

AMERICAN NATIONAL STANDARD
ANSI/ISA-18.2-2016

**Management of Alarm Systems
for the Process Industries**

Approved 17 March 2016



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ANSI/ISA-18.2-2016
Management of Alarm Systems for the Process Industries

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Preface

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Introduction

Purpose

This 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 lifecycle. This standard defines the terminology and models to develop an alarm system, and it defines the work processes recommended to effectively maintain the alarm system throughout the lifecycle.

This standard was written as an extension of existing ISA standards with due consideration of other guidance documents that have been developed throughout industry. Ineffective alarm systems have often been cited as contributing factors in the investigation reports following major process incidents. This standard is intended to provide a methodology that will result in the improved safety, quality, and operation in the process industries.

This standard is not the first effort to define terminology and practices for effective alarm systems. In 1955 ISA formed a survey committee titled Instrument Alarms and Interlocks. The committee evolved to Standard & Practices Committee 18. In 1965 the committee completed ISA-RP18.1, *Specifications and Guides for the Use of General Purpose Annunciators*. In 1979 ISA released, as a product of the ISA18 and ISA67 committees, ISA-18.1-1979 (R2004), *Annunciator Sequences and Specifications*. In 1994 Amoco, Applied Training Resources, BP, Exxon, Gensym, Honeywell, Mobil, Novacor, Texaco, Shell, and others formed the Abnormal Situation Management Consortium (ASM) to develop a vision for better response to process incidents, with additional support in 1994 from the U.S. National Institute of Standards and Technology (NIST). In 1999 the Engineering Equipment and Materials Users' Association (EEMUA) issued Publication 191, *Alarm Systems: A Guide to Design, Management and Procurement*, which was updated in 2007, and again in 2013. In 2003 the User Association of Process Control Technology in Chemical and Pharmaceutical Industries (NAMUR) issued recommendation NA 102, *Alarm Management*. This ISA standard was originally issued in 2009, and International Electrotechnical Commission (IEC) developed IEC 62682 from that version and issued it in 2014.

During the development and maintenance of this standard 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 implement third-party alarm system software,
- c) design or implement alarm systems,
- d) operate and maintain alarm systems, and
- e) audit or assess alarm system performance.

Organization

This standard is organized in two parts. The first part is introductory in nature, (Clauses 1 to 5). The main body of the standard follows (Clauses 6 to 18), which presents mandatory requirements and non-mandatory recommendations as noted.

