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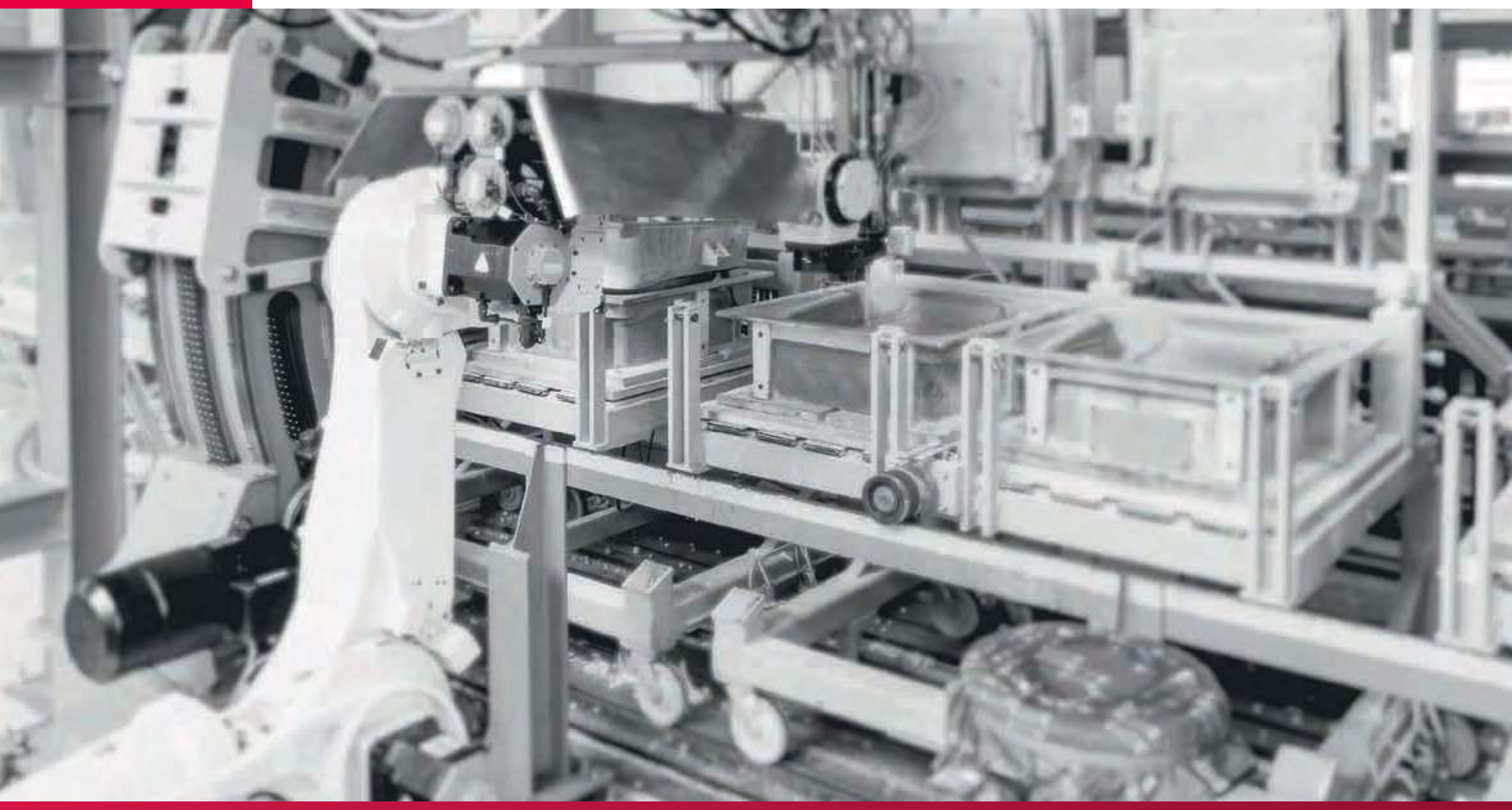

MACHINE SAFETY

White Paper

Installation of Interlocking devices to minimise defeat possibilities

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WHITE PAPER

Is your machine installation safety compliant to AS/NZS 4024.1602:2014?

Validation Report:

Installation of the tongue interlock switch does not meet the requirements of AS/NZS 4024.1602:2014

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Design to minimize defeat possibilities of interlocking devices as per AS4024.1602:2014

Introduction
Part 1602 Interlocking devices associated with guards - Principles for design and selection of AS4024.1:2014 is direct text adoption of the international standard 1SO 14119:2013.

