BS ISO 15519-2:2015

BSI Standards Publication

Specifications for diagrams for process industry

Part 2: Measurement and control

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Specifications for diagrams for process industry —

Part 2: Measurement and control

Spécifications pour schémas de l'industrie de traitement —

Partie 2: Mesurage et contrôle

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 10, *Technical product documentation*, SC 10, *Process plant documentation*.

ISO 15519 consists of the following parts, under the general title *Specifications for diagrams for process industry*:

— *Part 1: General rules*

— *Part 2: Measurement and control*

Introduction

0.1 General

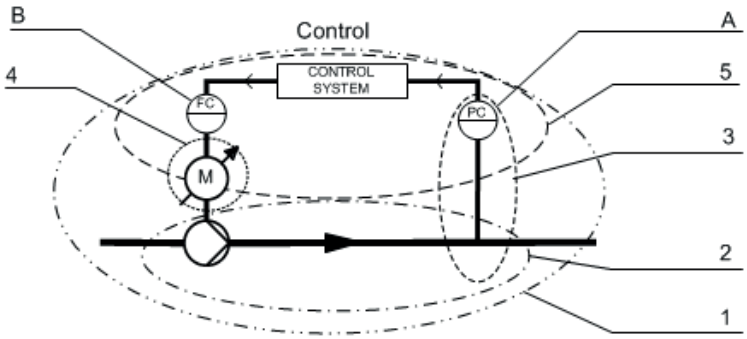
The ISO 15519 series consists of standards for specification of diagrams for process industry, published under the general title: Specification for diagrams for process industry.

This International Standard specifies preparation of different types of diagrams and use of graphical symbols, letter codes, and reference designation in diagrams. This International Standard addresses all process industry fields for example chemical, petrochemical, power, pharmaceutical, foodstuff, pulp, and paper.

This part of ISO 15519 deals with representation of measurement, actuation, and control in process diagrams which in this context covers process flow diagrams (PFD), process and instrument diagrams (PID), process control diagrams (PCD), and typical diagrams (TYD).

0.2 Engineering interrelations

Process diagrams, which represent the configuration of the process system and of the measurement, actuation, and control systems, involves engineering disciplines like process, mechanical, instrumentation, electrical, and control as illustrated in Figure 1.



Key

1 process
2 mechanical
3 instrumentation
4 electrical
5 control
A measurement
B actuation

Figure 1 — Interrelations between engineering disciplines

Figure 1 illustrates the discipline complexity of process systems which force diagrams not only to focus on individual disciplines but overlap to neighbouring disciplines. This is, for example, done in the process and instrumentation diagram which shows mechanical, instrumentation, and electrical objects in same diagram.

As process engineering by tradition is an ISO discipline and control engineering is IEC discipline representation of measurement and control in diagrams need to be coordinated and unambiguously.

0.3 Control system technology and influence on documentation

The technological development within Information Technology constantly challenges the process industry to use "state of the art" technology for engineering of process and control systems. This puts pressure on the standardization organisations to deliver up to date International Standards. As development time and expected lifetime of a standard at present is overtaken several times by the IT development, the standard developers need to develop standards which focus on basic principles and rules to secure high quality documentation and exchange of information.

At present, the configuration and functionality of the process control system are programmed direct in modern control system as control Programmable Logic Controller (PLC) and Distributed Control Systems (DCS). In addition, these systems are self-documenting which could lead to the assumption that traditional diagram documentation are superfluous.

Diagrams are however an important tool for documentation and representation of process system information in all lifecycle phases of a process plant. In the development and engineering phase, diagrams are used also for exchange and sharing of technical information between engineering disciplines and in operation and maintenance phases diagrams are used in daily operation and as part of operation and maintenance manuals.

0.4 Letter codes

ISO 14617-6, 7.3.1 have been moved to this part of ISO 15519 and the description has been changed to "Letter codes for Process Control Information (PCI)".

ISO 14617-6 will be revised at first periodical review or revision after publication of this International Standard.

0.5 Figures

Figures in this International Standard are only examples for illustration of a given rule in the standard.

0.6 Reference designation

In this part of ISO 15519, IEC 81346-1, IEC 81346-2, and ISO/TS 81346-3 are used to illustrate the application of reference designation in diagrams.

INTERNATIONAL STANDARD ISO 15519-2:2015(E)

Specifications for diagrams for process industry —

Part 2:
Measurement and control

1 Scope

This part of ISO 15519 provides rules and guidelines for representation of measurement, control, and actuation in diagrams for process industry.

General rules and guidelines for preparation of diagrams for process industry, for example types and descriptions of diagrams, layout of diagrams, graphical symbols, lines and connection, reference designation, are given in ISO 15519-1.

Rules and guidelines for preparation of electrotechnical diagrams are given in IEC 61082-1.

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.

ISO 10209, *Technical product documentation — Vocabulary — Terms relating to technical drawings, product definition and related documentation*

ISO 14617 (all parts), *Graphical symbols for diagrams*

ISO 15519-1, *Specification for diagrams for process industry — Part 1: General rules*

IEC 81346-1, *Industrial systems, installations and equipment and industrial products — Structuring principles and reference designations — Part 1: Basic rules*

IEC 81346-2, *Industrial systems, installations and equipment and industrial products — Structuring principles and reference designations — Part 2: Classification of objects and codes for classes*

ISO/TS 81346-3, *Industrial systems, installations and equipment and industrial products — Structuring principles and reference designations — Part 3: Application rules for a reference designation system*

3 Terms, definitions, and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 15519-1, ISO 10209, IEC 81346-1, and the following apply.

3.1 Terms related to control

3.1.1
actuator
functional unit that generates from the controller output variable the manipulated variable to drive the final controlling element

Note 1 to entry: If the final controlling element is mechanically actuated, it is controlled via an actuated drive. The actuator drives the actuating drive in this case.

Note 2 to entry: See Annex E for the relationship between related terms.

[SOURCE: IEC 60050-351:2013, 351-28-07]

3.1.2
closed-loop control
process whereby one variable (quantity), namely the controlled variable is continuously measured, compared with another variable (quantity), namely the reference variable, and influenced in such a manner as to adjust to the reference variable

Note 1 to entry: Characteristic for closed-loop control is the closed action in which the controlled variable continuously influences itself in the action path of the closed loop.

[SOURCE: IEC 60050-351:2013, 351-26-01]

3.1.3
control function
manipulation via the final controlling element of process media or process objects in order to bring the media or object into a condition or state defined by the process control system on basis of measured process variables and pre-defined values

3.1.4
control loop
assembly of elements incorporated in the closed action of a closed-loop control

[SOURCE: IEC 60050-351:2013, 351-26-11]

3.1.5
final controlling element
functional unit forming part of the controlled system and arranged at its input, driven by the manipulated variable and manipulating the mass flow or energy flow

Note 1 to entry: If the final controlling element is mechanically actuated, an additional actuator (positioner) is used in some cases.

Note 2 to entry: The output variable of the final controlling equipment is usually not free from feedback. The interface between the actuator and the final controlling element should therefore be selected in such a way that the manipulated variable is not affected by feedback from the final controlling element.

Note 3 to entry: See Annex E for the relationship between related terms.

[SOURCE: IEC 60050:2013, 351-28-08]

3.1.6
manipulate
to change flows of mass, energy, or information by means of a final controlling element

Note 1 to entry: Manipulating can be affected continuously or by switching operations.

Note 2 to entry: In control engineering, the final controlling element is regarded as belonging to a process.

[SOURCE: IEC 60050-351:2013, 351-22-08]

3.1.7
open-loop control
process in a system whereby one or more variables (variable quantities) as input variables influence other variables (variable quantities) as output variables in accordance with the proper laws of the system

Note 1 to entry: Characteristic for open-loop control is the open action path or in case of a closed action path the fact that the output variables being influenced by the input variables are not continuously influencing themselves and not by the same input variables.

[SOURCE: IEC 60050-351:2013, 351-26-02]

3.1.8
process variable
quantity, quality, or condition of a process media or process object which value may be subject to change and can usually be measured

3.2 Document types

3.2.1
process flow diagram
PFD
diagram representing the configuration of a process plant or a process system by means of graphical symbols

3.2.2
process and instrumentation diagram
PID
diagram representing the technical realization of a process system by means of graphical symbols for equipment, connections, process measurement, and manipulating objects

Note 1 to entry: The diagram type *process and instrumentation diagram*, used in this part of ISO 15519, is technically identical with the *piping and instrumentation diagram.* The argument for change of the designation is that the diagram type is used for both fluid and solid material processes. The abbreviation PID deviates from the traditional used abbreviation PID for the Piping and instrumentation diagram.

3.2.3
process control diagram
PCD
diagram representing the configuration of measuring, control, and actuating functions of a process system, by means of graphical symbols for measuring, control, and manipulating functions

3.2.4
typical diagram
TYD
diagram representing the detailed configuration of a definite measuring or actuating system which can be referred to in an associated diagram by a graphical symbol and document reference

3.3 Abbreviated terms

IEV International Electrotechnical Vocabulary

PCD Process control diagram

PCI Process control information

PFD Process flow diagram

PID Process and instrumentation diagram

SIF Safety instrumented function

SIL Safety integrity level

TYD Typical diagram

4 Documentation and process control principles

4.1 Introduction

The clause defines principles for documentation of process control (measurement, control, and actuation) and interchange information between process and control engineering.

4.2 Diagram types, structures, and life cycle aspects

Diagrams are used for visual representation of process functions. Objects and connections, represented by graphical symbols, serve as carrier of technical information either represented direct in the diagram or in associated lists or databases.

Depending on the task of the diagram and the stage in the live cycle matrix described in Figure 3, diagrams can represent process functions on high and generic level or on detailed and specific level.

Figure 2 represents the interrelationship between different types of diagrams from different standardization bodies.

The grade of detailing goes from top to down. The information flow from process engineering to control engineering is illustrated by the arrows.

Specification of amount and types of measurements and actuated objects connected to the control system are predominately made on basis of the process and instrumentation diagram.

The process control diagram specifies configuration of control system for process systems or process sub-systems. The information flow is showed reversible in order to illustrate the optimization process between process and control engineering especially during conceptual engineering.

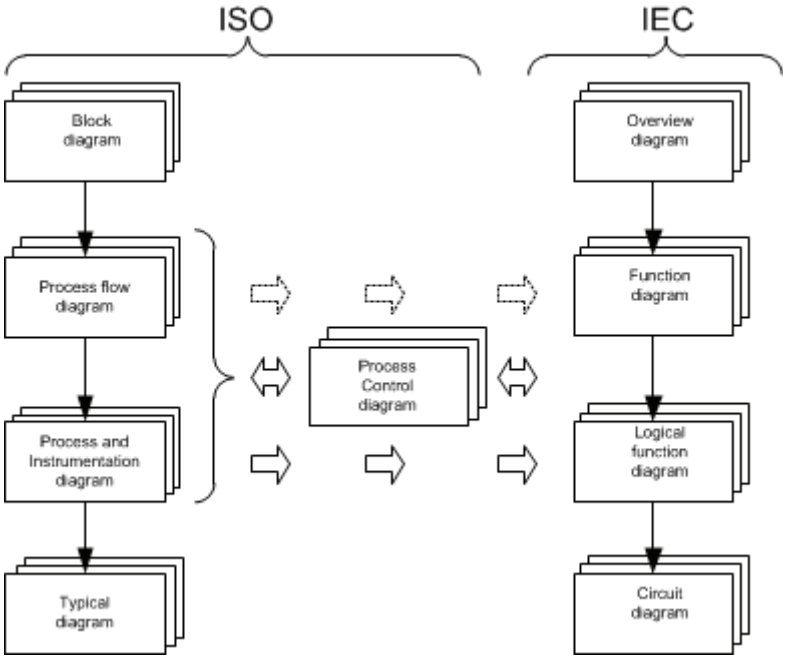


Figure 2 — Interrelationship between ISO and IEC diagrams

Rules for design of process diagrams, use of graphical symbols, etc. are described in Clauses 6 and 7.

The diagram types in Figure 2 contain differentiated types and amounts of information to suit the needs in the actual life cycle stages of the project. Figure 3 illustrates the application of three types of diagrams during the life cycle stages and the graduated application value of the diagrams in the different life cycle stages represented by the width of the bars.