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1 Scope

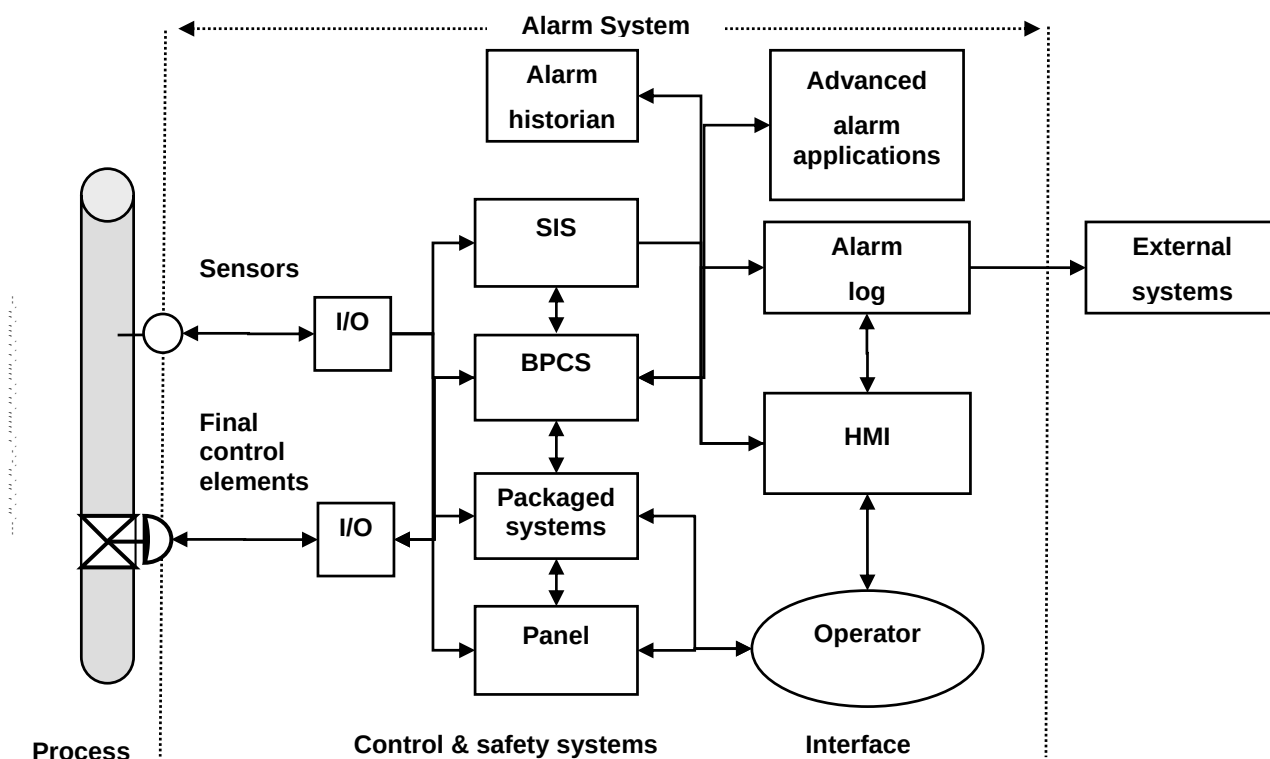
1.1 General applicability

This standard specifies general principles and processes for the lifecycle management of alarm systems based on programmable electronic controller and computer-based human-machine interface (HMI) technology for facilities in the process industries. It covers all alarms presented to the operator through the control system, which includes alarms from basic process control systems, annunciator panels, packaged systems (e.g., fire and gas systems, and emergency response systems), and safety instrumented systems.

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

In jurisdictions where the governing authorities (e.g., national, federal, state, province, county, city) have established process safety design, process safety management, or other requirements, in addition to the requirements of this standard, these should be taken into consideration.

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 panel. 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.



NOTE Other packaged systems (i.e., fire and gas systems) can be included in the control system.

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 standard. Management of operators is excluded from the scope of this standard.

1.2.2 Process sensors and final control elements

The alarms from sensors and final control elements are included in the scope of this standard. Process sensors and final control elements are shown in Figure 1 to indicate alarms can be implemented in these devices. The design and management of process sensors and final control elements are excluded from the scope of this standard.

1.2.3 Annunciator panels

The integration of independent alarm annunciator panels into an alarm system is included in the scope of this standard. The specification and design of annunciator panels is excluded from the scope of this standard. ISA-18.1-1979 (R2004), *Annunciator Sequences and Specifications*, provides information on alarm annunciator functions.

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 standard. The design and maintenance of the HMI are excluded from this standard. ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems*, provides information on HMI.

1.2.5 Safety instrumented systems

The alarms from safety instrumented systems are included in the scope of this standard. The safety instrumented system (SIS) is shown in Figure 1 to indicate alarms can be implemented in these devices. The design and management of safety instrumented systems are excluded from this standard. ISA-84.00.01, *Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 1: Framework, Definitions, System, Hardware and Software Requirements*, provides information on safety instrumented systems.

1.2.6 Fire detection and protective systems and security systems

The alarms and diagnostics from fire detection and protective systems or security systems that are presented to the operator through the control system are included in the scope of this standard. The design and management of fire detection and protective systems and security systems are excluded from the scope of this standard.

1.2.7 Event data

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

1.2.8 Alarm identification methods

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

1.2.9 Management of change

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

1.2.10 Purchase specification

This standard is not intended to be used as an alarm system purchase specification. It does not eliminate the need for sound engineering judgment. No particular technology is mandated.

2 Normative references

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

ISA-84.00.01-2004 (IEC 61511 Mod) Part 1, *Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 1: Framework, Definitions, System, Hardware and Software Requirements*

ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems*

3 Terms, definitions, and acronyms

For the purposes of this document, the following definitions apply.

3.1 Terms and definitions

3.1.1

absolute alarm

alarm generated when the alarm setpoint is exceeded (e.g., high-high, high, low, low-low)

3.1.2

acknowledge

operator action that confirms recognition of an alarm

3.1.3

active

an alarm in a 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 (e.g., 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**(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 process control system

EXAMPLE: alarm priority

3.1.10**alarm class**

group of alarms with common set of alarm management requirements (e.g., testing, training, monitoring, and audit requirements)

EXAMPLE: safety related alarm class

3.1.11**alarm deadband**

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

3.1.12**(alarm) filtering**

function which selects alarm records to be displayed according to a given element or elements of the alarm record

3.1.13**alarm flood**

condition during which the alarm rate is greater than the operator can effectively manage (e.g., more than 10 alarms per 10 minutes)

3.1.14**alarm group**

set of alarms with common association (e.g., 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 (e.g., operator action)

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 (e.g., seriousness of consequences and allowable response time)

3.1.23

alarm rate

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

3.1.24

(alarm) record

set of information which documents an alarm state change

3.1.25

alarm response procedure

guidance for response to an alarm (e.g., operator action, probable cause)

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

3.1.26**alarm setpoint****alarm limit****alarm trip point**

threshold value of a process variable or discrete state that is used to determine if the alarm is active

3.1.27**(alarm) sorting**

function which orders alarm records to be displayed according to a given element of alarm record

3.1.28**alarm summary****alarm list**

display that lists annunciated alarms with selected information (e.g., date, time, priority, and alarm type).

