IEC 62682

Edition 2.0 2022-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Management of alarm systems for the process industries

Gestion de systèmes d'alarme dans les industries de transformation



IEC 62682:2022-12(en-fr)



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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Management of alarm systems for the process industries

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INTERNATIONAL
ELECTROTECHNICAL
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INTERNATIONALE

ICS 13.320; 25.040.40

ISBN 978-2-8322-5885-9

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MANAGEMENT OF ALARM SYSTEMS FOR THE PROCESS INDUSTRIES

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IEC 62682 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes minor technical changes with respect to the previous edition, based on changes to ANSI/ISA-18.2:2016. These include the inclusion of packaged systems in the scope (Clause 1), definitions (Clause 3) and alarm system requirements specification (Clause 7). There are changes to improve clarity in wording throughout the document.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65A/1046/FDIS	65A/1064/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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- withdrawn,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

INTRODUCTION

This International Standard addresses the development, design, installation, and management of alarm systems in the process industries. Alarm management includes multiple work processes throughout the alarm management life cycle. This document defines the terminology and models to develop an alarm system, and it defines the work processes recommended to effectively maintain the alarm throughout the life cycle. Ineffective alarm systems have often been cited as contributing factors in the investigation reports following major process incidents. This document is intended to provide a methodology that will result in the improved safety, quality, and operation in the process industries.

The first edition of this document was adapted from ANSI/ISA-18.2-2009, *Management of Alarm Systems for the Process Industries*, an International Society of Automation (ISA) standard, and with due consideration of other guidance documents that have been developed throughout industry. This second edition has incorporated some changes made in ANSI/ISA-18.2-2016.

This document is not the first effort to define terminology and practices for effective alarm systems. In 1999 the Engineering Equipment and Materials Users' Association (EEMUA) issued Publication 191, *Alarm Systems: A Guide to Design, Management and Procurement*, with the 2nd edition published in 2007 and the 3rd edition published in 2013. In 2003 the User Association of Process Control Technology in Chemical and Pharmaceutical Industries (NAMUR) issued worksheet NA 102, *Alarm Management*, which was updated in 2008. During the development and maintenance of this document, every effort was made to keep terminology and practices consistent with the previous work of these respected organizations and committees.

This document provides requirements for alarm management and alarm systems. It is intended for those individuals and organizations that

a) manufacture or implement embedded alarm systems,

b) manufacture or install third-party alarm system software,

c) design or install alarm systems,

d) operate and maintain alarm systems, and

e) audit or assess alarm system performance.

This document is organized in parts. The first part (Clause 1 to Clause 3) are normative without any mandatory requirements. Clause 4 contains mandatory requirements. Clause 5 is normative without any mandatory requirements. The main body of the standard (Clause 6 to Clause 18), describes mandatory requirements and non-mandatory recommendations.

Within this document, mandatory requirements are stated with "shall", non-mandatory recommendations are stated with "should", and permissible requirements are stated with "may". The phase "is required" indicates the requirement has been stated previously in the document.