NOTE Life cycle stage principles are described in ISO 15226 and ISO/IEC 15288

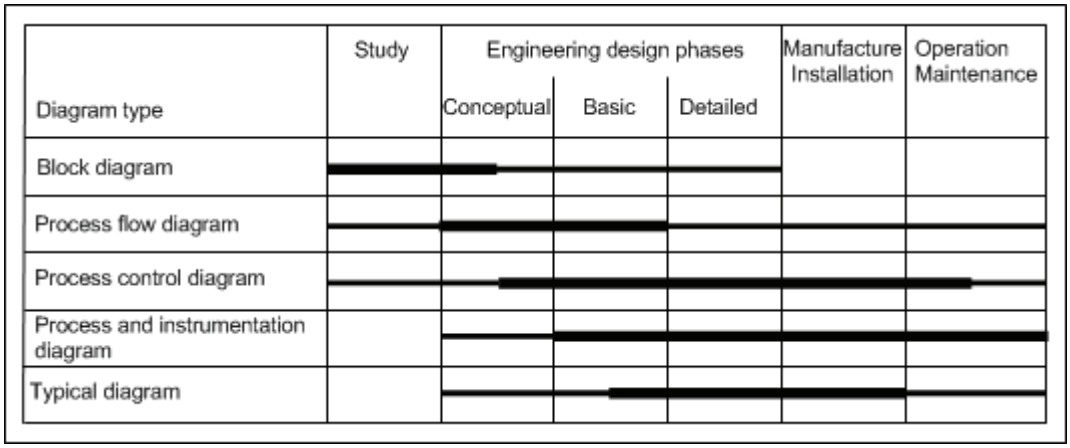


Figure 3 — Typical illustration of life cycle application value of diagrams

Measuring, control, and actuation are illustrated in diagrams with variable degree of detailing depending of needs for the actual life cycle stage. In the start of a project the representation in process flow diagrams (PFD) is pure functional. Later in the project course, when more detailed diagrams are developed, for example: process control diagram and process and instrumentation diagrams (PID), the amount of information is increased and the representation is extended to also to include products like sensors built in the process system also.

4.3 Process control interrelations

The function of process control is to steer and supervise the respective processes in accordance with predefined aims of process control engineering.

This is carried out by the following:

— recording of measured process situation (process variables);

— comparing measured values with predefined values;

— initiate actions via the control equipment and/or operator (control functions) to the final control elements.

Figure 4 illustrates the interrelations between process (measuring and manipulating) and control functions (control equipment and human operator).

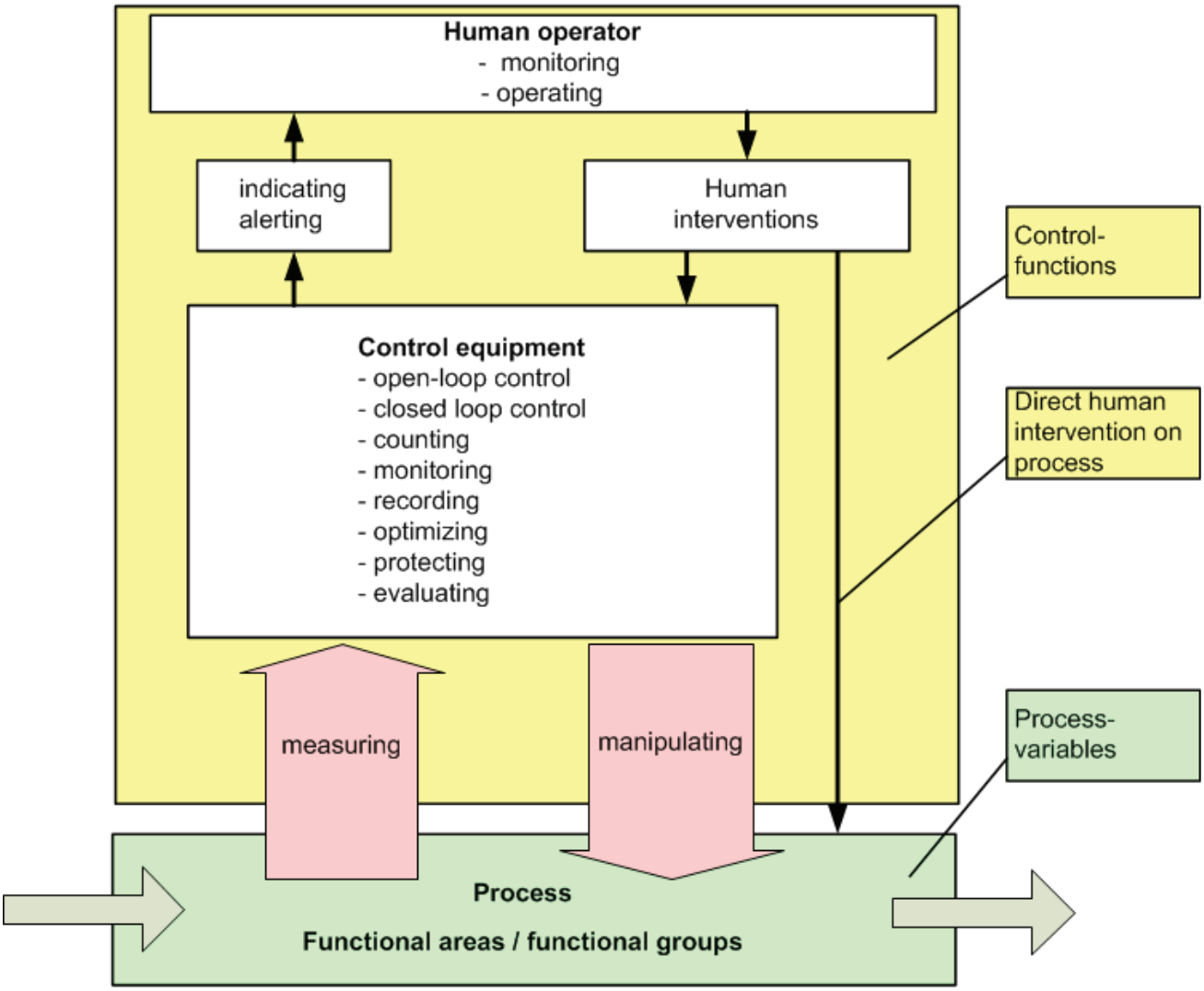


Figure 4 — Illustration of interrelations between process variables and control functions

4.4 Information exchange between process and control systems

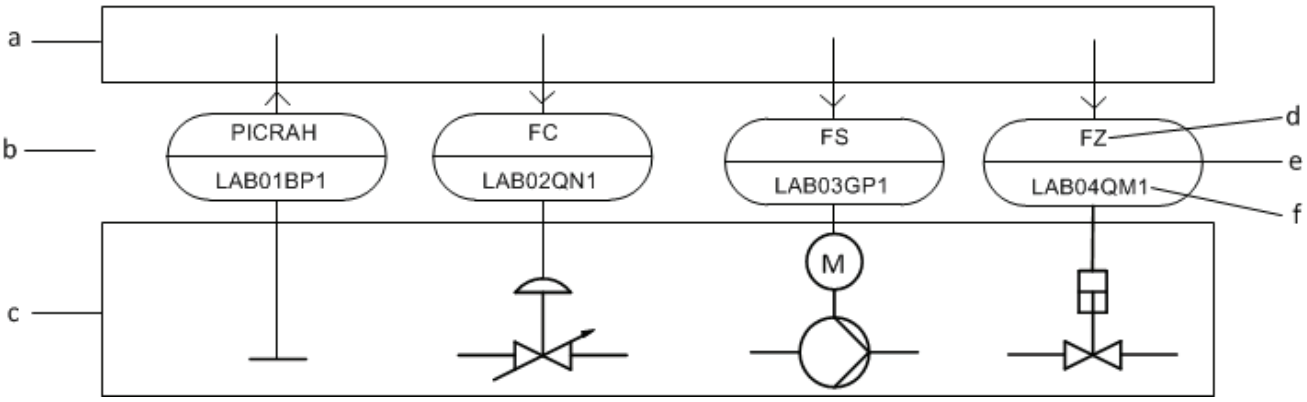
Letter codes are used for the exchange of information between process and control system. The individual information is identified by reference designation.

From the process system letter codes for measured process variables are transferred to the control system.

Correspondingly are letter codes for manipulation of process variables transferred from control system to the process system.

For visual emphasizing of letter codes, reference designation, and additional information in diagrams, process control information (PCI) symbols are used as information carrier.

The information exchange is illustrated in Figure 5. A detailed representation of especially the control system is given in informative Annex D.



Key

A control system
B information exchange
C process
D letter code of process variables and control functions
E PCI symbol
F reference designation

Figure 5 — Information exchange between process and control system

PCI symbols, letter codes, and reference designation are dealt with in Clause 5.

5 Exchange of process control information

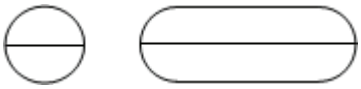
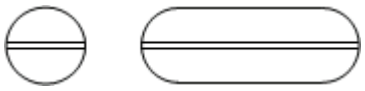
5.1 Symbols for information exchange

5.1.1 General

Exchange of information between the process system and the control system shall be represented within the process control information (PCI) symbol which consists of a circle or extended circle in case of not sufficient space for presentation of the information in one text string, see Table 1.

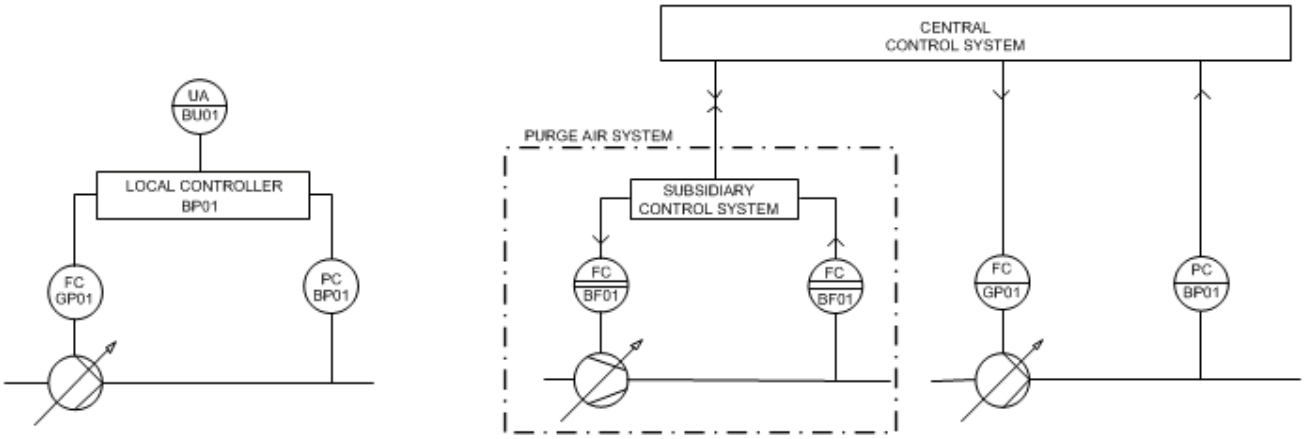
The information shall be placed inside and outside the PCI symbols, see 5.1.2 and 5.1.3.

Table 1 — PCI symbols and their applications

Symbols	Additional graphics	Measurement application	Actuation application
	None	Information available on field mounted instrument/display	Information from field mounted controller
	Horizontal single full line	Information available in central control system	Information from central control system
	Horizontal double full line	Information available in subsidiary control system	Information from subsidiary control system

The geographical availability or origin of information inside or outside the PCI symbol are illustrated by means of additional graphics within the PCI symbol, see Table 1.

PCI symbols are used both for exchange of measured process variables from the process system to the control system and exchange of control functions for actuation from the control system to the process objects which execute the control function within the process, see Figure 6.



a) Local control system with joint alarm to central control system

b) Subsidiary control system integrated in central control system

Figure 6 — Information exchange between process system and control system

The PCI symbol shall be connected, see Figure 6, to the following:

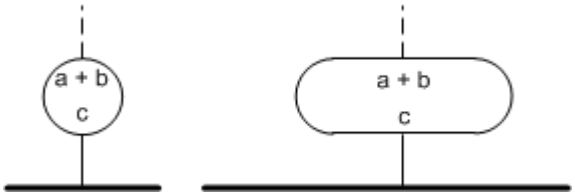
— the process system with a solid functional connection line without indications of for example signal flow directions, signal types, etc.;

— the control system with a solid or dashed functional connection line depending on the type of diagram, see Clause 6. Signal flow directions can be indicated just as the type of signal media.

For further information on graphical symbols, see Annex A.

5.1.2 Placement of information inside the PCI symbol

Letter codes for process variables and control functions, see 5.2, shall be placed in the upper part of the symbol and reference designation in the lower part of the symbol, see Figure 7.



Key

a process variables
b control functions
c reference designation

Figure 7 — Placement of information within the PCI symbol

5.1.3 Placement of information outside the PCI symbol

Information placed outside the PCI symbol shall be placed in the four quadrants around the symbol as illustrated in Figure 8. This allows for horizontal and vertical connections to the symbol.

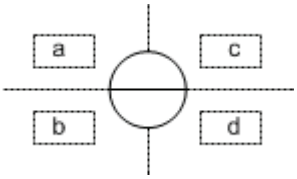
a) Reference to typical diagram, safety information, e.g. SIL or SIF identifiers;

b) Specification of type of measured variable when using letter code U (multivariable), e.g. pH, µS, MJ/s, etc.;

c) Information of high output/input functions, e.g. alarm or switching;

d) Information of low output/input function, e.g. alarm or switching.

