



# Security of Industrial Automation and Control Systems

An Overview of ISA/IEC 62443 Standards

# Quick Start Guide: An Overview of ISA/IEC 62443 Standards **Security of Industrial Automation and Control Systems**

## Executive Summary

This document is intended to provide the reader with a detailed overview of the ISA/IEC 62443 series of standards (series) and technical reports. The ISA/IEC 62443 series addresses the security of industrial automation and control systems (IACS) throughout their lifecycle. These standards and technical reports were initially developed for the industrial process sector but have since been applied to building automation, medical devices and transportation sectors.

There are several trends that have made cybersecurity an essential property of IACS, along with safety, integrity and reliability. First, over the last two decades, IACS technologies have migrated from vendor-proprietary to commercial off-the-shelf technologies such as Microsoft Windows™ and TCP/IP networking. Second, the value of data residing in the IACS for the business has significantly increased the interconnectivity of IACS both internal and external to the

organization. Finally, the means, resources, skills and motivation of cyber-attackers have significantly increased. The combination of these trends has made IACS more vulnerable to cyberattack. Figure 1 shows some of the notable cyberattacks that have impacted IACS.

Initially, the ISA99 committee considered IT standards and practices for use in the IACS. However, it was soon found that this was not sufficient to ensure the safety, integrity, reliability and security of an IACS. This is because the consequences of a successful cyberattack on an IACS are fundamentally different. While the primary consequences of a successful cyberattack on IT systems is financial and privacy loss due to information disclosure, the consequences for an IACS may additionally include loss of life or health, damage to the environment or loss of product integrity. There are several other differences between IT and IACS such as performance requirements, availability requirements, change management, the time between maintenance windows and equipment lifetime. [1]

The International Society of Automation (ISA) and the International Electrotechnical Commission (IEC) have joined forces to address the need to improve the cybersecurity of IACS. The ISA99 committee and the IEC Technical Committee 65/ Working Group 10 develop and publish the ISA/ IEC 62443 series. These documents describe a methodical engineered approach to addressing the cybersecurity of IACS. They can be purchased from either organization; the technical content is identical. The benefits of using a standards-based approach include reducing the likelihood of a successful cyberattack, the use of a common set of requirements among stakeholders, security throughout the lifecycle and a reduction in overall lifecycle cost.

Date	Target	Method
2010	Iran Uranium Enrichment	Stuxnet
2013	ICS Supply Chain attack	Havex
2015	Ukraine Power Grid	BlackEnergy, KillDisk
2016	Ukraine Substation	CrashOverride
2017	Global shipping company	NotPetya
2017	IoT DDos attack	BrickerBot
2017	Health care, Automotive, many others	WannaCry
2017	Saudi Arabia Petrochemical	TRITON/TRISIS
2017	Multinational Confectionary, Food & Beverage Company	NotPetya
2019	Norwegian Aluminum Company	LockerGaga
2021	Critical Infrastructure: Pipeline	Ransomware
2023	Asian National Power Grid	Chinese malware

**Table 1: Some notable cyberattacks impacting IACS**

Source: <https://www.csis.org/programs/strategic-technologies-program/significant-cyber-incidents>



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## Introduction

This document provides an overview of the ISA/IEC 62443 series and technical reports which specifies requirements for the security of IACS. The goal of the ISA/IEC 62443 series is to improve the safety, reliability, integrity and security of IACS using a risk-based, methodical and complete process throughout the entire lifecycle. The ISA/IEC 62443 series describes a set of common terms and requirements that can be used by asset owners, product suppliers and service providers to secure their control systems and the Equipment Under Control (EUC).

### Scope and Purpose

The scope of the ISA/IEC 62443 series is the security of IACS. An IACS is defined as a collection of personnel, hardware, software and policies involved in the operation of the industrial process and that can affect or influence its safe, secure and reliable operation.

Note that an IACS includes more than the technology that comprises a control system; it includes the people and work processes needed to ensure the safety, integrity, reliability and security of the control system. Without people who are sufficiently trained, risk-appropriate technologies, countermeasures and work processes throughout the security lifecycle, an IACS could be more vulnerable to cyberattack.

Because IACS are physical-cyber systems, the impact of a cyberattack could be severe. The consequences of a cyberattack on an IACS include, but are not limited to:

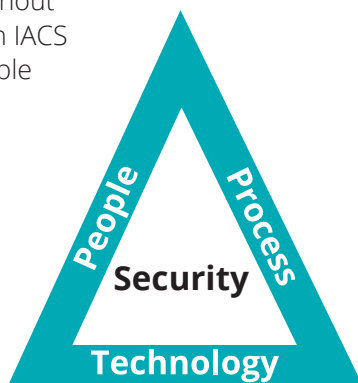


Figure 1:  
The Security Triad

- Endangerment of public or employee safety or health
- Damage to the environment
- Damage to the EUC
- Loss of product integrity
- Loss of public confidence or company reputation
- Violation of legal or regulatory requirements
- Loss of proprietary or confidential information
- Financial loss
- Impact on entity, local, state or national security

The first four consequences in the above list are unique to physical-cyber systems and are not typically present in traditional IT systems. Indeed, it is this difference that fundamentally results in the need for different approaches to securing physical-cyber systems and caused standards development organizations to identify the need for standards that are unique to IACS. Some other characteristics of IACS that are not typical in IT systems include: [1]

- more predictable failure modes
- tighter time-criticality and determinism
- higher availability
- more rigorous management of change
- longer time periods between maintenance
- significantly longer component lifetimes
- Safety, integrity, availability and confidentiality (SIAC) instead of CIA

Cyber threat actors include but are not limited to insiders (accidental or intentional), hackers, cybercriminals, organized crime and state-sponsored attackers. Types of cyberattacks include but are not limited to ransomware, destructive malware, directed remote access attacks and coordinated attacks on control systems and associated support infrastructure. Table 1 lists several noteworthy directed and non-directed cyberattacks impacting IACS.

