TRINE CENTER FOR TECHNICAL TRAINING

SACA
SMART AUTOMATION CERTIFICATION ALLIANCE

C-207 Programmable Controller Systems I

Skill Standards

Abstract

Defines the knowledge, skills, and abilities required to succeed in positions (e.g. controls engineer or maintenance technician) that install, troubleshoot, program, and maintain factory automation in a modern environment that uses Industry 4.0 technologies.

Version 1.3

Introduction to SACA

The Smart Automation Certification Alliance (SACA) is a non-profit foundation whose mission is to develop and deploy modular Industry 4.0 certifications for a wide range of industries. The vision is to provide highly affordable, accessible certifications that significantly increase the number of individuals who possess the skills represented by these credentials, thereby ensuring that companies have the highly skilled workers they need, and individuals are prepared to be successful in a "connected enterprise" world.

Industry-Driven Quality

SACA certifications are industry-driven, developed by industry for industry. They use a rigorous process that starts with the development of truly international skill standards, developed and endorsed by leading experts in Industry 4.0 technology throughout the world. Certifications examinations are created based on these standards, pilot-tested and statistically analyzed to ensure quality. Each certification includes a proctored hands-on evaluation (Gold) and an online, multiple choice test (Silver) to confirm that candidates have a knowledgeable foundation for certification success. SACA uses an annual standards and examination review process for all certifications to ensure that the certifications continue to remain highly up-to-date.

Certifying Individuals

Individuals can receive certifications through Trine University, an authorized SACA certification center. SACA ensures any certification center maintains high standards with proctored exams, certified evaluators, and approved equipment for consistent hands-on evaluation.

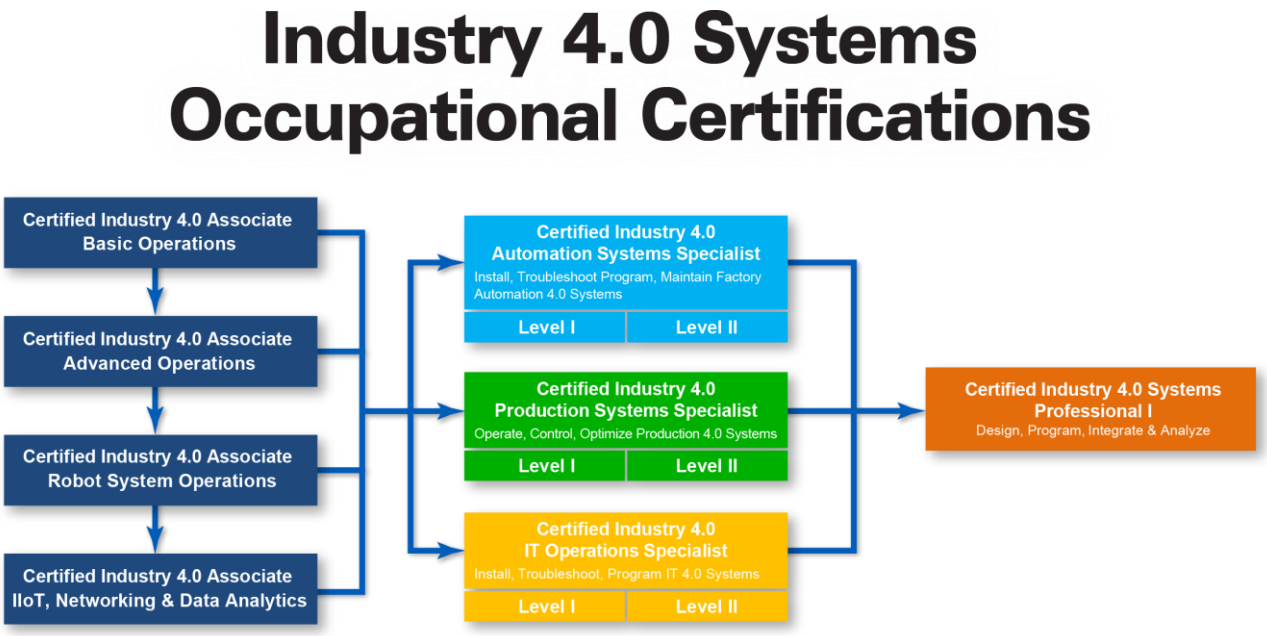
Certification Structure

SACA certifications use a modular structure to enable them to fit into wide range of individual needs and industries and educational environments. The three SACA certification categories include:

- Associate
- Specialist
- Professional

SACA Certification Structure

Each certification is stackable. Individuals can start with one certification and add other certifications to customize their documented skills. Certifications are occupationally focused so they prepare individuals for specific occupations.



