Grantek Systems Integration

Understanding Machine Safeguarding and Lockout/Tagout

October 18th 2017

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Director, Safety Practice
Today’s Speaker: Jeff Winter

BIO:
- TUV Certified Functional Safety Engineer (FS Eng)
- Board Certified Safety Professional (CSP)
- Industry speaker and writer
- American Society of Safety Engineers:
  - President of Three Rivers Chapter
  - Officer of Manufacturing Practice Specialty
- Z244.1 Accredited Standards Committee
- ISA Machine Safety Sub-Committee Chairman
- B11 Accredited Standards Committee
  - B11.19 Revision
  - B11.20 Revision
Today’s Agenda

• Lockout/Tagout Vs. Machine Safeguarding
• Applicable Regulations and Standards
• Highlights of the new ANSI/ASSE Z244.1 Standard
• Example application of the standard
• How to move forward
Common Industry Battles

Lockout/Tagout is the regulation and the only way to keep people safe!

Lockout/Tagout is hindering our production!

EH&S Operations
What is Machine Safeguarding?

Machine safeguarding is a precautionary safety feature on equipment comprised of devices and methods designed to protect employees from hazards created by the equipment while working nearby or while operating equipment.

**Simplified Goal:** Keep people away
What are the requirements of Machine Safeguarding?

Part 1910: Occupational Safety and Health Standards

Subpart O: Machinery & Machine Guarding

1910.212: General requirements for all machinery
1910.213: Woodworking machinery requirements
1910.214: Abrasive wheel machinery
1910.215: Cooperage machinery - reserved
1910.216: Mills and Calenders
1910.217: Mechanical power presses
1910.218: Forging machines
1910.219: Mechanical power-transmission apparatus
"Lockout/Tagout" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

**Simplified Goal:** Remove hazardous energy
What are the requirements of Lockout/Tagout?

Part 1910: Occupational Safety and Health Standards
Subpart J: General Environmental Controls
1910.147: Control of Hazardous Energy

1910.147 establishes minimum performance requirements for controlling hazardous energy. The regulation specifies that employers must establish an energy-control program to ensure that employees isolate machines from their energy sources and render them inoperative before any employee services or maintains them.
Lockout/Tagout Vs. Machine Safeguarding

- **Lockout/Tagout**
  - Protects employees during service and maintenance tasks
  - **Default:** Lockout by removing energy

- **Machine Safeguarding**
  - Protects all employees from general hazards, especially during normal operation
  - **Default:** Protect Operator by keeping away
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).

Two main goals of Machine Safeguarding:
- Identify hazards and evaluate risk (ideally based off their tasks)
- Appropriately apply control measures to protect against the hazards and reduce risks to acceptable levels
How does OSHA enforce 1910.147?

CPL 02-00-147:

- Inclusion of guidance on the minor servicing exception, specific energy control procedures, periodic inspections, and unexpected energization;
- Inclusion of information and guidance on Alternative Methods to Lockout/Tagout (LOTO)
How do employers demonstrate compliance?

“Assessment” standards make sure you identify and remediate hazards appropriately. (e.g. ANSI B11.0, ISO 12100, etc.)

“Product” standards give you confidence that safety devices and technology are fail safe and designed correctly. (e.g. ISO and IEC Type B2 Standards)

“Application” standards ensures safety devices and technology are applied, installed, and used properly. (e.g. ANSI B11.19, or ISO C-Type Standards)

“Performance” standards ensure each all safety systems (devices connected together) are designed to still work in the event of a failure. (e.g. ISO 13849-1, etc.)

“Validation” standards make sure ALL the pieces were put together properly to ultimately reduce the risk. (e.g. ISO 13849-2)
ANSI/ASSE Z244.1 History

• First publication 1982, reaffirmed in 1992
• Revised in 2003, reaffirmed in 2008 and 2014
• 2003 revision included major modifications were around “How to meet 1910.147 regulation.”
• 2016 revision had a 70% increase in participation from a variety of industries
• 2016 revision published in December of 2016
ANSI/ASSE Z244.1 Basics

2016 revision presents distinct requirements for controlling hazardous energy through 3 different approaches:

• Lockout (Primary approach)
• Tagout
• Alternative Methods
ANSI/ASSE Z244.1 Contents

1) Scope and Purpose
2) References
3) Definitions
4) Responsibilities
5) Design of Machinery/Equipment for the Control of Hazardous Energy
6) Hazardous Energy Program
7) Control of Hazardous Energy
8) Alternative Methods of Hazardous Energy Control
9) Annexes
Section 4 - Responsibilities

Notable changes in 2016 revision:

• All suppliers are now required to meet the design requirements (Section 5)
• Users (employers) now required to obtain equipment that complies with section 5.
• Users (employers) are responsible for upgrading non-compliant equipment to be compliant with section 5.