### ISA/IEC 62443 Series of Standards Development Organizations

There are two standards development organizations involved in the development of the

ISA/IEC 62443 series of standards and technical reports:

- International Society of Automation – ISA99 Committee
- International Electrotechnical Commission – IEC TC65/WG10 Committee

There is a formal liaison agreement between these two standards development organizations. The ISA/IEC 62443 series of standards and technical reports are developed primarily by the ISA99 Committee with input, review, and simultaneous adoption by both the ISA and IEC. The one exception is ISA/IEC 62443-2-4, which was developed by the IEC TC65/WG10 Committee and adopted by ISA. As a result, whether an ISA/IEC 62443 document is published by ISA or IEC, the content is identical except for the non-normative preface and foreword.

The United Nations Economic Commission for Europe (UNECE) confirmed at its annual meeting in late 2018 that it will integrate the widely used ISA/IEC 62443 Series into its forthcoming Common Regulatory Framework on Cybersecurity (CRF). The CRF will serve as an official UN policy position statement for Europe, establishing a common legislative basis for cybersecurity practices within the European Union trade markets. [2]

Refer to the *Published Standards and Technical Reports* section at the end of this document for a complete list of ISA and IEC cybersecurity-related documents currently available.

### Summary of ISA/IEC 62443 Series of Standards and Technical Reports

These documents are arranged in four groups, corresponding to the primary focus and intended audience. [4]

1. **General**—This group includes documents that address topics that are common to the entire series.
  - **Part 1-1: Terminology, concepts, and models** introduces the concepts and models used throughout the series. The intended audience includes anyone wishing to become familiar with the fundamental concepts that form the basis for the series

- **Part 1-2: Master glossary of terms and definitions** is a list of terms and abbreviations used throughout the series
  - **Part 1-3: System security conformance metrics** describes a methodology to develop quantitative metrics derived from the process and technical requirements in the standards
  - **Part 1-4: IACS security lifecycle and use cases** provides a more detailed description of the underlying lifecycle for IACS security, as well as several use cases that illustrate various applications
2. **Policies and procedures**—Documents in this group focus on the policies and procedures associated with IACS security.
- **Part 2-1: Establishing an IACS security program** describes what is required to define and implement an effective IACS cybersecurity management system. The intended audience includes asset owners who have responsibility for the design and implementation of such a program
  - **Part 2-2: IACS security program ratings** provides a methodology for evaluating the level of protection provided
- **Part 2-3: Patch management in the IACS environment** provides guidance on patch management for IACS. The intended audience includes anyone who has responsibility for the design and implementation of a patch management program
  - **Part 2-4: Security program requirements for IACS service providers** specifies requirements for IACS service providers such as system integrators or maintenance providers. This standard was developed by IEC TC65/WG10
  - **Part 2-5: Implementation guidance for IACS asset owners** provides guidance on what is required to operate an effective IACS cybersecurity program. The intended audience includes asset owners who have responsibility for the operation of such a program
3. **System Requirements**—The documents in the third group address requirements at the system level.