Representation of high and low output/input function for measurement and actuation are given in 5.2.5.



Key

a reference to documents, object properties, etc.
b specification of type of measured variable
c indication of high output/input functions
d indication of low output/input functions

Figure 8 — Placement of information outside the PCI symbol

5.2 Letter codes

5.2.1 General

Letter codes are used for identification of process variables and control functions.

Process variables are measured quantity, quality, or condition of process media or process objects, e.g. pressure, temperature, or calculated variables, e.g. energy flow based on direct measurements of volume flow, pressure, and temperature using built in mathematic functions and media property tables or output variables from an analyser. Process variable are also human observations based on human sensory.

Control functions are manipulating functions which via the final controlling element of process media or process objects in order to bring the media or object into a condition or state defined by the process control system on basis of measured process variables and pre-defined values. Control functions are also display and registration of process variables.

Letter codes shall be represented with upper-case letters.

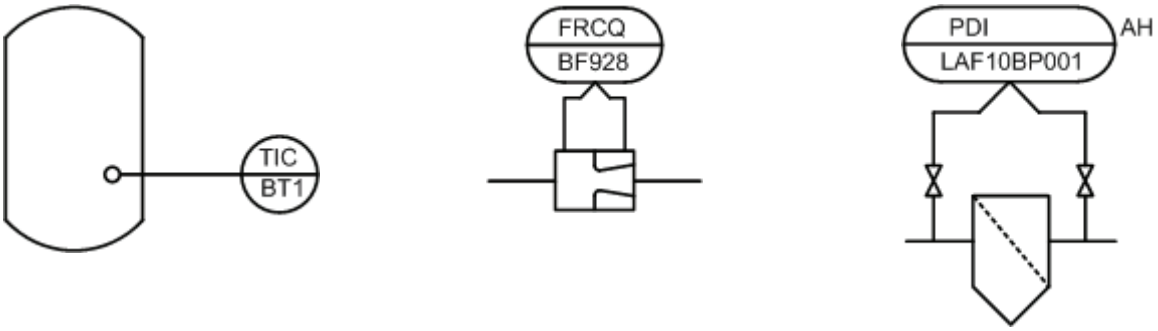
5.2.2 Representation of letter codes for process variables

Letter codes for process variables shall initiate the letter code string placed in the upper part of the PCI symbols.

The letter codes shall be taken from Table 2 and supplemented with modifying letter code from Table 3.

Examples of letter code strings are given in Figure 9.

In Figure 9 c), the process variable "D" is supplemented with modifier "D" to indicate differential pressure measurement over a filter.



a) Temperature measurement in a vessel used for indication and control

b) Flow measurement with venturi used for registration, control, and summation

c) Differential pressure measurement over a filter used for indication and alarm high (AH)

NOTE For accentuation, the letter codes for process variables and modifiers are underlined in the figure.

Figure 9 — Representation of process variables letter codes in PCI symbols

5.2.3 Representation of letter codes for control functions

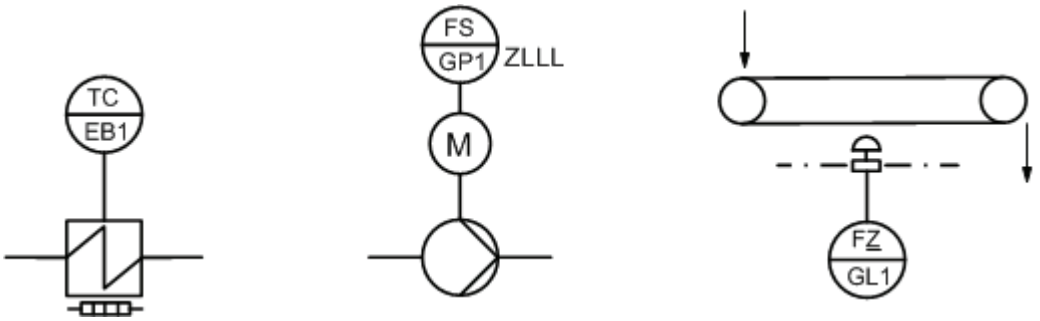
Letter codes for control functions shall follow letter codes for process variable in the letter code string placed in the upper part of the PCI symbol.

The letter codes shall be taken from Table 2 and supplemented with modifying letter codes from Table 3.

Examples of letter code strings are given in Figure 10.

In Figure 10 b), the control function "Z" is supplemented with modifiers "LLL" to indicate that the function is initiated at LLL level in an upstream tank. The rules for placement of information outside the PCI symbol are given in 5.1.3.

In Figure 10 c) is an illustrated representation of local emergency stop. The process variable, F, represents the function of the conveyor and the safety related control function, Z, the emergency aspect.



a) Temperature control with electrical heater

b) Pump, on-off controlled with safety stop at LLL level e.g. in an upstream tank

c) Conveyor with wire emergency stop

NOTE For accentuation, the letter codes for control functions and modifiers are underlined in the figure.

Figure 10 — Representation of control function letter codes in PCI symbols

5.2.4 Sequence of letter codes for control functions

Letter codes for control function shall be represented in following sequence: I, R, C, S, M, Z, and A, for example:

— ICA Indication, control (closed loop) and alarm;

— CS Control (closed loop) and switching (open loop);

— ICZA Indication, control (closed loop), switching (open loop) safety relevant, and alarm.

Table 2 — Letter codes for process variables and control functions

Letter code	Process variables	Application notes	Control functions	Application notes
A	Electric voltage		Alarming, message	9
B				
C	Electric current		Control (closed loop)	
D	Density			
E	Electric or electromagnetic variables (except A and C)	1		
F	Flow rate			
G	Distance, position or length			
H	Human observation	2		
I	Not to be used		Indicating	
J	Power			
K	Time			
L	Level	3		
M	Moisture, humidity			
N				
O	Not to be used			
P	Pressure, vacuum	3		
Q	Quality	4		
R	Radiation	5	Recording	
S	Speed, frequency	6	Switching (open loop)	
T	Temperature			
U	Multivariable	7		
V				
W	Weight, force			
X				
Y				
Z	Number of events, quantity	8	Switching (open-loop) safety/protection relevant	10

Application notes to Table 2

General Not used letter codes are, in principle, reserved for future standardization, however, users are allowed to use not used letter codes in a project for non-listed aspects. The meanings of such project related letter codes shall be explained in a diagram or in a supporting document. Users should be aware of that not used letter codes can be standardized for new aspects in the future.

1) E.g. resistance, impedance, inductance.

2) Based on one or more human sensory systems.

3) When a differential pressure measurement is used for level measurement then letter code L shall be used and not P.

4) The measured variable shall be indicated outside the circle, specifying the type of quality, e.g. pH-value, purity, conductivity, material property, viscosity, etc.

5) Heat radiation, light, nuclear.

6) Including vibration, rotary speed.

7) The generated variable shall be indicated outside the circle specifying the type of multivariable, e.g. general alarm, enthalpy.

8) The letter Z as measured variable shall be used when control or monitoring responses are event-driven as opposed to time or time schedule-driven. The letter can also signify presence or state.

9) Shall only be used for separate alarm control functions. If control functions S and Z at time of action also trigger an alarm/message, then the A shall not be used in addition to the in front letter codes S or Z.

10) A control function to be realized by a safety instrumented function according to IEC 61511-1 or an equipment protection system, when an acknowledgement is specified to enable a restart.

5.2.5 Modifying letter codes

Letter codes for process variables and control functions can be supplemented with a succeeding letter code, called modifier, see Table 3.

Table 3 — Letter code for modifiers

Letter code	Modifier functions	Application note/examples
D	Difference	Indication of that the measurement represents the difference of two measurements, e.g. differential pressure over a filter.
H	High limit	Indication of that the measured value is high compared to low. The modifier can be differentiated by doubling or tripling e.g. HH — Very high, HHH — Extremely high.
L	Low limit	Indication of that the measured value is low compared to high, The modifier can be differentiated by doubling or tripling e.g. LL — Very low, LLL — Extremely low.
P	Testing (point)	Indication of a not used measuring point, to which it is possible to connect a temporary measuring device, e.g. pressure transmitter.

Letter code combinations with modifiers H and L shall be represented outside the PCI symbol.

The sequence shall be A, S, and Z with increasing value away from the centre line of the PCI symbol as illustrated in Figure 11.

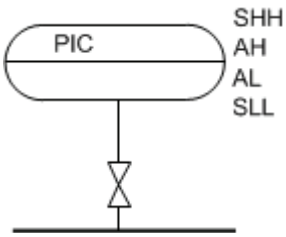


Figure 11 — Examples of sequence of letter code strings for high and low output functions

5.3 Reference designation

Reference designation shall comply with IEC 81346-1, IEC 81346-2, and ISO/TS 81346-3. Rules for application of reference designation in diagrams are given in ISO 15519-1.

Reference designation, shall be placed in the lower part of the PCI symbol.

The reference designation for an object can be IEC 81346-2 letter codes alone followed by a number or a combination of a plant specific identification system according to the rules given in IEC 81346-1 and the IEC 81346-2 letter codes as illustrated in Figure 12.

In Figure 12 a), the letter code PC in the upper line in the PCI symbol shows a pressure measurement to be used for control. In the reference designation LAB01BP01, the letter code BP indicates "converting of an input variable (in this case pressure) into a signal for further processing".

In Figure 12 b), the letter code FC in the upper line correspondingly illustrates flow control, which is executed by the flow control valve LAB01QN01. The letter code QN in the reference designation indicates "varying of flow of a flowable substance in closed enclosures".

a) Pressure measurement **b) Control valve**

NOTE For accentuation, the IEC 81346-2 letter codes in the reference designation are underlined.

Figure 12 — Examples of use of IEC 81346-2 letter codes in reference designations for objects

6 Representation in general

6.1 General

In addition to the general rules and guidelines for application of lettering, connections, graphical symbols, reference designation, etc. given in ISO 15519-1, the following apply for this part of ISO 15519.

6.2 Signal lines

In PFD signal lines shall be represented with dashed lines according to ISO 128-20.

In PCD signal lines shall be represented with full line.

Signal lines representing functions inside the PCI symbol, e.g. C (control closed loop), and signal lines representing functions outside the PCI symbol, e.g. SLL (switching open loop control at low value), shall be drawn separate between the PCI symbols.

Graphical symbols for indication of signal media, e.g. pneumatic or hydraulic, should only be used to differentiate, if the majority of signal lines in same diagram are electric. For graphical symbols for signal media, see Annex A.

The technical realization of signal transmission e.g. electronic, hard wired, bus system, etc., should not be represented diagrams.

6.3 Graphical symbols

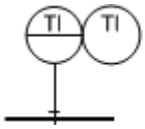
6.3.1 General

Graphical symbols shall be taken from ISO 14617 series. If the needed symbol is not included in ISO 14617, it shall be designed according to rules given in ISO 14617 and ISO 15519-1. Annex A includes a collection of ISO 14617 graphical symbols for main process equipment, measurement, actuation, and control.

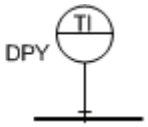
NOTE ISO 14617 series is under continuous revision, so some symbols used in figures might not yet be implemented in the ISO 14617 series. The ISO Online Browsing Platform (OBP) gives status of graphical symbols in the ISO 14617 series.

6.3.2 Instruments with integrated display

Instruments with integrated display for reading of measured value(s) should be represented either by Figure 13 a) or 13 b).



a) Form 1



b) Form 2

NOTE DPY = abbreviation of display, see ISO 14617-5:2002, 851.

Figure 13 — Representation of instruments with integrated display

6.3.3 Multifunction instruments

Instruments with two or more functions in common housing/envelope shall be represented with PCI symbols for each function. The PCI symbols shall be placed “side by side” as illustrated in Figure 14 showing a local pressure gauge with integrated switch.

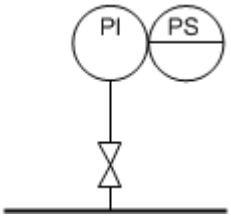


Figure 14 — Representation of multifunction instrument

6.3.4 Instruments forming a group

Two or more instruments which make up a functional group shall be represented close to each other and the functionality of the grouping shall be marked with an identifier as illustrated in Figure 15, showing three temperature measurements which are part of a "two out of three", 2oo3, measurement system.

