

Safe Tire Curing Solutions

FUNCTIONAL SAFETY SERVICES FROM SICK – FOR SAFE AND MORE PRODUCTIVE TIRE MANUFACTURING

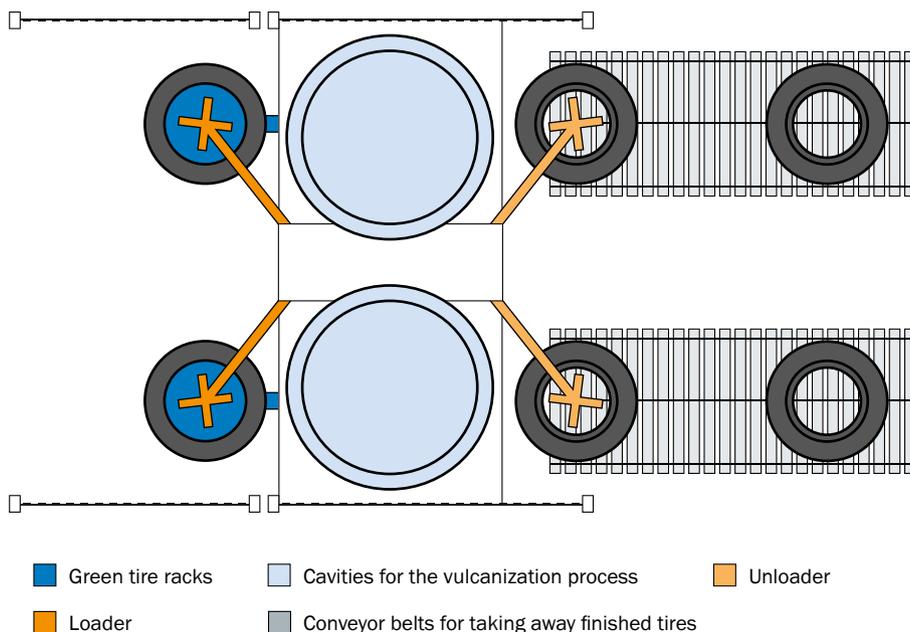
Safety solutions

SICK
Sensor Intelligence.

TIRE CURING MACHINES

THE VULCANIZATION PROCESS

Tire curing machines are used to shape and vulcanize green tires to their final condition. Shaping and vulcanizing can take between 10 and 60 minutes, depending on the size of the tire. In practice, tire curing machines can show gaps in terms of safety and often pose an increased risk of accidents.



Semi-automated loading

Tire curing machines usually have two cavities for shaping tires. They can be controlled together or individually. Green tires are usually loaded semi-automatically. This means that a worker positions the green tire manually on the two green tire stands in front of the cavities at the front of the machine. Automated loaders then pick up the green tires and feed them into the cavities. At the end of the tire curing process, two automated unloaders remove the finished tires from the cavities and place them on the conveyor belts at the rear of the machine for onward transport.

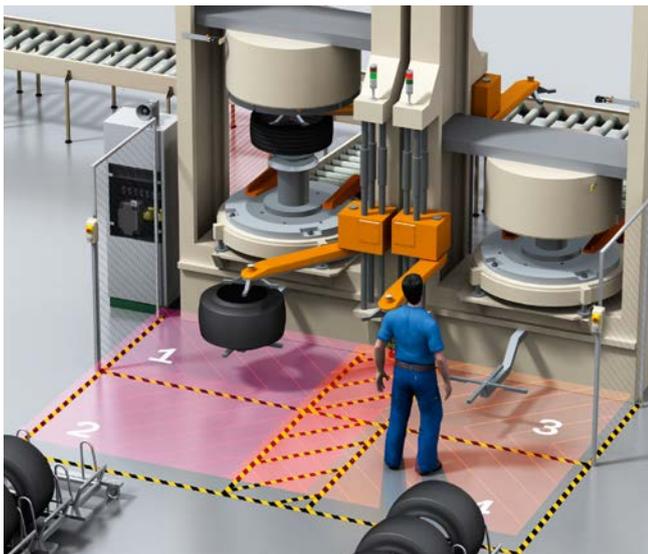
Detecting and dealing with hazards

Accidents occurring at tire curing machines in the past have shown that the process is very hazardous and protection is not usually sufficient. Typical hazards are to be found in all three operating modes – automatic mode, mold-changing mode, and manual mode – and include crushing, shearing, or drawing-in as a consequence of:

