls. Greater performance may be required	Typically control reliable, see also, 9.2
Circuit reset	Manual only	Manual only	Manual or automatic (hardware or software)
Manual suspension and mute	Allowed (for cycle completion, etc.)	Not allowed	Allowed (for muting, modes of operation, set up, etc.)
Use frequency	Variable; frequent (every cycle) to infrequent	Infrequently; only in emergency situations or for other immediate stop purposes	Variable; frequent (every cycle) to infrequent. Typically a stop command is only issued when a safe condition is not present
Effect	De-energize the relevant circuit and override related start functions	Remove all energy sources to hazards in the span of control and override all other functions and operations in all modes	Remove or control energy sources to the hazard in the span of control and override all other functions and operations in all modes associated with the hazard in the span of control
Final removal of power	Electromechanical or solid-state components	Electromechanical components or solid-state components designed for safety functions	Electromechanical or solid-state components designed for safety functions

Stop Categories

- **Category 0** - *an uncontrolled stop by immediately removing power to the machine actuators. (Additional braking can be necessary)*
- **Category 1** - *a controlled stop with power to the machine actuators available to achieve the stop then power is removed when the stop is achieved.*
- **Category 2** - *a controlled stop with power left available to the machine actuators.*

- These definitions are harmonized across all of the standards.
- Applies to all controllable power sources electric, hydraulic and pneumatic that produce motion.
- Type and category applied is determined by the risk assessment.