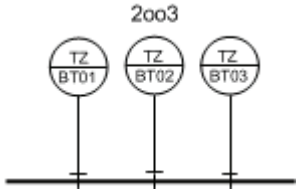
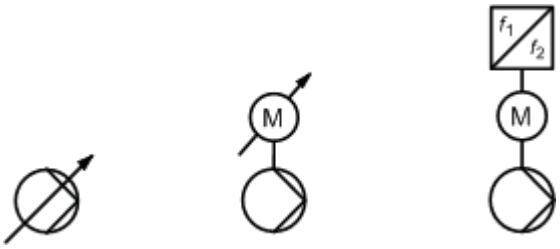


Figure 15 — Example of "two out of three" temperature measurement system

6.3.5 Differentiating of representation

The same function can be represented in different types of diagrams with different graphical appearance, see Figure 16.



a) flow control principle not specified

b) flow control by variable speed electrical motor

c) flow pump – flow control by electrical motor, speed controlled by a frequency converter

Figure 16 — Different degree of detailing of a variable flow pump

6.3.6 Graphical symbol "groups" in diagrams

Representation of particularly PCI symbols for measurements on "small" process symbols can often be a challenge due to lack of space in the diagram.

The general rules for readability given in ISO 15519-1, also applies for measurement and actuation. Modification of graphical symbol for process object can therefore often be necessary in order to locate the PCI symbols in functional correct positions.

Annex B gives examples of "grouping" of graphical symbols.

7 Representation in diagrams

7.1 Introduction

Clause 7 specifies rules for representation of measurement, control, and actuation. General rules for preparation of process diagrams can be found in e.g. ISO 15519-1.

Clause 7 deals with following types of diagrams:

— Process flow diagram, PFD;

— Process and instrumentation diagram, PID;

— Process control diagram, PCD;

— Typical diagram, TYD.

NOTE The Block Diagram (BLD) is not dealt with in this part of the standard, as it normally not includes representation of measurement and control.

Each diagram type is specifies, in tables, basic and additional information concerning measurement, control, and actuation. The basic information is mandatory in an early stage of the diagram. In a final stage of the diagram, the additional information should be added.

Examples of above mentioned process diagrams are given in Annex C.

7.2 Process flow diagram, PFD

7.2.1 Description

A process flow diagram represents the configuration of a process plant or a process system by means of graphical symbols.

7.2.2 Application

The diagram is used for project planning and coordination especially in the basic engineering phase and form basis for the preparation of process and instrumentation diagrams and process control diagrams.

Functional groups such as redundant pumps shall only be represented by one symbol, with remark of the redundancy e.g. 2 × 100 %.

7.2.3 Contents

General rules for representation of basic and additional information for measurement, control, and actuation in process flow diagrams are given in Table 4.

Table 4 — Basic and additional information for process flow diagram

Aspect	Basic information	Additional information
Graphical symbols for object and connections	— general graphical symbols for process equipment, valve actuators, PCI symbols — general graphical symbols for connections	— for safety systems and safety equipment — for functionality of main process control objects e.g. fail close for valve actuators — signal lines between measurement and actuated objects — specific graphical symbols for e.g. valve actuators
Reference designation		— process equipment — process control elements
Technical information		— additional information on PCI symbols e.g. SIF identifier or SIL — characteristic operation conditions e.g. flow rates, pressure, temperature, etc. — supplementary operation conditions — characteristic data of equipment — names of essential equipment — design parameters e.g. pressure, temperature, flow, etc. — denomination of drives and characteristic data of drives — dimension of main piping, ducts, etc.
Diagram information	— denomination of ingoing and outgoing systems	— interface between suppliers, partners, etc.

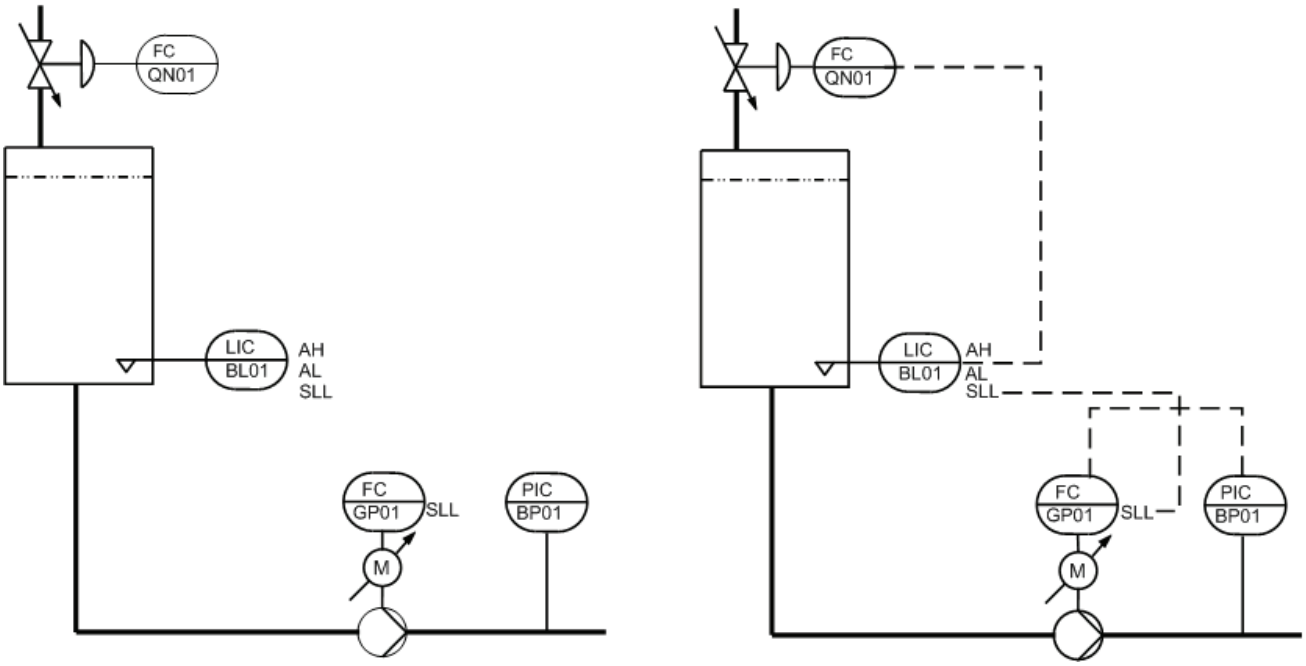
7.2.4 Representation

Compared to the representation in PFD's without signal lines, see Figure 17 a), the functional relations between measured process variables and actuated/final controlling object can be represented by signal lines in form of dashed lines, see Figure 17 b).

For operational control functions, letter code C, and switching functions, letter code S, the signal line shall "link" the PCI symbols.

For non-operational switching functions, letter code S, and safety/protection relevant switching functions, letter code Z, the signal line shall "link" the letter code strings placed outside the PCI symbols, see Figure 17 b).

Signal lines for different types of control functions should not be joined.



a) Without signal lines **b) With signal lines**

Figure 17 — Representation of measurement and control in PFD

7.3 Process and instrumentation diagram, PID

7.3.1 Description

A process and instrumentation diagram represents the technical realization of a process system by means of graphical symbols for equipment, process flow paths and process measurement, actuation, and control functions.

7.3.2 Application

The diagram is based on the relevant process flow diagram and is used for detailed engineering of process systems like piping, conveyance systems, instrumentation to coordinate mechanical, electrical, and instrumentation engineering.

In operation and maintenance, the process and instrumentation diagram is the “master” document for references to documentation, operation manuals, fault-finding, securing of systems for repair, and maintenance works.

7.3.3 Contents

General rules for representation of basic and additional information for measurement, control, and actuation in process and instrumentation diagrams are given in Table 5.

Table 5 — Basic and additional information for process and instrumentation diagram

Aspect	Basic information	Additional information
Graphical symbols and connections	— specific graphical symbols for process equipment incl. prime movers (electrical motors, combustion motors, turbines, etc.), valves incl. actuators, connections, etc. — PCI symbols including letter codes for measurement and control functions and additional information where necessary e.g. pH for a quality measurement — direction of flow	— supplementary information on graphical symbols, if needed, e.g. connections represent equipment of specific function e.g. gear pump — details such as heat trace heating — connection specifications e.g. pipe classes, insulation classes — graphical symbols for measurement point sensors — pipe reducers for change of dimensions, compensators, flow straighteners, mixing paths, etc. — inline and built-on measurement sensors
Reference designation	— complete reference designation for process equipment, process control elements and connections between the objects	
Technical information	— information of type of process media — design parameters like pressure, temperature, including indication, where design parameters change — dimension of connections e.g. piping, ducts — identification of safety requirements, e.g. SIL level according to IEC 61508	— denomination of main equipment — design and operation parameters e.g. flow, content/capacity of storages tanks, bunkers — nozzle designation on vessels — SIS reference to safety instrumented systems/loops
Diagram information	— denomination of ingoing and outgoing systems — reference to typical diagrams for process objects, like valves with actuators, etc.	— interface between suppliers, partners, etc. — location information e.g. building borderline

7.3.4 Representation

7.3.4.1 Built-in sensors in process objects

Sensors, which are built-in or penetrates the object envelopes or form part of a pressure enclosure e.g. pipeline, vessels, heaters, and conveyors, and for which mechanical engineering shall be aware of, shall be represented in the PID, see Figure 18.

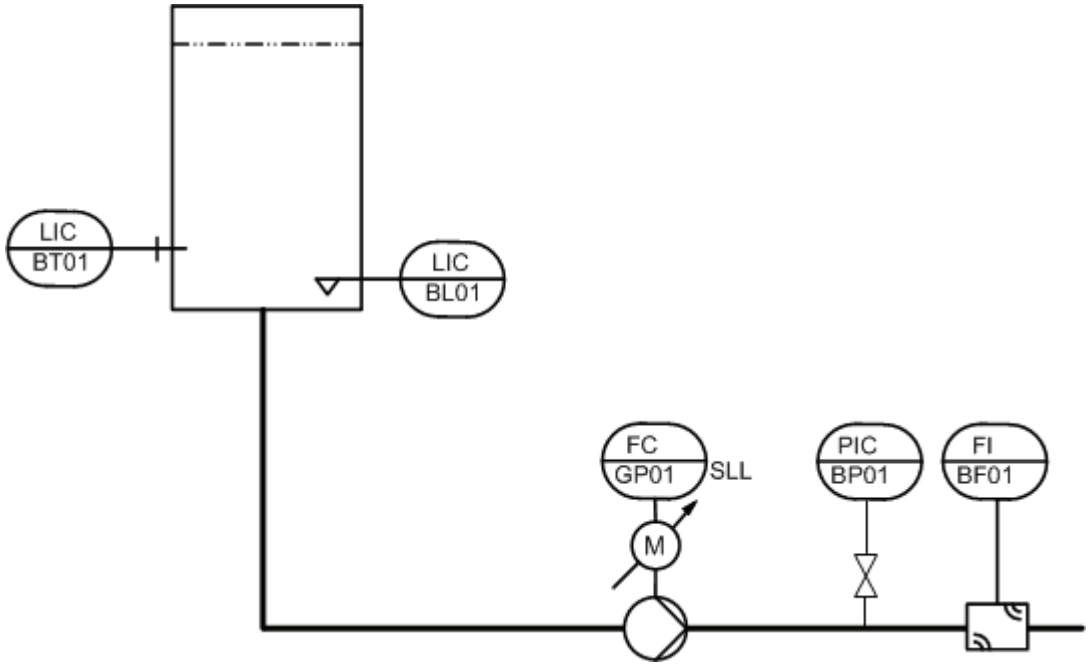


Figure 18 — Built-in sensors

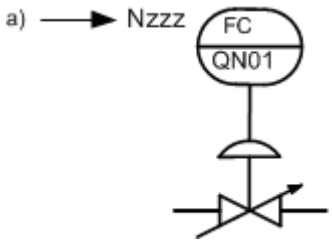
7.3.4.2 Instrument objects in PID

Instrument root valves are part of the pipeline.

Instrument block valves should not be shown in PID.

7.3.4.3 Reference to typical diagram

The reference to a typical diagram for an object in a process diagram, e.g. a pneumatic control valves, shall be placed as illustrated in Figure 19.



a) Reference to typical diagram.

Figure 19 — Placement of reference to typical diagram

7.4 Process control diagram, PCD

7.4.1 Description

The process control diagram represents the configuration of measurement, control, and actuation objects for a complete process system or part of a process system in order to understand the function of the process.

7.4.2 Application

PCDs are used in the engineering phase to communicate process control requirements and form basis for development of function and logical diagrams.

PCDs are based on process flow diagrams and process and instrumentation diagrams.

7.4.3 Contents

General rules for representation of basic and additional information for measurement, control, and actuation in process control diagrams are given in Table 6.

Table 6 — Basic and additional information for process control diagram

Aspect	Basic information	Additional information
Graphical symbols and connections	— graphical symbols for primarily process equipment, main measurement points, control functions, and final controlling elements — graphical symbols for control functions — signal connections between process measurement points, control functions, and final controlling elements	— graphical symbols for measurement point sensors, if required for understanding of the function (e.g. material thickness differential temperature measurement)
Reference designation	— reference designation of the objects	
Technical information	— letter codes of the process variables and control functions	— set point values
Diagram information	— designation and denomination of interfaces	— denomination of essential equipment — redundancy of essential process equipment and process control elements

7.4.4 Representation

7.4.4.1 General

The process system is only represented in the process control diagram by those objects which are integrated with measurement, control, and actuation and in addition those process objects necessary for understanding of the process system.

