

# INTERNATIONAL STANDARD



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**Industrial communication networks – Network and system security –  
Part 2-1: Establishing an industrial automation and control system security  
program**



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**Industrial communication networks – Network and system security –  
Part 2-1: Establishing an industrial automation and control system security  
program**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
NETWORK AND SYSTEM SECURITY –****Part 2-1: Establishing an industrial automation  
and control system security program**

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International Standard IEC 62443-2-1 has been prepared by IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this standard is based on the following documents:

FDIS	Report on voting
65/457/FDIS	65/461/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all existing parts of IEC 62443 series, published under the general title *Industrial communication networks – Network and system security*, can be found on the IEC website. The full list of existing and intended parts can also be found in the Bibliography of this standard.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

NOTE The revision of this international standard will be initiated shortly after this standard is published. The next revision will be aligned more closely with ISO/IEC 27001, which addresses many of the same issues but without consideration of the specialized requirements for continuous operation and safety that are common in the industrial automation and control systems environment.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**



## **0 INTRODUCTION**

### **0.1 Overview**

Cyber security is an increasingly important topic in modern organizations. Many organizations involved in information technology (IT) and business have been concerned with cyber security for many years and have well-established cyber security management systems (CSMS) in place as defined by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) (see ISO/IEC 17799 [23]<sup>1</sup> and ISO/IEC 27001 [24]). These management systems provide an organization with a well-established method for protecting its assets from cyber attacks.

Industrial automation and control system (IACS) organizations have begun using commercial off the shelf (COTS) technology developed for business systems in their everyday processes, which has provided an increased opportunity for cyber attack against the IACS equipment. These systems are not usually as robust, in the IACS environment, as are systems designed specifically as IACS at dealing with cyber attack for many reasons. This weakness may lead to health, safety and environmental (HSE) consequences.

Organizations may try to use the pre-existing IT and business cyber security solutions to address security for IACS without understanding the consequences. While many of these solutions can be applied to IACS, they need to be applied in the correct way to eliminate inadvertent consequences.

### **0.2 A cyber security management system for IACS**

Management systems typically provide guidance on what should be included in a management system, but do not provide guidance on how to go about developing the management system. This standard addresses the aspects of the elements included in a CSMS for IACS and also provides guidance on how to go about developing the CSMS for IACS.

A very common engineering approach when faced with a challenging problem is to break the problem into smaller pieces and address each piece in a disciplined manner. This approach is a sound one for addressing cyber security risks with IACS. However, a frequent mistake made in addressing cyber security is to deal with cyber security one system at a time. Cyber security is a much larger challenge that needs to address the entire set of IACS as well as the policies, procedures, practices and personnel that surround and utilize those IACS. Implementing such a wide-ranging management system may require a cultural change within the organization.

Addressing cyber security on an organization-wide basis can seem like a daunting task. Unfortunately there is no simple cookbook for security. There is good reason for this. There is not a one-size-fits-all set of security practices. Absolute security may be achievable, but is probably undesirable because of the loss of functionality that would be necessary to achieve this near perfect state. Security is really a balance of risk versus cost. All situations will be different. In some situations the risk may be related to HSE factors rather than purely economic impact. The risk may have an unrecoverable consequence rather than a temporary financial setback. Therefore a cookbook set of mandatory security practices will either be overly restrictive and likely quite costly to follow, or be insufficient to address the risk.

### **0.3 Relationship between this standard and ISO/IEC 17799 and ISO/IEC 27001**

ISO/IEC 17799 [23] and ISO/IEC 27001 [24] are excellent standards that describe a cyber security management system for business/information technology systems. Much of the content in these standards is applicable to IACS as well. This standard emphasizes the need

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<sup>1</sup> Numbers in square brackets refer to the Bibliography.

for consistency between the practices to manage IACS cyber security with the practices to manage business/information technology systems cyber security. Economies will be realized by making these programs consistent. Users of this standard are encouraged to read ISO/IEC 17799 and ISO/IEC 27001 for additional supporting information. This standard builds on the guidance in these ISO/IEC standards. It addresses some of the important differences between IACS and general business/information technology systems. It introduces the important concept that cyber security risks with IACS may have HSE implications and should be integrated with other existing risk management practices addressing these risks.