The standard describes the selection and the usage of interlocking devices/interlocks with and without guard locking on safety doors, safety covers and other movable safety guards. The term interlocking devices refers to safety switches that are fitted to safety doors and ensure the machine or system is safely shut down on opening the door.

Clause 7 of AS4024.1602:2014 “Design to minimize defeat possibilities of interlocking devices” details the requirements for protection against “tampering of safety devices in a reasonably foreseeable manner” with procedure described in significant detail.

STEP-1: Classification of Interlocking device.

First step: The user of the standard shall classify what type of Interlock device is being used for the application. AS4024.1602:2014 classifies all interlocking device to four types as per the table below:

Table 1: (obtained from Table 1 of AS/NZ 4024.1602:2014)

Technology	Actuation	Type of Interlock device	Example
Mechanical	Non-coded	Type 1	Limit switch, Hinge switch. 
	Coded	**Type 2***	Tongue switch, Trap key switch. 
Non Contact	Non-coded	Type 3	Magnetic reed switch, Inductive proximity switch. 
	Coded	**Type 4***	Coded magnet, RFID coded safety switch. 

***For Type 2 and Type 4** coded mechanical and coded non-contact position switch, the level of coding is described in Clause 3.13.1 to Clause 3.13.3.
3.13.1 low level coded actuator
coded actuator for which 1 to 9 variations in code are available.
3.13.2 medium level coded actuator
coded actuator for which 10 to 1 000 variations in code are available.
3.13.3 high level coded actuator
coded actuator for which more than 1 000 variations are available.

Example:
MC330-S2C2-A is a Type 4 device with low level coded actuator.

STEP-2: Motivation/Possible incentive to defeat an interlock device

In the next step, the user of the standard shall evaluate the strength of the motivation for defeating the interlocking device. For this purpose, the informative Annex H (shown below in Table 2) of AS4024.1602:2014 includes the methodology of the evaluation process:

Table 2: (obtained from Annex H of AS/NZ 4024.1602:2014)

Task	Automatic	Manual	Task permission in three modes of operation	Easier: more convenient	Faster: increased productivity	Flexibility: e.g: larger work pieces	Higher precision	Better visibility	Better audibility	Less physical effort	Reduced travel	Greater freedom of movement	Improved flow of movement	Avoidance of interruption	
Initial operation	–	X	Yes	Yes	0	0	0	0	0	0	0	0	0	0	
Program test estimated run	–	X	Yes	Yes	0	0	0	0	0	0	0	0	0	0	
Setup/ adjustment Conversion/ tooling	X		No	No	**	0	0	**	**	0	0	0	0	0	Appropriate mode of operation missing
Machining	X	Yes	Yes	0	0	0	0	0	0	0	0	0	0	0	

Information required for completion of the table are:

1. Understanding all modes of operations of the machine/equipment;
2. All tasks performed on the machine/equipment;
3. Determining if all the tasks can be performed without defeating the interlock;
4. Determining any motivation which can benefit from defeating the interlock.

In case of possible motivation to defeat, Figure 1 below explains the methodology of determining the possible incentive and required measure by the designer to prevent defeat.