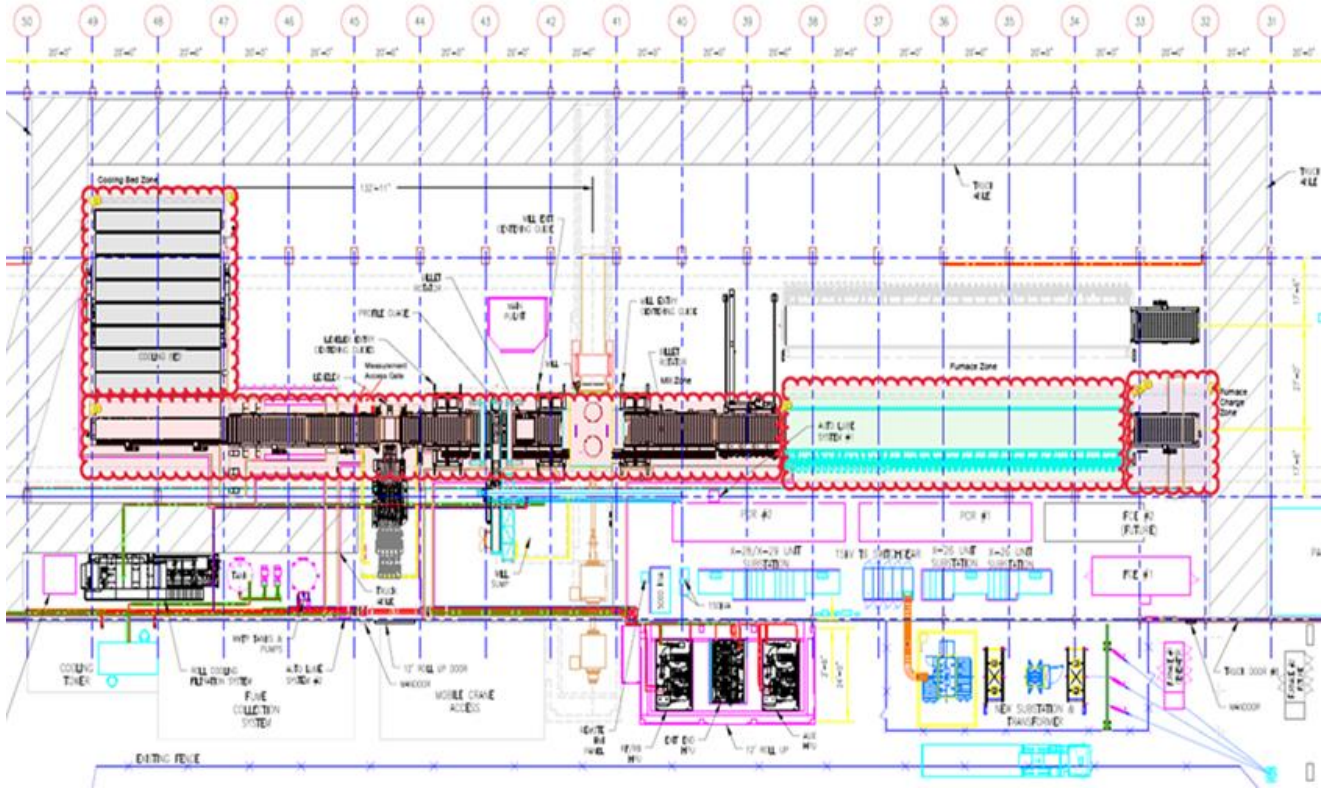
Stops

- Normal stop function (cat 0, 1, 2)
- Emergency stop function (cat 0, 1)
- Protective stop functions (cat 0, 1, 2)
- Categories of stops
  - Category 0 - uncontrolled stop by immediately removing power to the machine actuators.
  - Category 1 - controlled stop with power to the machine actuators available to achieve the stop then power is removed when the stop is achieved.
  - Category 2 - controlled stop with power left available to the machine actuators.
- Reference the risk assessment and machine operation

See also, **NFPA 79, ANSI B11.26, ANSI B11.TR4, IEC 61508, IEC 62061**, **and ISO 13849 Parts 1 and 2** for guidance regarding how to design safety functions.

