BS EN 61069-1:2016

BSI Standards Publication

Industrial-process measurement, control and automation — Evaluation of system properties for the purpose of system assessment

Part 1: Terminology and basic concepts

bsi.

National foreword

This British Standard is the UK implementation of EN 61069-1:2016. It is identical to IEC 61069-1:2016. It supersedes BS EN 61069-1:1993 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/1, System considerations.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2016

ISBN 978 0 580 86000 3
ICS 25.040.40

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2016.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61069-1

October 2016

ICS 25.040.40

Supersedes EN 61069-1:1993

English Version

Industrial-process measurement, control and automation - Evaluation of system properties for the purpose of system assessment - Part 1: Terminology and basic concepts (IEC 61069-1:2016)

Mesure, commande et automation dans les processus industriels - Appréciation des propriétés d'un système en vue de son évaluation - Partie 1: Terminologie et principes de base
(IEC 61069-1:2016)

Leittechnik für industrielle Prozesse - Ermittlung der Systemeigenschaften zum Zweck der Eignungsbeurteilung eines Systems - Teil 1: Terminologie und Konzepte
(IEC 61069-1:2016)

This European Standard was approved by CENELEC on 2016-07-20. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 65A/788/FDIS, future edition 2 of IEC 61069-1, prepared by SC 65A "System aspects" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61069-1:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-04-28
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-10-28

This document supersedes EN 61069-1:1993.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61069-1:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61069 Series	NOTE	Harmonized as EN 61069 Series.
IEC/TS 62603-1	NOTE	Harmonized as CLC/TS 62603-1.
IEC 61800-7-1:2015	NOTE	Harmonized as EN 61800-7-1:2016 (not modified).
IEC 61987-1:2006	NOTE	Harmonized as EN 61987-1:2007 (not modified).
IEC 61508-1:2010	NOTE	Harmonized as EN 61508-1:2010 (not modified).
IEC 82045-1:2001	NOTE	Harmonized as EN 82045-1:2001 (not modified).
IEC 60300-3-1	NOTE	Harmonized as EN 60300-3-1.
IEC 60654 Series	NOTE	Harmonized as EN 60654 Series.
IEC 60654-1	NOTE	Harmonized as EN 60654-1.
IEC 60654-2	NOTE	Harmonized as EN 60654-2.
IEC 60654-3	NOTE	Harmonized as EN 60654-3.
IEC 60654-4	NOTE	Harmonized as EN 60654-4.
IEC 60038	NOTE	Harmonized as EN 60038.
IEC 60721-3-1	NOTE	Harmonized as EN 60721-3-1.
IEC 60721-3-2	NOTE	Harmonized as EN 60721-3-2.
IEC 60721-3-3	NOTE	Harmonized as EN 60721-3-3.
IEC 60721-3-4	NOTE	Harmonized as EN 60721-3-4.
IEC 61326-1:2012	NOTE	Harmonized as EN 61326-1:2013 (not modified).
IEC 61000-4-3	NOTE	Harmonized as EN 61000-4-3.
IEC 61000-4-4	NOTE	Harmonized as EN 61000-4-4.
IEC 61000-4-5	NOTE	Harmonized as EN 61000-4-5.

IEC 61000-4-6	NOTE	Harmonized as EN 61000-4-6.
IEC 61000-4-8	NOTE	Harmonized as EN 61000-4-8.
IEC 61000-4-9	NOTE	Harmonized as EN 61000-4-9.
IEC 61000-4-10	NOTE	Harmonized as EN 61000-4-10.
IEC 61000-4-11	NOTE	Harmonized as EN 61000-4-11.
IEC 61000-2-4	NOTE	Harmonized as EN 61000-2-4.
ISO 9001:2015	NOTE	Harmonized as EN ISO 9001:2015.
IEC 60664-1	NOTE	Harmonized as EN 60664-1.
IEC 61010-1	NOTE	Harmonized as EN 61010-1.
IEC 62381	NOTE	Harmonized as EN 62381.
IEC 62443 Series	NOTE	Harmonized as EN 62443 Series [1].

[1] At draft stage.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Publication	Year	Title	EN/HD	Year
IEC 61000-4-2	-	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	-
IEC 61000-6-4	2006	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	EN 61000-6-4	2007
+A1	2010		+A1	2011
IEC 61508-4	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations	EN 61508-4	2010
IEC 61511-1	2003	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements	EN 61511-1	2004

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – EVALUATION OF SYSTEM PROPERTIES FOR THE PURPOSE OF SYSTEM ASSESSMENT –

Part 1: Terminology and basic concepts

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61069-1 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 1991. This edition constitutes a technical revision.