Associate Certifications

The Associate certifications include the following four (4) credentials:

- C-101 Certified Industry 4.0 Associate-Basic Operations
- C-102 Certified Industry 4.0 Associate-Advanced Operations
- C-103 Certified Industry 4.0 Associate-Robot System Operations
- C-104 Certified Industry 4.0 Associate-IIoT, Networking and Data Analytics

The Associate certifications are introductory certifications for those individuals working in an Industry 4.0 environment. These certifications are ideal for production technicians, IT professionals, and industrial maintenance technicians seeking to acquire Industry 4.0 skills.

Specialist Certifications

Specialist certifications are modular certifications, consisting of a series of core and elective micro-credentials, each with its own hands-on practical assessment and a written (online) knowledge assessment. Core micro-credentials certify skills that are applicable to all companies, while elective micro-credentials can be added to match with regional or specific company needs.

- Automation Systems Specialist
- IT Systems Specialist
- Operations Specialist
- Electrical Systems Specialist
- Control Systems Specialist
- Robotics Specialist
- Network Systems Specialist
- Instrumentation Specialist
- Mechanical Systems Specialist
- Electro-Fluid Power Systems Specialist

Certified Industry 4.0 Electrical Systems Specialist

SACA's Certified Industry 4.0 Electrical Systems Specialist certification prepares individuals to succeed as an industrial electrician in modern production environments that use Industry 4.0 technologies. In this role, individuals will install, troubleshoot, repair, and maintain industrial electrical circuits and electric motor systems.

Core Micro-Credentials:
C-101 Associate-Basic Operations
C-201 Electrical Systems 1
C-202 Electric Motor Control Systems 1
C-204 Motor Control Troubleshooting 1
C-206 Electrical System Installation 1

Certified Industry 4.0 Automation Systems Specialist

SACA's Certified Industry 4.0 Automation Systems Specialist certification prepares individuals to succeed in multi-skill maintenance technician positions in modern production environments that use Industry 4.0 technologies. This certification also features a variety of elective micro-credentials that are ideal for individuals seeking to become versed in Industry 4.0 automation or those pursuing SACA Professional Certification.

Core Micro-Credentials:

C-101 Associate-Basic Operations
C-201 Electrical Systems 1
C-202 Electric Motor Control Systems 1
C-203 Variable Frequency Drive Systems 1
C-204 Motor Control Troubleshooting 1
C-205 Sensor Logic Systems 1 (*)
C-206 Electrical System Installation 1
C-207 Programmable Controller Systems 1 (**)
C-208 Programmable Controller Troubleshooting 1
C-209 Pneumatic Systems 1
C-210 Mechanical Power Systems I
C-211 Industry 4.0 Total Productive Maintenance Management
C-212 Ethernet Communications 1
C-213 Smart Sensor and Identification Sys. 1
C-214 Smart Factory Systems 1
C-215 Robot System Operations 1 (***)
C-216 Robot Systems Integration 1

Elective Micro-Credentials:

C-255 Hydraulic Systems 1
C-256 Hydraulic Maintenance
C-257 Process Control Systems 1
C-258 Process Control Troubleshooting 1
C-259 Rigging Systems 1
C-260 Rigging Systems 2

(*) - or SACA C101 Associate-Basic Operations and C-102 Associate-Advanced Operations Certifications

(**) - or SACA C-102 Associate-Advanced Operations and C-104 Associate-IIoT and Data Analytics Certifications

(***) - or SACA C-103 Associate-Robot Systems Certification

Professional Certifications

SACA's Certified Industry 4.0 Professional certification is an engineering certification that focuses on analysis, design, and optimization of Industry 4.0 systems. It prepares engineers to succeed in positions in modern production environments that use Industry 4.0 technologies. The Certified Industry 4.0 Professional certification is designed in a modular format.

- Robot Systems Applications Design 1
- Smart Factory Systems Optimization 1
- Smart Factory Systems Optimization 2
- Smart Factory Systems Architecture Design 1
- Manufacturing Execution Systems 2
- Flexible Manufacturing Systems Optimization
- Process Simulation and Design 1

SACA

SMART AUTOMATION CERTIFICATION ALLIANCE

SILVER & GOLD CERTIFICATIONS

All SACA Certifications can be attained on two levels: Silver and Gold.

SACA Silver Certifications are awarded to candidates who successfully pass the written knowledge exam delivered online through the SACA testing portal. Silver Certifications are ideal for individuals seeking to validate online core achievement or when hands-on testing is not available.