MANAGEMENT OF ALARM SYSTEMS FOR THE PROCESS INDUSTRIES

1 Scope

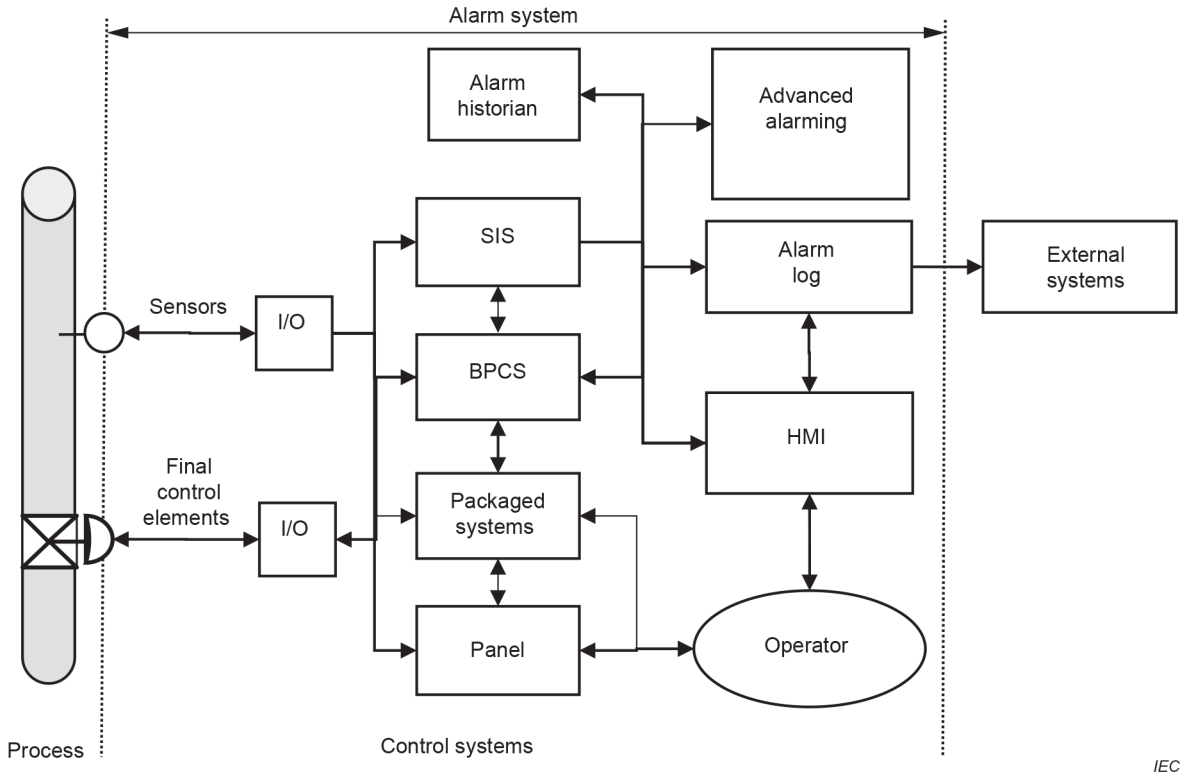
1.1 General applicability

This document specifies general principles and processes for the management of alarm systems based on controls system and human-machine interfaces (HMI) for facilities in the process industries. It covers all alarms to be presented to the operator through the control system, which includes alarms from basic process control systems, annunciators, packaged systems, and safety instrumented systems.

The practices in this document are applicable to continuous, batch, and discrete processes. There can be differences in implementation to meet the specific needs based on process type.

The primary function within the alarm system is to notify operators of abnormal process conditions or equipment malfunctions and support the response. The alarm systems can include both the basic process control system (BPCS) and the safety instrumented system (SIS), each of which uses measurements of process conditions and logic to generate alarms. Figure 1 illustrates the concepts of alarm and response dataflow through the alarm system. The alarm system also includes a mechanism for communicating the alarm information to the operator via an HMI, usually a computer screen or an annunciator. Additional functions of the alarm system are an alarm and event log, an alarm historian, and the generation of performance metrics for the alarm system. There are external systems that can use the data from the alarm system.

Figure 1 is not intended to represent physical wiring.



NOTE 1 Packaged systems (e.g., refrigeration machines) can be included in the control system.

NOTE 2 Panel can refer to annunciator panel or other panel types.

NOTE 3 The lines are intended to represent data flow and not physical wiring.

Figure 1 – Alarm system dataflow

1.2 Exclusions and inclusions

1.2.1 Operators

The functions of the operator receiving and responding to alarms are included in the scope of this document. Management of operators is excluded from the scope of this document.

1.2.2 Process sensors and final control elements

The alarms implemented in sensors and final control elements are included in the scope of this document. The design and management of process sensors and final control elements are excluded from the scope of this document.