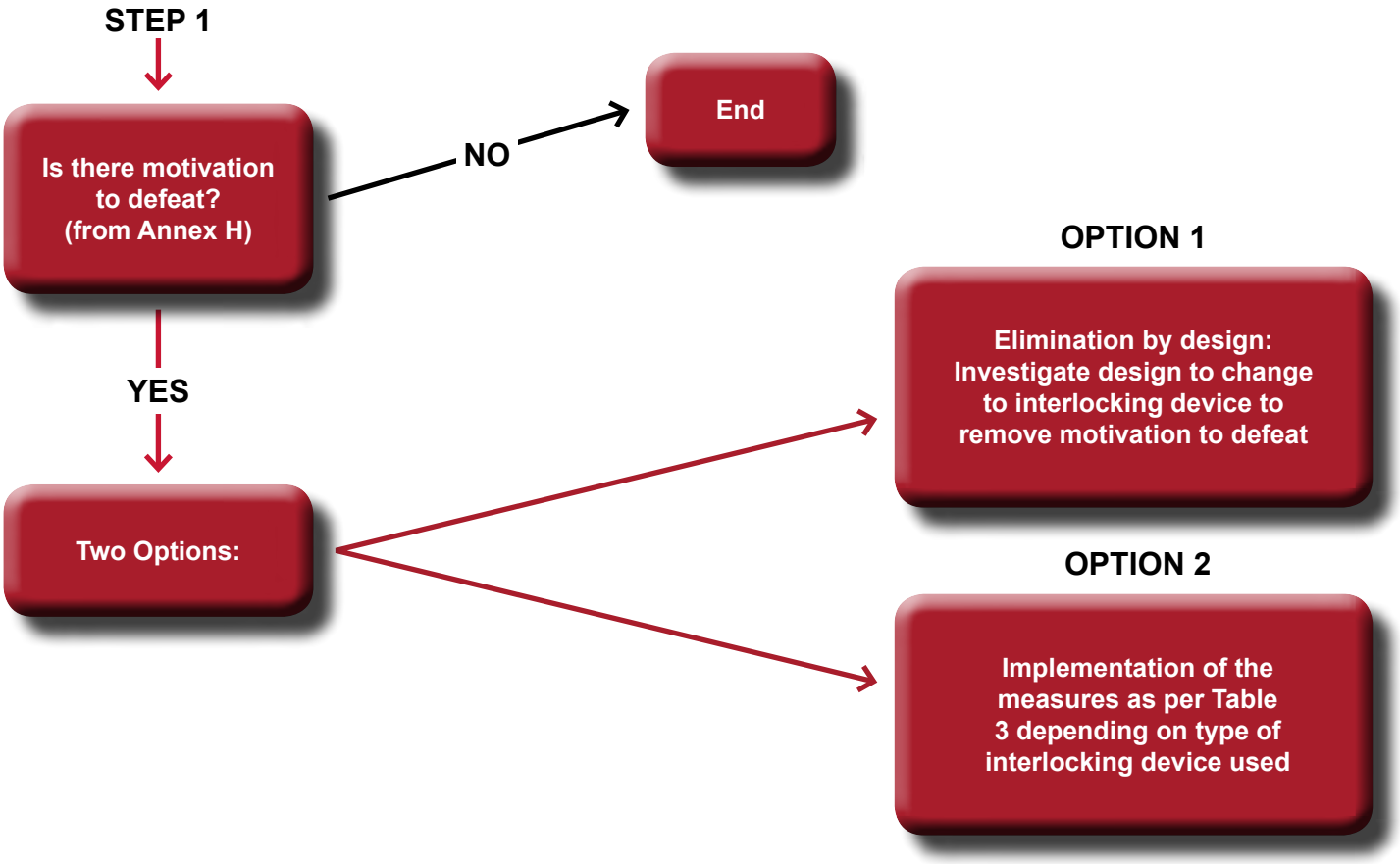


Figure 1: (obtained from Figure 9 of AS4024.1602:2014)

STEP-3: Installation of interlock devices

Implementation of the measure depending on type of interlocking device used.

If it is not possible to eliminate the motivation by design (Option 1 of Figure 1), then Option 2 requires implementation of measures as per Table 3 below, depending on the interlocking device.

Table 3: (obtained from Table 3 of AS/NZ 4024.1602:2014)

Principles and Measures	Type 1 and Type 3 interlocking devices except hinge switch	Type 1 interlocking device, hinged only	Type 2 and 4 interlocking devices (low or medium level coded)	Type 2 and 4 interlocking devices (high level coded)	Trapped key systems, (medium or high level coded) (see NOTE: 2)
Mounting out of reach	X		X		
Physical obstruction/Shielding					
Mounting in hidden position					
Status monitoring or cycle testing					
Non-detachable fixing of position switches and actuators					
Non-detachable fixing of position switch		M			M
Non-detachable fixing of actuator		M	M	M	M
Additional interlocking device and checking for plausibility	R		R		