- Closing of the upper part of the mold
- Up and down movement of loaders
- Up and down movement of unloaders
- Movements of the central mechanism and the bladder expander
- Movements of the ejector and the stripper
- Movements of the conveyor belt
- Movements of auxiliary equipment such as the PCI (post cure inflator)

SAFETY REQUIREMENTS ACCORDING TO EN 16474

For a more sustainable approach to avoiding hazard risks, new machines are to be equipped with more advanced safety technology to meet the requirements of EN 16474 Tire Curing Machines – Safety Requirements. Most existing machines can be retrofitted with this technology too.



In practice, new machines which already meet the safety requirements set out in EN 16474 are often operated in a different way compared to old machines. Retrofitting existing machines is, therefore, to be recommended in order to ensure a uniform operating concept for all machines. This not only reduces the risk of accidents in the long term but also ensures optimum productivity.

In Germany, statutory accident insurance institutions like the BG RCI (Berufsgenossenschaft Rohstoffe und chemische Industrie) have also issued an official recommendation to retrofit used tire curing machines as a mandatory measure. Successful retrofitting requires the use of optimized safety technology combined with extensive experience of planning and carrying out such modifications.

BEST POSSIBLE PRODUCTIVITY

The SICK safety solution for tire curing machines ensures much more than safeguarding your machines in compliance with related safety standards. It also maximizes productivity.

With the intelligent safety system you avoid interrupting the shaping process when new green tires are in process. Moreover, accidental triggering of a protective device no longer brings the process to a halt. As a result, waste in production is reduced significantly.



FUNCTIONAL SAFETY SERVICES FROM SICK – FOR SAFE AND MORE PRODUCTIVE TIRE MANUFACTURING



Description of the solution

The SICK safety solution for tire curing machines is designed specifically to safeguard machines in compliance with standards. It includes all technical protective devices as well as the associated engineering.

The intelligent protection concept optimizes productivity, avoids waste, and ensures acceptance by operators.

The loading area is protected by a safety laser scanner which uses its intelligent approach function to automate restarting.

Either monitored access points or opto-electronic protective devices can be used to protect the area at the rear of the machine.

The solution features configuration and validation on site as well as diagrams in E-PLAN format. This saves time and gives you security at all levels.

At a glance

- Protection compliant with standards EN 16474 and GB30747
- Custom-made solution including hardware and engineering
- Engineering documentation with SICK VERIFIED SAFETY quality seal
- Loading area protected by a safety laser scanner with intelligent evaluation of protective fields
- Protection of rear area can be adapted flexibly
- Commissioning and acceptance (optional)

Your benefits

- Best possible productivity thanks to an intelligent safety system
- Safety through fulfillment of requirements of EN 16474 and GB30747 for tire curing machines
- Solution featuring state-of-the-art technology without integration of own resources
- Individual operation of both cavities with full safety
- No interruptions to production thanks to sensors installed inside protective housings
- Can be used in existing and new equipment
- Cost-effective solution thanks to quick and experienced implementation by SICK

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Solution concept

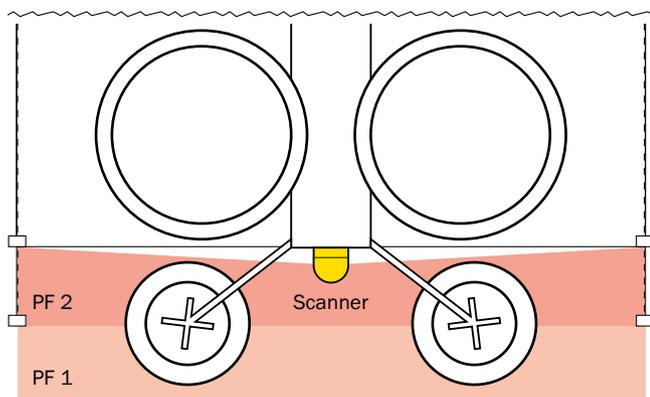
Protecting the area at the front of the machine