SACA Gold Certifications are awarded to candidates that successfully pass the written knowledge exam and successfully complete a hands-on performance assessment on SACA-approved equipment. Gold Certifications are ideal for individuals seeking to show they possess job-ready, hands-on Industry 4.0 skills.

C-207 Programmable Controller Systems I

E-Learning Content

8. Introduction to Programmable Controllers
9. PC-PLC Connections
10. PLC Operation
11. PanelView Plus Terminal-PLC Connections
12. PLC Program Operations
13. PLC Memory Organization
14. PLC Programs
15. PLC Program Analysis
16. PLC Motor Control
17. Program Interlocking

1. PLC Timers
2. PLC Counters
3. PLC Event Sequencing
4. Master Control Reset
5. PLC Subroutines
6. Math and Data Move Instructions
7. SACA Test / Study Guide

Prepares individuals to program, configuration, adjust, monitor, and operate industrial programmable logic controller (PLC) systems. Key skills include: adhering to PLC safety rules, performing normal startup/shutdown, operating PLC in different modes, performing emergency shutdown and reset, monitoring for proper operation through indicators and PC-based PLC software, configuring processor software drivers for communication to PC, configuring and loading of HMI programs, operating HMI with PLC, configuring PLC discrete I/O, transferring programs between PC and PLC processor, interpreting basic and intermediate level PLC ladder logic programs (with contacts, coils, timers, counters, math, comparison instructions), PLC project creation/editing, and interpreting common PLC program logic applications using electro-pneumatic actuators and on/off motor control systems.

990-PAB53AF Technical Trainer for Gold Certification

Amatrol's Portable PLC Troubleshooting Learning System (990-PAB53AF) teaches Programmable Logic Controller (PLC) programming, operation, and applications used throughout industry. The system also utilizes FaultPro, the industry's premier computer-based fault insertion system. This portable system provides hands-on experience with real-world components, including the powerful Allen-Bradley L16 CompactLogix 5300 PLC, a PanelView Plus terminal, an Ethernet Switch, an I/O Simulator, five application circuits, and a master control relay circuit. Learners will study industry-relevant applications and troubleshooting skills that will build a strong foundation for a successful career in a variety of industries.

APT Manufacturing Industrial Controls Center Portable PLC/HMI Trainer

This trainer was developed by APT Manufacturing, Rockwell Automation, and FANUC America. We wanted an industrial system that students at all levels can learn from. The beginner can learn panel build and basic ladder program and the advance can write their own programs and integrate with an existing robotic system.

- Rockwell CompactLogix 5380 controller with Integrated Motion (5069-L306ERM)
- 16 24VDC digital inputs & 16 24VDC digital outputs
- Rockwell AB 10” PanelView 5000 Graphic Terminal (PanelView 5310)
- 5 Port Stratix Ethernet Switch
- Dual Ethernet Access Ports and Cable Glands for external device connections
- Pre-loaded with structured program template
- Endless possibilities - can connect to almost any device!
- PLC robot integration program template installed

SACA FAQ's

Who and What is SACA?

Smart Automation and Certification Alliance is a third-party certification body whose purpose is to validate technical knowledge and ability and prepare the next generation of skilled workers.

Each SACA certification is stackable, allowing individuals to start with one certification and add other certifications to customize their documented skills. Certifications are occupationally focused so they prepare individuals for specific occupations in the world of Industry 4.0.

How will SACA contribute to Student Success in the Workforce?

SACA credentials provide students industry driven competencies in an applied learning (hands on lab) format. These skills translate directly to jobs that are in high demand, great paying, and leading to exciting lifelong career paths.

What's the difference between Silver and Gold SACA certifications?

Silver is a theory only, multiple choice, proctored exam. Exams are 1 - 2 hour in length and varies from 40 to 100 questions depending on the subject.

Gold is a combination of theory in addition to hands on skills. This is the lab portion of the certification and vastly ranges from 15 minutes to 4 hours till completion depending on the subject.

Are Instructors required to be SACA certified?

Yes! Instructors must earn the SACA certification for the courses they teach to be credentialed.

How do Instructors earn SACA Silver certifications?

Instructors can take the theory exam before or at the same time as the exam is being taken with the students. Trine University will help you with this process.

How do Instructors earn SACA Gold certifications?

Instructors will work with Trine University to complete and validate the hands-on skills required.

What resources are students allowed to use while taking the certification exams?

Formulas are available within the testing environment as well as a calculator, and blank piece of paper. Note: All resources are pending SACA approval and may be modified.