## **INDUSTRIAL COMMUNICATION NETWORKS – NETWORK AND SYSTEM SECURITY –**

### **Part 2-1: Establishing an industrial automation and control system security program**

#### **1 Scope**

This part of IEC 62443 defines the elements necessary to establish a cyber security management system (CSMS) for industrial automation and control systems (IACS) and provides guidance on how to develop those elements. This standard uses the broad definition and scope of what constitutes an IACS described in IEC/TS 62443-1-1.

The elements of a CSMS described in this standard are mostly policy, procedure, practice and personnel related, describing what shall or should be included in the final CSMS for the organization.

NOTE 1 Other documents in the IEC 62443 series and in the Bibliography discuss specific technologies and/or solutions for cyber security in more detail.

The guidance provided on how to develop a CSMS is an example. It represents the author's opinion on how an organization could go about developing the elements and may not work in all situations. The users of this standard will have to read the requirements carefully and apply the guidance appropriately in order to develop a fully functioning CSMS for an organization. The policies and procedures discussed in this standard should be tailored to fit within the organization.

NOTE 2 There may be cases where a pre-existing CSMS is in place and the IACS portion is being added or there may be some organizations that have never formally created a CSMS at all. The authors of this standard cannot anticipate all cases where an organization will be establishing a CSMS for the IACS environment, so this standard does not attempt to create a solution for all cases.

#### **2 Normative references**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC/TS 62443-1-12 – *Industrial communication networks – Network and system security – Part 1-1: Terminology, concepts and models*

#### **3 Terms, definitions, abbreviated terms, acronyms, and conventions**

##### **3.1 Terms and definitions**

For the purposes of this document, the terms and definitions given in IEC/TS 62443-1-1 and the following apply.

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<sup>2</sup> This standard is derived from ANSI/ISA 99.02.01:2009 and wholly replaces it for international use. It is intended that the second edition of IEC/TS 62443-1-1 be an International Standard, not a TS, after inclusion of some normative requirements to which conformance is possible.

### **3.1.1**

#### **access account**

access control function that allows the user access to a particular set of data or functions for certain equipment

NOTE Many times accounts are linked to user identifications (IDs) and passwords. These user IDs and passwords may be linked to an individual or group of individuals such as a control room work team performing the same set of operating tasks.

### **3.1.2**

#### **administrative practices**

defined and documented practices/procedures that individuals are personally accountable to follow at all times

NOTE These are usually in the conditions of employment for the organization. In the IACS environment, these often have HSE implications.

### **3.1.3**

#### **asset**

physical or logical object owned by or under the custodial duties of an organization, having either a perceived or actual value to the organization

[IEC/TS 62443-1-1, 3.2.6]

NOTE In this specific case, an asset is any item that should be protected as part of the CSMS.

### **3.1.4**

#### **authentication**

security measure designed to establish the validity of a transmission, message or originator or a means of verifying an individual's authorization to receive specific categories of information

[IEC/TS 62443-1-1, 3.2.13]

### **3.1.5**

#### **burner management system**

system for the safe start-up, monitoring and shutdown of burner systems associated with boilers, flares, incinerators, gas turbines, thermal oxidizers, and other fired equipment

### **3.1.6**

#### **business continuity plan**

document with identified procedures for recovering from a significant disruption and restoring business operations

NOTE 1 This umbrella term also refers to other aspects of disaster recovery, such as emergency management, human resources and media or press relations.

NOTE 2 A business continuity plan also identifies procedures for sustaining essential business operations while recovering from a significant disruption.

### **3.1.7**

#### **business continuity planning**

process to develop a business continuity plan

### **3.1.8**

#### **change management**

process of controlling and documenting any change in a system to maintain the proper operation of the equipment under control

### **3.1.9**

#### **compliance**

adherence to the requirements in one standard by another

Adapted from [ISO/IEC 10746-2, 15.1]

NOTE This is a relationship between two specifications, A and B, which holds when specification A makes requirements which are all fulfilled by specification B (when B complies with A)

### **3.1.10 conformance**

relationship between an implementation and a standard where any proposition that is true in the standard must be true in its implementation

Adapted from [ISO/IEC 10746-2, 15.1]

NOTE The conformance relationship holds when specific requirements in the specification (the conformance requirements) are met by the implementation. Conformance assessment is the process through which this relation is determined.