Symbol and signal lines representing “secondary” process control objects, like feedback signals for valve positioners and frequency converters, limit, and torque switches from electrical actuators, shall not be represented in PCD.

7.4.4.2 Layout of PCD

PCD shall be drawn with horizontal layers with following structure from top to bottom:

— Process control symbols for operator interface

— Process control symbols

— PCI symbols inclusive of letter codes and reference designation

— Graphical symbols representing the primary process objects.

7.4.4.3 Graphical symbols

Process objects, like pumps, valves, heat exchangers, etc., shall be represented by general graphical symbols.

Actuators shall be represented by actuator symbols without indication of type or indication of power media. Only if it of importance for understanding of the diagram actuator symbol of specific type should be used.

7.5 Typical diagrams, TYD

7.5.1 Description

Typical diagrams are detailed diagrams which represent standardized detailed configuration of definite measuring systems e.g. a transmitter including instrument valves or a definite actuating system, e.g. a pneumatic control valve with actuator, valve positioner, etc.

Objects of identical technical configuration but different signal interfaces with the control system shall be represented in separate typical diagrams.

7.5.2 Application

Typical diagrams contribute to limitation of the technical documentation, as several objects in process diagram can refer to same typical diagram and to the communication between the engineering disciplines.

7.5.3 Contents

General rules for representation of basic and additional information for measurement, control, and actuation in typical diagrams are given in Table 7.

Table 7 — Basic and additional information in typical diagrams

Aspect	Basic information	Additional information
Graphical symbols and connections	— graphical symbols for objects of which the item, e.g. a pneumatic control valve, are combined of — graphical symbols for measurement and control objects	
Reference designation	— reference designation on product level	
Technical information	— item list	
Diagram information	— simplified graphical symbol showing the representation used in process and instrumentation diagrams	

7.5.4 Representation

7.5.4.1 General

The TYD shall document all interfaces e.g. instrument air supply, power supply, incoming, and outgoing signal (analogue and binary), see example in Annex C.

Each TYP is allocated a unique document identity, which is used as reference in PID, see Figure 19.

7.5.4.2 Reference designation

The objects in the typical diagram are designated with a product oriented reference designations which can be linked to the reference designation of the main object for example a pneumatic on-off valve fail to close, see Figure 20.

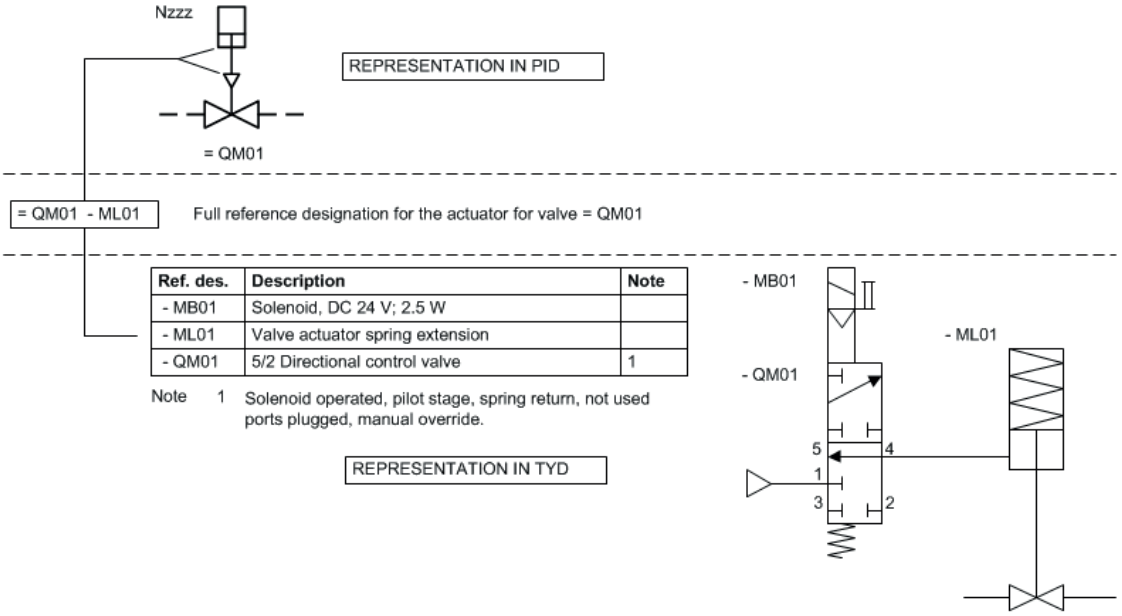


Figure 20 — Combination of function and object oriented reference designations

Annex A
(informative)

Graphical symbols for connections main process equipment, measurement, actuation, and control

The graphical symbols in this annex are taken from ISO 14617. This annex also includes graphical symbols proposed or developed since publication of ISO 14617 are also included.

The right column shows registrations numbers. Two or more registration numbers indicates the symbols used for creation of the symbol. The following indexes give source information of the graphical symbols and their registration numbers:

A ISO 14617

B Preliminary registration number for graphical symbols, which will be implemented in ISO 14617, at next review/revision.

C Symbol examples from standards or standards under approval, which are planned implemented in ISO 14617, at next review/revision.

Vx Application variant of an ISO 14617 graphical symbol.

Table A.1 — Connections, arrows, etc.

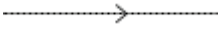
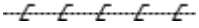
Entry no.	Symbol	Symbol name	Registration number
A.1.01		Functional connection, pipeline Line width 0,50	401V1[A]
A.1.02		Functional connection, instrument connection, control connection in process control diagrams (PCD) Line width 0,25	401V2[A]
A.1.03		Pilot line, signal lines in process flow diagrams (PFD) Line width 0,25	422[A]
A.1.04		Direction in general, except for energy and signal flow Form 1	241[A]
A.1.05		Direction in general, except for energy and signal flow Form 2	242[A]
A.1.06		Signal flow	249[A]
A.1.07		Electric type	435[A]

Table A.1 *(continued)*

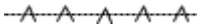
Entry no.	Symbol	Symbol name	Registration number
A.1.08		Hydraulic type	434[A]
A.1.09		Pneumatic type	433[A]
A.1.10		T-branch, form 1	X504[A]
A.1.11		T-branch, form 2	X505[A]
A.1.12		Crossing with connection	X506[A]
A.1.13		Interruption of connection line	P078[B]

Table A.2 — Main process objects pumps, fans, heat exchangers, etc.

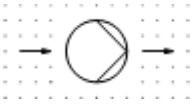
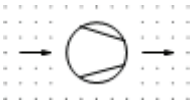
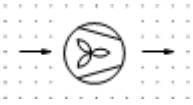
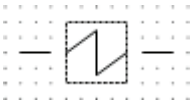
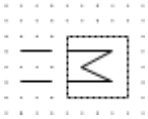
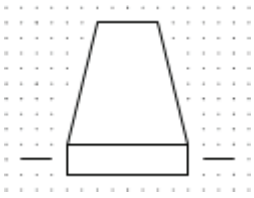
Entry no.	Symbol	Symbol name	Registration number
A.2.01		Pump, general	2301[A]
A.2.02		Fan, ventilator, blower, compressor, general	2302[A]
A.2.03		Fan, blower, ventilator, impeller type, general	X6325[C]
A.2.04		Heating or cooling surface, general Form 1	2501[A]
A.2.05		Heating or cooling surface, general Form 2	P014[B]
A.2.06		Cooling tower, general	2521[A]

Table A.3 — Valves, actuators, etc.

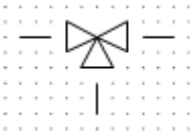
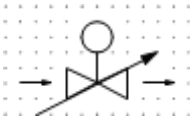
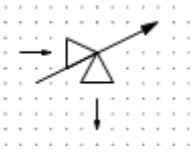
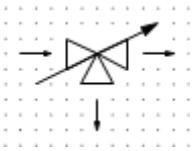
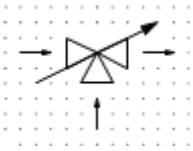
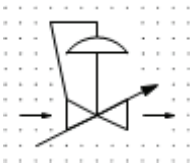
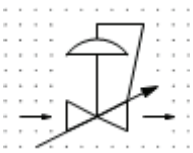
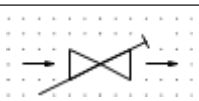
Entry no.	Symbol	Symbol name	Registration number
A.3.01		2-way on-off valve, straight type, general	2101[A]
A.3.02		2-way valve, angle type, general	2102[A]
A.3.03		3-way valve, general	2103[A]
A.3.10		Non return valve, general Form 1	X6105[C]
A.3.11		Non return valve, general Form 2	P090[B]
A.3.20		Control valve, general, continuously adjustability, shown with general actuator	2101[A] 210[A] P050[B]
A.3.21		Control valve, angle type, general	X6111[C]
A.3.22		Control valve, 3-way distributing mode, general	X6112[C]
A.3.23		Control valve, 3-way mixing mode, general	X6113[C]
A.3.24		Self-operating back-pressure control valve	X2132[A]
A.3.25		Self-operating pressure-reducing control valve	X2133[A]
A.3.26		Control valve, preset adjustability, balancing valve	X6119[C]
A.3.30		Safety valve, general	X6120[C]

Table A.3 *(continued)*

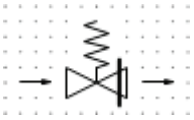
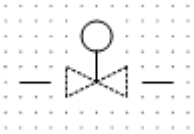
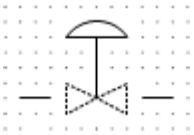
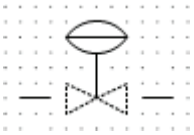
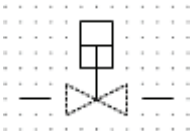
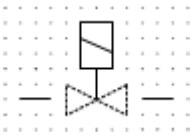
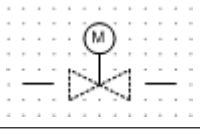
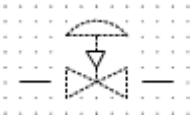
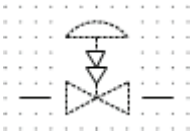
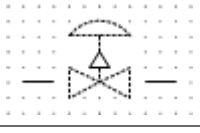
Entry no.	Symbol	Symbol name	Registration number
A.3.31		Safety valve, spring loaded, straight type, general	X6121[C]
A.3.32		Safety valve, spring loaded, angle type, general	X6122[C]
A.3.40		Actuator, without indication of type or control media	P050[B]
A.3.41		Diaphragm actuator, single acting	725[A]
A.3.42		Diaphragm actuator, double acting	726[A]
A.3.43		Cylinder actuator, linear or rotating	P051[B]
A.3.44		Electromagnetic actuator	P001[B]
A.3.45		Electrical motor actuator	P002[B]
A.3.50		Automatic return, fail close	654V1[A]
A.3.51		Automatic return, quick closing	654V2[A]
A.3.52		Automatic return, fail open	654V3[A]

Table A.3 *(continued)*

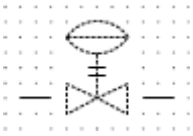
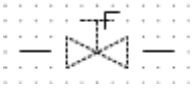
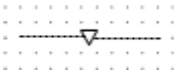
Entry no.	Symbol	Symbol name	Registration number
A.3.53		Double acting, fail freeze	659[A]
A.3.54		Valve locking device	P088[B]
A.3.55		Interlocking device	666[A]
A.3.56		Key	687[A]

Table A.4 — Measurement devices, sensors, etc.