## ISA/IEC 62443 Series of Standards

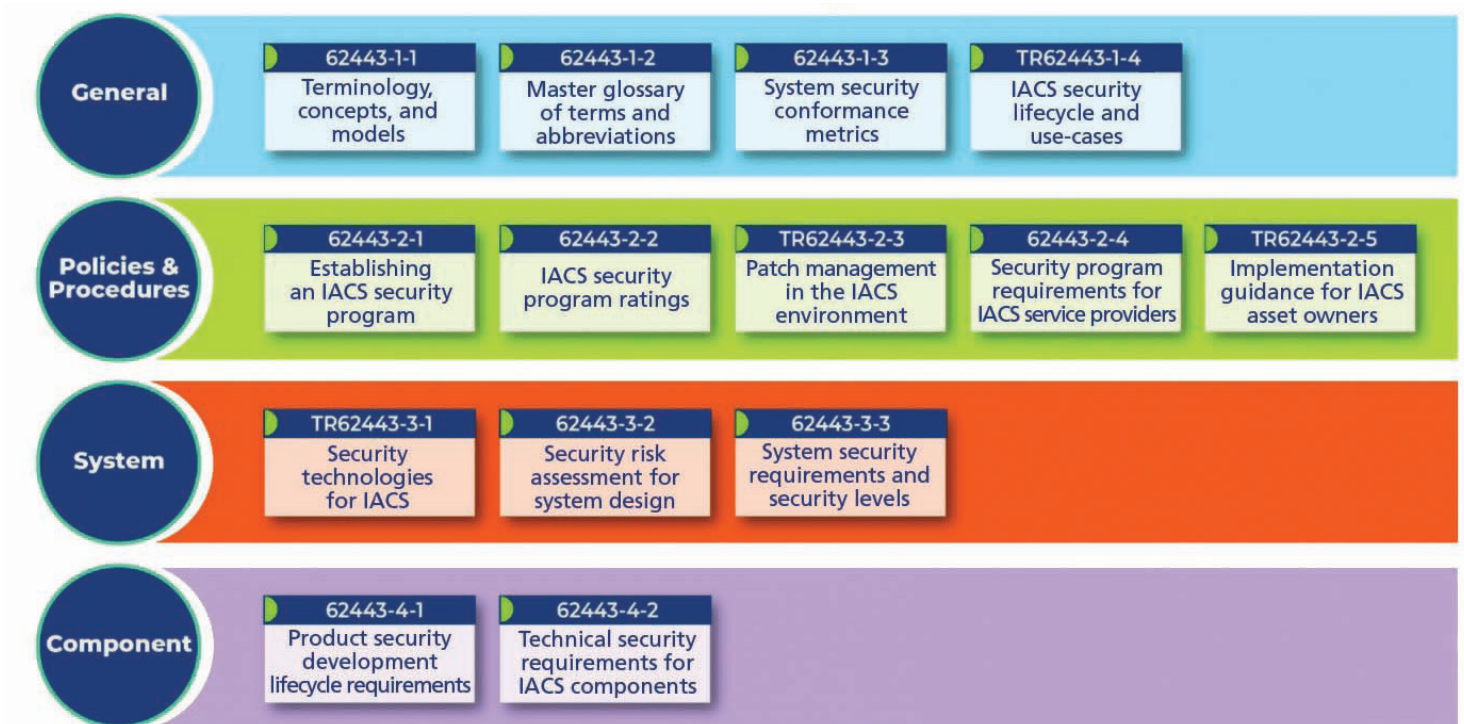


Figure 2: The ISA/IEC 62443 Series

- **Part 3-1: Security technologies for IACS** describes the application of various security technologies to an IACS environment. The intended audience includes anyone who wishes to learn more about the applicability of specific technologies in a control systems environment
- **Part 3-2: Security risk assessment for system design** addresses cybersecurity risk assessment and system design for IACS. The output of this standard is a zone and conduit model, and associated risk assessments and target security levels. These are documented in the CRS. This standard is primarily directed to asset owners and system integrators
- **Part 3-3: System security requirements and security levels** describes the requirements for an IACS system based on security level. The principal audience include suppliers of control systems, system integrators and asset owners

**4. Component Requirements**—The fourth and final group includes documents that provide information about the more specific and detailed requirements associated with the development of IACS products.

- **Part 4-1: Product security development lifecycle requirements** describes the requirements for a product developer's Security Development

Lifecycle (SDL). The principal audience include suppliers of control systems and component products

- **Part 4-2: Technical security requirement for IACS components** describes the requirements for IACS components based on security level. Components include embedded devices, host devices, network devices and software applications. The principal audience include suppliers of component products that are used in control systems

Table 2 shows the complete list of ISA/IEC 62443 standards and technical reports. The "Part" can be derived from the document number, for example ISA/IEC 62443-2-1 is referred to as Part 2-1 in this document.

The document types are:

- IS—International standard
- TR—Technical report
- TS—Technical specification

Finally, the publication date is shown for each document as of the publication date of this document. ISA/IEC standards are on a five-year update cycle, so many of the published documents are currently in revision.

## Fundamental Concepts

### Security Program

Part 2-1 specifies asset owner security program requirements for the IACS. A security program consists of the implementation and maintenance of personnel, policy and procedure, and technology-based capabilities that reduce the cybersecurity risk of an IACS.

In the context of Part 2-1, the asset owner is also the Operator of the IACS and the EUC. The security program covers the entire lifecycle of the IACS. Because the lifetime of an IACS can be longer than the product supplier support timeframe, the standard recognizes that not all requirements can be met by legacy systems, so compensating countermeasures may be needed to secure the IACS.

Although the asset owner is ultimately accountable for the secure operation of the IACS, implementation of security capabilities

	Part	Type	Title	Date
Overview	1-1	TS	Terminology, concepts, and models	2007
	1-2	TR	Master glossary of terms and abbreviations	
	1-3		System cybersecurity conformance metrics	
	1-4		IACS security lifecycle and use cases	
Policies & Procedures	2-1	IS	Establishing an IACS security program	2009
	2-2		IACS security program ratings	
	2-3	TR	Patch management in the IACS environment	2015
	2-4	IS	Security program requirements for IACS service providers	2018
	2-5	TR	Implementation guidance for IACS asset owners	
Systems	3-1	TR	Security technologies for IACS	
	3-2	IS	Security risk assessment for system design	2020
	3-3	IS	System security requirements and security levels	2013
Component	4-1	IS	Product security development life-cycle requirements	2018
	4-2	IS	Technical security requirements for IACS components	2019

**Table 2: ISA/IEC 62443 Series Status**

requires the support of product suppliers and service providers. The asset owner must include requirements for security throughout the supply chain to meet the overall security program requirements.

The security program for the IACS must be coordinated with the overall Information Security Management System (ISMS) of the organization. The ISMS sets the overall security governance and policies for the organization. However, as mentioned above, the IACS is significantly different from IT systems, so there are additional requirements and considerations for its security program.

## Risk Management

### Risk Assessment

Part 3-2 describes the requirements for addressing the cybersecurity risks in an IACS, including the use of zones and conduits, and security levels. While Part 3-2 includes the requirements for the risk assessment process, it does not specify the exact methodology to be used. The methodology used must be established by the asset owner and should be consistent with the overall risk assessment methodology of the organization. Examples using the risk matrix methodology are included as informative content. Figure 3 shows the risk assessment process.

### Zones and Conduits

A zone is defined as a grouping of logical or physical assets based upon risk or other criteria such as criticality of assets, operational function, physical or logical location, required access or responsible organization.

A conduit is defined as a logical grouping of communication channels that share common security requirements connecting two or more zones.

A key step in the risk assessment process is to partition the System Under Consideration (SuC) into separate zones and conduits. The intent is to identify those assets which share common security characteristics in order to establish a set of common security requirements that reduce cybersecurity risk.