1.2.3 Annunciators

The integration of annunciators into an alarm system is included in the scope of this document. The specification and design of annunciators is excluded from the scope of this document.

1.2.4 Human machine interface

The appearance of alarms in the HMI and functions of alarm related displays are included in the scope of this document. The design and maintenance of the HMI are excluded from this document.

NOTE ANSI/ISA-101.01-2015 provides information on HMI design and maintenance.

1.2.5 Safety instrumented systems

The alarms implemented in a safety instrumented system are included in the scope of this document. The design and management of safety instrumented systems are excluded from this document.

NOTE IEC 61511-1 provides information on safety instrumented systems.

1.2.6 Fire and gas detection and protective systems

The alarms from fire and gas detection and protective systems presented to the operator through the control system are included in the scope of this document. The design and management of fire and gas detection and protective systems is excluded from the scope of this document.

1.2.7 Security systems

The alarms from security systems presented to the operator through the control system are included in the scope of this document. The design and management of security systems is excluded from the scope of this document.

1.2.8 Packaged systems

The alarms from packaged systems presented to the operator through the control system are included in the scope of this document. The design and management of packaged systems is excluded from the scope of this document.

1.2.9 Event data

The indication and processing of analog, discrete, and event data other than alarm indications are excluded from the scope of this document. The analysis techniques using both alarm and event data are excluded from the scope of this document.

1.2.10 Alarm identification methods

Required methods of alarm identification are not specified in this document. Examples of alarm identification methods are listed.

1.2.11 Management of change

A specific management of change (MOC) procedure is not included in this document. Some requirements and recommendations for an MOC procedure are included.

1.2.12 Purchase specification

This document is not intended to be used as an alarm system purchase specification.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions, and acronyms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
absolute alarm
alarm generated when the alarm setpoint is exceeded

EXAMPLE: High-high, high, low, low-low.

3.1.2
acknowledge
operator action that confirms recognition of an alarm

3.1.3
active
alarm state in which the alarm condition is true

Note 1 to entry: Functions such as deadband, on or off delays and latching can allow the alarm to be active when the alarm condition is false or the alarm to not be active when the alarm condition is true.

3.1.4
adaptive alarm
alarm for which the setpoint is changed by an algorithm

EXAMPLE: Setpoint calculated based on production rate.

3.1.5
adjustable alarm
operator-set alarm
alarm for which the setpoint can be changed manually by the operator

3.1.6
advanced alarming
collection of techniques that can help manage annunciations during specific situations

EXAMPLE: State-based alarming.

3.1.7
alarm
audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a timely response

3.1.8
annunciation
alarm annunciation
function of the alarm system to call the attention of the operator to an alarm

3.1.9
alarm attribute
setting for an alarm within the control system

EXAMPLE: Alarm priority.

3.1.10
alarm banner
graphic element that lists annunciated alarms with selected information

Note 1 to entry: Return to normal indications can also appear on the alarm summary.

Note 2 to entry: Information can include the date, time, priority, and alarm type.

3.1.11
alarm class
group of alarms with common set of alarm management requirements

EXAMPLE: Safety related alarm class.

3.1.12
alarm deadband
change in signal from the alarm setpoint necessary for the alarm to return to normal

3.1.13
alarm flood
condition during which the alarm rate is greater than the operator can effectively manage

EXAMPLE: More than 10 alarms per 10 minutes.

3.1.14
alarm group
set of alarms with common association

EXAMPLE: Grouping alarms by process unit, process area, equipment set, or service.

3.1.15
alarm historian
long term repository for alarm records

3.1.16
alarm log
short term repository for alarm records

3.1.17
alarm management
alarm system management
collection of processes and practices for determining, documenting, designing, operating, monitoring, and maintaining alarm systems

3.1.18
alarm message
text string displayed with the alarm indication that provides additional information to the operator

EXAMPLE: Message with operator action or probable cause.

