HRC – Human-robot collaboration
ISO/TS 15066

We automate. And we create. Safe HRC.

Determination of the type of collaboration

- **Conformance**
  - The human and robot share a workstation. They are working together and can both take action at any time.

- **Sequencer cooperation**
  - The robot and the human work one after the other. The robot performs its task first, followed by the human.

- **Parallel cooperation**
  - The robot and the human work side by side. They share the same workspace but do not work at the same time.

- **Collaboration**
  - The human and robot perform their tasks simultaneously, sharing the same workspace.

Reducing risk in human-robot collaboration (HRC)

- **Safety-rated control**
  - The combination of various methods is possible, such as the combination of method 3 and 4.

- **Hand-guided robotic**
  - The robot can be moved manually by the operator.

Explanations on the options for risk reduction

**Methods of human-robot collaboration in accordance with EN ISO 10218-2 and ISO/TS 15066**

**Method 1 – safety-rated control**

- The robot’s control system is designed to ensure that the robot stops immediately if a fault condition is detected.

**Method 2 – separation monitoring**

- The robot and the human are kept at a safe distance from each other, and the robot’s movements are monitored to ensure safety.

**Method 3 – power and force limiting**

- The robot’s power and force are limited to ensure that the human is not at risk of injury.

**Method 4 – power and force limiting**

- The robot’s power and force are further limited, ensuring that the human is even more protected.

EN ISO 13849-1

Applicable for electrical/electronic/programmable electronic/hydraulic/ pneumatic/mechanical systems

**PL definition for each safety function**

**Determination of the required performance level (PL)**

1. Safety-related stop
2. Safety-related emergency stop
3. Process-based safety function
4. Safety monitoring

**Probability of a dangerous failure per hour – comparison PL/SIL**

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<th>PL3</th>
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</table>

**Specification of categories**

- **Category 0**: No protection needed
- **Category 1**: Protection required by law
- **Category 2**: Protection required by regulations
- **Category 3**: Protection required by regulations
- **Category 4**: Protection required by regulations

**Lexicon**

- **Safety**: The protection against injuries or damage to property that is achieved by means of technical safety measures.
- **Safety function**: A safety-related function that is designed to stop a dangerous situation before it leads to an accident.
- **Safety-related function**: A function that is designed to stop a dangerous situation before it leads to an accident.

**Validation**

- **Mechanical load parameters**: The mechanical load parameters are determined according to ISO 10218-2.

**SIL Level for the human body**

- **SIL 0**: No protection needed
- **SIL 1**: Protection required by law
- **SIL 2**: Protection required by regulations
- **SIL 3**: Protection required by regulations
- **SIL 4**: Protection required by regulations

**Annex G EN ISO 10218-2**

- **DGUV-FB HM-080**: Measurement of force and pressure.
- **ISO/TS 15066**: Measurement of force and pressure.
- **PILZ**: Measurement of force and pressure.

**Safety regulations for robot systems according to EN ISO 10218-2**

- **Safety-related**: The robot’s movements are monitored to ensure safety.
- **Technical safety**: The robot’s technical safety features are verified.
- **Functional safety**: The robot’s functional safety features are verified.

**Safety requirements for robot systems according to EN ISO 10218-2**

- **Safety-related**: The robot’s movements are monitored to ensure safety.
- **Technical safety**: The robot’s technical safety features are verified.
- **Functional safety**: The robot’s functional safety features are verified.