### **3.1.11 consequence**

result that occurs from a particular incident

### **3.1.12 critical**

very important device, computer system, process, and the like that, if compromised by an incident, could have high financial, health, safety or environmental (HSE) impact to an organization

### **3.1.13 cyber security management system**

program designed by an organization to maintain the cyber security of the entire organization's assets to an established level of confidentiality, integrity and availability, whether they are on the business side or the IACS side of the organization

### **3.1.14 device requirements**

countermeasure characteristics necessary for the devices within a zone to achieve the desired target security level

### **3.1.15 gatekeeper**

trusted individual that senior managers consult to prioritize issues they need to address over the remaining issues that others are more suited to address

### **3.1.16 health, safety and environment**

responsibility for protecting the health and safety of workers and the surrounding community and maintaining high environmental stewardship

### **3.1.17 human-machine interface**

aggregate of means by which people (the users) interact with a particular machine, device, computer program or other complex tool (the system)

NOTE In many cases, these involve video screens or computer terminals, push buttons, auditory feedback, flashing lights, and the like. The human-machine interface provides means of:

- Input, allowing the users to control the machine;
- Output, allowing the machine to inform the users.

### **3.1.18**

#### **incident**

event that is not part of the expected operation of a system or service that causes or may cause, an interruption to, or a reduction in, the quality of the service provided by the system

### **3.1.19**

#### **independent audit**

review of an organization (policies, procedures, processes, equipment, personnel, and the like) by an external group not affiliated with the organization

NOTE This may be required for public companies.

### **3.1.20**

#### **information technology**

computer-related assets of an organization that represent nonphysical assets, such as software applications, process programs and personnel files

NOTE 1 This use of the term information technology is not abbreviated throughout this document.

NOTE 2 Another use of the term information technology (IT) refers to the company's internal organization (for example, the IT department) or the items traditionally maintained by this department (that is, the administrative computers, servers and network infrastructure). This use of the term information technology is abbreviated as IT throughout this standard.

### **3.1.21**

#### **legacy system**

existing industrial automation and control system in a facility that may not be available as a commercial off the shelf (COTS) item

NOTE A legacy system may have been COTS at one time, but it may be no longer available and/or supported.

### **3.1.22**

#### **likelihood**

quantitative estimation that an action, event or incident may occur

### **3.1.23**

#### **local user**

user who is inside the perimeter of the security zone being addressed

NOTE A person in the immediate manufacturing area or control room is an example of a local user.

### **3.1.24**

#### **manufacturing execution system**

production scheduling and tracking system used to analyze and report resource availability and status, schedule and update orders, collect detailed execution data such as material usage, labor usage, operating parameters, order and equipment status and other critical information

NOTE 1 This system accesses bills of material, routing and other data from the base enterprise resource planning system and is typically used for real-time shop floor reporting and monitoring that feeds activity data back to the base system.

NOTE 2 Refer to IEC 62264-1 for additional information.

### **3.1.25**

#### **MAC address**

hardware address that differentiates one device on a network from another

### **3.1.26**

#### **operator**

particular type of user that is usually responsible for the correct operation of the equipment under control

**3.1.27****patch management**

area of systems management that involves acquiring, testing and installing multiple patches (code changes) to an administered computer system

NOTE Patch management tasks include: maintaining current knowledge of available patches, deciding which patches are appropriate for particular systems, ensuring that patches are installed properly, testing systems after installation and documenting all associated procedures, such as specific configurations required remotely across heterogeneous environments according to recognized best practices.

**3.1.28****process engineer**

person typically responsible for the technical aspects of the industrial operation and who uses the IACS and other tools to oversee and manage the industrial automation in the facility

**3.1.29****process information management system**

set of systems that provides supporting information to assist with the operation of the facility

**3.1.30****programmable logic controller**

programmable microprocessor-based device that is used in industry to control assembly lines and machinery on the shop floor as well as many other types of mechanical, electrical and electronic equipment in a plant.

