IEC 62382

Edition 3.0 2024-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Control systems in the process industry – Electrical and instrumentation loop check

Systèmes de commande dans l'industrie de transformation – Contrôle de boucle des circuits électriques et des appareillages

IEC 62382:2024-08(en-fr)

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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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTROL SYSTEMS IN THE PROCESS INDUSTRY – ELECTRICAL AND INSTRUMENTATION LOOP CHECK

FOREWORD

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IEC 62382 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) general re-organization of the content of the previous edition, moving informative content to the annexes;
b) replacing the forms based on I/O type in IEC 62382:2012, Annex A to Annex E with an example of a generic loop check form;

c) providing additional references to other applicable standards.

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

Draft	Report on voting
65E/1082/FDIS	65E/1114/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/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The inspection and verification of the individual measurements and controls in conjunction with the control systems used to monitor these devices is referred to as loop check. In industry, numerous methods and philosophies are used to check the instrumentation and controls after mechanical installation within projects for modified or new facilities.

This document was created to provide a better understanding of what loop check consists of and also to provide a standard methodology for executing a loop check.

Annex A provides examples of checks for various loop components to aid the user in establishing the desired loop check plans for a specific project. Annex B provides an example of a loop check form.

CONTROL SYSTEMS IN THE PROCESS INDUSTRY – ELECTRICAL AND INSTRUMENTATION LOOP CHECK

1 Scope

1.1 General applicability

This document defines procedures and specifications for loop check, which comprises the activities between the completion of the loop construction (including installation and point-to-point checks) and the beginning of cold commissioning. This document is applicable for the construction of new plants and for expansion or retrofits (i.e. revamping) of electrical and instrument (E&I) installations in existing plants (including PLC, DCS, panel-mounted and field instrumentation). It does not include a detailed checkout of power distribution systems, except as they relate to the loops being checked (i.e. a motor starter or a power supply to a four-wire transmitter). Loop checks can be performed throughout the lifecycle of the plant. This document is also applicable when loop checks are performed after commissioning. This document describes what is intended to be tested but not how the test is performed, due to the wide range of technologies and equipment available.

The intent of this document is to provide a means for all parties, including the owner, the installer and the vendor, to clearly establish and agree on the scope of activities and responsibilities involved in performing these tests in order to achieve a timely delivery and acceptance of the automation system. The activities described in this document can be taken as a guideline and adapted to the specific requirements of the process, plant or equipment.

1.2 Exclusions

1.2.1 Prior and post activities

Engineering and manufacturing activities prior to or after the loop checks, such as FAT, SAT, SIT and commissioning, are not covered by this document.

1.2.2 Regulated industries

For applications in the pharmaceutical or other highly specialized industries, additional guidelines (e.g. good automated manufacturing practice (GAMP)), definitions and stipulations apply in accordance with existing standards.

1.2.3 Safety instrumented systems

All loops are checked in accordance with this document. However, loops involved in safety instrumented systems are subjected to additional testing. The IEC 61511 series provides requirements for checks and validation of safety instrumented systems.

1.2.4 Manufacturing execution systems

Testing and verification of manufacturing execution systems (MES) is not covered by this document.

1.2.5 Advanced process control

Testing and verification of advanced process control (APC) are not covered by this document.

1.2.6 Security for industrial automation and control systems

The IEC 62443 series provides requirements for network and system security.

1.2.7 User-specific procedures and requirements

This document does not describe any user-specific procedures and requirements that can be related to loop check, e.g. positioning of process isolation valves, what state to leave the loop in after check, calibration. It is the user's responsibility to ensure that these are added to the loop check requirements as necessary.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 62381, *Automation systems in the process industry – Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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

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

3.1.1
advanced process control
APC

system comprising several tools and techniques whose common characteristic is taking process automation beyond the limits of single-loop control

Note 1 to entry: APC includes model-based software that is used to direct the process operation and is commonly referred to as multivariable predictive control or model predictive control.

3.1.2
asset management system
software that works with or is a feature of the BPCS and that facilitates setting and recording of configuration, as well as display and recording of diagnostics, of instrumentation connected to the BPCS

3.1.3
automation system
complete system for the monitoring and control of production facilities

Note 1 to entry: An automation system can include a BPCS and can also include a SIS and other subsystems.

3.1.4
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 SIF

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 can implement various functions such as process control functions, monitoring, and alarms.

[SOURCE: IEC 61511-1:2016, 3.2.3]

3.1.5
basic software
software containing the graphic faceplates, base-level alarms and switch points, basic interlocking and analogue control, at a minimum

Note 1 to entry: In the case of safety loops, any safety switch point should be included if it is not in the basic database.

3.1.6
cold commissioning
phase, during which the activities associated with the testing and operation of equipment or facilities using test media such as water or inert substances prior to any chemical in the system being introduced take place

3.1.7
control system
system which responds to input signals from the process and/or from an operator and generates output signals causing the process to operate in the desired manner

Note 1 to entry: The control system includes sensors and final elements and can be either a BPCS or a SIS or a combination of the two.

[SOURCE: IEC 61511-1:2016, 3.2.10]

3.1.8
factory acceptance test
FAT
activity, including inspection and testing, to demonstrate that the automation system, subsystem, or component is in accordance with the specification and is typically conducted at the vendor's facility

3.1.9
factory integration test
FIT
activity, including inspection and testing, conducted at the vendor's facility to demonstrate that the merging of some or all of the various subsystems and components into one overall automation system functions in accordance with the specification

3.1.10
function diagram
graphical description of the E&I functions of the control system

Note 1 to entry: Refer to IEC 62708 and the IEC 61131 series.