Partitioning the SuC into zones and conduits can also reduce overall risk by limiting the scope of a successful cyber-attack. Part 3-2 requires or recommends that some assets are partitioned as follows should:

- business and control system assets
- safety related assets
- temporarily connected devices
- wireless devices
- devices connected via external networks

### Cybersecurity Requirements Specification

Part 3-2 also requires that required security countermeasures from the risk assessment as well as security requirements based on company

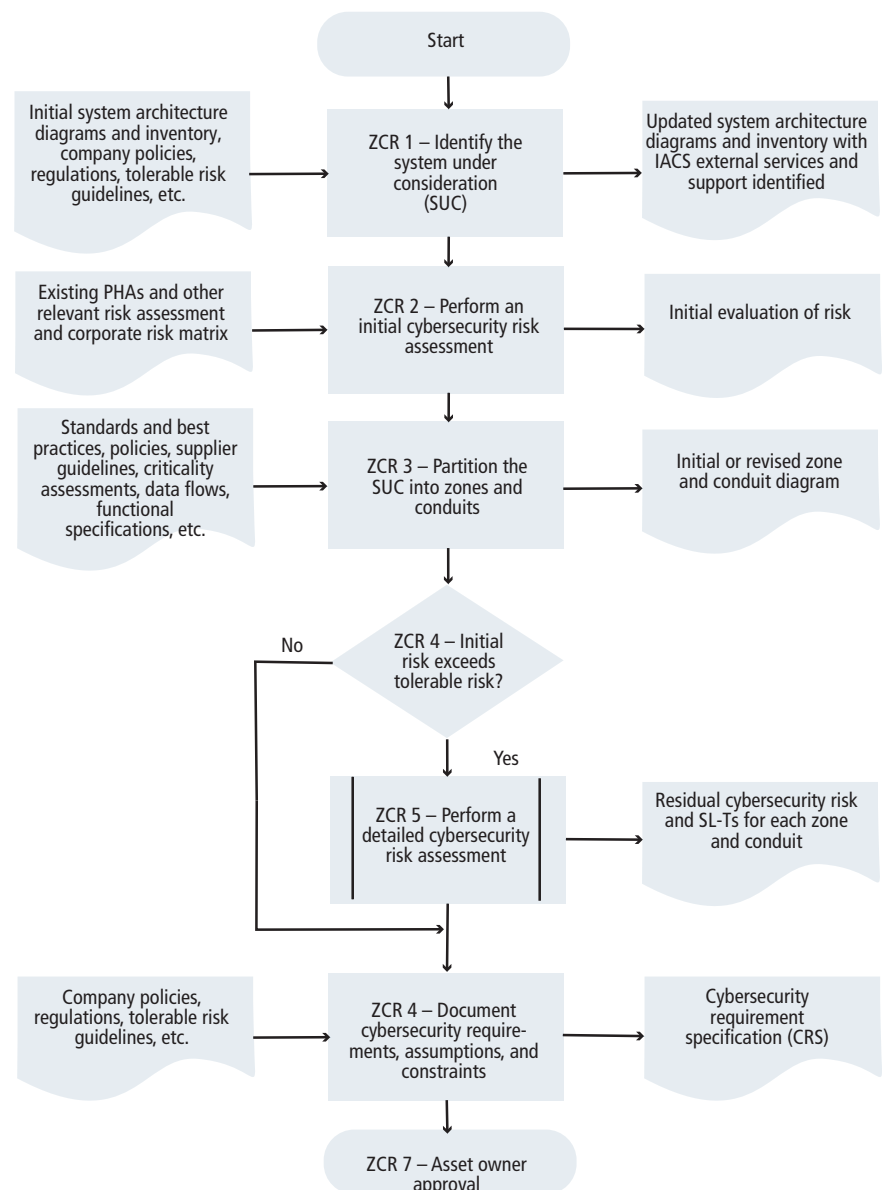


Figure 3: Risk Assessment Process



or facility-specific policies, standards and relevant regulations are documented in a CRS. The CRS does not have to be a standalone document; it can be included as a section in other relevant IACS documents.

The CRS includes information such a description of the SuC, zone and conduit drawings, threat environment(s) and countermeasures from risk assessments.

### Threat Modeling

Part 4-1 describes the requirements for the security development lifecycle (SDL) of control system and component products. One of the key processes in the product SDL is threat modeling which is a systematic process to identify data flows, trust boundaries, attack vectors and potential threats to the control system. The security issues identified in the threat model must be addressed in the final release of the product and the threat model itself must be periodically updated during the product's lifecycle.

### Foundational Requirements

Foundational Requirements (FRs) form the basis for technical requirements throughout the ISA/IEC 62443 series. All aspects associated with meeting a desired IACS security level (people, processes and technology) are derived through meeting the requirements associated with the seven following FRs:

- FR 1 – Identification and authentication control (IAC)
- FR 2 – Use control (UC)
- FR 3 – System integrity (SI)
- FR 4 – Data confidentiality (DC)
- FR 5 – Restricted data flow (RDF)
- FR 6 – Timely response to events (TRE)
- FR 7 – Resource availability (RA)

FRs are used to organize the requirements for IACS Systems (Part 3-3) and components (Part 4-2).

The combination of FR 1 and FR 2 is sometimes called access control; they were split into two FRs to keep the total number of requirements at a manageable level.

### Security Levels

Security level is defined as the measure of confidence that the SuC, zone or conduit is free from vulnerabilities and functions in the intended manner.

Part 3-3 further defines the security level in terms of the means, resources, skills and motivation of the threat actor, as shown in Table 3. It is used as a means to discriminate between requirement enhancements for systems (Part 3-3) and components (Part 4-2).