Actions to Consider

• Require Suppliers and OEMS to follow Z244.1 as part of corporate specifications to ensure all future equipment fits into your program.
Section 5 – Design Requirements

Notable changes in 2016 revision:

• Risk assessments are now required during the design phase of a project
• Documentation requirements
  – Procedures for use of energy isolating devices
  – Instructions for tasks requiring partial energization
  – Instructions for servicing and maintenance tasks
  – Instructions for releasing or controlling stored energy
• Use of warnings (e.g. labels, placards, etc.)
• Control Integration now commensurate with the risk
• Requirements for tamper resistance

Actions to Consider

• Evaluate what requirements are currently specified to suppliers. Do they easily support your current Lockout/Tagout program or conflict? Don’t know?
Section 6 – Hazardous Energy Control Program

Notable changes in 2016 revision:
• Greater detail in the development of a hazardous energy control program, including the elements in each section.
• Addition of a change management program.
• New decision process for the selection of Lockout, Tagout, and Alternative Methods.

Actions to Consider
• How mature is your current Lockout/Tagout program? Does it even include the option for alternative methods?
Section 7 – Control of Hazardous Energy

Notable changes in 2016 revision:
• Added elements needed in the development of procedures
• Verification of isolation has added emphasis on testing
• Expanded procedures for user-directed Lockout/Tagout device removal

Actions to Consider
• Do your Lockout/Tagout procedures include all appropriate elements to be best practice? (and compliant)
Section 8 – Alternative Methods

Notable changes in 2016 revision:
• Before Alternative Methods can be used:
  – Practicability/justification analysis
  – A risk assessment
  – Hazard control hierarchy evaluation
  – Evaluation of selected alternative method
• Alternative Methods must be designed by qualified individuals

Actions to Consider
• Do you check if your suppliers and/or designers are certified in functional safety?
Potential Situations to use Alternative Methods

• Hazardous energy must be present because is required to perform the task
• Lockout or Tagout is not feasible or practicable
• When a documented risk assessment shows the task can be performed with acceptable risk
• When inherent hazards (e.g. thermal, radiation, etc.) are unable to be controlled using Lockout or Tagout
• When energy is required to maintain equipment in a safe state
• When repetitive cycling of an energy isolation device compromise the safety function
Annexes – Industry Best Practices

Actions to Consider

• Are any of the suggestions in the Annex worth turning into requirements for your company (either through your program or your specifications)?

• How do your current templates compare to the examples? Do they capture the same information?
Building a Program with Z244.1

- Lockout/Tagout Program
  - Alternative Methods Justification
  - Task Based Risk Assessment Process
  - Inspection and Testing of Safeguards
  - Training & Awareness
- Machine Safeguarding Program
  - Acceptable Methods of Safeguarding
  - Documentation Requirements
  - Design & Functional Requirements
  - Verification & Validation Requirements
  - Deviations & Exceptions Management
- Safety Specifications
- Project Management Processes
  - Stage Gates and Approvals
Example Approach for applying a method

Maintenance, Cleaning, or Scheduled Servicing

Unscheduled & unplanned activities that happen frequently and are considered to be routine, repetitive and integral to the process

Current Safeguarding or Protective Measures

- No Guards
- Fixed Guards
- Presence Sensing Devices
  - PL A, B, or C
  - PL E or PL D Protection Devices
    - Auto Reset
    - Manual Reset

Need a 2nd Point of Control and Protective Measure

Operational Safeguards Measures Adequate

Live work tasks

- Lock-out/Tag-out
- By Permit or by trained people only
Example Application of Z244.1
### STEP 1: Risk Assessment

#### Hazard Based Risk Assessment

<table>
<thead>
<tr>
<th>Item ID</th>
<th>Area</th>
<th>Hazard</th>
<th>Frequency</th>
<th>Severity</th>
<th>Probability</th>
<th>Likelihood</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA 1.1</td>
<td>Upper Infeed Chute Conveyor</td>
<td>Slippage, nip point, entanglement</td>
<td>Daily</td>
<td>3</td>
<td>2</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>RA 3.1</td>
<td>Upper Infeed Conveyor Slides</td>
<td>Slippage, nip point, entanglement</td>
<td>Weekly</td>
<td>2</td>
<td>3</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>RA 4.1</td>
<td>Upper Infeed Conveyor Slides</td>
<td>Slippage, nip point, entanglement</td>
<td>Daily</td>
<td>3</td>
<td>2</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>RA 5.1</td>
<td>Upper Palletizer</td>
<td>Slippage, nip point, entanglement</td>
<td>Weekly</td>
<td>2</td>
<td>3</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>RA 5.1</td>
<td>Upper Palletizer</td>
<td>Slippage, nip point, entanglement</td>
<td>Daily</td>
<td>3</td>
<td>2</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