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

a) Reorganization of the material of IEC 61069-1:1991 to make the overall set of standards more organized and consistent;
b) IEC TS 62603-1:2014 has been incorporated into this edition.

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

FDIS	Report on voting
65A/788/FDIS	65A/798/RVD

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

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

A list of all parts in the IEC 61069 series, published under the general title *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment*, can be found on the IEC website.

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

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

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

INTRODUCTION

IEC 61069 deals with the method which should be used to assess system properties of a basic control system (BCS). IEC 61069 consists of the following parts:

Part 1: Terminology and basic concepts

Part 2: Assessment methodology

Part 3: Assessment of system functionality

Part 4: Assessment of system performance

Part 5: Assessment of system dependability

Part 6: Assessment of system operability

Part 7: Assessment of system safety

Part 8: Assessment of other system properties

Assessment of a system is the judgement, based on evidence, of the suitability of the system for a specific mission or class of missions.

To obtain total evidence would require complete evaluation (for example under all influencing factors) of all system properties relevant to the specific mission or class of missions.

Since this is rarely practical, the rationale on which an assessment of a system should be based is:

– the identification of the importance of each of the relevant system properties;
– the planning for evaluation of the relevant system properties with a cost-effective dedication of effort to the various system properties.

In conducting an assessment of a system, it is crucial to bear in mind the need to gain a maximum increase in confidence in the suitability of a system within practical cost and time constraints.

An assessment can only be carried out if a mission has been stated (or given), or if any mission can be hypothesized. In the absence of a mission, no assessment can be made; however, examination of the system to gather and organize data for a later assessment done by others is possible. In such cases, the standard can be used as a guide for planning an evaluation and it provides methods for performing evaluations, since evaluations are an integral part of assessment.

In preparing the assessment, it can be discovered that the definition of the system is too narrow. For example, a facility with two or more revisions of the control systems sharing resources, e.g., a network, should consider issues of co-existence and inter-operability. In this case, the system to be investigated should not be limited to the “new” BCS; it should include both. That is, it should change the boundaries of the system to include enough of the other system to address these concerns.

The part structure and the relationship among the parts of IEC 61069 are shown in Figure 1.