There are three types of security levels that are used throughout the ISA/IEC 62443 series:

- **Capability Security Levels (SL-C)** are the security levels that systems (Part 3-3) or components (Part 4-2) can provide when properly integrated and configured. These levels state that a particular system or component is capable of meeting the SL-T natively without additional compensating countermeasures
- **Target Security Levels (SL-T)** are the desired level of security for a particular automation solution. They are determined as the result of the risk assessment process (Part 3-2) and are documented in the CRS. SL-T are used to select products and design additional countermeasures during the integration phase of the IACS lifecycle
- **Achieved Security Levels (SL-A)** are the actual levels of security for a particular automation solution. These are measured after the

Security Level	Definition	Means	Resources	Skills	Motivation
1	Protection against casual or coincidental violation				
2	Protection against intentional violation using simple means with low resources, generic skills, and low motivation	simple	low	generic	low
3	Protection against intentional violation using sophisticated means with moderate resources, IACS-specific skills, and moderate motivation	sophisticated	moderate	IACS-specific	moderate
4	Protection against intentional violation using sophisticated means with extended resources, IACS-specific skills, and high motivation	sophisticated	extended	IACS-specific	high

Table 3: Security Level Definition



automation solution is commissioned and in operation. Part 2-2 combines SL-A with operational and maintenance policies and procedures to form the security program rating for a particular automation solution

### Maturity Model

While security levels are a measure of the strength of technical requirements, maturity levels are a measure of processes (people, policies and procedures). Parts 2-1, 2-2, 2-4 and 4-1 use maturity levels to measure how thoroughly requirements are met.

As shown in Table 4, the maturity model is based on the Capability Maturity Model Integration (CMMI), with Levels 4 and 5 combined into Level 4.

### Design Principles

#### Secure by Design

Secure by design is a design principle where security measures are implemented early in the lifecycle of the IACS. The intent is that robust security policies, security architectures and secure practices are established early in development and implemented throughout the lifecycle. This design principle applies to both product development and automation solution development. When using a secure by design philosophy, security measures operate natively within the control system or component without requiring the addition of compensating countermeasures.

#### Reduce Attack Surface

Reducing the attack surface is a design principle where the physical and functional interfaces of an IACS that can be accessed and exposed to potential attack are minimized, making it more difficult for an attack to succeed. Reducing attack

surface includes design principles such as:

- Access control—restricting physical and logical access to IACS systems and networks
- Network segmentation—segmenting IACS networks and controlling the traffic between them
- Least function—hardening IACS systems and networks by removing unneeded functions
- Least privilege—limiting privileges to the minimum necessary for the role or function

#### Defense in Depth

Defense in depth is defined as the *provision of multiple security protections, especially in layers, with the intent to delay or prevent an attack*. Defense in depth implies layers of security and detection, even on single systems, and requires attackers to break through or bypass multiple layers without being detected. The IACS is still protected even if a vulnerability in one layer is compromised. Special attention must be paid to a single vulnerability that allows the potential compromise of multiple layers.

#### Essential Functions

Essential functions are defined as functions or capabilities that are required to maintain health, safety, the environment and availability of the EUC. Essential functions include:

- the safety instrumented function (SIF)
- the control function
- the ability of the operator to view and manipulate the EUC

The loss of essential functions is commonly termed: loss of protection, loss of control and loss of view, respectively. In some use cases additional functions such as history may be considered essential.

Level	CMMI	62443	Description
1	Initial	Initial	<ul style="list-style-type: none"> <li>• Product development is typically ad-hoc and often undocumented</li> <li>• Consistency and repeatability may not be possible</li> </ul>
2	Managed	Managed	<ul style="list-style-type: none"> <li>• Product development managed using written policies</li> <li>• Personnel have expertise and are trained to follow procedures</li> <li>• Processes are defined but some may not be in practice</li> </ul>
3	Defined	Defined (Practiced)	<ul style="list-style-type: none"> <li>• All processes are repeatable across the organization</li> <li>• All processes are in practice with documented evidence</li> </ul>
4	Quantitatively Managed	Improving	<ul style="list-style-type: none"> <li>• CMMI Levels 4 and 5 are combined</li> <li>• Process metrics are used control effectiveness and performance</li> <li>• Continuous improvement</li> </ul>
5	Optimizing		

Table 4: Maturity Level Definition

Part 3-3 requires that security measures shall not adversely affect essential functions of a high-availability IACS unless it is supported by a risk assessment. The concept of essential functions places some design constraints on the design of IACS security measures:

- access control shall not prevent the operation of essential functions
- essential functions shall be maintained if the zone boundary protection (firewall) goes into a fail close/island mode
- a denial-of-service event on the control system or Safety Instrumented System (SIS) network shall not prevent safety instrumented functions from acting

## Roadmap for the ISA/IEC 62443 Series

### Principal Roles

To understand how to use the ISA/IEC 62443 series it is first necessary to understand the relationship between roles, control system, automation solution and IACS. Figure 4 visualizes this relationship. The left-hand side of the figure shows the roles that are identified in the ISA/IEC 62443 series:

- **Asset Owner** is the organization that is accountable and responsible for the IACS. The asset owner is also the operator of the IACS and the EUC

- **Maintenance Service Provider** is the individual or organization that provides support activities for an automation solution
- **Integration Service Provider** is an organization that provides integration activities for an automation solution including design, installation, configuration, testing, commissioning and handover to the asset owner. The integration service provider may also facilitate and assist in the activity to partition the SuC into zones and conduits and perform the risk assessment
- **Product Supplier** is the organization that manufactures and supports a hardware and/or software products. Products may include control systems, embedded devices, host devices, network devices and/or software applications

### Component, System, Automation Solution and IACS

The right-hand side of the figure shows the types of systems that are identified in the ISA/IEC 62443 series::