NOTE Typically programmed as in [14], a PLC is designed for real time use in rugged, industrial environments. Connected to sensors and actuators, PLCs are categorized by the number and type of I/O ports they provide and by their I/O scan rate.

**3.1.31****process safety management**

regulation intended to prevent a disaster in chemical and biotechnology systems by addressing sound management and engineering design.

**3.1.32****remote access**

communication with, or use of, assets or systems within a defined perimeter from any location outside that perimeter

**3.1.33****remote user**

user who is outside the perimeter of the security zone being addressed

EXAMPLE A person in an office in the same building, a person connecting over the corporate wide area network (WAN) and a person connecting over public infrastructure networks are all remote users.

**3.1.34****risk assessment**

process of identifying and evaluating risks to the organization's operations (including mission, functions, image, or reputation), the organization's assets or individuals by determining the likelihood of occurrence, the resulting impact, and additional countermeasures that would mitigate this impact

NOTE Synonymous with risk analysis and incorporates threat and vulnerability analyses.

**3.1.35****risk mitigation**

actions to reduce the likelihood and/or severity of an event

**3.1.36**

**risk tolerance**

risk the organization is willing to accept

**3.1.37**

**self-assessment**

review of an organization (that is, policies, procedures, operations, equipment and personnel) by a group inside the organization

NOTE This group may be either directly associated with the organization's business process or may be in another part of the organization, but should be intimately familiar with the risks associated with that business process.

**3.1.38**

**Six Sigma®**

process-focused methodology designed to improve business performance through improving specific areas of strategic business processes

**3.1.39**

**social engineering**

practice of obtaining confidential information by manipulation of legitimate users

**3.1.40**

**stakeholder**

individual or group with an interest in the success of an organization in delivering intended results and maintaining the viability of the organization's products and services

NOTE Stakeholders influence programs, products and services. In this particular case, stakeholders are personnel in an organization responsible for promoting and overseeing the cyber security process. These personnel include the manager of the cyber security program as well as the cross-functional team of individuals from all of the departments affected by the cyber security program.

**3.1.41**

**system administrator**

person(s) responsible for managing the security of the computer system

NOTE This may include operating system maintenance, network management, account administration and patch management, in accordance with the change management process.

**3.1.42**

**system requirements**

attributes of the desired target security level

**3.1.43**

**ushered access  
shadowing**

procedure for monitoring the actions of a remotely connected user

**3.1.44**

**vulnerability assessment**

formal description and evaluation of the vulnerabilities in a system

**3.2 Abbreviated terms and acronyms**

This subclause defines the abbreviated terms and acronyms used in this document.

ANSI	American National Standards Institute
CFR	U.S. Code of Federal Regulations
ChemITC	Chemical Information Technology Center of the American Chemistry Council
COTS	Commercial off the shelf



CPU	Central processing unit
CSCSP	Chemical Sector Cyber Security Program
CSMS	Cyber security management system
CSVA	Cyber security vulnerability assessment
DCS	Distributed control system
DMZ	Demilitarized zone
DoS, DDoS	Denial of service, Distributed denial of service
FDN	Field device network
FTP	File transfer protocol
HMI	Human machine interface
HSE	Health, safety and environmental
HVAC	Heating, ventilation, and air-conditioning
IACS	Industrial automation and control system(s)
ID	Identification
IEC	International Electrotechnical Commission
IEEE	The Institute of Electrical and Electronics Engineers
IP	Internet protocol
ISA	International Society of Automation
ISO	International Organization for Standardization
IT	Information technology
KPI	Key performance indicator(s)
LAN	Local area network
MAC	Media access control
MES	Manufacturing execution system
NERC	North American Electric Reliability Council (applies to U.S. and Canada)
NIST	U.S. National Institute of Standards and Technology
OS	Operating system
PC	Personal computer
PCN	Process control network
PCSRF	NIST Process Control Security Requirements Forum
PIM	Process information management
PIN	Personal identification number
PLC	Programmable logic controller
PSM	Process safety management
RAID	Redundant array of independent disks
RCN	Regulatory control network
SANS	SysAdmin, Audit, Networking, and Security Institute
SCADA	Supervisory control and data acquisition
SI	International System of Units