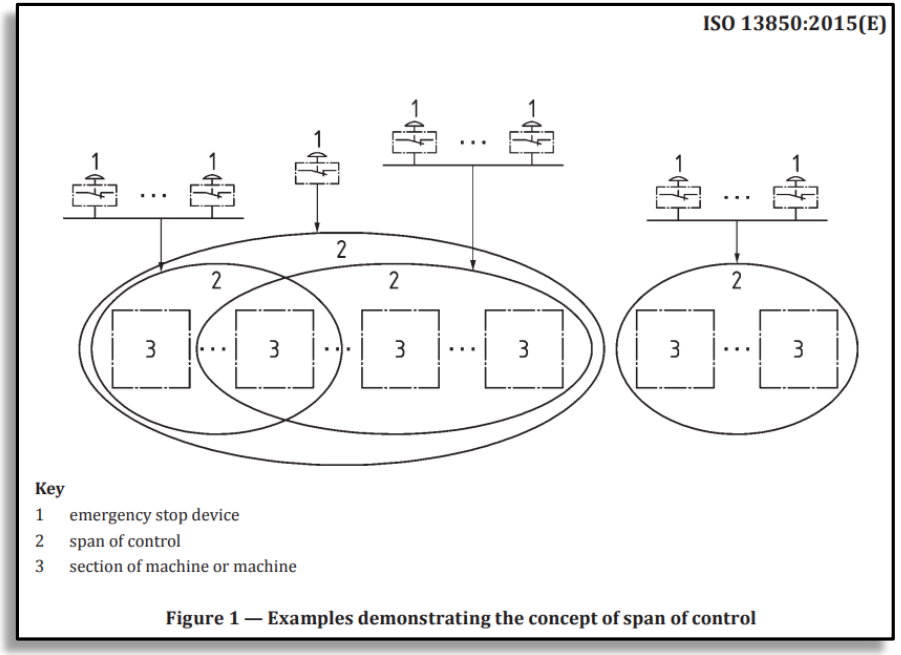
Span of Control – determined by a layout analysis B11.0 – 2020 (Annex – J)

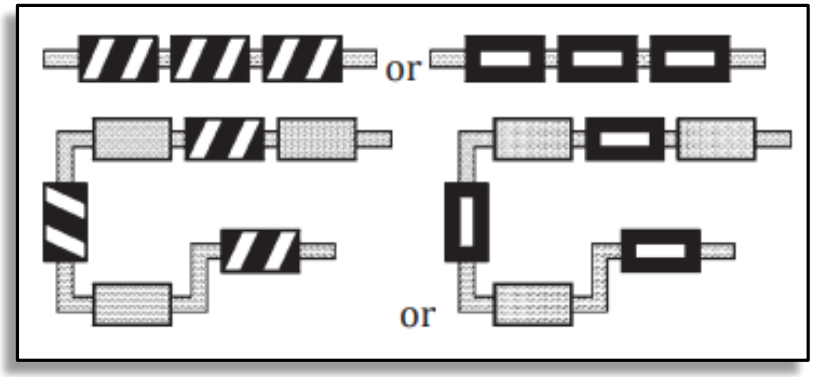
- The assignment of estop spans of control shall be determined taking into account the following:
  - *a) the physical layout of the machine, based on the visible area of the machine;*
  - *b) the possibility to recognize hazardous situations (e.g. visibility, noise, odor);*
  - *c) any safety implications relating to the production process;*
  - *d) the foreseeable exposure to hazards;*
  - *e) the possible adjacent hazards.*