- **IACS Components** are provided by a product supplier and include the following types:
  - Embedded device—special purpose device designed to directly monitor or control an industrial process
  - Host device—general purpose device running an operating system capable of hosting one or more software applications, data stores or functions from one or more suppliers
  - Network device—device that facilitates data flow between devices, or restricts the data flow, but may not directly interact with a control process
  - Software application—one or more software programs and their dependencies that are used to interface with the process or the control system itself
- **The IACS System** consists of an integrated set of embedded devices (e.g., PLC), Host Devices, network devices and software applications provided by one or more product suppliers
- **Automation Solution** is the realization of a control system at a particular facility. It includes essential functions such as safety functions and control functions and

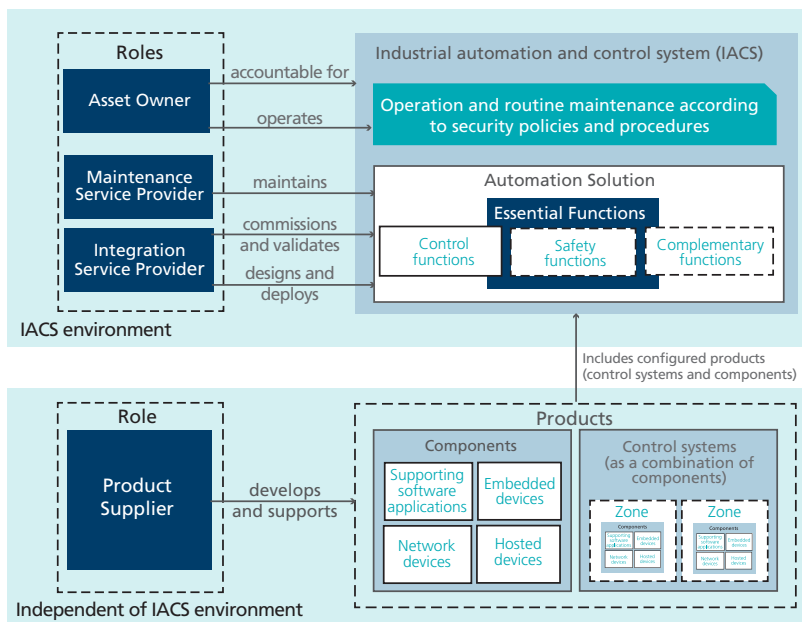


Figure 4: Roles, Products, Automation Solution, and IACS

other supporting functions such as historization and engineering

- **The IACS** includes the automation solution and the operational and maintenance policies and procedures necessary to support it

### Hierarchical View

Figure 5 shows the hierarchical relationships among the ISA/IEC 62443 series of standards. A hierarchical relationship means that one standard derives its requirements from the requirements in another standard. The arrowhead shows the direction of derivation.

- **Part 1-1** introduces the concepts and models that are used throughout the ISA/IEC 62443 series. In particular, it describes the foundational requirements, which are used to organize technical requirements throughout the series
- **Part 2-1** sets the requirements for the security program of an asset owner. All of the other standards in the ISA/IEC 62443 series derive their requirements from Part 2-1 and expand upon them in more detail
- **Part 3-2** sets the requirements for the partitioning of the SuC into zones and conduits and their risk assessment. The risk assessment defines the SL-T, which is used to procure systems and components that have the capabilities defined in Part 3-3 and Part 4-2, respectively. Part 3-2 also requires a CRS, which is used to create the automation solution

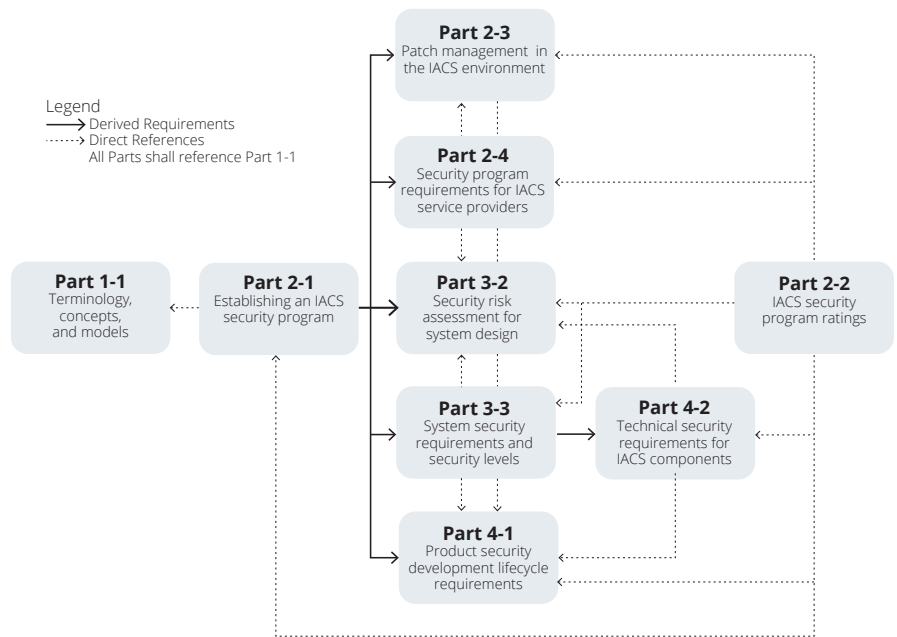


Figure 5: ISA/IEC 62443 Standards – Hierarchical View

- **Part 4-1** is used by a product supplier to establish and sustain a SDL, which is used to create control systems and component products
- **Part 2-4** sets the requirements for service providers that are involved in support of the IACS. Integration service providers provide integration services for the automation solution, and maintenance service providers provide maintenance services for the IACS.
- **Part 2-3** sets the requirements for the patch management process, which is used to reduce cybersecurity vulnerabilities in the automation solution