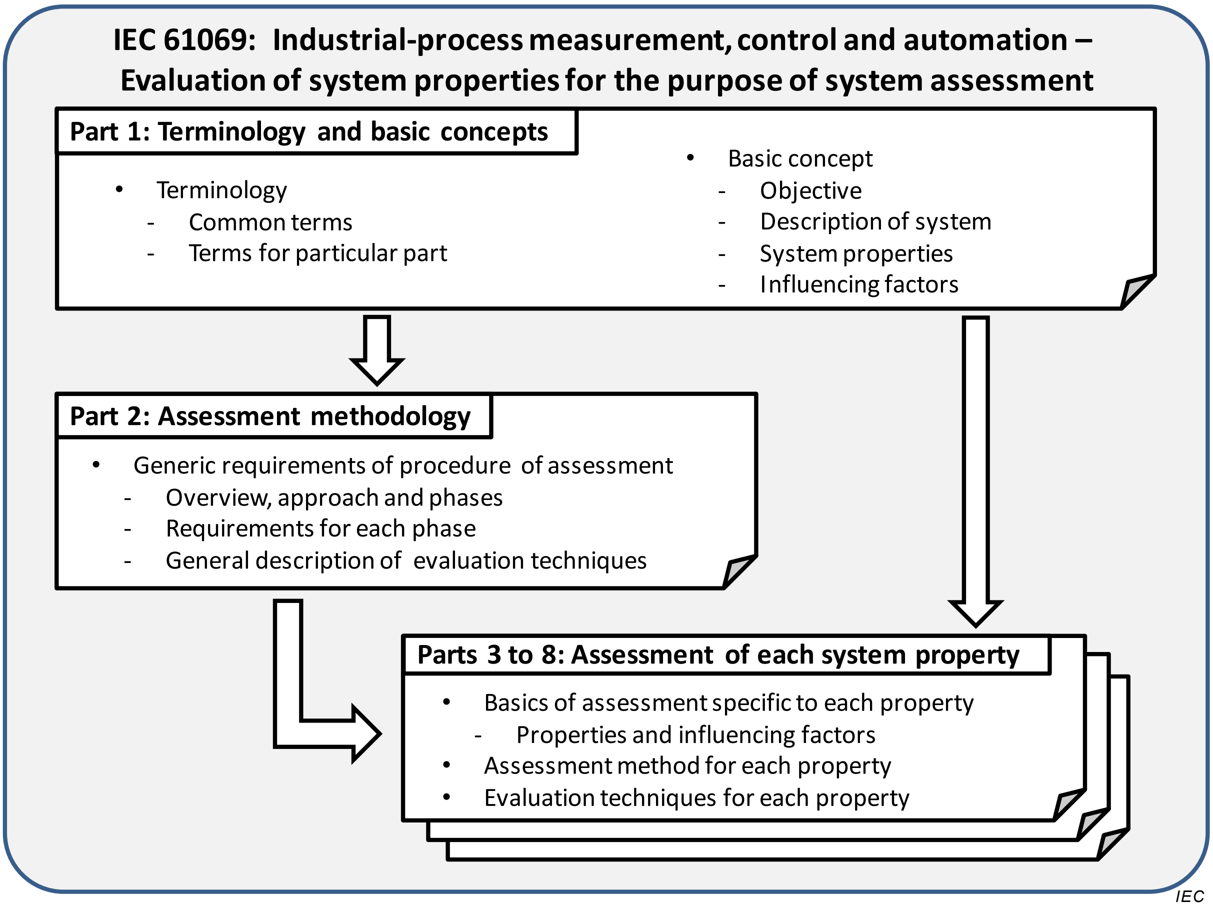


Figure 1 – General layout of IEC 61069

Some example assessment items are integrated in Annex A.

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – EVALUATION OF SYSTEM PROPERTIES FOR THE PURPOSE OF SYSTEM ASSESSMENT –

Part 1: Terminology and basic concepts

1 Scope

This part of IEC 61069 defines the terminology and outlines basic concepts in the assessment of a basic process control system (BPCS) and a basic discrete control system (BDCS). These two general system types cover the areas of discrete, batch and continuous applications. In IEC 61069 these two, BPCS and BDCS, together are referred to as "basic control system(s)", (BCS).

The treatment of safety in IEC 61069 is confined to hazards that can be present within the BCS itself.

Considerations of hazards that can be introduced by the process or equipment under control, of the BCS to be assessed, are excluded.

Where the BCS risk reduction is intended to be less than 10 (i.e. SIL $<$ 1, per IEC 61508-4), then assessment comes under IEC 61069.

A BCS with a safety integrity level (SIL) or performing any safety instrumented function (SIF) is not covered by IEC 61069, where SIL is defined by IEC 61508-4 and SIF is defined by IEC 61511-1.

This part of IEC 61069 is intended for the users and manufacturers of systems, and also for those who are responsible for carrying out assessments as an independent party.

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.

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-6-4:2006, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*
IEC 61000-6-4:2006/AMD1:2010

IEC 61508-4:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations* (see http://www.iec.ch/functionalsafety)

IEC 61511-1:2003, *Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and software requirements*

3 Terms, definitions, abbreviated terms, acronyms, conventions and symbols

3.1 Terms and definitions

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

3.1.1
accuracy
closeness of agreement between the result of a measurement / output and the (conventional) true value of the quantity being measured / calculated

3.1.2
assessment, <of a system>
process of judgement, based on evidence, suitability of a system, for a specific mission or class of missions

[SOURCE: ISO 15513:2000, 3.3, modified – "competency against prescribed standards of performance" replaced with ", based on evidence, suitability of a system, for a specific mission or class of missions"]

3.1.3
assessment activity
set of actions to evaluate one or more assessment items

3.1.4
assessment authority
body that has legal powers and rights of assessment

[SOURCE: ISO/IEC Guide 2:2004, 4.5, modified – The term itself has been modified (addition of "assessment") and addition of the words "of assessment" at the end of the definition]

3.1.5
assessment item
set of a system property which is evaluated and an influencing factor which is considered for the evaluation

3.1.6
assessment program
documented plan of coordinated set of assessment activities, not necessarily interdependent, that continue over a period of time and are designed to conduct the assessment

3.1.7
assessment protocol
set of formal rules describing the assessment

3.1.8
assessment specification
document which specifies scope, requirements and constraints of the assessment

3.1.9
availability
ability of an item to be in a state to perform a required function under given conditions at a given instant or over a given time interval, assuming that the required external resources are provided

[SOURCE: IEC 60050-192:2015, 192-01-23, modified – The definition has been extended]

3.1.10
base load
loading of the system when no SRD specified tasks are active, but includes system diagnostics and similar functions

3.1.11
basic control system
basic discrete control system (BDCS) and/or basic process control system (BPCS)

3.1.12
basic discrete control system
BDCS
system which responds to input signals from the machine(s), its(their) associated equipment, other programmable systems and/or an operator and generates output signals causing the machine(s) and its(their) associated equipment to operate in the desired manner but which does not perform any functional safety functions with a claimed SIL ≥ 1, realizing the mission(s) and task(s)

[SOURCE: IEC 61511-1:2003, 3.2.3, modified – In the term, "process" replaced by "discrete" and acronym corrected to “BDCS”. In the definition, “the process, its associated equipment” and “safety instrumented functions” replaced with “the machine(s), its (their) associated equipment” and “functional safety functions”, respectively.]