3.1.11
functional requirements specification
specification listing the detailed operational requirements for a control system (i.e. what the system does, not how it does it)

3.1.12
hot commissioning
phase during which the activities associated with the testing and operation of equipment or facilities using the actual chemical process prior to making an actual production run take place

3.1.13
installer
company that will install or has installed the automation system, subsystem, or component on site

3.1.14
instrument specification
data sheet with all essential E&I data concerning tagging, function, description, measuring range, accuracy, location, process data, instrument data, etc.

Note 1 to entry: Refer to ISA-TR20.00.01 for examples of instrument specifications.

3.1.15
loop
all the hardware and software necessary to work together for the measurement or communication or control, or a combination thereof, of a process variable

Note 1 to entry: The loop consists of all associated components and functions including sensor, logic, control, actuator, and HMI.

3.1.16
loop diagram
representation of hardware or basic software functions, or both, of a control loop with graphical symbols

Note 1 to entry: A loop diagram shows equipment in its topological order and wiring including the terminals.

Note 2 to entry: Refer to IEC 62708 and ISA-5.4.

3.1.17
loop list
tabulation of all loops with tagging, function, service description, and PID reference

3.1.18
owner
company that operates the production facilities where the automation system is or will be installed

3.1.19
precommissioning
phase, during which the activities of non-operating adjustments, cold alignment checks, cleaning, and testing of machinery take place

3.1.20
safety instrumented system
SIS
instrumented system used to implement one or more SIFs

Note 1 to entry: A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s) (e.g. see IEC 61511-1:2016, Figure 6). It also includes communication and ancillary equipment (e.g. cables, tubing, power supply, impulse lines, heat tracing).

Note 2 to entry: A SIS can include software.

Note 3 to entry: A SIS can include human action as part of a SIF.

[SOURCE: IEC 61511-1:2016, 3.2.67, modified – In Note 3 to entry, Figure 6 and the reference to ISA TR84.00.04:2015, part 1 have been omitted.]

3.1.21
site acceptance test
SAT
activity, including inspection and testing, conducted at the site of the installation, to demonstrate that the installation of the automation system, any subsystem, or any component is in accordance with the applicable standards, codes, specifications, and installation instructions

3.1.22
site integration test
SIT
activity, including inspection and testing, conducted at the site of the installation, to demonstrate that the merging of the various subsystems and components into one overall automation system is completed and that all components work together in accordance with the specification

3.1.23
start-up
milestone marking the end of cold commissioning and formally setting process equipment into operation leading into production

3.1.24
vendor
manufacturer, distributor, or systems integrator of the automation system, subsystem, or component

3.2 Abbreviated terms

The following abbreviated terms are used (for terms not otherwise defined):

DCS	distributed control system
E&I	electrical and instrumentation
HART	highway addressable remote transducer
HMI	human machine interface
HVAC	heating, ventilation and air conditioning
I/O	input and output
MCC	motor control centre
P&ID	piping (or process) and instrument diagram
PLC	programmable logic controller
SIF	safety instrumented function

4 Loop check schedule

Loop checks are performed to verify the proper operation of all loops prior to the commissioning of a new plant or plant modification. They follow the installation of all the loop components and the functionality checks of the control system after field installation. These functionality checks shall be performed in accordance with IEC 62381. The loop checks will ideally occur in the precommissioning phase of the schedule.

However, normal occurrence is that the loop checks begin when any specific loop is completed and determined to be ready for check even if it is during the construction phase. The owner or owner's designated representative shall determine prerequisites prior to beginning a loop check. The loop check can substantially overlap the construction phase.

Loop checks are the last systematic check of a control system to ensure that:

- all loop documents (loop diagrams, loop check sheets, etc.) are current and available;
- all instrumentation and equipment have been delivered according to the design specifications;
- the installation has occurred in accordance with engineering documents; and
- all loops function as required.

The proper operation of all loops shall be verified prior to proceeding to the commissioning phase of the project. The loop checks are the quality check of the engineering design; the delivered instrumentation and associated equipment; and their installation. The main loop-related activities in the commissioning phase following loop check are loop tuning and verification of all other loop operations and control schemes.

Figure 1 provides a general illustration of a portion of the timeline of a project from construction to production, where the control system checks described in IEC 62381 and the loop checks described in this document occur. The industry and the specifics of a project can vary the relative timing of each test.

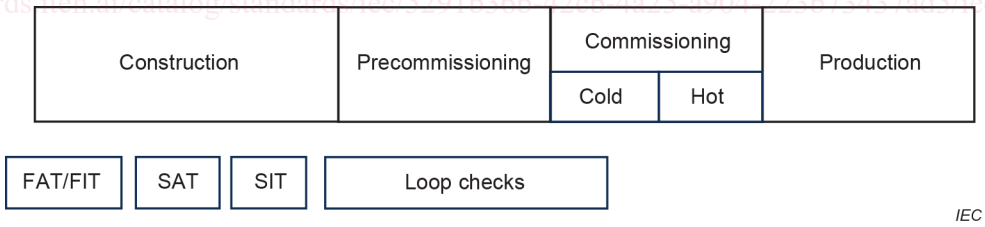

Figure 1 – Project phases and E&I testing

5 Loop check content

5.1 Included activities

5.1.1 General

The loop check includes the following elements of a loop.

- Hardware components – check the functionality and interoperability of:
  - all loop components, located in the field, control room, or other rooms (e.g. rack room), their configuration and their interconnection;
  - input and output cards of the control system; and
  - connections of the loop to other systems.