



# Safe Robotics

## HUMAN-ROBOT COLLABORATION

Functional safety systems

**SICK**  
Sensor Intelligence.

### Safe robots and Industry 4.0

One of the major issues associated with Industry 4.0 is making workflows flexible. In industrial manufacturing, there is an increasing need for flexible machines that are able to work autonomously and can be adapted to changing production conditions quickly and easily. Humans must be able to intervene unhindered – yet also be protected against all identified hazards. Effective protective measures have always been a must for robots due to their speed, movement, and force. In the increasingly close interaction between humans and robots, safety technology is taking on a key role: as well as making working environments safer, it is taking productivity to a new level. This can only be achieved with an adaptive perception of the environment with intelligent, rugged, and reliable sensors and safe control systems.

As a provider of complete solutions, SICK can deliver products, systems, and services for safe robot applications.



## FLEXIBLE AND STRONG: HUMAN AND ROBOT

Humans and robots each bring their own benefits to the production process: humans, on the one hand, shine with their cognitive skills such as creativity, learning, imagination, orientation, problem-solving ability, etc., while robots tirelessly complete their tasks, which are repeated time and time again, with power and precision.

### Combining strengths with intelligence

Closer interaction between humans and machines is a natural consequence of combining benefits. In turn, this interaction is driving an increase in the requirements to be met by functional safety in automated and flexible production, both now and in the future.

Clever and flexible safety solutions not only help to protect operating personnel. They also increase productivity by making processes safer and thus help to reduce downtime:

- Machines must function autonomously
- Production processes have to be adaptable
- Processes should only be stopped when absolutely necessary
- Operators must be able to intervene unhindered and be protected against all identified hazards

### “Sensitizing” robots

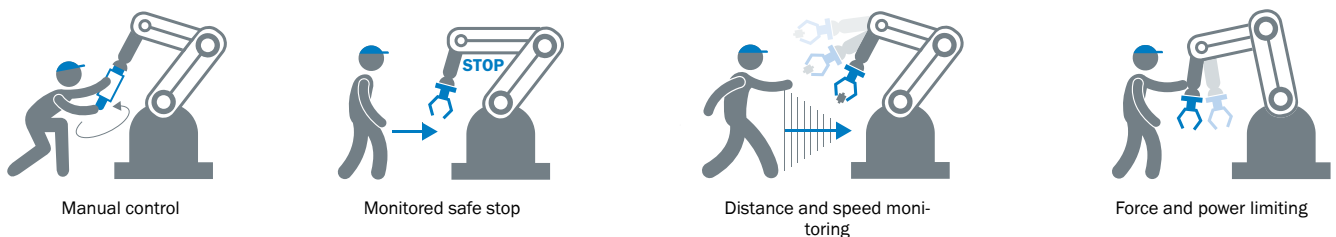
Robots can only be “sensitized” if safety solutions are able to deliver a flexible response. Machines must be able to adaptively perceive the production environment. This requires intelligent, rugged, and reliable sensors and systems. The sensors are networked with one another and the machine, thus providing the flexibility in production that is defined in Industry 4.0. Robots no longer simply act autonomously in accordance with a defined program. They are able to provide a flexible response to “stimuli” triggered by humans whenever this is required by the production process or on account of safety.

### Standards and requirements of safe collaborative robot applications

Essentially, the following standards apply for the safety of industrial robots and robot systems: ISO 10218-1 is intended for the manufacturers of industrial robots and ISO 10218-2 for integrators or manufacturers of robot systems. Technical specification ISO/TS 15066 provides a basis for the design of collaborative robot applications.

The closer the interaction between humans and robots, the more stringent the requirements to be met by the design. The validation effort for risk reduction measures increases to the same extent. Ultimately, a risk assessment must be carried out for every robot application, even if the robot used features structural measures to reduce risk.

### Collaborative operating modes according to ISO 10218-2 and ISO/TS 15066



The closer the interaction between humans and robots, the greater the validation effort for the measures taken to reduce risk.

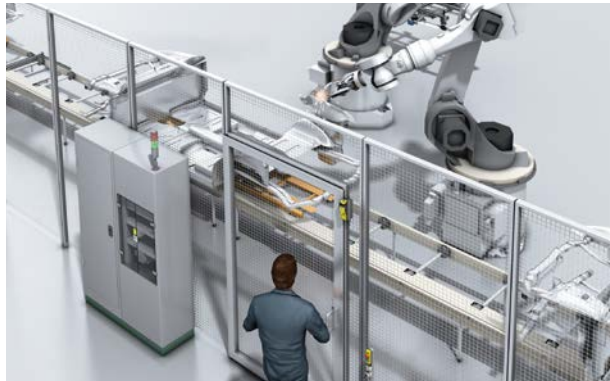
## COEXISTENCE, COOPERATION, COLLABORATION

The interaction of humans with active robots and devices that are similar to robots can be characterized based on two interaction parameters: space and time. If there is no common space and no common time in which the human being and the active robot move, the movements of the robot do not pose a risk and the situation is deemed “not interactive”. Situations in which humans and robots share a common space but at different times are deemed “cooperative”. The term “collaborative” is used to describe situations in which humans and robots are working in the same space at the same time.