Product Development Lifecycle	Automation Solution Lifecycle	
	Integration	Operation and Maintenance
Part 1-1: Terminology, Concepts, and Models		
	Part 2-1: Establishing an IACS Security Program	
		Part 2-2: IACS Security Program Rating
		Part 2-3: Patch Management in the IACS Environment
		Part 2-4: Security program requirements for IACS service providers
		Part 3-2: Security Risk Assessment for System Design
	Part 3-3: System security requirements and Security levels	
Part 4-1: Product Security Development Lifecycle Requirements		
Part 4-2: Technical security requirements for IACS components		

Figure 6: ISA/IEC 62443 Standards - Lifecycle View



### **Lifecycle View**

Another view of the ISA/IEC 62443 series is the lifecycle view. There are two independent lifecycles described in the series: the product development lifecycle, and the automation solution lifecycle. The automation solution lifecycle is further divided into an integration phase and an operation and maintenance phase. Table 6 shows the relationship between the parts of the ISA/IEC 62443 series and the various lifecycles and phases.

Note that Part 3-3 spans the product development lifecycle and the integration phase of the automation solution lifecycle. This is because while the product supplier is the main audience for Part 3-3, the integration service provider may also combine components to create control systems. An example would be a SCADA system, where the integration service provider integrates the SCADA system with embedded devices (e.g., PLC) to create an automation solution.

### **ISA/IEC 62443 Series for Asset Owners**

Asset owner activities:

- establish and sustain a security program that includes IACS-specific requirements
- partition zones and conduits and perform associated risk assessments
- document IACS requirements in the CRS
- procure products and services that meet IACS requirements
- operate and maintain the IACS
- assess the effectiveness of the IACS security program

Applicable ISA/IEC 62443 standards:

- ISA/IEC 62443-2-1, Establishing an IACS security program
- ISA/IEC 62443-2-2, Security Program ratings
- ISA/IEC 62443-2-3, Patch management in the IACS environment
- ISA/IEC 62443-2-4, Requirements for IACS service providers
- ISA/IEC 62443-3-2, Security risk assessment for system design
- ISA/IEC 62443-3-3, System security requirements and security levels

### **ISA/IEC 62443 Series for Product Suppliers**

Product supplier activities:

- establish and sustain an SDL
- provide control system products that meet security level capabilities
- provide component products that meet security level capabilities
- provide ongoing lifecycle support for their control system and component products

Applicable ISA/IEC 62443 standards:

- ISA/IEC 62443-4-1, Product SDL requirements
- ISA/IEC 62443-3-3, System security requirements and security levels
- ISA/IEC 62443-4-2, Technical security requirements for IACS components
- ISA/IEC 62443-3-2, Security risk assessment for system design

### **ISA/IEC 62443 Series for Service Providers** ***Integration Service Providers***

Integration service provider activities:

- establish and sustain a security program for automation solution integration
- design and implement automation solutions that meet the requirements in the CRS
- apply security patches during the integration phase of the automation solution lifecycle

Applicable ISA/IEC 62443 standards:

- ISA/IEC 62443-2-1, Establishing an IACS security program
- ISA/IEC 62443-2-3, Patch management in the IACS environment
- ISA/IEC 62443-2-4, Requirements for IACS service providers
- ISA/IEC 62443-3-2, Security risk assessment for system design
- ISA/IEC 62443-3-3, System security requirements and security levels

### ***Maintenance Service Providers***

Maintenance service provider activities:

- establish and sustain a security program for maintenance services

- provide services and capabilities that meet the IACS security policies and procedures specified by the asset owner

- **ISA/IEC 62443 IACS Security Assurance (IACSSA)** (under development) this program aims to offer the world's first ISA/IEC 62443 OT site assessment certification

Applicable ISA/IEC 62443 standards:

- ISA/IEC 62443-2-3, Patch management in the IACS environment
- ISA/IEC 62443-2-2, IACS security program ratings
- ISA/IEC 62443-2-4, Requirements for IACS service providers

ISASecure certification programs can be found at [ISASecure.org](https://www.isasecure.org).

## Certification and Training

### ISASecure® Certification

The ISA Security Compliance Institute is a non-profit organization that has developed several product certification programs for controls systems and components. Currently available ISASecure certification programs are:

- **Security Development Lifecycle Assurance (SDLA) / ISA/IEC 62443-4-1** certifies that the SDL of a product supplier meets the requirements in Part 4-1
- **IIoT Component Security Assurance (ICSA) / ISA/IEC 62443-4-2** is a security certification program for IIoT components and IIoT gateways
- **System Security Assurance (SSA) / ISA/IEC 62443-3-3** certifies that control system products have the capability to meet the requirements in Part 3-3 and have been developed in accordance with an SDLA program



- **Component Security Assurance (CSA) / ISA/IEC 62443-4-2** certifies that component products have the capability to meet the requirements in Part 4-2 and have been developed in accordance with an SDLA program. Certified component products can be embedded devices, host devices, network devices and software applications



### ISA Cybersecurity Training

ISA offers the following cybersecurity-related training courses:

- [Cybersecurity Awareness training for Water/Wastewater Industry Professionals](#) (IC31)
- [Using the ISA/IEC 62443 Standards to Secure Your Control System](#) (IC32, IC32E, IC32M, IC32V)
- Introduction to Industrial Automation Security and the ISA/IEC 62443 Standards (IC32C)\*
- [Assessing the Cybersecurity of New or Existing IACS Systems](#) (IC33, IC33E, IC33M, IC33V)
- [IACS Cybersecurity Design and Implementation](#) (IC34, IC34M, IC34V)
- [IACS Cybersecurity Operation and Maintenance](#) (IC37, IC37M, IC37V)

The last letter of the course code designates the type of course as follows:

- **<none> - Classroom training - Our most robust form of training—many include hands-on labs.**
- **C - Custom training** - \*One-day overview course available only through our Custom Training Solutions
- **E - Instructor-guided online training** - Learn at your own pace when it's convenient for you to complete the assignments by the milestone deadline
- **M - Self-paced modular training** - Learn at your own pace at a time that is convenient for you
- **V - Virtual Classroom training** - covers the same material as the classroom course, but in a virtual setting so you can attend remotely

Visit our [course formats webpage](#) for full details about each course format.