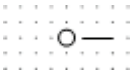
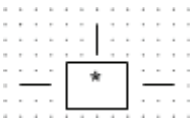
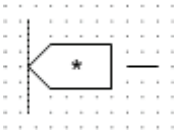
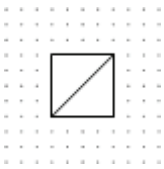
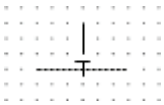
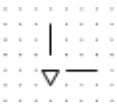
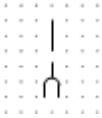
Entry no.	Symbol	Symbol name	Registration number
A.4.01		Point of measurement	1011[A]
A.4.02		Sensor, built-in type, general The * can be replaced by a supplementary symbol or a chemical formula.	X7270[C]
A.4.03		Sensor, general The * can be replaced by a supplementary symbol or a chemical formula.	P125[B]
A.4.04		Signal converter, transmitter	753[A]
A.4.10		Temperature measurement, general in pipeline and ducts	X7230[C]
A.4.20		Level, general	X7250[C]
A.4.21		Level, ultrasonic or radar type	X7251[C]
A.4.22		Level, vibration type	X7253[C]

Table A.4 *(continued)*

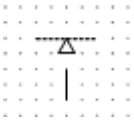
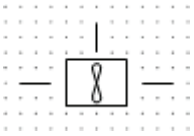
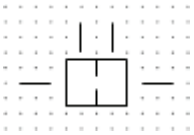
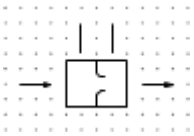
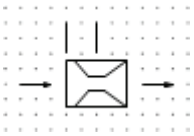
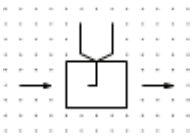
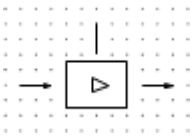
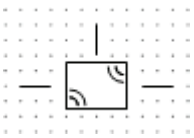
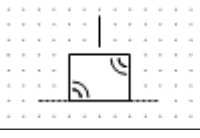
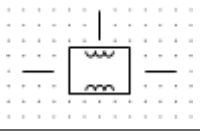
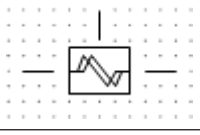
Entry no.	Symbol	Symbol name	Registration number
A.4.23		Level, electrode type	X7254C
A.4.30		Weighing, general	X7261C
A.4.40		Flow, propeller or turbine type	X7271C
A.4.41		Flow, orifice type	X7272C
A.4.42		Flow, nozzle type	X7273C
A.4.43		Flow, venturi type	X7274C
A.4.44		Flow, pitot tube type	X7275C
A.4.45		Flow, vortex type	X7276C
A.4.46		Flow, ultrasonic inline type	X7277C
A.4.47		Flow, ultrasonic clamp-on type	X7278C
A.4.48		Flow, magnetic type	X7279C
A.4.49		Flow, Coriollis type	X7280C

Table A.4 *(continued)*

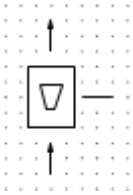
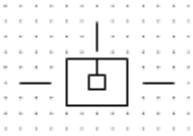
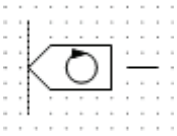
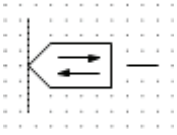
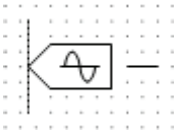
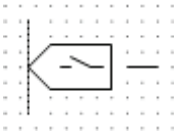
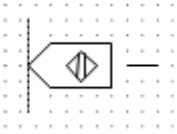
Entry no.	Symbol	Symbol name	Registration number
A.4.50		Flow, Variable area type	X7281[C]
A.4.51		Flow switch	X7282[C]
A.4.60		Sensor, rotation	P127[B]
A.4.61		Sensor vibration, general	P128[B]
A.4.62		Sensor, vibration, rotating machines	P129[B]
A.4.70		Limit switch, mechanical	X7290[C]
A.4.71		Limit switch, proximity	X7291[C]
A.4.90		Emergency stop	P131[B]

Table A.5 — Process control information symbols (PCI), etc.

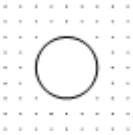
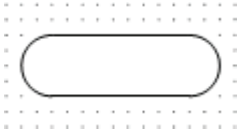
Entry no.	Symbol	Symbol name	Registration number
A.5.01		PCI, circle form, field mounted	1041[A]
A.5.02		PCI, extended form, field mounted	1041V1[A]

Table A.5 *(continued)*

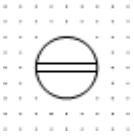
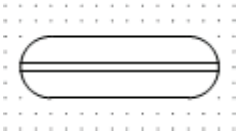
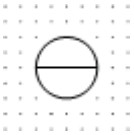
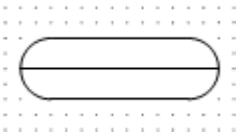
Entry no.	Symbol	Symbol name	Registration number
A.5.03		PCI, circle form, local control system	1041[A] 1103[A]
A.5.04		PCI, extended form, local control system	1041V1[A] 1103[A]
A.5.05		PCI, circle form, central control system	1041[A] 1101[A]
A.5.06		PCI, extended form, central control system	1041V1[A] 1101[A]

Table A.6 — Process control symbols, etc.

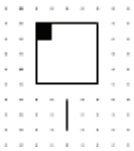
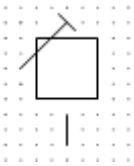
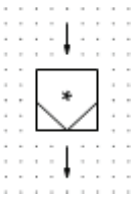
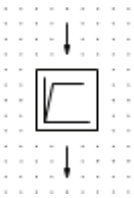
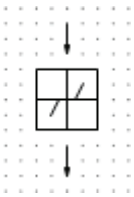
Entry no.	Symbol	Symbol name	Registration number
A.6.01		Set point Form 1	P100[B]
A.6.02		Set point Form 2	X7363[C]
A.6.03		Controller, general	895[A]
A.6.04		Control integrator	X7352[C]
A.6.05		Dead band	X7353[C]

Table A.6 *(continued)*

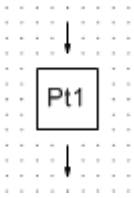
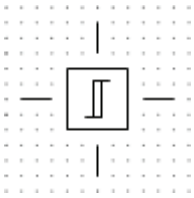
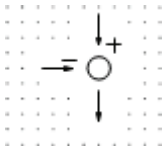
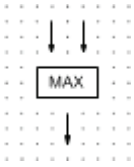
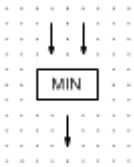
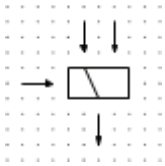
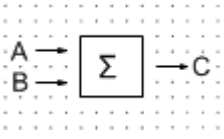
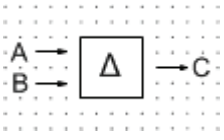
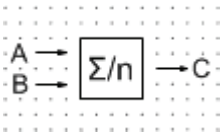
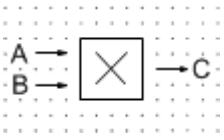
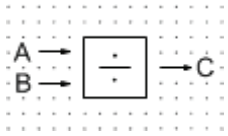
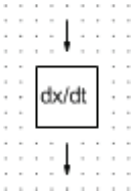
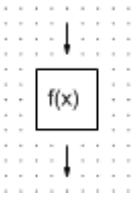
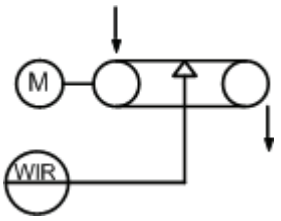
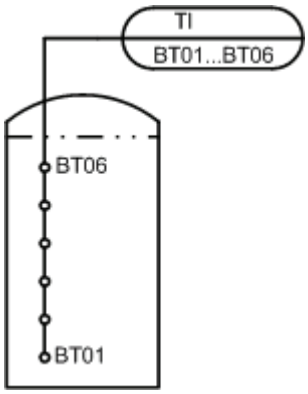
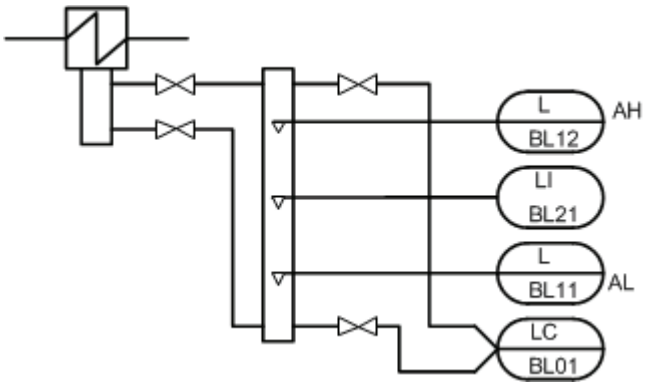
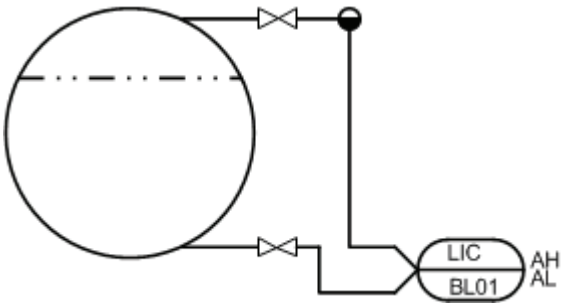
Entry no.	Symbol	Symbol name	Registration number
A.6.06		1. Order delay	X7354C
A.6.07		Limit value, high or low	X7364C
A.6.08		Subtraction	X7358C
A.6.09		Maximum selector	X7359C
A.6.10		Minimum selector	X7360C
A.6.11		Selector	X7362C
A.6.12		Summation	X7365C
A.6.13		Difference	X7355C
A.6.14		Average	X7366C
A.6.15		Multiplication	X7356C

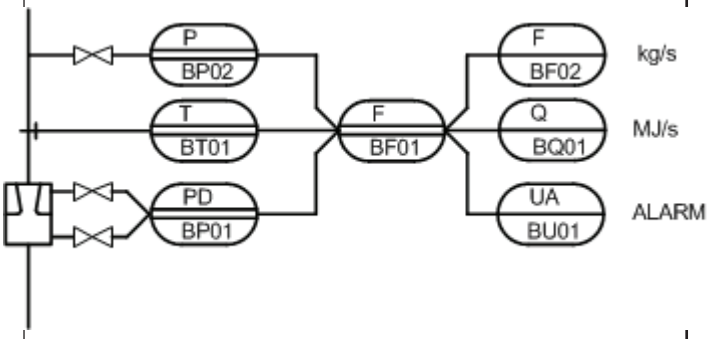
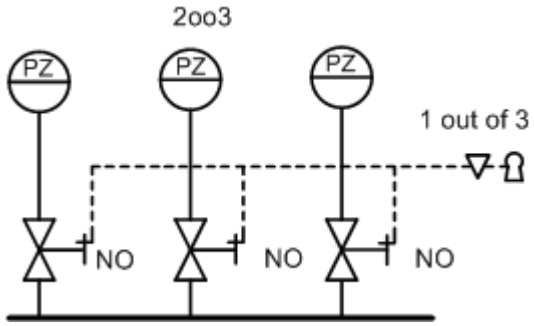
Table A.6 *(continued)*

Entry no.	Symbol	Symbol name	Registration number
A.6.16		Division	X7357C
A.6.17		Differentiation	X7350C
A.6.18		Polygon table	X7351C

Annex B
(informative)

Examples of representation of measurement, control, and actuation tasks

Ref	Process control task	Representation
B.1	Conveyor with integrated weighing device	
B.2	Temperature multi-spot measurement in a vertical tank	
B.3	Standpipe on heat exchanger with hot well	
B.4	Level measurement on a steam/water vessel	

Ref	Process control task	Representation
B.5	Measuring system with transmitter with integrated mathematic functions, electronics, e.g. steam table Output like the following: — Mass flow — Energy flow — Instrument alarm	
B.6	Interlock of instrument root valves for three pressure switches in a two out of three coupling The instrument root valves are normal open (NO) and manually operated. Operation of the root valves are interlocked only allowing one valve out of three to be operated at a time	

Annex C
(informative)

Diagram examples

This annex gives examples of representation of measurement, control, and actuation in following types of diagrams. The diagram examples focus preferably on representation of measurement, control, and actuation.