#### Task Based Risk Assessment

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task Type</th>
<th>Task Description</th>
<th>Task Frequency</th>
<th>Hazard</th>
<th>Hazard Type</th>
<th>Hazard Area</th>
<th>Risk Level</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Operator</td>
<td>Operation</td>
<td>Daily</td>
<td>Slipping hazard</td>
<td>Slipping hazard</td>
<td>RA 1.1</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>Operator</td>
<td>Operation</td>
<td>Daily</td>
<td>Slipping hazard</td>
<td>Slipping hazard</td>
<td>RA 3.1</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>Operator</td>
<td>Operation</td>
<td>Daily</td>
<td>Slipping hazard</td>
<td>Slipping hazard</td>
<td>RA 5.1</td>
<td>Medium</td>
<td></td>
</tr>
</tbody>
</table>

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Hazard Based Risk Assessment

Task Based Risk Assessment
### STEP 2: Risk Reduction Plan

#### Risk Reduction Information

<table>
<thead>
<tr>
<th>Risk Reduction Measure</th>
<th>Inherently Safe Design Measures</th>
<th>Engineered Controls Measures</th>
<th>Administrative Control Measures</th>
<th>Description of Risk Reduction Requirements</th>
<th>Associated Hazard Areas</th>
<th>Associated Hazards</th>
<th>s</th>
<th>Risk Scores</th>
<th>Anticipated Residual Risk</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Not Required</td>
<td>Not Required</td>
<td></td>
<td>Appropriate pinch point hazard labelling shall be placed at the feed rollers</td>
<td>Infeed Area</td>
<td>T1, H1</td>
<td>1</td>
<td>1</td>
<td>Low</td>
<td>None</td>
</tr>
<tr>
<td>R2</td>
<td>Impactical</td>
<td></td>
<td></td>
<td>An interlocked door shall be installed at the Main Drive Access. Opening this door during normal operation shall put the machine in a safe state.</td>
<td>Infeed Area</td>
<td>T1, H1</td>
<td>1</td>
<td>1</td>
<td>Low</td>
<td>None</td>
</tr>
<tr>
<td>R3</td>
<td>Impactical</td>
<td></td>
<td></td>
<td>An enclosure shall be installed around the machine to prevent access to all associated hazard areas. The enclosure shall start at the Top/Seal Area and end at the Discharge Area. The left and right panels of the enclosure shall be a fixed barrier guard that allows entry into the machine and allows product to pass through. The back of the barrier shall be a fixed barrier that allows visibility into the machine and shall prevent the ability to crawl under or reach over into the hazard areas. The front barrier shall be comprised of a series of interlocked access doors. Opening any of those doors during normal operation shall put the machine in a safe state. These doors shall prevent the ability to crawl under or reach over into the hazard areas.</td>
<td>Side/Bottom Seal Area, Knife Area, Feed Area, Top Seal Area, Pickoff Area, Discharge Area</td>
<td>T2, T3, T5, T6, T8, T9, T12, T13, T15, T17, T18</td>
<td>H2, H4, H5, H6, H10, H12, H13, H14, H15</td>
<td>1</td>
<td>1</td>
<td>Low</td>
</tr>
<tr>
<td>R4</td>
<td>Impactical</td>
<td></td>
<td></td>
<td>A fixed guard shall be installed as a shield around the heating elements to prevent accidental contact. Appropriate burn hazard labeling shall be placed on the interlocked access door for the corresponding hazard area</td>
<td>Side/Bottom Seal Area, Top Seal Area</td>
<td>T4, T13</td>
<td>H3, H5</td>
<td>1</td>
<td>1</td>
<td>Low</td>
</tr>
</tbody>
</table>
STEP 2.5: Evaluation of Existing Measures