Span of Control – determined by a layout analysis – ANSI B11.0 Annex J, ISO 13850

- Task/hazard identification
- Task zone
  - Physical area where people will do a task
- Control zone (for engineered controls)
  - interlock devices
  - presence-sensing devices
  - emergency stops
  - enabling devices
  - hold-to-run controls
  - resets
- Each span of control can cover section(s) of a machine, an entire machine or a group of machines
- Spans of control may overlap
- Estops must be clearly depicted by graphics not text





Machine Guarding

Minor Servicing Exception

E-stop

Lockout/Tagout

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	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

Risk Reduction Methods
Hierarchy of remediation

- Tasks/Hazards in all modes of operation
- Fundamental question…
  - *Is this a maintenance or minor servicing task?*

LOTO / Isolate Hazardous Energy

Machine Guarding

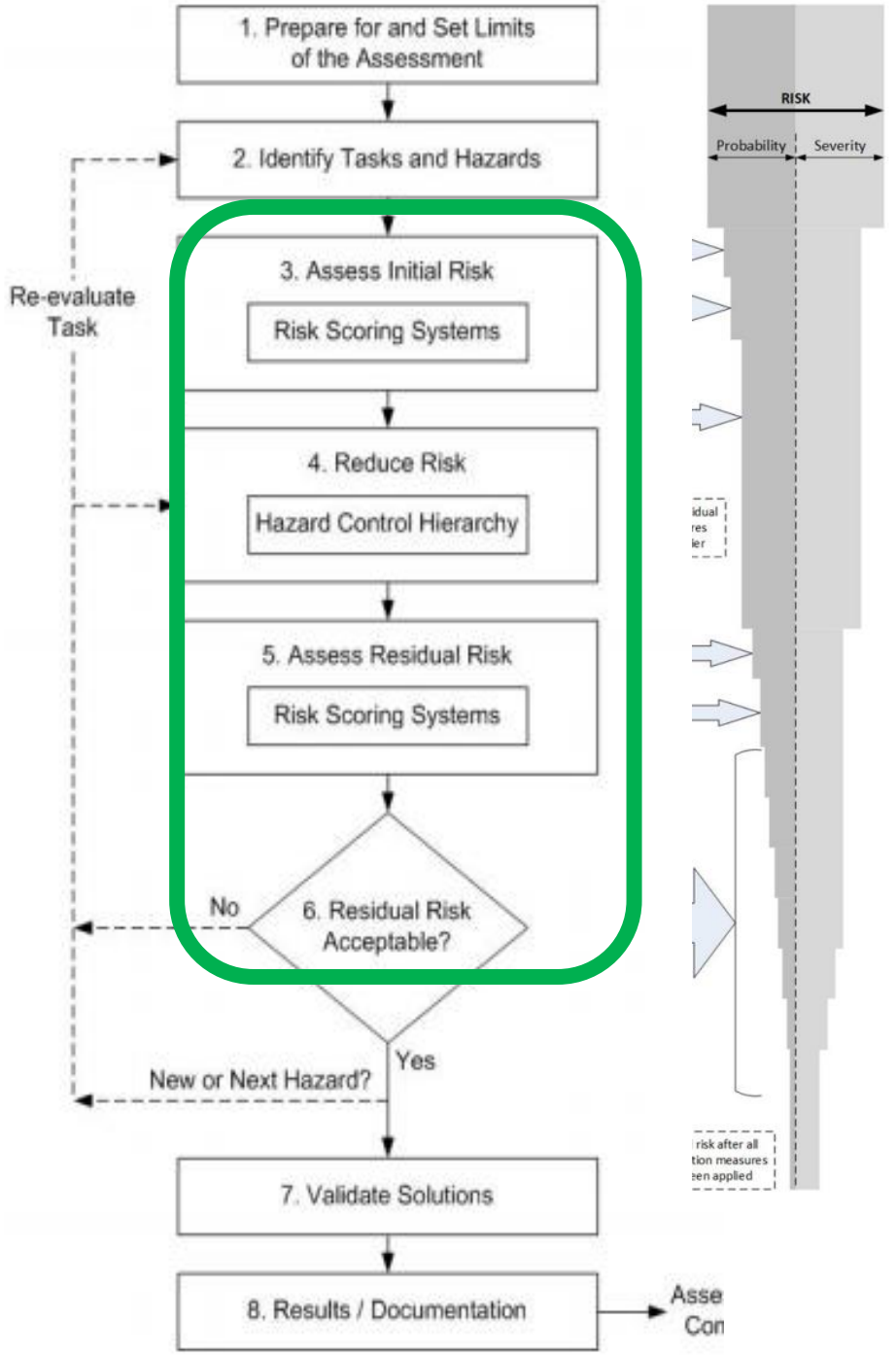
Minor servicing must be routine, repetitive and integral to the operation of the system.