3.1.19
alarm off-delay
debounce
time an alarm remains active after the process measurement has returned within the alarm setpoint

3.1.20
alarm on-delay
time before an alarm becomes active after the process measurement has exceeded the alarm setpoint

3.1.21
alarm philosophy
document that establishes the basic definitions, principles, and processes to design, implement, and maintain an alarm system

3.1.22
alarm priority
relative importance assigned to an alarm within the alarm system to indicate the urgency of response

EXAMPLE: Priority can use seriousness of consequences and allowable response time to determine urgency.

3.1.23
alarm rate
number of annunciated alarms, per operator, in a specific time interval

3.1.24
alarm record
record
set of information which documents an alarm state change

3.1.25
alarm response procedure
guidance for response to an alarm

Note 1 to entry: The guidance can be in many forms and not only in the form of a procedure document.

Note 2 to entry: The guidance can include operator action, probable cause, and other information.

3.1.26
alarm setpoint
alarm limit
alarm trip point
threshold value of a process variable or discrete state that is used to determine the active state of the alarm

3.1.27
alarm summary
alarm list
display that lists annunciated alarms with selected information

Note 1 to entry: Return to normal indications can also appear on the alarm summary.

Note 2 to entry: Information can include the date, time, priority, and alarm type.

3.1.28
alarm system
system for generating and handling alarms to help the operator manage abnormal situations

Note 1 to entry: The operator is included in the alarm system. See Figure 1.

3.1.29
alarm system requirements specification
document which describes the functional requirements of the alarm system

3.1.30
alarm type
alarm attribute which gives a distinction of the alarm condition

EXAMPLE: Low process variable alarm, high process variable alarm, and discrepancy alarm.

3.1.31
allowable response time
maximum time between the annunciation of the alarm and when the operator must take corrective action to avoid the consequence

3.1.32
annunciator
device or group of devices that call attention to changes in process conditions

3.1.33
assessment
comparison of information from monitoring and additional qualitative (subjective) measurements against stated goals and defined performance metrics

3.1.34
audit <of alarm management>
comprehensive assessment that includes the evaluation of alarm system performance and of the work practices used to administer the alarm system

3.1.35
bad-measurement alarm
alarm generated when the signal for a process measurement is outside the expected range

EXAMPLE: Bad-measurement alarm generated at 3,8 mA for a 4 mA to 20 mA signal.

3.1.36
basic process control system
BPCS
system which responds to input signals from the process, its associated equipment, other programmable systems and/or operators and generates output signals causing the process and its associated equipment to operate in the desired manner but which does not perform any safety instrumented function

Note 1 to entry: A BPCS includes all of the devices necessary to ensure that the process operates in the desired manner.

Note 2 to entry: A BPCS typically may implement various functions such as process control functions, monitoring, and alarms.

[SOURCE: IEC 61511-1:2016, 3.2.3, modified − “SIF” has been changed to "safety instrumented function"]

3.1.37
benchmark
initial audit of an alarm system designed to specifically identify problem areas for the purpose of formulating improvement plans

3.1.38
bit-pattern alarm
alarm that is generated when a pattern of digital signals matches a predetermined pattern

3.1.39
calculated alarm
alarm generated from a calculated value instead of a direct process measurement

3.1.40
call-out alarm
alarm that notifies and informs an operator by means other than, or in addition to, the operator console

EXAMPLE: Alarm annunciated via pager or telephone.

3.1.41
chattering alarm
alarm that repeatedly transitions between the active state and the not active state in a short period of time

3.1.42
classification
process of separating alarms into alarm classes based on common requirements

Note 1 to entry: Requirements can include testing, training, and auditing.

3.1.43
console
operator console
hardware, software, and furniture or enclosure at which users monitor and/or control the process, which can include multiple stations, communication devices, and other devices

Note 1 to entry: The span of control of the operator is usually determined by the information available at the operator console.