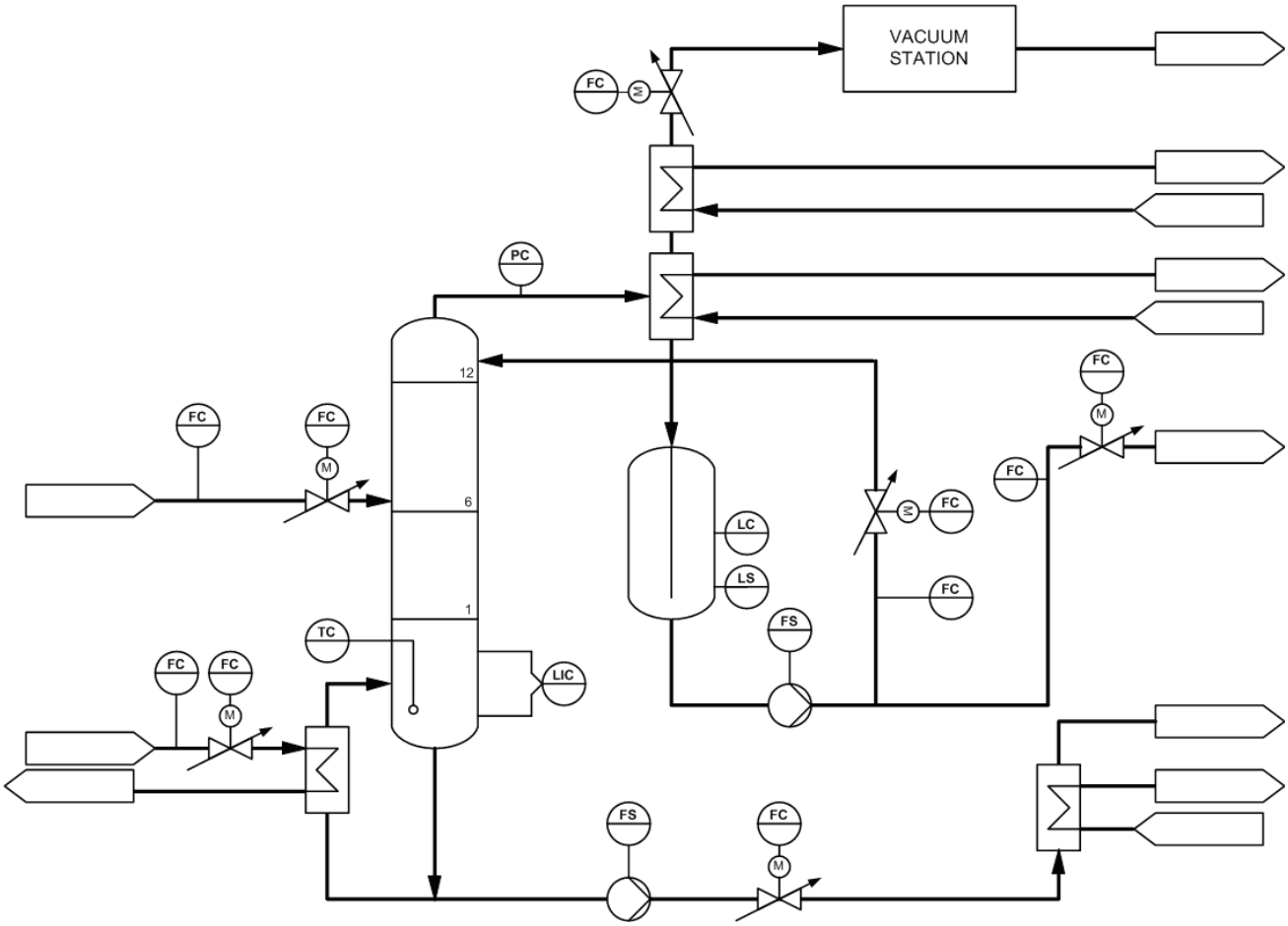


Figure C.1 — Process flow diagram with basic information

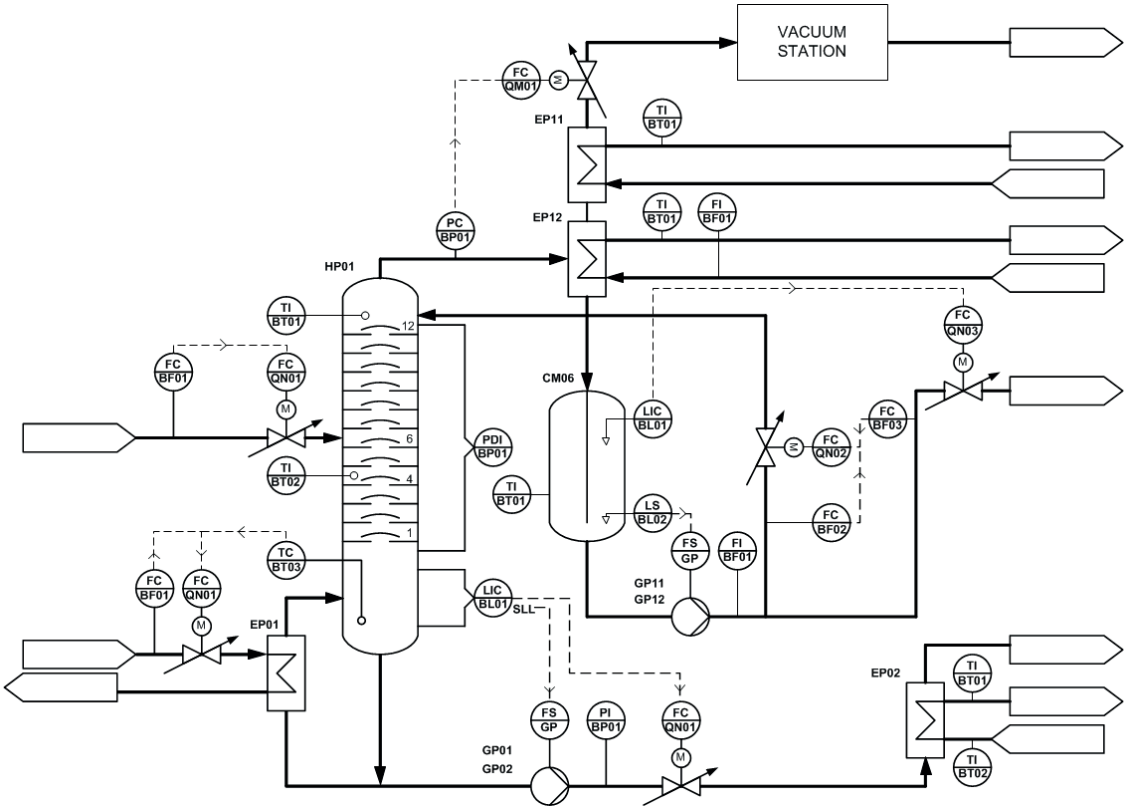


Figure C.2 — Process flow diagram with basic and additional information

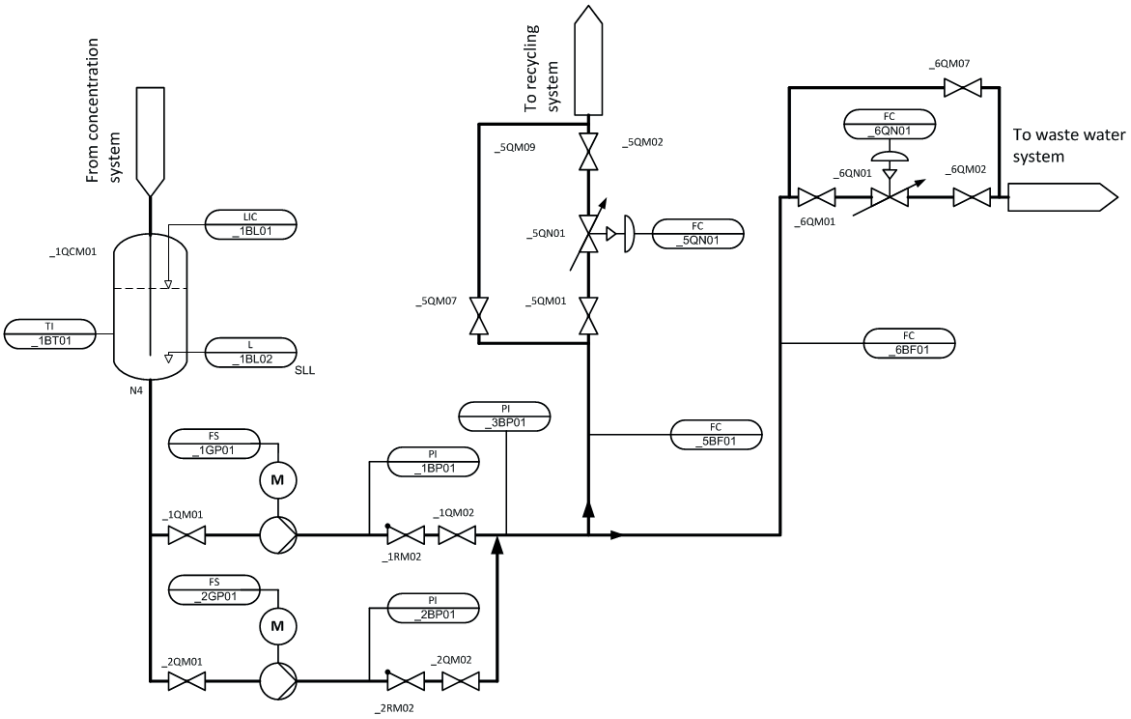


Figure C.3 — Process and instrumentation diagram with basic information

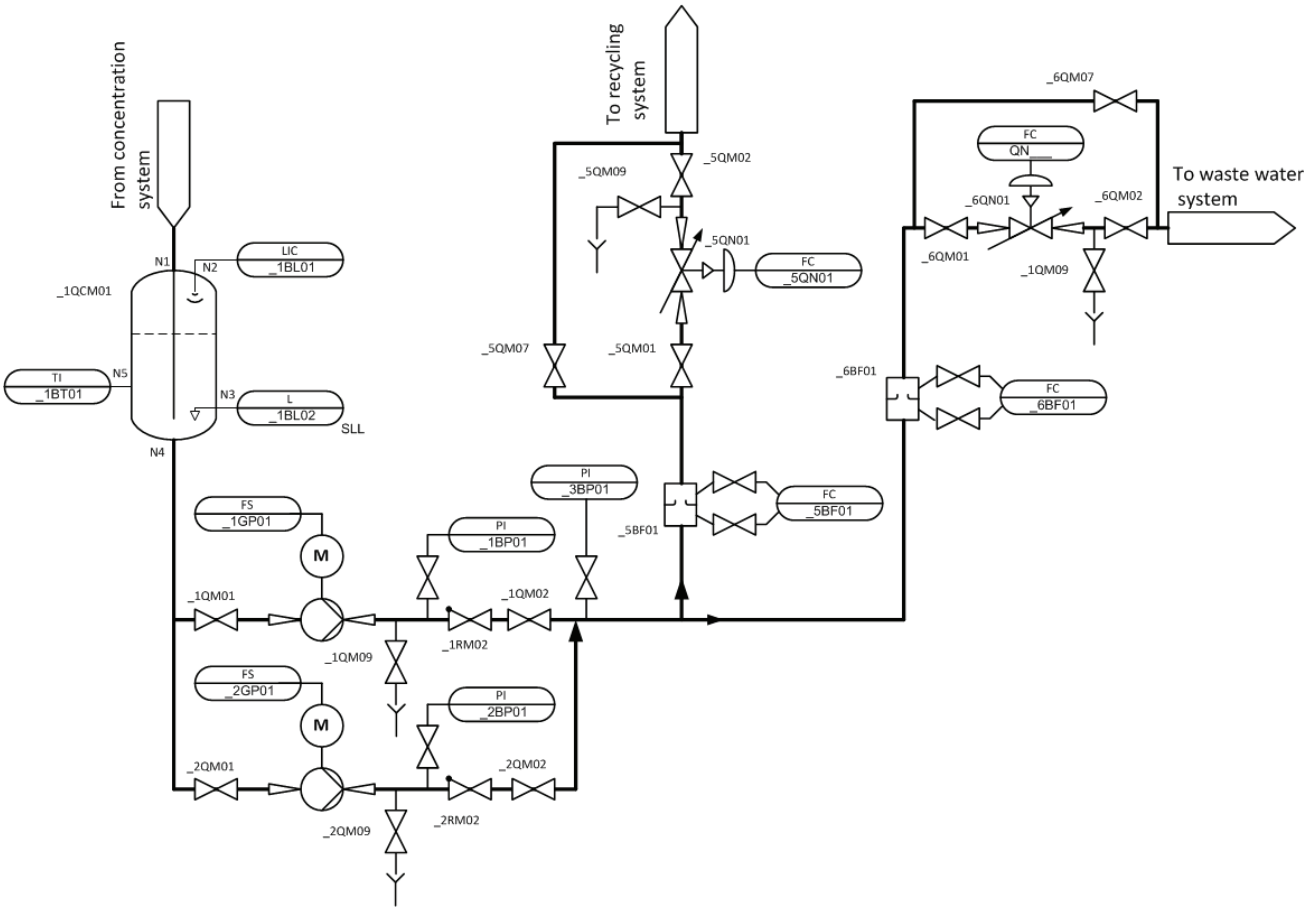


Figure C.4 — Process and instrumentation diagram with basic and additional information