Minor Service Exception to Lockout Tagout

Minor Servicing Exception - 29 CFR 1910.147 (a)(2)(ii)

- Regulation: Machine Guarding or alternative protection means minor jams, minor tool changes & adjustments, exchange
- Requirement: Protect operators from machine production hazards when performing minor servicing
- Tasks: Minor servicing such as clearing jams, loading parts, etc.

Must provide alterna measures that offe effective protecti



Minor Servicing Exception

1910.147 (a)(2)(ii)(B)

Note: ***Exception to paragraph (a)(2)(ii):*** Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered by this standard if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection (See Subpart O of this Part).

1. Performed during normal operations
2. Is routine, repetitive and integral to the use of the equipment for production
3. Just as effective – does not increase risk

ANSI/ASSE Z244.1 *Control of Hazardous Energy - Lockout/Tagout and Alternative Methods*

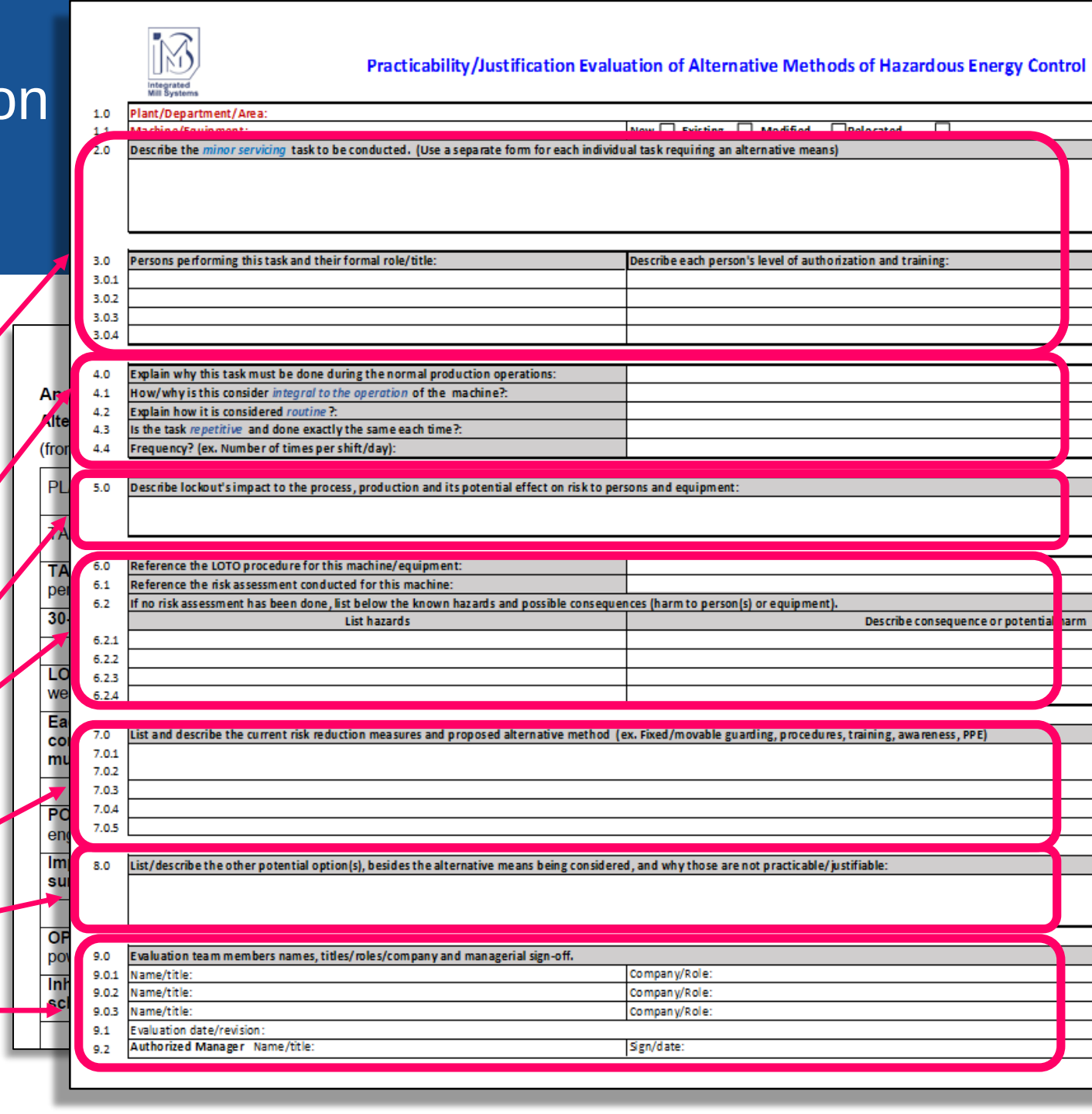
Minor Servicing Exception

1910.147 (a)(2)(ii)(B)

https://www.osha.gov/dts/osta/lototraining/tutorial/tu-overvw.html

Practicability/Justification of alternative methods

- IMS Practicability/Justification Evaluation documentation
  - based on ANSI Z244.1 2016 Annex L – *Sample Alternative Methods Practicability/Justification Evaluation*
- Elements of justification/practicability
  - Details on the task/people
  - Routine, repetitive, integral to operation
  - LOTO's impact to normal production
  - LOTO procedure or list of hazards
    - Best is a risk assessment
  - Efficacy of proposed alternative method
  - Elimination of other options
  - Those responsible



Practicability/Justification Evaluation of Alternative Methods of Hazardous Energy Control

1.0	Plant/Department/Area:	
2.0	Describe the *minor servicing* task to be conducted. (Use a separate form for each individual task requiring an alternative means)	
3.0	Persons performing this task and their formal role/title:	Describe each person's level of authorization and training:
3.0.1		
3.0.2		
3.0.3		
3.0.4		
4.0	Explain why this task must be done during the normal production operations:	
4.1	How/why is this consider *integral to the operation* of the machine?:	
4.2	Explain how it is considered *routine* ?:	
4.3	Is the task *repetitive* and done exactly the same each time?:	
4.4	Frequency? (ex. Number of times per shift/day):	
5.0	Describe lockout's impact to the process, production and its potential effect on risk to persons and equipment:	
6.0	Reference the LOTO procedure for this machine/equipment:	
6.1	Reference the risk assessment conducted for this machine:	
6.2	If no risk assessment has been done, list below the known hazards and possible consequences (harm to person(s) or equipment).	
	List hazards	Describe consequence or potential harm
6.2.1		
6.2.2		
6.2.3		
6.2.4		
7.0	List and describe the current risk reduction measures and proposed alternative method (ex. Fixed/movable guarding, procedures, training, awareness, PPE)	
7.0.1		
7.0.2		
7.0.3		
7.0.4		
7.0.5		
8.0	List/describe the other potential option(s), besides the alternative means being considered, and why those are not practicable/justifiable:	
9.0	Evaluation team members names, titles/roles/company and managerial sign-off.	
9.0.1	Name/title:	Company/Role:
9.0.2	Name/title:	Company/Role:
9.0.3	Name/title:	Company/Role:
9.1	Evaluation date/revision:	
9.2	Authorized Manager Name/title:	Sign/date:

Machine Guarding

Minor Servicing Exception

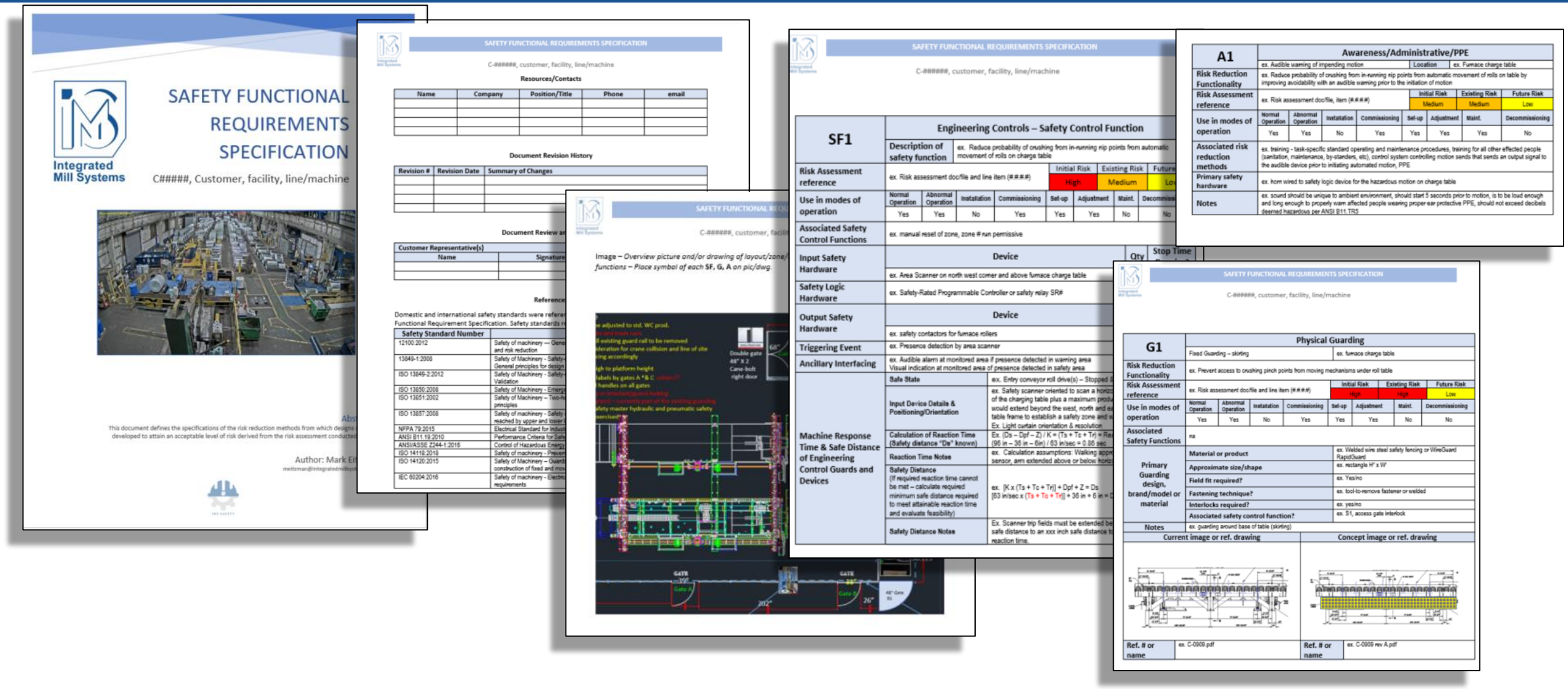
E-stop

Lockout/Tagout

Table 6 — Potential Effects/Additional Characteristics of Risk Reduction Measures

Risk Reduction Measures			Possible Effect on Risk Factors				Possibly susceptible to: (even when properly applied)	
Hierarchy		Examples	Severity	Probability				
Classification	Type			Expo-sure	Avoid-ance	Occur-rence	Failure	Error / Misuse
Inherently Safe by Design (Redesign)	Limiting Interaction	modify the process to eliminate/reduce human interaction		•		•		•
	Elimination	replace task, increase clearance	•	•				
		energy magnitude reduction	•			•	•	
	Substitution	automated material handling	•	•	•	•	•	•
		use less hazardous chemicals	•			•		•
		reduce force, speed, etc. through selection of inherently safe components	•		•			
Engineering Controls (Guards, Devices and Control Functions)	Separation	fixed guards, shields		•		•	•	•
	Detect / Control Access	Interlock devices, presence sensing devices		•		•	•	•
	Control Hazardous Motion	two-hand / single actuating controls		•	•	•	•	•
		enabling devices, jog controls			•	•	•	•
	Restricting Operation	controlled selection of operating modes				•		•
	Monitor / Limit Hazards	speed / force monitoring and limiting	•		•	•	•	
	Emergency Action	emergency stop devices	•		•	•	•	
Administrative Controls	Awareness Means (Warnings & Instructions)	awareness barriers		•	•	•		•
		awareness signals (audible and/or visible)			•	•	•	•
		awareness signs / markings			•	•		•
	Information for Use (Training & Procedures)	safe work procedures, training			•	•		•
	Administrative Methods	safe-holding safeguarding method			•	•		•
	Supervision	supervisory control of configurable elements			•	•		•
	Control of hazardous energy	isolation of hazardous energy	•	•		•		•
	Tools	hand tools	•		•	•	•	•
	PPE	safety glasses, hearing protection, gloves	•		•	•	•	•