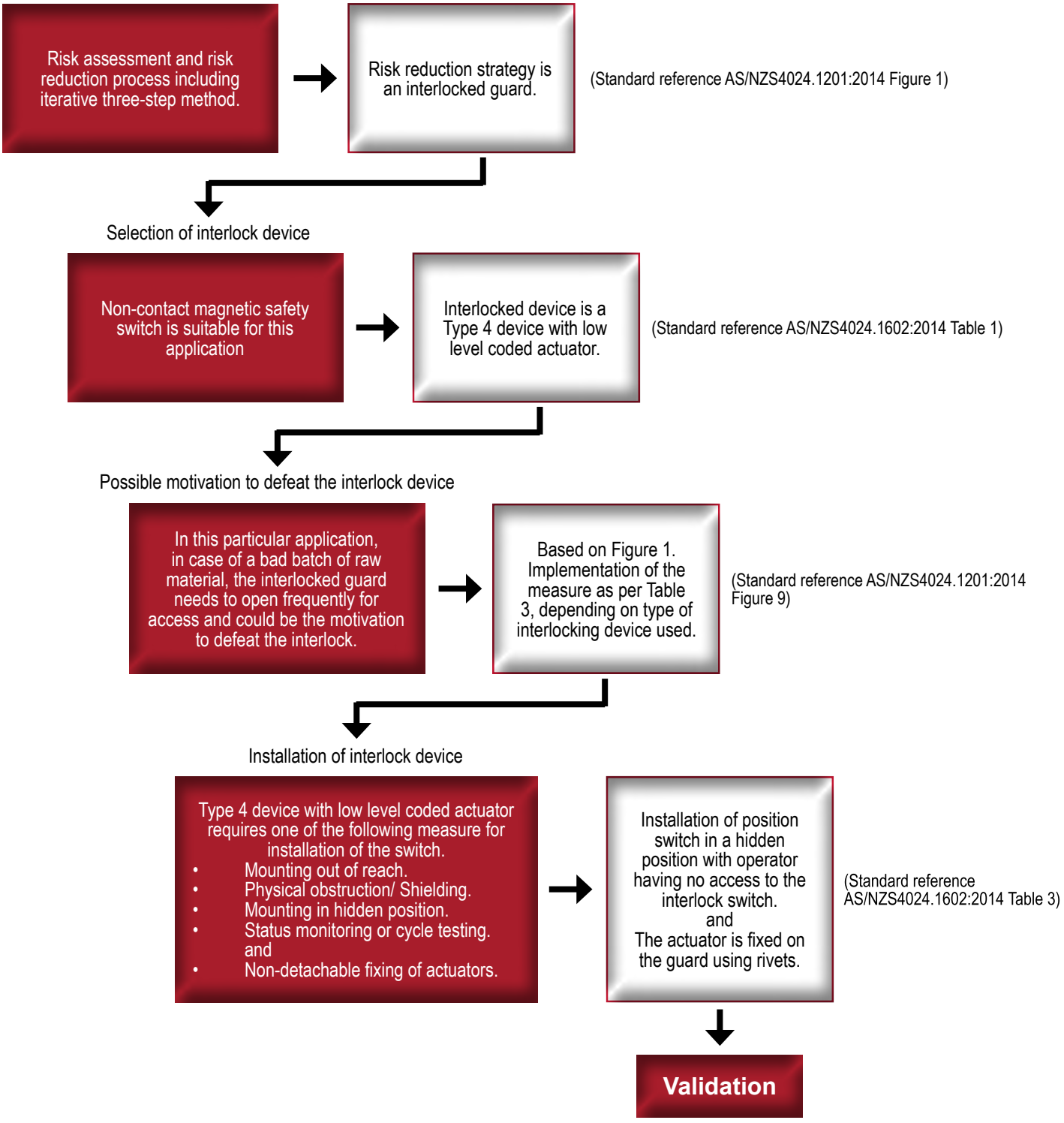
X: Mandatory to apply to at least one of the measures.
M: Mandatory measure.
R: Recommended measure (additionally).
NOTE 1: Table 3 is intended to be used for selection of appropriate measures against defeating of interlocking devices. According to the risk assessment the application of more than one of the indicated measures can be necessary.
NOTE 2: If the number of trapped key devices used within one site is known, coded actuators can be used as a sufficient measure against reasonably foreseeable defeating under the following conditions.
- If the coding is marked on the device each interlocking device should have a different coding,
And
- the actuator should be medium or high level coded.
NOTE 3: There is a clear distinction between the coding level of actuator keys and the coding of “locking bolt or catch mechanisms” in a trapped key system. This table refers solely to the coding level of actuator keys.
NOTE 4: Measures in accordance with Table 3 provide minimum requirements.

Depending on the type of interlock device from step 1, use the above table 3 to implement principle and measure required.