How long do students or instructors wait before re-attempting a failed attempt?

Re-attempts can be proctored again after 24 hours.

Is Trine University an Authorized Certification Assessment Center for SACA?

Yes! Trine University partnered with SACA in 2021 and Trine University has several Amatrol Industrial trainers that are SACA Gold certification approved.

What do Employers have to say about SACA?

"Technology disruption is widening the gap between student learning and industry relevance of learning. At the same time, it is also shortening the shelf life of degrees and opening up variable pathways of learning. To narrow this gap, we are actively participating with the Smart Automation Certification Alliance and other industry stakeholders working alongside education to create relevant standards around Industry 4.0 and more importantly access to relevant stackable learning."

- Michael Cook, Director Global Academic Partnerships, Rockwell Automation

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C-207 Programmable Controller Systems I Skill Standards

- **Introduction to Programmable Controllers**
    - Can you describe the functions of the six basic components of a programmable controller?
    - Can you describe three levels of networking and give an example of each?

- **PC-PLC Connections**
    - Do you know how to connect a PC to a CompactLogix processor using a USB connection?
    - Can you describe how to connect an Allen-Bradley CompactLogix controller to an EtherNet/IP Network?
    - Can you explain two types of addressing used for EtherNet/IP networks?
    - Do you know how to configure the RSLinx EtherNet/IP communications driver?
    - Can you configure the IP address of a 1769-L16ER CompactLogix controller?

- **PLC Operation**
    - Can you describe the basic operation of a programmable controller?
    - Can you explain the function of Studio 5000 programming software?
    - Do you know how to determine a controller's firmware version using RSLinx?
    - Can you use Studio 5000 programming software to open and download a controller project?

- **PanelView Plus Terminal-PLC Connections**
    - Can you describe the components of a PanelView Plus terminal?
    - Do you know how to configure the IP address of a PanelView Plus terminal?
    - Can you explain the basic operation of a PanelView Plus terminal?
    - Can you describe how to transfer an application using FactoryTalk View Studio software?
    - Do you know how to operate a PanelView Plus terminal?

- **PLC Program Operations**
    - Can you describe the function of a tag?
    - Can you explain the function of Module-Defined tag structures and give an application?
    - Can you describe the format of Module-Defined tag names?
    - Can you explain the function and operation of Input / Output diagrams?
    - Can you describe the basic operation of controller ladder logic?

- **PLC Memory Organization**
    - Can you list five types of numbering systems and explain their importance to controllers?
    - Can you explain the memory organization of the CompactLogix?
- **PLC Programs**
    - Can you describe the function of a CompactLogix project?
    - Do you know how to create a CompactLogix project?
    - Can you explain the function of I/O configuration?
    - Can you configure a discrete I/O module in a CompactLogix project?
- **PLC Program Analysis**
    - Can you explain the function of the ladder editor window and its components?
    - Can you describe a firmware mismatch and how to avoid them?
    - Can you explain the function of project documentation and give an application?
- **PLC Motor Control**
    - Can you describe two methods by which a controller output can control a motor?
    - Can you explain the function and operation of Seal-In logic?
    - Do you know how to create a tag?
- **PLC Program Interlocking**
    - Can you describe the function and operation of a program interlock and give an application?
    - Can you explain the basic operation of a variable speed drive?
- **PLC Timers**
    - Can you describe the function of two types of timer instructions and give an application of each?
    - Can you explain the operation of the Timer On-Delay (TON) Instruction?
    - Can you explain the operation of a time-driven sequence program?
- **PLC Counters**
    - Can you describe two types of PLC counter instructions?

- **PLC Event Sequencing**
    - Can you define event-driven sequencing?
    - Can you explain the operation of a reciprocating actuator controller program?
    - Can you describe the operation of a continuous-cycle reciprocating program?
    - Can you explain the operation of a controller program with manual and automatic modes?
    - Do you know three methods of stopping a PLC-controlled machine?
    - Can you describe the operation of a PLC-based on/off process control system?

- **Master Control Reset**
    - Do you know the function of a program control instruction?
    - Can you describe the operation of an MCR instruction?

- **PLC Subroutines**
    - Can you explain the operation of the JSR instruction?
    - Do you know the function of the JMP and LBL instructions?

- **Math and Data Move Instructions**
    - Can you describe the function of controller math instructions and give an application?
    - Can you use the CompactLogix ADD instruction?
    - Can you explain the operation of the CompactLogix SUB instruction?
    - Do you know the operation of the CompactLogix MUL instruction?
    - Can you explain the operation of CompactLogix comparison instructions?