Safety Functional Requirement Specification - SFRS



SAFETY FUNCTIONAL REQUIREMENTS SPECIFICATION

Integrated Mill Systems

C#####, Customer, facility, line/machine

SAFETY FUNCTIONAL REQUIREMENTS SPECIFICATION

C-######, customer, facility, line/machine

Resources/Contacts

Name	Company	Position/Title	Phone	email

Document Revision History

Revision #	Revision Date	Summary of Changes

Customer Representative(s)

Name	Signature

Safety Standard Number	
12100:2012	Safety of machinery — General principles for design — Risk assessment and risk reduction
13849-1:2008	Safety of Machinery - Safety-related parts of control systems - Part 1: General principles for design
ISO 13849-2:2012	Safety of Machinery - Safety-related parts of control systems - Part 2: Validation
ISO 13850:2008	Safety of Machinery - Emergency stop - Principles for design
ISO 13851:2002	Safety of Machinery – Two-hand control devices – Functional aspects and principles
ISO 13857:2008	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
NFPA 79:2015	Electrical Standard for Industrial Machinery
ANSI B11.19:2010	Performance Criteria for Safeguarding
ANSI/ASSE Z244-1:2016	Control of Hazardous Energy - Lockout, Tagout and Alternative Methods
ISO 14118:2018	Safety of machinery - Prevention of unexpected start-up
ISO 14120:2015	Safety of Machinery – Guards – General requirements for the design and construction of fixed and movable guards
IEC 60204:2016	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Image – *Overview picture and/or drawing of layout/zone/functions – Place symbol of each* **SF, G, A** *on pic/dwg.*

SF1	Engineering Controls – Safety Control Function							
Description of safety function	ex. Reduce probability of crushing from in-running nip points from automatic movement of rolls on charge table							
Risk Assessment reference	ex. Risk assessment doc/file and line item (####)				Initial Risk: High	Existing Risk: Medium	Future: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: No	Decommissioning: No
Associated Safety Control Functions	ex. manual reset of zone, zone # run permissive							
Input Safety Hardware	Device						Qty	Stop Time
	ex. Area Scanner on north west corner and above furnace charge table							
Safety Logic Hardware	ex. Safety-Rated Programmable Controller or safety relay SR#							
Output Safety Hardware	Device							
	ex. safety contactors for furnace rollers							
Triggering Event	ex. Presence detection by area scanner							
Ancillary Interfacing	ex. Audible alarm at monitored area if presence detected in warning area Visual indication at monitored area of presence detected in safety area							
Machine Response Time & Safe Distance of Engineering Control Guards and Devices	Safe State	ex. Entry conveyor roll drive(s) – Stopped						
	Input Device Details & Positioning/Orientation	ex. Safety scanner oriented to scan a horiz... of the charging table plus a maximum produ... would extend beyond the west, north and e... table frame to establish a safety zone and w... Ex. Light curtain orientation & resolution						
	Calculation of Reaction Time (Safety distance "Dx" known)	Ex. (Ds – Dpf – Z) / K = (Ts + Tc + Tr) = Re... (96 in – 36 in – 6in) / 63 in/sec = 0.86 sec						
	Reaction Time Notes	ex. Calculation assumptions: Walking appr... sensor, arm extended above or below horiz...						
	Safety Distance (If required reaction time cannot be met – calculate required minimum safe distance required to meet attainable reaction time and evaluate feasibility)	ex. [K x (Ts + Tc + Tr)] + Dpf + Z = Ds [63 in/sec x (Ts + Tc + Tr)] + 36 in + 6 in = D						
	Safety Distance Notes	Ex. Scanner trip fields must be extended be... safe distance to an xxx inch safe distance t... reaction time.						