3.1.13
basic process control system
BPCS
system which responds to input signals from the process, its associated equipment, other programmable systems and/or an operator and generates output signals causing the process and its associated equipment to operate in the desired manner

[SOURCE: IEC 61511-1:2003, 3.2.3]

3.1.14
capacity
number of information translations which the system is able to execute without negatively impacting any other system capabilities

Note 1 to entry: Capacity may be e.g.

1) quantity of information translations, of some type within a define period of time or
2) quantity of information translations, of some type or
3) quantity of information translations or
4) task quantity, or
5) task(s) completion within a defined period time.

3.1.15
class
abstraction of a set of similar objects

3.1.16
class of mission
abstraction of a collection of missions which share common requirements

3.1.17
coverage
extent to which the system provides functions to perform industrial-process measurement and control tasks

3.1.18
configurability
extent to which the system facilitates selection, setting up and arrangement of its modules to perform the given tasks

3.1.19
credibility
extent to which a system is able to recognize and signal the state of the system and to withstand incorrect inputs or unauthorized access

3.1.20
cycle time
time span between two consecutive cyclically recurring events

[SOURCE: IEC 61800-7-1:2015, 3.3.5.5]

3.1.21
dead band
finite range of values of the input variable within which a variation of the input variable does not produce any measurable change in the output variable

Note 1 to entry: When this type of characteristic is intentional, it is sometimes called a neutral zone.

[SOURCE: IEC 60050-351:2013, 351-45-15]

3.1.22
dependability
extent to which a system can be relied upon to perform exclusively and correctly a task under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

3.1.23
efficiency
extent to which the operating means provided by the system minimise operator time and effort required in using the system to accomplish his tasks within stated constraints

3.1.24
element
part of system providing a single function that is indivisible and can be individually considered and tested, comprised of hardware and/or software

3.1.25
evaluation, <of a system property>
systematic determination of the extent to which a system property meets its specified criteria

[SOURCE: ISO/IEC 12207:2008, 4.12, modified – Specific use of the term (“<of a system>”) added and “an entity” replaced with “a system property”]

3.1.26
fall-back
functional fall-back: capacity of returning to a known functional level or mode in case of failure or abnormal operation

3.1.27
flexibility
extent to which the system can be adapted

3.1.28
function
operation performed by (a) module(s) which enables the system to perform a task

3.1.29
functionality
extent to which the system provides functions to perform tasks required by the system mission

3.1.30
functional safety
part of the overall safety that depends on functional and physical units operating correctly in response to their inputs

Note 1 to entry: See IEC TR 61508-0 [10][1].

[SOURCE: IEC 60050-351:2013, 351-57-06]

3.1.31
harm
injury or damage to the health of people, or damage to property or the environment

[SOURCE: ISO/IEC Guide 51:2014, 3.1]

3.1.32
hazard
potential source of harm

[SOURCE: ISO/IEC Guide 51:2014, 3.2]

3.1.33
hysteresis
phenomenon represented by a characteristic curve which has a branch, called ascending branch, for increasing values of the input variable, and a different branch, called descending branch, for decreasing values of the input variable

[SOURCE: IEC 60050-351:2013, 351-45-16]

3.1.34
influencing factor
observable qualitative or measurable quantitative item that affects a system property

3.1.35
information translation
conversion or conveyance of information entering the system or module at its boundary into derived information exiting the system or module at its boundary

Note 1 to entry: Information translation is a view of a function which represents a particular aspect of the function.

3.1.36
information translation function
function which executes information translation

---

[1] Numbers in square brackets refer to the Bibliography.

3.1.37
integrity
assurance provided by a system that the tasks will be performed correctly, unless notice is given of any state of the system which could lead to the contrary

3.1.38
intuitiveness
extent to which the operating means provided by the system are immediately understandable by the operators

3.1.39
maintainability
ability of a system under given conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources

3.1.40
measurement
process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity

Note 1 to entry: Measurement does not apply to nominal properties.

Note 2 to entry: Measurement implies comparison of quantities, including counting of entities.

Note 3 to entry: The French word "mesure" has several meanings in everyday French language. It is for this reason that the French word "mesurage" has been introduced to describe the act of measurement. Nevertheless, the French word "mesure" occurs many times in forming terms, following current usage, and without ambiguity. Examples are: unité de mesure (unit of measurement), méthode de mesure (measurement method), instrument de mesure (measurement instrument). This does not mean that the use of the French word "mesurage" in place of "mesure" in such terms is not permissible when advantageous.

[SOURCE: ISO/IEC Guide 99:2007, 2.1, modified – Note 3 to entry modified.]

