



tec.nicum academy

Functional Safety of Machinery

Essential course to become a Functional Safety Engineer (FSE)



academy

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Schmersal Group



Introduction to ISO 13849

Qualification as a expert in Functional Safety of Machinery

Schmersal is an accepted course provider for the “Functional Safety of Machinery” training course of the TÜV Rheinland Functional Safety Training Program, through tec.nicum, its Services and solutions division.

During the 4-day face-to-face training participants will experience theory, practical examples, discussions on General Machine Safety based on ISO 12100 and Functional Safety according to ISO 13849 and IEC 62061, added to by all the knowledge and experience of the trainers and the course provider.

Engineers with proven experience in Machine Safety and Functional Safety will go in-depth into the requirements, the demands of international standards and, by passing a final exam, will receive an official Functional Safety Engineer (TÜV Rheinland) certificate, confirming their knowledge.

International regulations, basic risk assessment concepts, examples of protective equipment for machinery, safety functions, circuit designs, Performance Level (PL) and Safety Integrity Level (SIL) calculations will be described, discussed, designed, and tested during the course.

Agenda

Day 1

Functional safety training program

- Machine Directive, A, B and C standards
- Standards and status of standards regarding Functional Safety in Machine safeguarding
- Basic concepts of European Guidelines (Machinery Directive/Regulation and CE Marking)
- Importance (meaning) of harmonised and non-harmonised standards
- Machines and safety components listed in the appendix IV of the Machinery Directive

Risk analysis

Methods for determination of necessary measures for the reduction of risks at machines (ISO 12100)

- Hazards & risks
- 3-Step risk reduction strategy: Direct, Indirect, and Indicative safety
- Proof and documentation
- Safety function definition
- Procedure acc. to ISO 13849 and EN 62061

- Risk matrix & risk graph
- Required PL & SIL calculations
- Examples
- Comparison of safety classifications

Day 2

Introduction to ISO 13849

- Importance (meaning) of safety categories
- Control categories
- Basic safety principles, well-trying safety principles and well-trying components
- Principal information regarding deterministic fault consideration, faults, and fault exclusions acc. to ISO 13849-2

Safety devices

- Definition of safety devices, advantages and disadvantages, installation requirements, configuration of safety devices
- Types of protective equipment for machinery (separating and non-separating guards)
- Interlocking, guarding locking, position switches, proximity switches, ESPEs, AOPDs, AOPDDRs, mats, edges, bumpers, two-hand controls, enabling devices
- Guards, interlocking devices:
 - Types, examples regarding application, installation requirements acc. to different safety categories
 - Circuit examples
 - Faults, fault exclusions
 - Normative requirements
- Other safety devices:
 - Type, installation requirements, advantages, and disadvantages
 - Calculation of safety distances

Safety functions of machines

- Power-drive systems
- Start/re-start interlock, start functions, reset
- Hold-to-run controls
- Emergency off, emergency switching off, stop categories, muting etc.
- Realisation acc. to the different safety categories
- Stop functions
- Other safety functions

Circuits, schematics & examples

- Connection of safety devices to controls, interface circuits
- Realisation acc. to the different safety categories
- Examples for correct and incorrect typical circuits

Day 3

New standards regarding safety of machinery

- Importance (meaning) of these standards regarding quality management, documentation and safety related availability

ISO 13849

- Contents of ISO 13849-1, application area, restrictions regarding applicability
- Designated architectures (categories)

- Failure probability (MTTFd, B10d, T10d)
- Failure probability (DC)
- Failure probability (CCF)
- Failure probability (PL calculations)
- Documentation requirements and quality management
- Requirements regarding software
- Random and systematic failures
- Use of standard components in safety functions
- Proof of safety, verification, and validation of safety functions
- Examples

Validation

- Validation acc. to ISO 13849-2

Examples

- Examples for proof of functional safety acc. to ISO 13849-1

Day 4

IEC 62061

- Content of IEC 62061, application area
- Design process
- SRS – Safety Requirements Specification
- Documentation requirements and quality management, life cycle model
- Meaning of terms SIL, SIL CL, HFT, SFF and their context
- Subsystems architectures
- Requirements regarding safety relevant application software
- Proof of safety, verification, and validation of safety functions

Examples

- Examples for proof of functional safety acc. to IEC 62061

Day 5

Exam

- Day 5 of the in-person training: Start 9 am | End 12 pm
- Exam duration: 3 hours
- The exam consists of 70 multiple choice questions and 12 open questions
- The standards EN ISO 13849 part 1/part 2 and EN 62061 are essential working material for the exam. Additionally, a calculator should be brought along for the quantitative assessment

Course objectives

This training course has been developed to create high-level knowledge in:

- Risk assessment and reduction
- Specifying machine guarding
- Developing safety functions
- Performance level calculation and validation
- Calculation and validation of the Safety Integrity Level

tec.nicum: global service and engineering hubs

tec.nicum – Solutions & Services GmbH is a subsidiary of Schmersal Group. It offers a wide range of services relating to machine and occupational safety.

tec.nicum comprises a global consultancy network of TÜV Rheinland-certified Functional Safety Engineers and Machinery CE Experts. Services can be called upon around the world.

The range of services at tec.nicum is based on six modules: academy in the training and workshop section, consultancy services in the consulting section, engineering in the designing of safety solutions section, integration section in the field of practical implementation, the development of software solutions and new digital technologies in the digitalisation section and the provision of complete solutions in the outsourcing section.



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