Using safety laser scanners with simultaneous protective fields to protect the area at the front of the machine offers a range of critical advantages over all other conceivable protection concepts where productivity and investment security are concerned:

- Protection against all dangerous movements is assured at all times
- Selective switching off of dangerous movements based on position of person(s) in hazardous area
- Tire curing process is not interrupted when new green tires are fed in
- Protective device does not have to be reset in the operating field (loader) during normal production operation
- Unobstructed and easy access to the machine (e.g., for mold changing) at all times
- Safety laser scanner can be mounted at a protective area of the machine for safe long-term operation

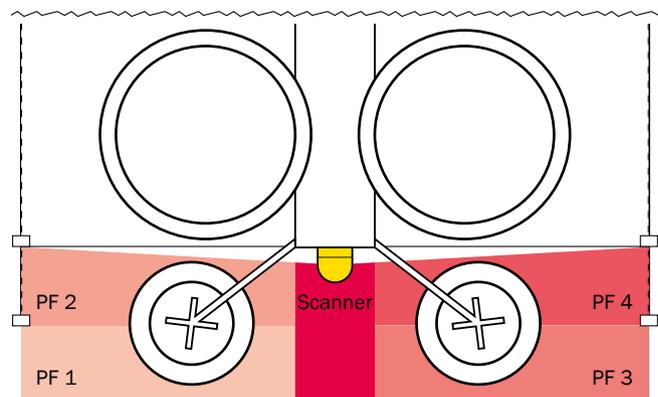
Options for protecting the area at the front of the machine

Two simultaneous protective fields: common monitoring of both cavities



Two simultaneous protective fields: concurrent monitoring of both cavities with one safety laser scanner

Four simultaneous protective fields: individual monitoring of each of both cavities



Safety laser scanners featuring state-of-the-art technology offer up to four simultaneous protective fields for concurrent monitoring with just one device.

This means that for the first time in individual operation of a tire curing machine, the left-hand section of the machine can be monitored and protected entirely independently of the right-hand section.

Combined with automated restart, this results in a smooth production workflow with maximum productivity.

Example product selection

The following components are typically required to protect the area at the front of a tire curing machine:

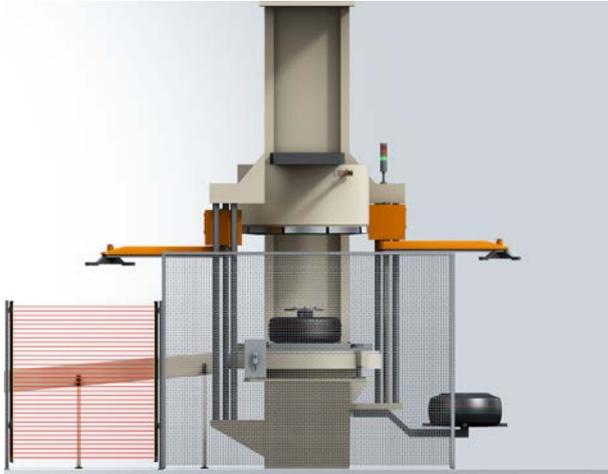
- S3000 Standard safety laser scanner
- System plug for S3000
- Mounting kit
- Connecting cable
- Flexi Soft main module
- Flexi Soft I/O module
- Flexi Soft system plug

Protection for the rear area

Various concepts for protecting the area at the rear of the machine have been proving their worth in practice for many years. You can select your preferred solution or even combine multiple solutions to achieve the same safety level.