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

3.1.29**alarm system**

collection of hardware and software that detects an alarm state, communicates the indication of that state to the operator, and records changes in the alarm state

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

3.1.30**alarm system requirements specification**

document which describes the functionality of the alarm system

3.1.31**alarm type**

alarm attribute which gives a distinction of the alarm condition

EXAMPLE: low process variable alarm, high process variable alarm, or discrepancy alarm

3.1.32**alert**

audible and/or visible means of indicating to the operator an equipment or process condition that requires awareness and which does not meet the criteria for an alarm

3.1.33**allowable response time**

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

3.1.34**annunciator**

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

3.1.35

assessment

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

3.1.36

audit

comprehensive assessment that includes the evaluation of alarm system performance and of the work practices used to administer the alarm system

3.1.37

bad-measurement alarm

alarm generated when the signal for a process measurement is outside the expected range (e.g., 3.8mA for a 4 to 20mA signal)

3.1.38

benchmark

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

3.1.39

bit-pattern alarm

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

3.1.40

calculated alarm

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

3.1.41

call-out alarm

alarm that notifies and informs an operator by means other than, or in addition to, a console display (e.g., pager or telephone)

3.1.42

chattering alarm

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

3.1.43

classification

process of separating alarms into alarm classes based on common requirements (e.g., testing, training, monitoring, and auditing requirements)

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), or packaged systems.

3.1.45**controller-output alarm**

alarm generated from the output signal of a control algorithm (e.g., PID controller) instead of a direct process measurement

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 (e.g., 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 (e.g., 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

Note 1 to entry: For example, mode changes or device state changes.

[SOURCE IEC 62264-2:2013, modified – a note has been added.]

3.1.53

first-out alarm

first-up alarm

alarm determined (i.e., by first-out logic) to be the first, in a multiple-alarm scenario

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 (e.g., regulatory requirements) above general alarms

EXAMPLE: safety alarm

3.1.56

human machine interface (HMI)

collection of hardware and software used by the operator 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**

the 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, or stale alarm

3.1.64**operator****controller**

person who monitors and makes changes to the process

3.1.65**(operator) console**

interface for an operator to monitor and/or control the process, which may include multiple displays or annunciators, and defines the boundaries of the operator's span of control

3.1.66**operator station**

human-machine interface within the operator console

Note 1 to entry: Operator station can include multiple screens.

3.1.67**out-of-service**

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

3.1.68**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

3.1.69**plant state****plant mode**

defined set of operational conditions for a process plant

EXAMPLE: shutdown, normal operation

3.1.70**prioritization**

process of assigning a level of operational importance to an alarm

3.1.71

process area

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

[SOURCE: IEC 62264-1:2013, 3.1]

3.1.72

rate-of-change alarm

alarm generated when the change in process variable per unit time (dPV/dt) exceeds a defined setpoint

3.1.73

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

3.1.74

re-alarms alarm

re-triggering alarm

alarm that is automatically re-annunciated to the operator under certain conditions

3.1.75

recipe-driven alarm

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

3.1.76

remote alarm

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

3.1.77

reset

operator action that unlatches a latched alarm

3.1.78

return to normal

clear

alarm transition from an active alarm state to a not active alarm state

3.1.79

safety alarm

safety related alarm

an alarm that is classified as critical to process safety for the protection of human life or the environment

3.1.80**safety instrumented system (SIS)**

instrumented system used to implement one or more safety instrumented functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final elements(s)

[SOURCE: IEC 61511]

Note 1 to entry: This can include either safety instrumented control functions or safety instrumented protection functions or both.

3.1.81**shelve**

temporarily suppress an alarm, initiated by the operator, with engineering controls (e.g., time-limited) that unsuppress the alarm

3.1.82**silence**

operator action that terminates the audible alarm indication

3.1.83**stale alarm**

alarm that remains annunciated for an extended period of time (e.g., 24 hours)

3.1.84**state-based alarm****mode-based alarms**

alarm that has attributes modified or is suppressed based on operating states or process conditions

3.1.85**statistical alarm**

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

3.1.86**suppress**

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

EXAMPLE: shelve, suppress by design, remove from service

3.1.87**suppressed by design**

alarm annunciation to the operator prevented based on plant state or other conditions

3.1.88**system diagnostic alarm**

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

EXAMPLE: communication error

3.1.89

tag

point

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

3.1.90

unacknowledged

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

3.2 Abbreviations

ACKED	Acknowledged
ASRS	Alarm system requirements specification
BPCS	Basic process control system
cGMP	current good manufacturing practice
DSUPR	Designed suppression
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

4 Conformance to this standard

4.1 Conformance guidance

To conform to this standard, it shall be shown that each of the mandatory requirements has been satisfied.

4.2 Existing systems

For existing alarm systems designed and constructed in accordance with codes, standards, or practices prior to the issue of this standard, the owner/operator shall determine that the equipment is designed, maintained, inspected, tested, and operated in a safe manner. The