ISO 14119 – Understanding Different Types of Interlocks

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Workplace Safety and Prevention Services
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Objective

- To provide an overview of ISO 14119 and provide a better understanding of different types of interlocking devices.
Agenda

- What is an Interlocking Device?
- Overview of ISO 14119
- Example of an interlocking device
- Some definitions
- ‘Types’ of interlocking devices
- Different types of guard locking devices
- Supplementary guard locking release
What is an Interlocking Device?

- A mechanical, electrical, or other device which prevents hazardous machine functions under specific conditions.
  - ...generally when the guard that the interlock is affixed to is not closed

[International Organization for Standardization, [ISO] 14119 2013, p 3]
ISO 14119:2013 - Safety of Machinery – Interlocking devices associated with guards – Principles for design and selection

Overview

- Current version of ISO 14119 is ‘2013’ version
- Standard Type - ‘Type-B2’ – Standard for Safeguards
- An updated version of ISO 14119 is currently under development (see ISO/DIS 14119.2)
Machine Safety Standard Types

Type C
Machine Safety Standards

Type B
B2 Standards for Safeguards
B1 Particular Safety Aspects

Type A
Basic Concepts, Principles for Design

- Type C: e.g. ISO 10218, CSA Z434, CSA Z142
- Type B:
  - B2: e.g. ISO 13850, ISO 14119
  - B1: e.g. ISO 13849, ISO 13857
- Type A:
  - e.g. ISO 12100, CSA Z432,
Example of an interlocking device

Key
1 guard
2 interlocking device
3 actuator
a Direction of opening

[International Organization for Standardization, [ISO] 14119 2013, Figure 1, p.2]
ISO 14119 – Some Definitions

▪ **Interlocking guard** – A guard equipped with an interlocking device that is integrated into the control system and performs the following functions:

  o Prevents operation of hazardous machine functions.

  o Sends a stop signal if opened during operation of hazardous machine functions.

  o When the guard is closed, hazardous machine functions that the closed guard prevents access to can operate (*guard closure does not by itself cause hazardous machine functions to start*).

▪ **Interlocking guard with a start function (control guard)** – An interlocking guard which, upon reaching its closed position, gives a command to initiate the hazardous machine function(s) without the use of a separate start control.

[International Organization for Standardization, [ISO] 14119 2013, p.2]
ISO 14119 – Some Definitions

- **Guard Locking Device** – A device that locks a guard in the closed position and is integrated into the control system.

- **An Interlocking guard with guard locking** - A guard equipped with an interlocking device that, in conjunction with the machine control system performs the following functions:
  
  o Prevents operation of hazardous machine functions until guard is closed and locked
  
  o Guard remains closed and locked until hazardous machine functions have ceased
  
  o When guard is closed an locked hazardous machine functions can operate (*guard closure and locking does not by itself cause hazardous machine functions to start*).
### Interlocking Device ‘Types’

#### Table 1 — Overview of interlocking devices

<table>
<thead>
<tr>
<th>Actuation principle examples</th>
<th>Actuator examples</th>
<th>Type</th>
<th>Examples: see Annex³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical contact/force</td>
<td>Uncoded</td>
<td>Type 1</td>
<td>A.1</td>
</tr>
<tr>
<td></td>
<td>Rotary cam</td>
<td></td>
<td>A.2, A.4</td>
</tr>
<tr>
<td></td>
<td>Linear cam</td>
<td></td>
<td>A.3</td>
</tr>
<tr>
<td></td>
<td>Hinge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coded</td>
<td>Type 2</td>
<td>B.1</td>
</tr>
<tr>
<td></td>
<td>Tongue (t-shaped actuator)</td>
<td></td>
<td>B.2</td>
</tr>
<tr>
<td></td>
<td>Trapped-key</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Non-contact</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inductive</td>
<td>Uncoded</td>
<td>Type 3</td>
<td>C</td>
</tr>
<tr>
<td>Magnetic</td>
<td>Suitable ferric metal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic</td>
<td>Magnet, solenoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitive</td>
<td>Any suitable object</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrasonic</td>
<td>Any suitable object</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optic</td>
<td>Any suitable object</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic</td>
<td>Coded</td>
<td>Type 4</td>
<td>D.1</td>
</tr>
<tr>
<td>Magnetic</td>
<td>Coded magnet</td>
<td></td>
<td>D.2</td>
</tr>
<tr>
<td>RFID</td>
<td>Coded RFID tag</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optic</td>
<td>Optically coded tag</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[International Organization for Standardization, [ISO] 14119 2013, Table 1, p. 7]
Guard interlocking without guard locking

- A guard equipped with an interlocking device ‘without guard locking’ can be opened at any time during machine operation.