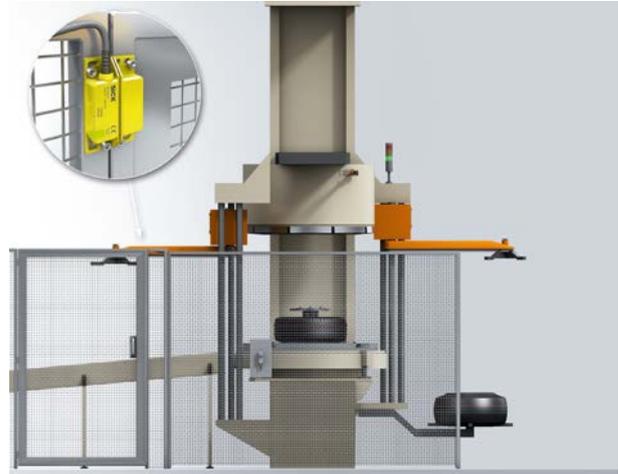
Options for protecting the area at the rear of the machine

Electro-sensitive protective devices



Solution variant featuring safety light curtains or multiple light beam safety devices – rugged and reliable for barrier-free access to the area at the rear of the machine.

Physical guards



Solution variant featuring physical guards and interlocking or locking. Use of proven technology in day-to-day industrial operation.

Example product selection

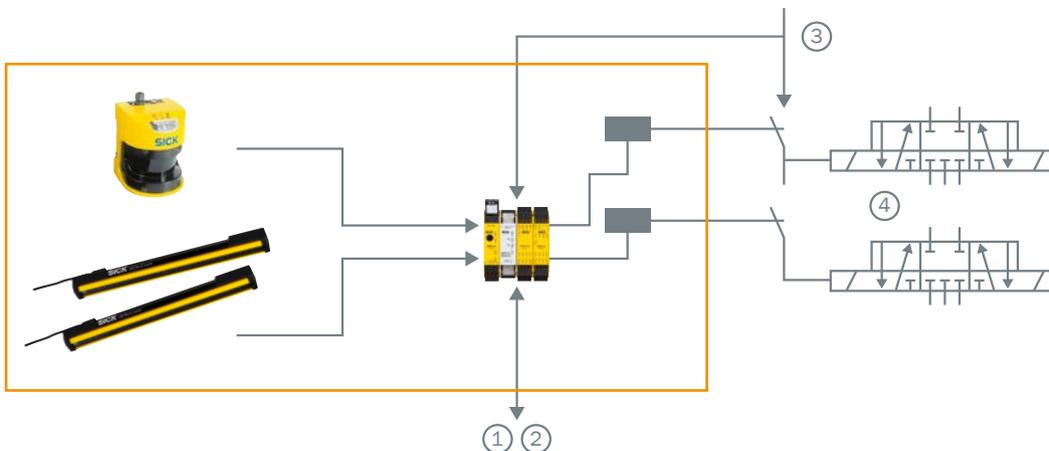
The following components are typically required to protect the area at the rear of a tire curing machine:

- deTec4 Core safety light curtain
- Device columns
- Mounting kits
- Connecting cables

Integration in the machine control system

The safety system intervenes in the machine automation in the form of an enabling function. This ensures that only minimum changes have to be made to the existing control system. Moreover, this type of integration makes it easy to standardize the system from one machine to another, thus optimizing the cost of retrofitting many machines of the same type.

Simplified representation of interfacing between sensors and actuators



① Machine closed/locked

② Status indicators, etc.

③ Machine control system – control and monitoring signals

④ Machine actuators

Project workflow

Identification of requirements

Retrofitting protective devices to existing machines requires careful planning in order to ensure accurate dimensioning and compliance with standards.