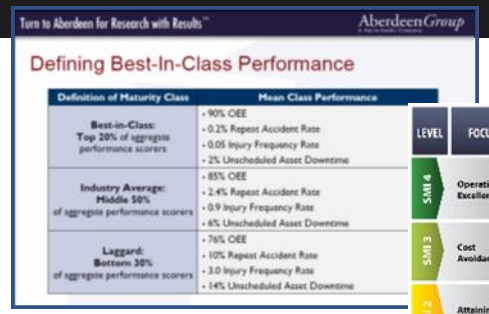
A1	Awareness/Administrative/PPE							
	ex. Audible warning of impending motion			Location: ex. Furnace charge table				
Risk Reduction Functionality	ex. Reduce probability of crushing from in-running nip points from automatic movement of rolls on table by improving avoidability with an audible warning prior to the initiation of motion							
Risk Assessment reference	ex. Risk assessment doc/file, item (####)				Initial Risk: Medium	Existing Risk: Medium	Future Risk: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: Yes	Decommissioning: No
Associated risk reduction methods	ex. training - task-specific standard operating and maintenance procedures, training for all other effected people (sanitation, maintenance, by-standers, etc), control system controlling motion sends that sends an output signal to the audible device prior to initiating automated motion, PPE							
Primary safety hardware	ex. horn wired to safety logic device for the hazardous motion on charge table							
Notes	ex. sound should be unique to ambient environment, should start 5 seconds prior to motion, is to be loud enough and long enough to properly warn affected people wearing proper ear protective PPE, should not exceed decibels deemed hazardous per ANSI B11.TR5							

G1	Physical Guarding							
	Fixed Guarding – skirting			ex. furnace charge table				
Risk Reduction Functionality	ex. Prevent access to crushing pinch points from moving mechanisms under roll table							
Risk Assessment reference	ex. Risk assessment doc/file and line item (####)				Initial Risk: High	Existing Risk: High	Future Risk: Low	
Use in modes of operation	Normal Operation: Yes	Abnormal Operation: Yes	Installation: No	Commissioning: Yes	Set-up: Yes	Adjustment: Yes	Maint.: No	Decommissioning: No
Associated Safety Functions	na							
Primary Guarding design, brand/model or material	Material or product	ex. Welded wire steel safety fencing or WireGuard RapidGuard						
	Approximate size/shape	ex. rectangle H' x W'						
	Field fit required?	ex. Yes/no						
	Fastening technique?	ex. tool-to-remove fastener or welded						
	Interlocks required?	ex. yes/no						
	Associated safety control function?	ex. S1, access gate interlock						
Notes	ex. guarding around base of table (skirting)							
Current image or ref. drawing				Concept image or ref. drawing				
Ref. # or name	ex. C-0909.pdf			Ref. # or name	ex. C-0909 rev A.pdf			

5 part series on Manufacturing Safety

PORTAGE COUNTY SAFETY COUNCIL

A Forum For Workplace Safety



1. ✓ **Societal Demands for Safety and Productivity - Sept. 1**
2. ✓ **Regulatory Compliance (laws and standards) and Risk Assessments - Sept 8**
3. ✓ **Risk Reduction Methods, Technologies and Techniques for Machinery Safety - Sept 15**
4. ★ **Engineered Controls and Safety Circuits – Sept 22**
5. **Installation, Validation and Post Commissioning Management of Change – Sept 29**

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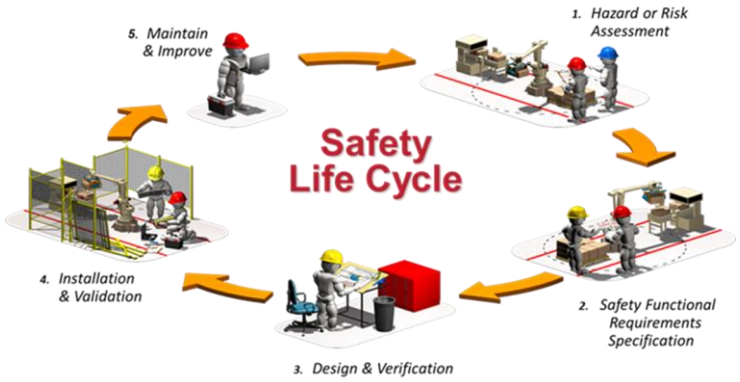

Portage County Safety Council
Machine Safety Workshop Part 3 or 5
Risk Reduction Methods
and SFRS (Safety Functional Requirements Specification)

Sept. 15, 2021

Integrated Mill Systems

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