<table>
<thead>
<tr>
<th>Effectiveness of Existing Safeguarding Methods</th>
<th>Analysis</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation and Performance of Safeguarding Devices</td>
<td>Acceptable</td>
<td>Interlocked guard door meets the application and installation requirements of ANSI B11.19</td>
</tr>
<tr>
<td>Proper use, design, and performance of Safety Functions</td>
<td>Acceptable</td>
<td>The interlocked guard appears to act as the safety function “Safety-Stop Initiated by a Safeguard.” This function meets the requirements of ISO13850-1</td>
</tr>
<tr>
<td>Consideration of industry best practices/methods for selection, design, and application of safeguarding devices</td>
<td>Unknown</td>
<td>No industry standards were specified by customer or provided in documentation by the Machine Builder in regards to the assessment process, risk reduction process, application of safeguarding measures, or safety-related parts of control systems.</td>
</tr>
<tr>
<td>Stopping performance of equipment</td>
<td>Acceptable</td>
<td>Use of Safe Torque Off (STO) function on drives achieves adequate stopping performance. Machine Stop time &lt;100ms and interlocked guard meets the safe mounting distance requirements of ANSI B11.19 Annex D.</td>
</tr>
<tr>
<td>Measures to ensure exclusivity/individual control</td>
<td>Acceptable</td>
<td>The access point is only large enough for one person to access at a time. Full visibility of the access point is possible during the entire duration of the task.</td>
</tr>
<tr>
<td>Measures to ensure tamper resistance</td>
<td>Acceptable</td>
<td>Interlock Switch is a non-contact, type 4, cased magnetic switch as defined in ISO14119 and cannot be easily defeated by mechanical means.</td>
</tr>
<tr>
<td>Safeguarding does not introduce new hazards</td>
<td>Unacceptable</td>
<td>The design of the lift-up interlocked door introduces a shear hazard near the hinge when closing.</td>
</tr>
</tbody>
</table>

**NOTES:**
## STEP 3: Evaluation of Task for Lockout

<table>
<thead>
<tr>
<th>Areas of Interpretation</th>
<th>Grantek’s Interpretation and/or Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determination of exposure to hazard(s)</td>
<td>Grantek follows the process established in ANSI B11 0.2010 to properly identify tasks, identify hazards, evaluate risk, score risk, and determine necessary risk reduction measures to reduce risk to an acceptable level. See Section 5.3 for Grantek’s risk scoring matrix.</td>
</tr>
</tbody>
</table>
| Definition for a “Routine Task” | OSHA CPL 02-00-147 defines “Routine” as an activity that must be performed as part of a regular and prescribed course of procedure and be performed in accordance with established practices. Grantek determines a task to be “Routine” if all the following conditions are met:  
  - Task is required to be performed as part of a normal operating procedure as defined by the OEM, Machine Builder, or designer of the equipment/process.  
  - Task has a documented procedure in order to perform in a safe manner. |
| Definition for a “Repetitive Task” | OSHA CPL 02-00-147 defines “Repetitive” as an activity that must be repeated regularly as part of the production process or cycle. Grantek determines a task to be “Repetitive” if one of the following conditions are met:  
  - Task is required to be performed at regularly scheduled intervals (More than once per 24-hour period on continuous operations).  
  - Task is required as the result of a consistent condition that normally occurs (More than once per 24-hour period on continuous operations). |
| Definition for a “Integral Task” | OSHA CPL 02-00-147 defines “Integral” as an activity that must be inherent to the production process. Grantek determines a task to be “Integral” if one of the following conditions are met:  
  - Not performing the task may stop or damage the machine or process.  
  - Not performing the task may negatively affect the product or process being produced.  
  - The task requires the removal or bypassing of a guard or safeguarding device to perform the task. |

### Task Evaluation

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>N</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

**Available Methods**

- CPG  
- Food  
- Beverage  
- Life Sciences & Pharma  
- Energy & Renewable Energy
STEP 3: Evaluation of Task for Lockout

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Task Qualification</th>
<th>Task Impacts to Hazardous Energy</th>
<th>Control Measure</th>
<th>Requirements</th>
<th>RESIDUAL RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>T10</td>
<td>No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Description of Requirements for Method of Equivalent Protection:</td>
<td>Measures for Exclusive Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full body access not possible, therefore door(s) with interlocking device provides exclusive control.</td>
<td>1/1 Low</td>
</tr>
<tr>
<td>T11</td>
<td>No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Description of Requirements for Method of Equivalent Protection:</td>
<td>Measures for Exclusive Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full body access not possible, therefore door(s) with interlocking device provides exclusive control.</td>
<td>1/1 Low</td>
</tr>
<tr>
<td>T12</td>
<td>No</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td></td>
<td></td>
<td></td>
<td>Description of Requirements for Method of Equivalent Protection:</td>
<td>Measures for Exclusive Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full body access not possible, therefore door(s) with interlocking device provides exclusive control.</td>
<td>1/1 Low</td>
</tr>
<tr>
<td>T13</td>
<td>Yes</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Description of Requirements for Method of Equivalent Protection:</td>
<td>Measures for Exclusive Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Proper PPE (Flash PPE required Category of PPE determined by task's risk). Electric and pneumatic energy isolating devices to be installed after the control panel.</td>
<td>1/1 Low</td>
</tr>
</tbody>
</table>
STEP 4 & 5: Verification & Validation

Design Verification

Circuit Performance & Architecture Verification

Example Emergency Stop Validation Procedure
Rule of Thumb:

The absence of an injury does not mean the presence of safety. If you don’t have written documentation explaining how your machine is safe, then it's not safe.
Questions?