In practice it has proven worthwhile to work through the following tasks systematically in separate work packages:

Task	Description
Risk assessment	Specification of the limits and functions of the machine, identification of hazards, risk evaluation and analysis, documentation of risk assessment
Safety hardware design	Hardware planning on CAD (e.g., EPLAN) taking into account the specifications as well as relevant laws and directives and including technical clarification. Creation of connection diagrams and technical documentation in electronic format. Creation of hardware list with selection of the most suitable devices and accessories.
Control cabinet	Construction of a new or adaptation of an existing control cabinet in compliance with the specification and relevant laws and directives
Safety software design	Creation, testing, and verification of the complete application software for the safety controller and the configuration of all safety sensors
Commissioning	Commissioning of the entire safety system on site at the machine
Validation of functional safety	Validation of all functions of the safety system on site at the machine
Acceptance report	Report documenting in detail the acceptance of the entire safety system against the specification on every machine at every location in the world

Project planning

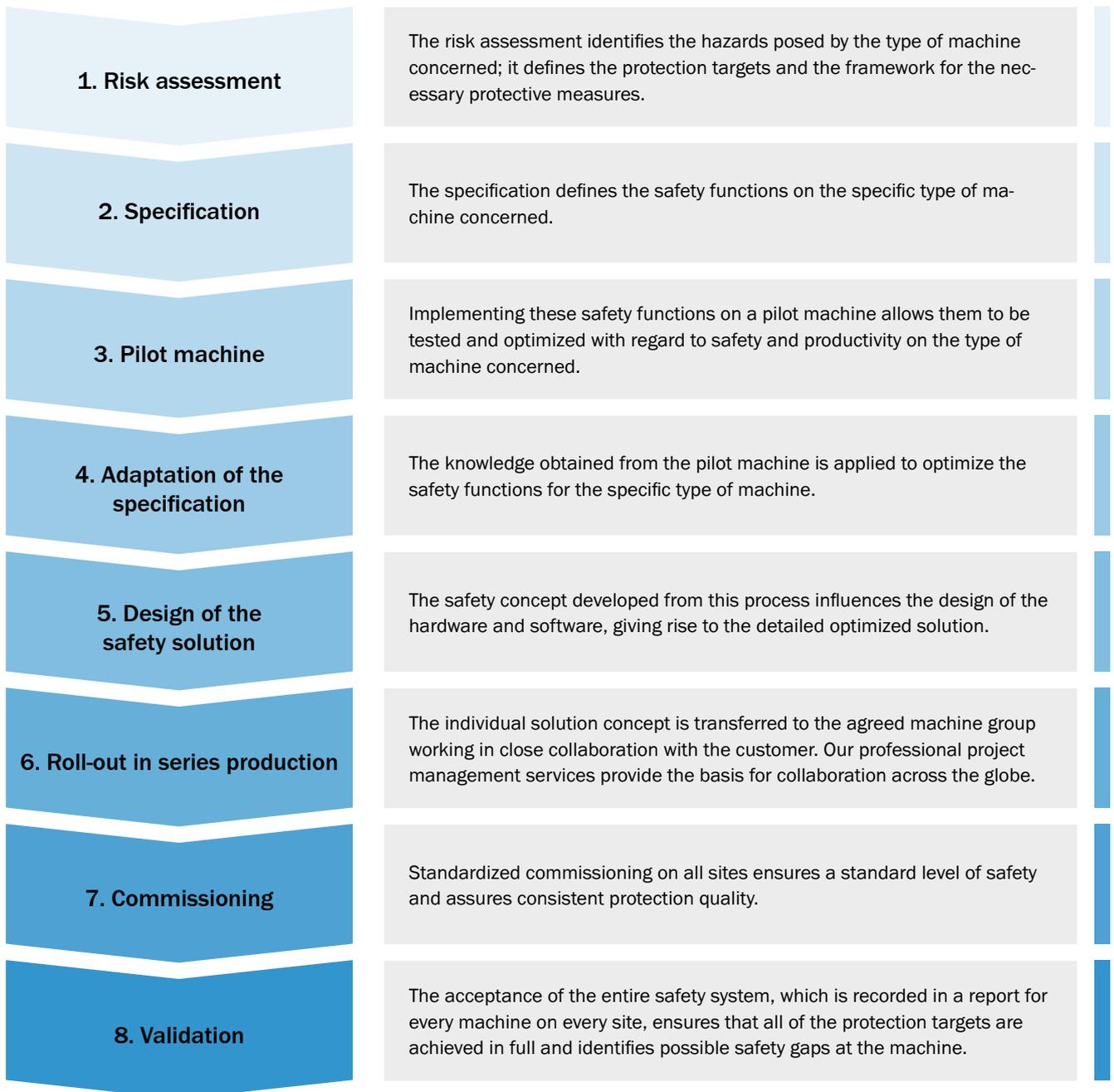
An example project workflow to help guide you through the work packages you need to process can be found on the following pages. You will also find an extract from the comprehensive portfolio of safety services that SICK is able to provide all over the world.