3.1.44
control system
system that responds to input signals from the equipment under control and/or from an operator and generates output signals that cause the equipment under control to operate in the desired manner

Note 1 to entry: The control system can include one or more basic process control systems (BPCS), safety instrumented systems (SIS).

Note 2 to entry: The control system can include one or more packaged systems.

[SOURCE: IEC 61508-4:2010, 3.3.3, "EUC" has been deleted from the term defined, "from the process" has been changed to "from the equipment under control", "causing" has been changed to "that cause", notes have been modified]

3.1.45
controller-output alarm
alarm generated from the output signal of a control algorithm instead of a direct process measurement

EXAMPLE: Alarm on output on PID controller.

3.1.46
decommission
process to remove an alarm from the alarm system

3.1.47
deviation alarm
alarm generated when the difference between two values exceeds an alarm setpoint

EXAMPLE: Alarm on deviation between primary and redundant instruments or a deviation between process variable and controller setpoint.

3.1.48
discrepancy alarm
mismatch alarm
alarm generated by the difference between the expected plant or device state to its actual state

EXAMPLE: Alarm when a motor fails to start after it is commanded to the on state.

3.1.49
display
visual representation of information used by the operator for monitoring and control

3.1.50
dynamic alarming
automatic modification of alarm attributes based on process state or conditions

3.1.51
enforcement
enhanced alarming technique that can verify and restore alarm attributes in the control system to the values in the master alarm database

3.1.52
event
representation of a solicited or unsolicited fact indicating a state change

EXAMPLE: Mode changes and device state changes.

[SOURCE: IEC 62264-2:2013, 3.1.2, modified – "in the enterprise" has been deleted and an example has been added.]

3.1.53
first-out alarm
first-up alarm
alarm determined to be the first in a multiple-alarm scenario

Note 1 to entry: The first alarm is determined by logic.

3.1.54
fleeting alarm
alarm that transitions between an active alarm state and a not active alarm state in a short period of time without rapidly repeating

3.1.55
highly managed alarm
HMA
alarm belonging to a class with additional requirements above general alarms

Note 1 to entry: Regulatory requirements can be additional requirements.

EXAMPLE: Safety related alarm.

3.1.56
human machine interface
HMI
collection of hardware and software used by the operator and others to monitor and interact with the control system and with the process via the control system

3.1.57
implementation
transition stage between design and operation during which the alarm is put into service

Note 1 to entry: Implementation includes activities such as commissioning and training.

3.1.58
instrument diagnostic alarm
alarm to indicate a field device or signal fault

EXAMPLE: Out-of-range alarm.

3.1.59
interim alarm
alarm used on a temporary basis to replace an out-of-service alarm

3.1.60
latching alarm
alarm that remains in alarm state after the process condition has returned to normal and requires an operator reset before the alarm returns to normal

3.1.61
master alarm database
authorized list of rationalized alarms and associated attributes

Note 1 to entry: The list can be in many forms and not only in the form of a database.

3.1.62
monitoring
measurement and reporting of quantitative (objective) aspects of alarm system performance

3.1.63
nuisance alarm
alarm that annunciates excessively, unnecessarily, or does not return to normal after the operator action is taken

EXAMPLE: Chattering alarm, fleeting alarm, and stale alarm.

3.1.64
operator
controller
person who monitors and makes changes to the process

3.1.65
operator alert
audible and/or visible means of indicating to the operator an equipment or process condition for evaluation when time allows which could result in a response

3.1.66
out-of-service
state of an alarm during which the alarm indication is indefinitely suppressed, typically manually, for reasons such as maintenance

3.1.67
packaged system
self-contained combination of hardware and software that can provide alarm, HMI, and control functionality for a specific process function that is part of a facility

3.1.68
plant state
plant mode
defined set of operational conditions for a process plant

EXAMPLE: Shutdown, normal operation.