3.1.41
mission, <of a system>
collective task assigned to the system to achieve a defined goal in a defined period under defined conditions

3.1.42
model
mathematical or physical representation of a system or a process, based with sufficient precision upon known laws, identification or specified suppositions

[SOURCE: IEC 6005-351:2013, 351-42-26]

3.1.43
module
distinct unit, which is capable of performing distinct function(s), composed of element(s), and which can be easily joined to or arranged with other units

3.1.44
observation
process of monitoring pattern response

[SOURCE: IEC 62528:2007, 3.1.34]

3.1.45
operability
extent to which the operating means provided by the system are efficient, intuitive, transparent and robust to accomplish the operators' tasks

3.1.46
operating condition
condition prescribed for evaluating the performance of a measuring instrument or measuring system or for comparison of measurement results with influencing factors in place

[SOURCE: ISO/IEC Guide 99:2007, 4.11, modified – Term modified ("reference" removed from term) and Notes 1 and 2 to entry removed.]

3.1.47
operating load
loading of a system created by the tasks, as specified in the SRD, when those tasks operate as designed

3.1.48
operator
person who uses the system to fulfil the mission

Note 1 to entry: In IEC 61069, operator is used in a generic way and includes all persons who may perform any tasks to fulfil the mission.

3.1.49
performance
precision and speed with which the system executes its tasks under defined conditions

3.1.50
reliability
ability of an item to perform a required function under given conditions for a given time interval

[SOURCE: IEC 60050-192:2015, 192-01-24]

3.1.51
repeatability error
algebraic difference between the extreme values obtained by a number of consecutive measurements of the output over a short period of time for the same value of the input under the same operating conditions, approaching from the same direction, for full range traverses

Note 1 to entry: Repeatability error is usually expressed in percentage of span and does not include hysteresis and drift.

[SOURCE: IEC 61987-1:2006, 3.28, modified – "non-repeatability" removed from term.]

3.1.52
resolution
smallest change in the measurand, or quantity supplied, which causes a perceptible change in the indication

[SOURCE: IEC 60050-311:2001, 311-03-10]

3.1.53
response time
time interval between the initiation of an information translation and the instant when the associated response is made available under defined conditions

3.1.54
robustness
extent to which the system correctly interprets and responds to operator actions performed, using unambiguous methods and procedures, and removes ambiguities by providing appropriate feedback

3.1.55
safety
freedom from unacceptable risk to the outside from the functional and physical units considered

Note 1 to entry: The definition of "safety" in combination with other words may gradually (as in "product safety", "machinery safety") or completely (as in "workers safety", "safety belt" or "functional safety") change. For the use of the word safety, see ISO/IEC Guide 51:2014, Clause 4. [ISO/IEC Guide 2, *Standardization and related activities – General vocabulary*]

Note 2 to entry: In standardization the safety of products, processes and services is generally considered with a view to achieving the optimum balance of a number of factors, including non-technical factors such as human behaviour, that will eliminate avoidable risks of harm to persons and goods to an acceptable degree. [ISO/IEC Guide 2]

Note 3 to entry: In many other languages than English there is only one word for safety and security.

[SOURCE: IEC 60050-351:2013, 351-57-05]

3.1.56
safety integrity level
SIL
discrete level (one out of a possible four), corresponding to a range of safety integrity values, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

Note 1 to entry: The target failure measures (see IEC 61508-4:2010, 3.5.17) for the four safety integrity levels are specified in Tables 2 and 3 of IEC 61508-1:2010.

Note 2 to entry: Safety integrity levels are used for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems.

Note 3 to entry: A safety integrity level (SIL) is not a property of a system, subsystem, element or component. The correct interpretation of the phrase "SIL n safety-related system" (where n is 1, 2, 3 or 4) is that the system is potentially capable of supporting safety functions with a safety integrity level up to n.

[SOURCE: IEC 61508-4:2010, 3.5.8]

3.1.57
security

freedom from unacceptable risk to the physical units considered from the outside

Note 1 to entry: In many other languages than English there is only one word for safety and security.

Note 2 to entry: Security in the context of this document is a general term encompassing physical security, information security, cyber security and others.

[SOURCE: IEC 60050-351-07:2013, 351-57-06, modified – Note 2 to entry added.]

3.1.58
spare capacity
remaining system capacity to run additional tasks

3.1.59
system configuration
arrangement of the elements of a system

[SOURCE: IEC 82045-1:2001, 3.4.5, modified – "system" added to term.]

3.1.60
system property
defined parameter suitable for the description and differentiation of BCS(s)

[SOURCE: ISO/IEC Guide 77-2:2008, 2.18, modified — "system" added to term, "products" replaced with "BCS(s)" and notes to entry removed.]