INDIVIDUAL PROJECT SUPPORT

Based on many decades of experience, SICK is able to offer customer-oriented solutions for specific requirements and can be relied upon for active support in all relevant work steps.

Example project workflow





IDENTIFICATION OF REQUIREMENTS WITHIN THE ORGANIZATION

The implementation of an individual end-to-end solution starts with a comprehensive analysis of the actual situation within your organization. This analysis is carried out based on the following questionnaire, which is designed to identify your specific requirements. Contact us once you have worked through the questions in your organization. We will happily work with you to develop a suitable solution.

- Is the loading of the machine under automated or semi-automated control?
- Does the machine work in common mode or individual operation?
- Does the machine feature auxiliary equipment (e.g., post cure inflators)?
- Are different operating modes (production, manual mode, and mold-changing) required?
- Are there special operating modes, e.g., for quality monitoring (thermocouple mode)?
- Can the rear of the machine be accessed?
- Does access at the rear need to be restricted?
- Is space at a premium?

Our end-to-end solutions for upgrading tire curing machines are characterized by safety engineering that is compliant with standards and produces verifiable results, offering you professional outcomes based on comprehensive empirical values from a large variety of retrofitted machines all over the world.



Machine safeguarding evaluation

- Identification of electrical and mechanical hazards
- Risk assessment of identified hazards
- Evaluation of existing protective measures
- Recommendation of new or improvement of existing protective measures
- Consideration of valid provisions and regulations
- Service can be retrieved worldwide

→ www.sick.com/machine_safeguarding_evaluation

Your benefits

- Detailed knowledge of the safety status of the machines
- Concrete statements on the urgency of improvement measures
- High flexibility thanks to product-neutral perspective
- Economic, well-thought-out recommendations for reducing detected risks
- Reduced effort when drafting safety concepts
- Enables simple and standard-compliant implementation of the recommended protective measures for safety technology
- Foundation for fulfilling due diligence with documented inspection of the machine
- Guaranteed quality thanks to standardized processes and sustainable competence management



Risk assessment

- Performance of or instruction for risk assessments
- Determination of applicable directives and standards
- Identification of hazards
- Risk evaluation
- Specification of safety requirements

→ www.sick.com/risk_assessment

Your benefits

- Saves time and resources thanks to involvement of experienced SICK experts
- Independent and comprehensive expertise provide certainty when assessing risks
- Periodic qualification of SICK specialists ensures the latest directives and standards are incorporated in new and repeat projects
- High level of quality thanks to standardized processes and sustainable competency management



Safety concept

- Specification of safety functions and required safety level (PLr or SILr)
- Recommendation for technical implementation of safety functions in the form of a block diagram
- Definition of parameters for the selection of protective devices
- Safety concept specification

→ www.sick.com/safety_concept

Your benefits

- Saves time and resources thanks to involvement of experienced SICK experts
- Increases machine safety as a result of compliance with essential safety and health requirements and standards
- Choose from any safeguarding component available on the market
- Ensures effectiveness and competitiveness by preventing unnecessary measures
- High level of quality thanks to standardized processes and sustainable competency management



Safety hardware design

- Selection and interconnection of suitable components
- Specification of measures for controlling and avoiding systematic errors
- Determination and verification of the safety level
- Hardware concept specification
- Creation of a SISTEMA project file