## ISA Cybersecurity Certificates



ISA offers the following cybersecurity certificate courses for students who have completed the training courses listed above. Certificates are not to be confused with product certifications offered by ISASecure.

- [ISA/IEC 62443 Cybersecurity Fundamentals Specialist \(IC32\)](#) provides a detailed look at how the ISA/IEC 62443 standards framework can be used to protect critical control systems. It also explores the procedural and technical differences between the security for traditional IT environments and those solutions appropriate for SCADA or plant floor environments
- [ISA/IEC 62443 Cybersecurity Risk Assessment Specialist \(IC33\)](#) focuses on information and skills to assess the cybersecurity of a new or existing industrial automation and control system (IACS); and to develop a cybersecurity requirements specification (CRS) that can be used to document the cybersecurity requirements of the project
- [ISA/IEC 62443 Cybersecurity Design Specialist \(IC34\)](#) focuses on the activities associated with the design and implementation of industrial automation control system (IACS) cybersecurity countermeasures
- [ISA/IEC 62443 Cybersecurity Maintenance Specialist \(IC37\)](#) focuses on the activities associated with the ongoing operations and maintenance of IACS cybersecurity implemented in the Design & Implementation phase
- ISA/IEC 62443 cybersecurity expert, which is earned by successful completion of the all four cybersecurity certificates

### ISA Training for Product Suppliers and Certifying Bodies

ISASecure joined forces with ISA Training to develop the following ISA/IEC 62443 based courses specifically designed for product suppliers, accessors, and certifying bodies.

- [Overview of ISA/IEC 62443 for Product Suppliers \(IC46M\)](#) is a self-paced modular

course that provides an overview of how the ISA/IEC 62443 series of standards can be used by the supplier to implement a SDL, and to develop IACS systems and components that are secure by design and offer security by default. It also covers how to suppliers can independently certify that these systems and components comply with the relevant ISA/IEC 62443 standards

- [ISASecure for Product Suppliers and Assessors \(IC47, IC47V\)](#) is intended for product suppliers who want to build products conforming to 62443 standards that also meet ISASecure certification requirements. It is also intended for conformance/certification assessors of software development processes, and system/component products who need to understand the ISASecure certification programs and the ISA/IEC 62443 standards on which it is based

## Published Standards and Technical Reports

**ISA-62443-1-1-2007 / IEC TS 62443-1-1:2009**– Security for Industrial Automation and Control Systems, Part 1-1: Terminology, Concepts and Models

**ISA-62443-2-1-2009 / IEC 62443-2-1:2010**– Security for Industrial Automation and Control Systems, Part 2-1: Establishing an Industrial Automation and Control Systems Security Program

**ANSI/ISA-TR 62443-2-3-2015 / IEC TR 62443-2-3:2015**–Security for Industrial Automation and Control Systems, Part 2-3: Patch Management in the IACS Environment

**ANSI/ISA-62443-2-4-2018 / IEC 62443-2-4:2015+Amd1:2017 CSV**–Security for Industrial Automation and Control Systems, Part 2-4: Security Program Requirements for IACS Service Providers

**IEC TR 62443-3-1:2009**–Security for Industrial Automation and Control Systems, Part 3-1: Security Technologies for Industrial Automation and Control Systems

**ISA-62443-3-2-2020**–Security for Industrial Automation and Control Systems, Part 3-2: Security Risk Assessment for System Design



**ANSI/ISA-62443-3-3-2013 / IEC 62443-4-2:2013**– Security for Industrial Automation and Control Systems, Part 3-3: System Security Requirements and Security Levels

**ANSI/ISA-62443-4-1-2018 / IEC 62443-4-1:2018**– Security for Industrial Automation and Control Systems, Part 4-1: Product Security Development Lifecycle Requirements

**ANSI/ISA-62443-4-2-2018 / IEC 62443-4-2:2019**– Security for Industrial Automation and Control Systems, Part 4-2: Technical Security Requirements for IACS Components

**IEC TR 63069:2019**– Industrial-Process Measurement, Control and Automation– Framework for Functional Safety and Security

**IEC TR 63074:2019**– Safety Of Machinery– Security Aspects Related to Functional Safety of Safety-Related Control Systems

## References

### **NIST SP 800-82 Revision 2, Guide To Industrial Control Systems (ICS) Security**

United Nations Commission to Integrate ISA/IEC 62443 Into Cybersecurity Regulatory Framework, ISA InTech magazine, Jan-Feb 2019

### **The 62443 Series of Standards: Industrial Automation and Control Security**, ISA99 committee

### **Frequently Asked Questions: The ISA99 Committee and 62443 Standards**, ISA99 committee

### **Instrumentation And Control Systems Security Explained: the What and the Why**, ISA99 committee

This document contains some information that is based on ISA99 Committee draft documents. Please refer to the published documents for the definitive set of requirements currently available.