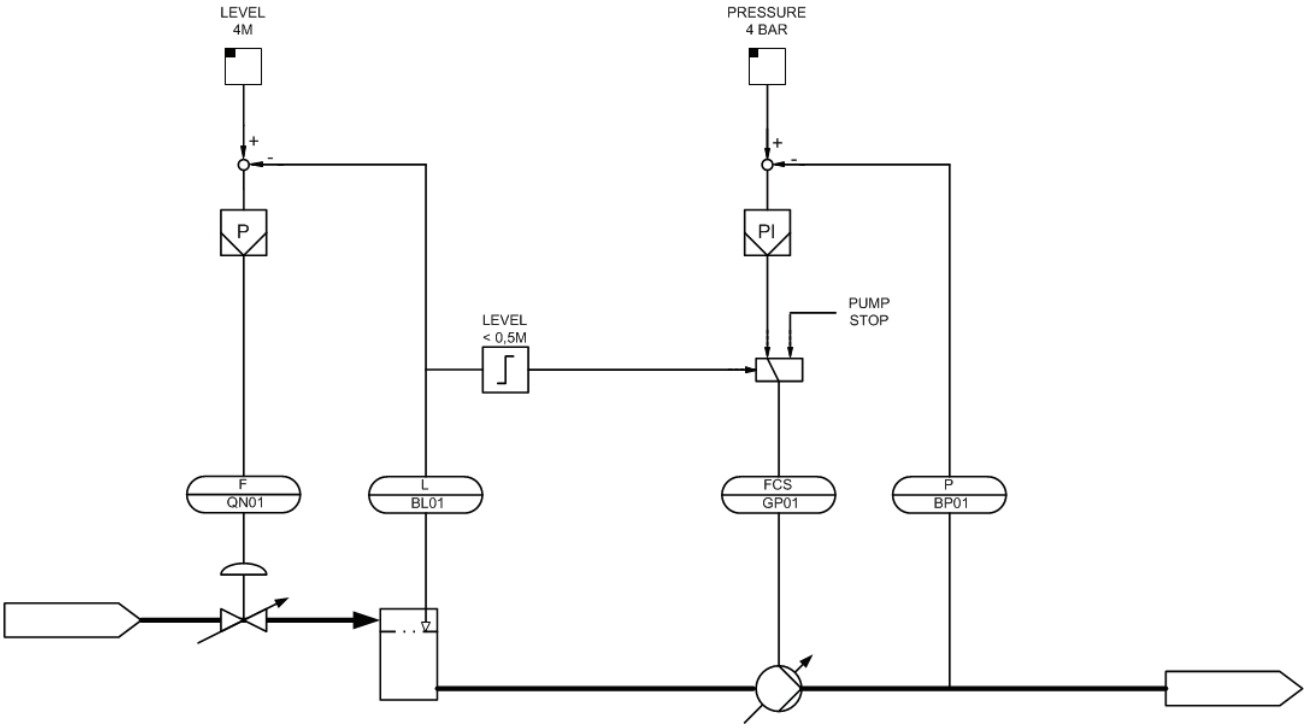
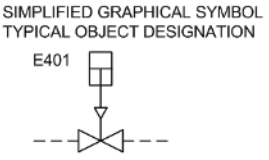


Figure C.5 — Process control diagram

Ref	Description	Note
BG01	LIMIT SWITCH BOX	1
MB01	SOLENOID, DC 24V, 2.5 W	
ML01	VALVE ACTUATOR , SPRING CLOSING	
QM01	5/2 DIRECTIONAL CONTROL VALVE	2
RM01/02	FLOW CONTROL VALVE , ADJUSTABLE, REVERSE FREE FLOW	
RP01	SILENCER	

Note 1 LIMIT SWITCH BOX WITH 2 X SPDT MICRO SWITCHES, INTEGRATED WITH OPEN / CLOSED OPTICAL INDICATOR

2 SOLENOID OPERATED , PILOT STAGE, SPRING RETURN, MANUAL OVERRIDE, NOT USED PORTS PLUGGED



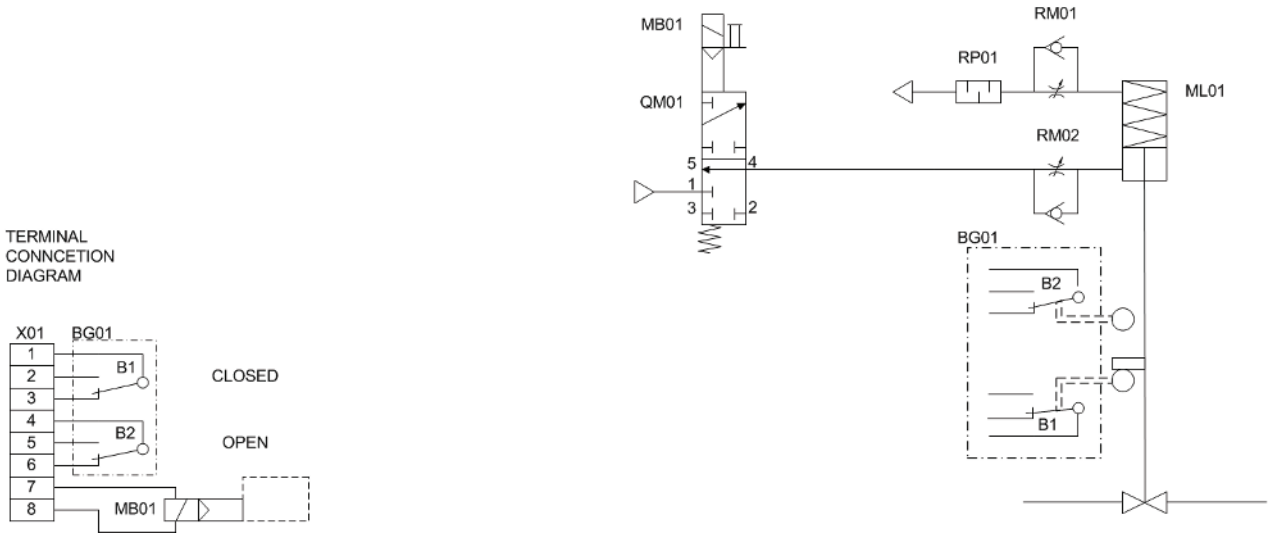


Figure C.6 — Typical diagram

Annex D
(informative)

Information exchange between process and control system

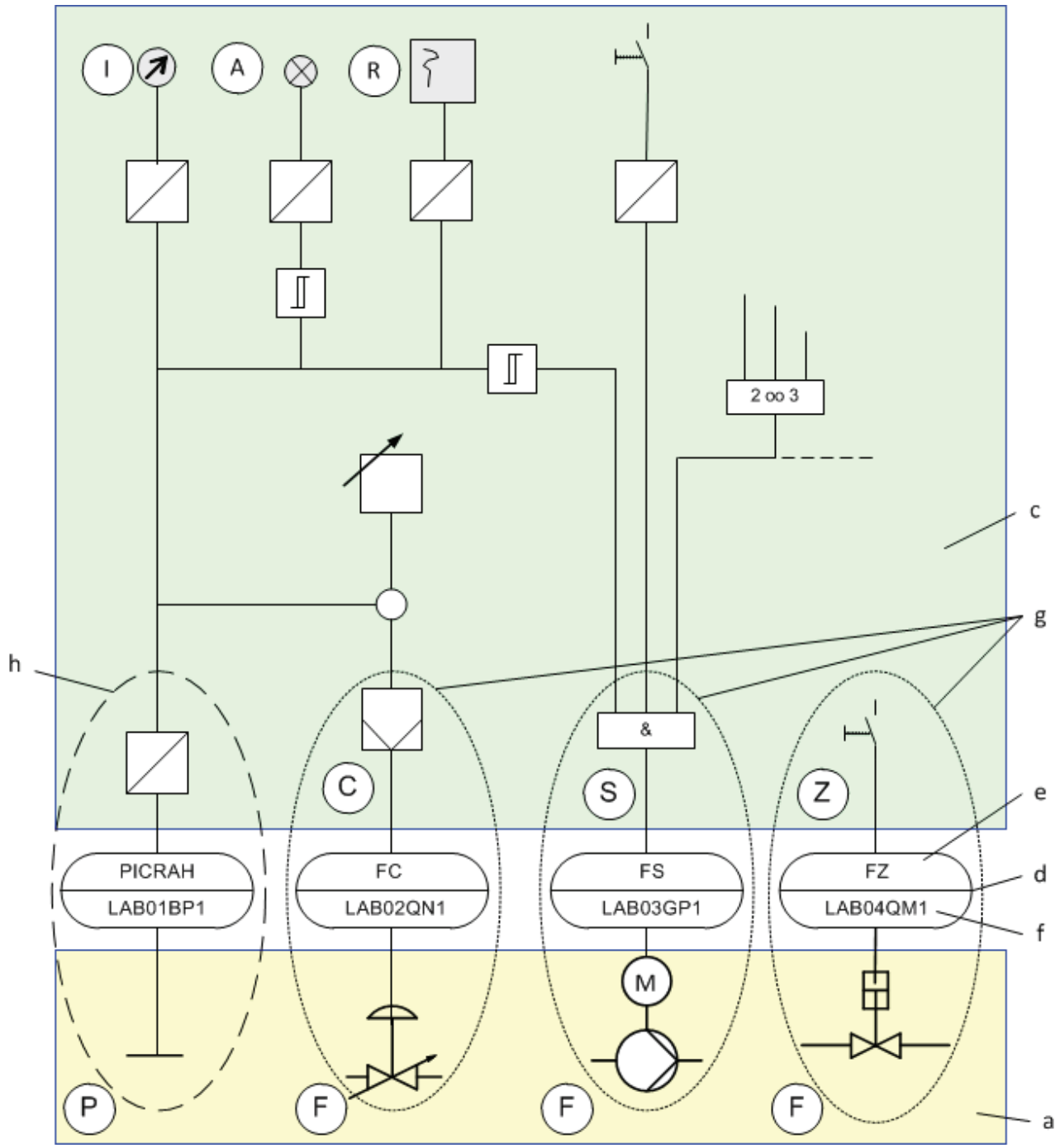
A process is controlled by measured and manipulated objects to fulfil the designed product quality.

Measured values of process variables supply all required information in order to act as soon as the set values do not match with the real values. Figure D.1 illustrates the following:

— the information exchange between the process and the control system by means of PCI symbols including letter codes for process variables and control functions and reference designation;

— the correlations between the process and the control system;

— the configuration of control functions.



Key

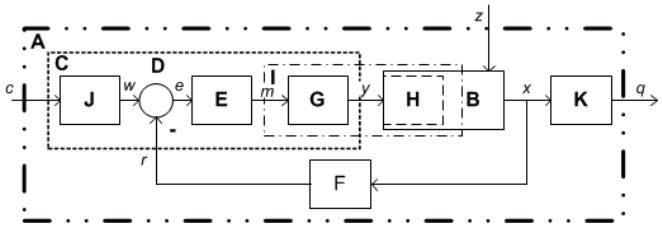
a process system - process variables according to Table 2
c controlling system – control functions according to Table 3
d process control information – PCI – symbol
e letter code of process variables and control functions
f letter code for reference designation
g control chain
h measuring chain

Figure D.1 — Information exchange between process and control system – Detailed representation

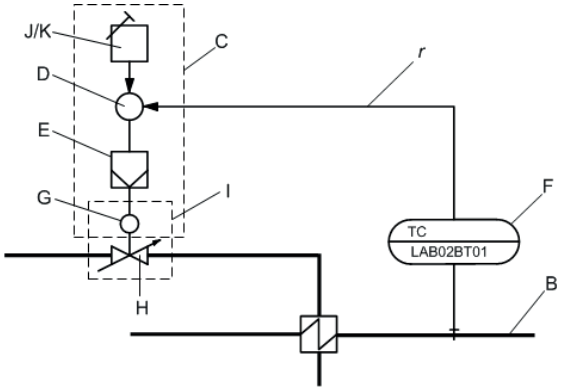
Annex E
(informative)

Relationship between terms for closed loop control, measurement, actuation, etc.

Figure E.1 illustrates typical terms for elementary process control based on IEC 60050-351.



a) Functional diagram



b) Process diagram

Key

A	control system	c	command variable
B	controlled system	e	error variable
C	controlling system	m	controller output variable
D	comparing element	q	final controlled variable
E	controlling element	r	feedback variable
F	measuring element	w	reference variable
G	actuator	x	controlled variable
H	final controlling element	y	manipulated variable
I	final controlling equipment	z	disturbance variable
J	reference variable generator		
K	generation of the final controlled variable		

Figure E.1 — Representation of elementary control terms according to IEC 60050-351

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[1] ISO 3511 (all parts), *Industrial process measurement control functions and instrumentation — Symbolic representation*

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[3] ISO 11005, *Technical product documentation — Use of main documents*

[4] ISO 15226, *Technical product documentation — Life cycle model and allocation of documents*

[5] ISO 16484-2, *Building automation and control systems (BACS) — Part 2: Hardware*

[6] ISO 16484-3, *Building automation and control systems (BACS) — Part 3: Functions*

[7] ISO/IEC 15288, *System and software engineering — System life cycle processes*

[8] IEC 60050-351:2013, *International Electrotechnical Vocabulary*

[9] IEC 61082-1, *Preparation of documents used in electrotechnology — Part 1: Rules*

[10] IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

[11] IEC 61511 (all parts), *Functional safety — Safety instrumented systems for the process industry sector*

[12] IEC 62023, *Structuring of technical information and documentation*

[13] IEC 62424, *Representation of process control engineering — Requests in P&I diagrams and data exchange between P&ID tools for PCE-CAE tools*

[14] ISA 5.1, *Instrumentation Symbols and Identification*

NOTE It is the overall ISO/TC10/SC10 plan to withdraw ISO 3511 (all parts). The graphical symbols have already been transferred to the ISO 14617 series. Diagram rules for the application of graphical symbols for measurement and control in diagrams are transferred to this International Standard. Letter codes for process variables and control functions are likewise transferred from ISO 14617 series to this International Standard

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