→ www.sick.com/safety_hardware_design

Your benefits

- Saves time and resources thanks to the involvement of experienced SICK experts
- Provides greater safety by implementing measures for avoiding and controlling systematic errors
- Incorporates all technologies (pneumatic, hydraulic and electrical) for comprehensive service
- High level of quality thanks to standardized processes and sustainable competency management



Safety software design

- Specification of safety-related application software, including the definition of input and output signals
- Creation and verification of safety-related application software according to the V-model for software development

→ www.sick.com/safety_software_design

Your benefits

- Saves time and resources thanks to involvement of experienced SICK experts
- Provides safety through standardized implementation according to the V-model, including measures for avoiding and controlling errors
- Reduces complexity by using modular and clearly structured programming of safety functions
- High level of quality thanks to standardized processes and sustainable competency management



Commissioning

- Configuration and parameter setting of components or systems, optimized for each application
- Final functional testing of components or systems
- Documentation of the configuration and parameter setting in the acceptance report
- Briefing of operating personnel

→ www.sick.com/commissioning

Your benefits

- High productivity: via application-optimized components and system settings
- Cost savings: quick transition to normal operation under professional supervision
- Planning reliability: via effective cooperation between SICK, the system integrator and the customer



Validation of functional safety

- Creation of a verification and validation plan to thoroughly check for proper selection, installation, implementation and functioning of the safety-related parts of the control system (SRP/CS)
- Configuration of safety-related parts of the control system
- Analysis and testing according to the verification and validation plan
- Specification of the necessary adjustment and, if necessary, revision of the safety-related application program

→ www.sick.com/validation_of_functional_safety

Your benefits

- Saves time and resources: experienced SICK experts provide efficient execution
- Ensures protection objectives have been met thanks to standardized validation using analysis and testing
- Implements the two-man rule: execution and checking completed by two qualified individuals
- Comprehensive service: specification and implementation of any adjustments that may be necessary
- High level of quality thanks to standardized processes and sustainable competency management



Periodic inspection

- Evaluation of the optical protective devices to ensure they have been installed correctly and according to the specification
- Inspection of whether the protective device is operating according to current machine usage
- Identification of operational changes and manipulations
- Readjustment of the optical protective devices and removal of contamination
- Production of an inspection report and issuance of a test seal

→ www.sick.com/inspection

Your benefits

- Safety is determined and corresponding documentation is provided in the inspection report as proof that the legal obligation for testing has been fulfilled
- High testing quality through certification and periodic inspections in accordance with IEC 17020 is carried out by independent bodies and with on-going competency management
- Quick identification of the safety status and the period of validity by means of test seals as proof to regulators of current inspections
- Safety is ensured due to early detection of changes to application conditions and manipulations
- High machine reliability due to periodic checking and, if necessary, removal of contamination or readjustment
- Automatic reminder of required testing periods within the framework of the service contracts to ensure equipment is working properly



VERIFIED SAFETY – Safety made by SICK

With its VERIFIED SAFETY seal of quality, SICK provides an assurance that the results have been obtained and verified by certified staff in line with a defined process. VERIFIED SAFETY means guaranteed functional safety with verifiable quality.

Specialists – On site, wherever you are

SICK has specialists to support you wherever you are in the world. Our experts are entirely familiar with local standards and directives. All of our specialists are part of a global network. This means that we can offer you the right skills for local and international projects.



Competence management – Knowledge assured in the long term

Competence is not just about theoretical knowledge. At SICK, every specialist must also have the necessary experience and prove his or her capability by taking regular tests. Across the globe, competence is shared and secured for the future through the SICK Competence Management program.

We are happy to provide seminars to share our knowledge further. SICK is a recognized provider of Functional Safety Engineer training as part of the TÜV Rheinland Functional Safety Program.