3.1.61
System Requirements Document
SRD
description of the mission and needs of the BCS from the target application standpoint

3.1.62
System Specification Document
SSD
description of the BCS implementation based on the needs as described in the SRD

3.1.63
system safety
extent to which the system itself as a physical entity will not impose a hazard

Note 1 to entry: System safety does not include the safety of the process or equipment under control.

Note 2 to entry: System safety does not include functional safety.

3.1.64
task
logically complete operation forming a part of the system mission

3.1.65
test
empirical evaluation

3.1.66
transparency
extent to which the operating means provided by the system apparently places the operator in direct contact with his tasks

3.2 Abbreviated terms, acronyms, conventions and symbols

This listing encompasses terms, acronyms, conventions and symbols used in IEC 61069-1 through IEC 61069-8.

BCS	basic control system
BDCS	basic discrete control system
BPCS	basic process control system
CRT	Cathode Ray Tube
EDI	Electronic Data Interchange
E/E/PE	electrical/electronic/programmable electronic
GPS	Global positioning system
I/O	Input and Output
IEC	International Electrotechnical Committee
ISO	International Organization for Standardization

PID Proportional-Integral-Derivative
QA Quality Assurance
QM Quality Management
SAT Site Acceptance Test
SIL safety integrity level
SRD system requirements document
SSD system specification document
TCP/IP Transmission Control Protocol / Internet Protocol
ZVEI German Electrical and Electronic Manufacturers' Association

3.3 Explanation of terms with regard to BCS concepts

Figure 2 provides a pictorial representation of the relationship between the System Requirements Document (SRD) and the System Specification Document (SSD) of the BCS.

The hierarchy of capability of both the requirements and realization is shown.

Figure 2 also shows mappings of lower level requirements and how they are realized in the system.

The SRD describes the mission and needs of the BCS from the target application standpoint.

The SSD describes the implementation based on the needs as described in the SRD.

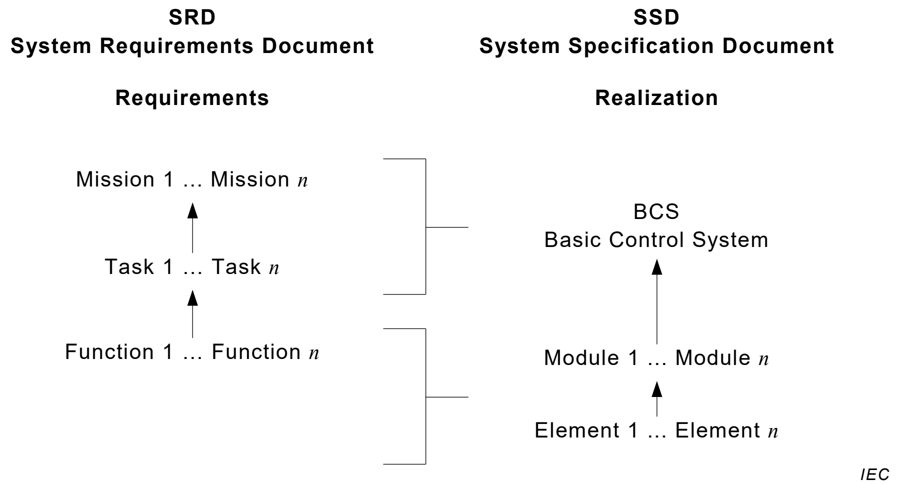
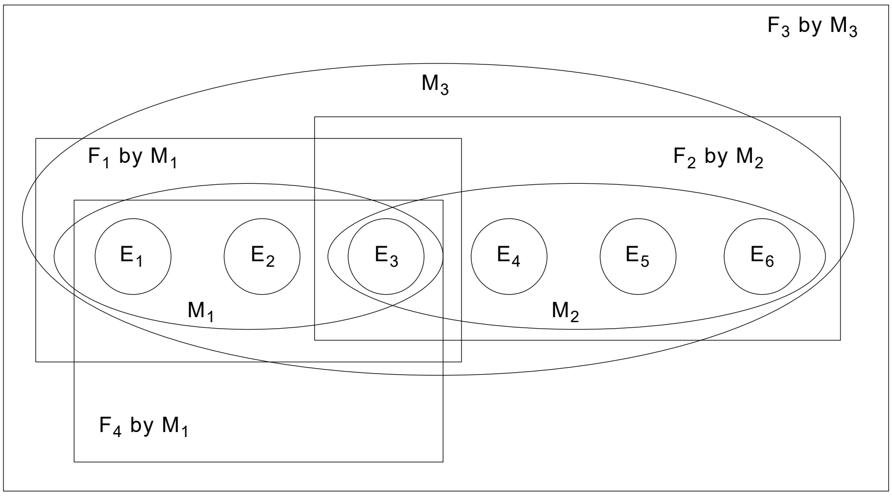


Figure 2 – Relationship of terms with regard to SRD and SSD

Figure 3 depicts the mapping of multiple functions (requirements) onto multiple modules/elements (realization) in an overlapping manner typical of an actual application/implementation.