Application	Different work-space	Shared workspace
Sequential processing	(not interactive)	Cooperation
Simultaneous processing	Coexistence	Collaboration

### Coexistence

Even in industrial robot applications into which no human intervention is required during the production process, it will still be necessary for an operator to enter the hazard zone of the robot cell, e.g., for the purpose of maintenance work. In applications of this type, the hazard zone of the robot cell must be fenced off and the access doors must be interlocked. The interlock must ensure that hazardous robot functions are shut down whenever an operator enters the hazardous area, and it must be maintained as long as a person remains present inside the hazardous area or the access doors are opened.



### Cooperation

The processes involving an operator loading and unloading robot cells are a very common application for industrial robots. In cooperative application scenarios like this, operator and robot complete the necessary stages of the process in the same workspace at different times. Here too, technical safety measures are required. Depending on how the loading and unloading system is set up, it may be appropriate to use optoelectronic protective devices.



### Collaboration

In certain applications, it is necessary for humans and active robots to interact in the same workspace at the same time. In these scenarios, which we describe as collaborative, the force, speed, and movement paths of the robot must be limited. They must also be monitored and controlled based on the actual degree of risk. This degree of risk is directly dependent upon the distance between human and robot. Reliable sensors are required for presence detection.





# SERVICES FOR SAFE ROBOTICS

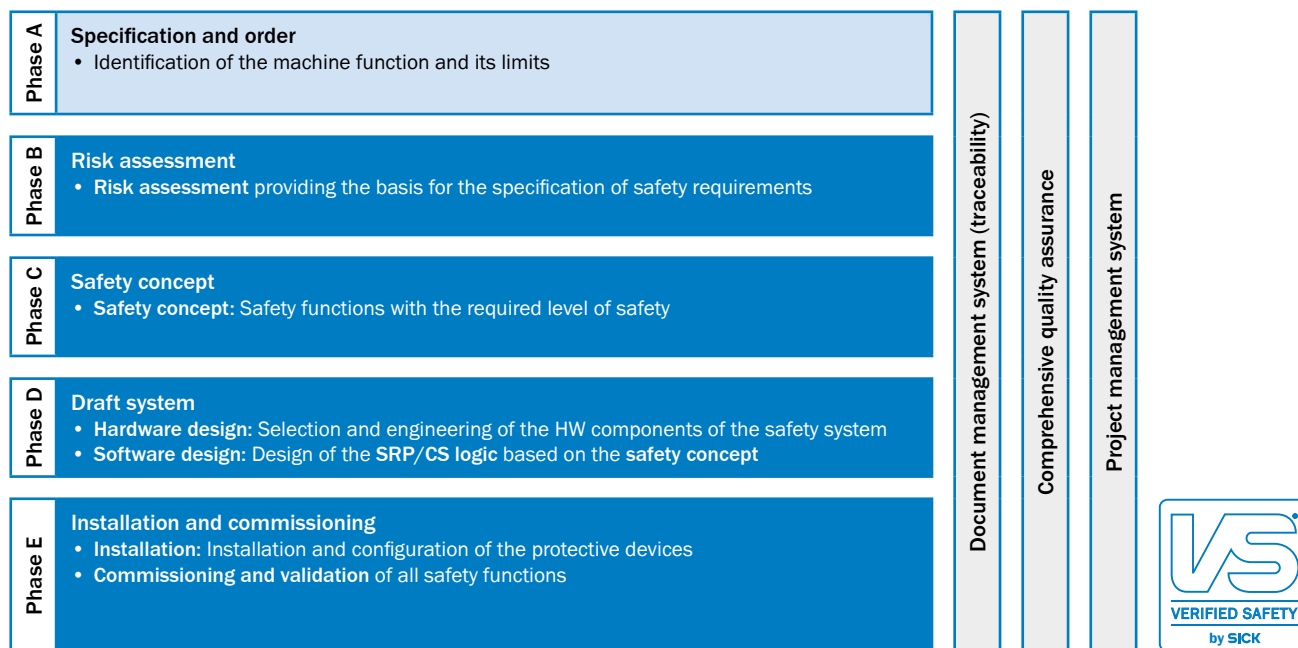
Are you planning to integrate a robot into your application or have you purchased a robot that you would like to integrate into your application?

- A risk assessment must be completed for every robot application. Do you need the assistance of our safety experts in order to identify and take suitable action to reduce risks?
- Are you familiar with the guidelines and standards that are applicable to robot applications (e.g., ISO 12100, ISO 10218-1/2, ISO/TS 15066)?
- Do you need assistance with how these guidelines and standards apply to your robot application?
- Is the interaction between human and robot so close, that the stringent safety requirements and validation for human-robot collaboration must be applied?

Our safety experts are ideally placed to answer all of these questions. They will help and support you from risk assessment through safety concept and beyond to the commissioning of your robot application.

## The SICK safety services for the conformity and design of safe machines and systems

SICK delivers services in the area of “consulting and design for machine safety” according to the process mapped out below. The services provided by SICK during each phase are clearly identifiable. They can be purchased from SICK individually or as a comprehensive service solution within the scope of a CE conformity process.



→ [www.sick.com/safe-robotics](http://www.sick.com/safe-robotics)