Customer project management – Project risks under control at all times

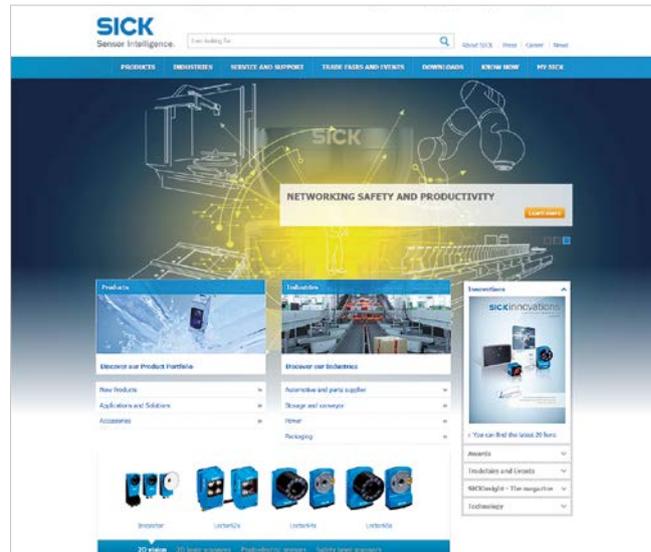
At SICK, all management systems for developing projects follow a uniform and consistent management philosophy.

Projects follow a defined process from acquisition through customer approval. Regular checks against milestones guarantee completeness, reveal any deviations early on, and enable corrective measures to be introduced promptly. Professional and standardized project management is the basis for successful planning, economic implementation, and precise control of projects.



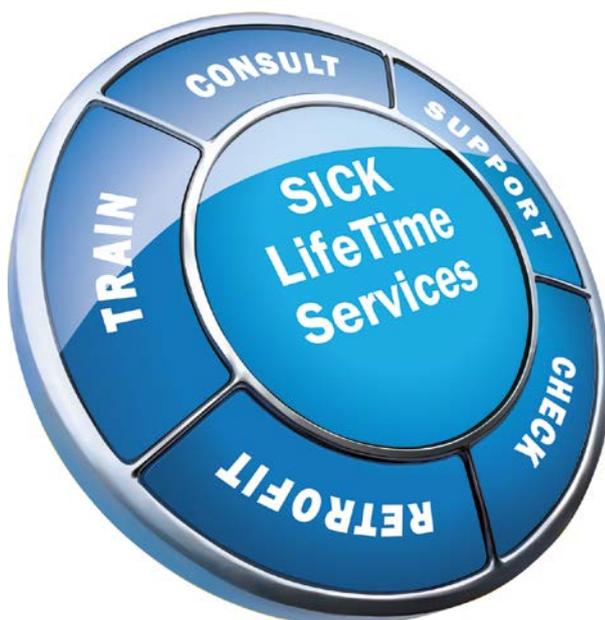
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- ✔ Easily order online and track your delivery.
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- ✔ Check the status of your orders and quotes and get information on status changes by e-mail.
- ✔ Save time by using past orders.
- ✔ Easily export orders and quotes, suited to your systems.



SERVICES FOR MACHINES AND PLANTS: SICK LifeTime Services

Our comprehensive and versatile LifeTime Services are the perfect addition to the comprehensive range of products from SICK. The services range from product-independent consulting to traditional product services.



- 
Consulting and design
 Safe and professional
- 
Product and system support
 Reliable, fast, and on-site
- 
Verification and optimization
 Safe and regularly inspected
- 
Upgrade and retrofits
 Easy, safe, and economical
- 
Training and education
 Practical, focused, and professional

SICK AT A GLANCE

SICK is a leading manufacturer of intelligent sensors and sensor solutions for industrial applications. With more than 8,000 employees and over 50 subsidiaries and equity investments as well as numerous agencies worldwide, we are always close to our customers. A unique range of products and services creates the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents and preventing damage to the environment.

We have extensive experience in various industries and understand their processes and requirements. With intelligent sensors, we can deliver exactly what our customers need. In application centers in Europe, Asia and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes us a reliable supplier and development partner.

Comprehensive services round out our offering: SICK LifeTime Services provide support throughout the machine life cycle and ensure safety and productivity.

For us, that is “Sensor Intelligence.”

Worldwide presence:

Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Hong Kong, India, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Poland, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Arab Emirates, USA, Vietnam.

Detailed addresses and further locations → www.sick.com