M_n = $Module_n$
E_n = $Element_n$
F_n = $Function_n$

Figure 3 – Relation among function, module and element

4 Basis of an assessment

The purpose of the assessment of a system is to determine qualitatively and/or quantitatively the capability of the system to accomplish a specific mission.

Assessment of a system is judgement, based on evidence, of suitability of relevant system properties for a specific mission or class of missions.

To obtain total evidence would require complete (i.e. under all influencing factors) evaluation of all system properties of relevance to the specific mission or class of missions.

Since total evidence is rarely practical, an assessment of a system needs:

– to identify the criticality of the relevant system properties to accomplish the mission;
– to plan for evaluation of the relevant system properties with a cost-effective dedication of effort to the various system properties.

In conducting the assessment of a system, it is crucial to bear in mind the need to gain a maximum increase in confidence in the suitability of a system within practical cost and time constraints.

To accomplish a mission, a system is expected to be capable of performing the tasks necessary to support the mission, such as regulating pressures or flows, optimizing reactor conditions, etc.

The system is expected to provide the functions to enable these tasks to be performed. Such functions are, for example, those for measuring flows, storing data and displaying information. These functions are implemented in modules and elements. An element can be a piece of hardware, an orifice plate, an analogue to digital convertor, or a piece of software performing a flow calculation, storing a picture-image, etc. BCSs perform the tasks required, using the available functions, modules, and elements in various configurations. This characteristic of the system makes it difficult to synthesize the capability of a system to fulfil a specific task by evaluating the characteristics of the individual constituent functions, modules, and elements alone.

When conducting the assessment of a system, other appropriate standards and guides should be applied where these are available.

To facilitate the assessment of a system, the system properties should be segregated into related groups specified in this part of IEC 61069. This is especially useful in those cases where not all aspects need to be, or can be, evaluated. The boundaries of the system to be assessed shall be clearly defined and the conditions at these boundaries should be specified. These conditions can influence the behaviour of the system.

The scope of the assessment of a system largely depends on the mission and boundaries of the system, the influencing factors and the objective of the assessment.

The scope of the assessment can be conveniently summarized in the form of a matrix, listing on one axis the system properties and on the other axis the influencing factors to be considered. This matrix can be used to note which of the influencing factors is to be considered for each system property.

NOTE Other recognised assessments are available and currently used for systems including BCS other than the protocol given in IEC 61069. IEC 60300-3-1 can be consulted for a list of methodologies.

5 Assessment considerations

5.1 Basic control system (BCS)

5.1.1 Overview

A system accomplishes its mission by means of the interaction of its modules, with functions of each module. These modules are either centralized in one location or decentralized in several locations.

The capability of a system to accomplish the mission cannot be assessed by synthesizing the data obtained from evaluations of the properties of the individual modules and elements only. However these evaluations can provide useful and perhaps necessary inputs to the assessment of a system.

Many of the system properties are derived from the interaction of the modules.

In structuring the system, a functional model provides a useful tool to identify and classify the various functions and subfunctions of the system to be evaluated for the assessment.

In a generalized functional model of a system the following functions can be identified (see Figure 4):

- Process/machine interface functions;
- data processing functions;
- communication functions;
- human interface functions;
- external system interface functions.

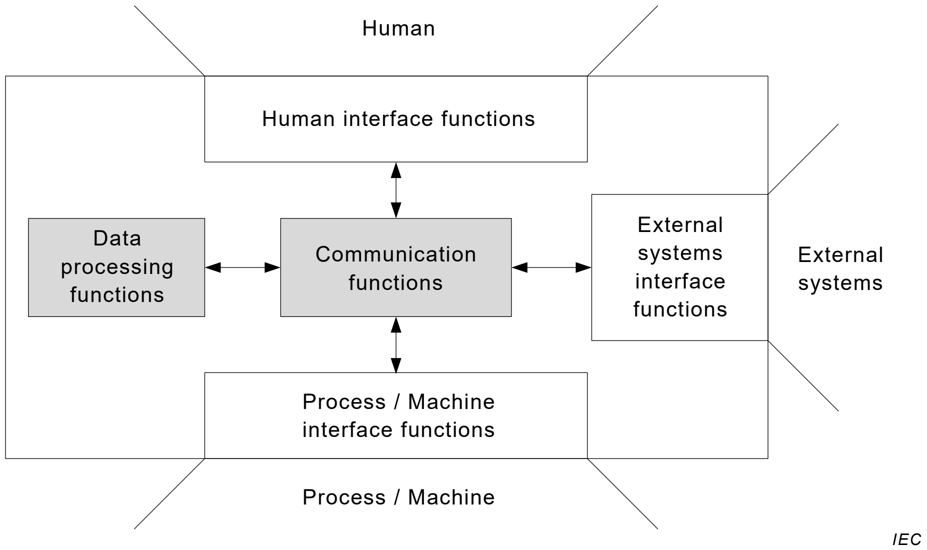


Figure 4 – Model of basic control systems

Each individual function may be distributed between distinctly different modules.