3.1.69
prioritization
process of assigning a level of operational importance to an alarm

3.1.70
process area
physical, geographical or logical grouping of resources determined by the site

3.1.71
rate-of-change alarm
alarm generated when the change in process variable per unit time ($\mathrm{d}PV/\mathrm{d}t$) exceeds a defined setpoint

3.1.72
rationalization
process to review potential alarms using the principles of the alarm philosophy, to select alarms for design, and to document the rationale for each alarm

3.1.73
re-alarming alarm
re-triggering alarm
alarm that is automatically re-annunciated under certain conditions

3.1.74
recipe-driven alarm
alarm with setpoints that depend on the recipe that is currently being executed

3.1.75
remote alarm
alarm from a remotely operated facility or directed to a remote interface

3.1.76
reset
operator action that unlatches a latching alarm

3.1.77
return to normal
clear
alarm transition from an active alarm state to a not active alarm state

3.1.78
safety instrumented system
SIS
instrumented system used to implement one or more safety instrumented functions

Note 1 to entry: A SIS is composed of any combination of sensor (s), logic solver (s), and final elements(s). It also includes communication and ancillary equipment (e.g., cables, tubing, power supply, impulse lines, heat tracing).

Note 2 to entry: A SIS may include software.

Note 3 to entry: A SIS may include human action as part of a SIF (see ISA TR 84.00.04:2015, part 1).

[SOURCE: IEC 61511-1:2016, 3.2.67, modified – Removed figure from notes and reference to figure from note 1]

3.1.79
safety related alarm
safety alarm
alarm that is classified as critical for the protection of human life or the environment

EXAMPLE: An alarm indicating a potential asphyxiation hazard.

3.1.80
shelve
temporarily suppress an alarm, initiated by the operator, with engineering controls to unsuppress the alarm

Note 1 to entry: Engineering controls can include time limits.

3.1.81
silence
operator action that terminates the audible alarm indication

3.1.82
stale alarm
alarm that remains annunciated for an extended period of time

EXAMPLE: Alarm that remains annunciated for 24 hours.

3.1.83
state-based alarm
mode-based alarms
alarm that has attributes modified or is suppressed based on operating states or process conditions

3.1.84
statistical alarm
alarm generated based on statistical processing of a process variable or variables

3.1.85
suppress
prevent the annunciation of the alarm to the operator when the alarm is active

EXAMPLE: Shelve, suppress by design, remove from service.

3.1.86
suppress by design
alarm annunciation to the operator prevented based on plant state or other conditions

3.1.87
system diagnostic alarm
alarm generated by the control system to indicate a fault within the system hardware, software or components

EXAMPLE: Communication error.

3.1.88
tag
control system point
point
unique identifier assigned to a process measurement, calculation, or device within the control system

3.1.89
unacknowledged
alarm state in which the operator has not yet confirmed recognition of an alarm indication

3.1.90
unshelve
transition from the shelved alarm state to the normal or unacknowledged state

3.1.91
unsuppress
transition from a suppressed alarm state to the normal or unacknowledged state

3.2 Abbreviated terms

ACKED	Acknowledged
ASRS	Alarm system requirements specification
BPCS	Basic process control system
CGMP	Current good manufacturing practice
DSUPR	Suppressed-by-design
ERP	Enterprise resource planning
FMEA	Failure mode and effects analysis
HAZOP	Hazard and operability study
HMA	Highly managed alarms
HMI	Human machine interface
I/O	Input/output
LOPA	Layer of protection analysis
MES	Manufacturing execution system
MOC	Management of change
NORM	Normal
OOSRV	Out-of-service
P&ID	Piping (or process) and instrumentation diagram
PHA	Process hazards analysis
RTNUN	Return to normal unacknowledged
SHLVD	Shelved
SIS	Safety instrumented system
UNACK	Unacknowledged