Description of the Principle and Measures

- **Mounting out of reach:** Mounting the interlock device in position which is out of reach of the operator.
- **Physical obstruction/Shielding:** Mounting of the interlock device behind a physical obstruction or barrier.
- **Mounted in hidden opposition:** Mounting of the interlock device in a position not visible to operator.
- **Status monitoring/Cyclic testing:** Two technique implemented in the control system to ensure that the interlock device is not defeated.
- **Non-detachable fixing of interlock device switch:** Mounting of the interlock device switch part with non detachable fixing like rivet, one-way screw, weld etc.
- **Non-detachable fixing of interlock device actuator:** Mounting of the interlock device actuator with non detachable fixing like rivet, one-way screw, weld etc.

Practical example of Installation of interlock device to AS4024.1602:2014



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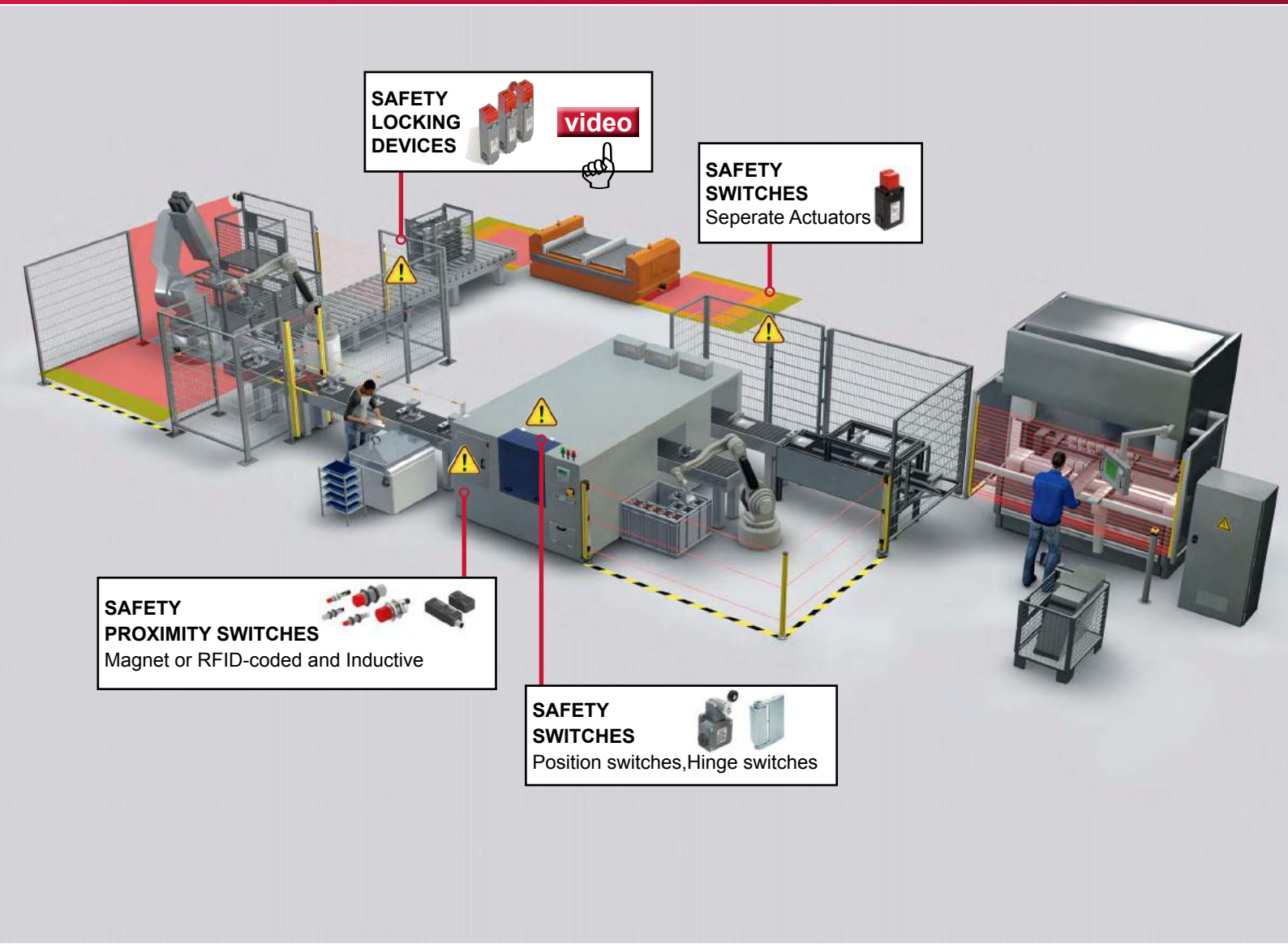

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