  - Upon opening the guard, the interlocking device sends a stop signal to the system.

  - It is important to ensure that the access time to machine hazards is longer than system stopping performance.

[International Organization for Standardization, [ISO] 14119 2013, p.8]
Guard interlocking with guard locking

- A guard equipped with an interlocking device ‘with guard locking’ is prevented from opening by the guard locking device until all hazardous machine functions have ceased.

- There are two types of guard locking functions:
  
  i. **Unconditional Unlocking** – Unlocking of the guard can be initiated anytime by operator.
     - When unlocking starts a stop command is generated
     - The time required for the guard locking device to unlock shall be > the time for hazardous machine function to cease.
  
  ii. **Conditional Unlocking** – Interlock guard locking device only unlocks when all hazardous machine functions have ceased

[International Organization for Standardization, [ISO] 14119 2013, p.8]
Operation of different types of guard locking devices

- Mechanical guard locking devices shall use ‘direct mechanical blocking due to form’.
- Friction and force alone shall not be relied upon.

Manually applied/released guard locking device

![Manually Applied Guard Locking Device Diagram]

Key
1 movable guard
2 position switch
a Closed.
b Not closed.

Powered mechanical power-actuated guard locking devices - operation modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Spring applied</td>
</tr>
<tr>
<td></td>
<td>Engaged</td>
</tr>
<tr>
<td>b)</td>
<td>Power-ON applied</td>
</tr>
<tr>
<td></td>
<td>Engaged</td>
</tr>
<tr>
<td>c)</td>
<td>Spring released</td>
</tr>
<tr>
<td></td>
<td>Released</td>
</tr>
<tr>
<td>d)</td>
<td>Power-ON applied</td>
</tr>
<tr>
<td></td>
<td>Engaged</td>
</tr>
</tbody>
</table>

Powered electromagnetic guard locking device operation modes

![Powered Electromagnetic Guard Locking Device Diagram]

[International Organization for Standardization, [ISO] 14119 2013, Annex F, Fig. F.5, p.54]

[International Organization for Standardization, [ISO] 14119 2013, Fig.5. p.11]
Supplementary guard locking releases

- Depending on the application supplementary release of guard locking may be required.
- *(Note: Escape and emergency releases must meet a minimum of a Category B)*

Escape release of guard locking – some requirements

- Unlocking of guard from inside safeguarded space shall be easily possible without auxiliary means regardless of operating condition.
- Unlocking means shall be manually operated and act directly on the locking mechanism.
- Unlocking shall generate a stop command
- Unlocking means for escape release shall only be accessible from inside safeguarded space.

*International Organization for Standardization, [ISO] 14119 2013, p.17*
Supplementary guard locking releases cont’d…

Emergency release of guard locking – some requirements

- Unlocking of guard from outside safeguarded space shall be possible and easily actuated without auxiliary means regardless of operating condition.

- Unlocking means shall be manually operated and act directly on the locking mechanism.

- Unlocking shall generate a stop command.

- The unlocking results in a blocking of the locking means in the released condition.

- The emergency guard release shall be clearly marked “to be used only in emergency situation”, and shall be positioned or shielded to prevent accidental opening.

Note: A guard locking device with emergency release can be used as an escape release and mounted inside the safeguarded space provided it meets the escape release conditions.

[International Organization for Standardization, [ISO] 14119 2013, p.17]
Supplementary guard locking releases cont’d...

Auxiliary release of guard locking – some requirements

- Deliberate unlocking of the guard locking device from outside the safeguarded space shall only be by the use of a ‘tool’ or ‘key’ regardless of operating condition.

- Shall be protected against unintended actuation.

- Shall generate a stop command

-Resetting shall only by possible by means of a tool or other method (i.e. at a control system level)

[International Organization for Standardization, [ISO] 14119 2013, p.18]
Selection of an interlocking device

- All phases of machine life must be considered.

The following factors shall be taken into account:
- Conditions of use and intended use
- Hazards present at the machine
- Severity of the possible injury
- Probability of failure of the interlocking device
- The required PL level or SIL for the safety function
- Information for use provided for the interlocking device from the manufacturer
- Means to prevent A Type 4 interlocking device actuator from being reconfigured by non-authorized personnel

[International Organization for Standardization, [ISO] 14119 2013, p.18]
References

- International Organization for Standardization (2013). *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*
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