It is possible to reallocate dynamically each module to perform a distinct different function at another moment in time.

For example, a control function can be resident in or shared between:

– a module with its own data acquisition and real time trending capability;
– a module for process control with separate modules for data acquisition and data output, transferring data to each other via a communication network; or
– an external computer for process control tasks, making use of a BCS to perform data acquisition, data output and human interface tasks.

The functional model facilitates a clear description of the boundaries of the system to be assessed and serves to identify the elements which are within the scope of assessment.

The functional model also shows the relationship between the elements, and it supports the formulation of methods to assess the effectiveness of the functions within the system.

5.1.2 Process / machine interface functions

The process / machine interface functions receive signals from the process / machine or their associated equipment, and send output signals to the process / machine or their associated equipment.

5.1.3 Data processing functions

The data processing functions can be used for continuous control, batch control, discrete control, reporting, archiving and/or trending, etc. They act to process and transform information provided by the process/machine interface functions.

The data processing functions can be dedicated to individual tasks or they can support a combination of tasks required to achieve the system mission.

5.1.4 Communication functions

The communication functions provide the communication between modules and elements. The function can be distributed over the system being implemented as dedicated hardware and software in each module.

5.1.5 Human interface functions

The human interface functions provide operators, engineers, technologists, maintenance personnel and management personnel with access to the BCS. The functions can be resident in a specific element or distributed between several elements.

5.1.6 External system interface functions

The external system interface functions access and convert data available in the external system into a system specific protocol and format and vice versa.

The external system interface functions access and convert data available from/to the external system into a system specific protocol and format and vice versa.

5.2 System properties

5.2.1 Overview

The properties of a system can be classified into the categories listed in 5.2.2 to 5.2.7 (see Figure 5).

Each category can be divided into lower level categories. These further categorizations are specified in other parts of IEC 61069.

The assessment shall include evaluation of requirements specified by the national and international standards and regulations where applicable.

The evaluation method of a system property and the criteria for its judgement depend much on the intended mission of the system to be evaluated.

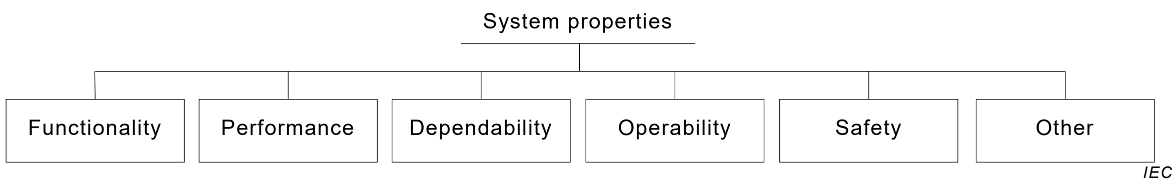


Figure 5 – System properties

5.2.2 Functionality

Functionality is a system property which indicates the extent to which the system provides, and facilitates assembly of, functions to perform tasks required by the system mission.

5.2.3 Performance

Performance is a system property which indicates the precision and speed with which the system executes its tasks under defined conditions.

5.2.4 Dependability

Dependability is a system property which indicates the extent to which the system can be relied upon to perform its intended functions.

5.2.5 Operability

Operability is a system property which indicates the extent to which the operating means provided by the system are efficient, intuitive, transparent and robust to accomplish the operators' tasks.

5.2.6 System safety

System safety is a system property which is a measure of the extent to which the system is free of hazard.

5.2.7 Other system properties

Other system properties are those not addressed in IEC 61069-3 through IEC 61069-7. See IEC 61069-8 for description of other system properties.

Examples of other system properties include the following:

– quality assurance, etc.;
– system support provided by the vendor and by the user, documentation, training, spare parts, etc.;
– compatibility of hardware and software, communications, etc.;
– physical properties such as heat dissipation, weight, etc.;

Each other system property listed above may be divided into a number of related characteristics.

5.3 Influencing factors

Prior to the evaluation of the system properties, it is necessary to define the range of operating conditions which the system is to withstand during its mission period.

The influencing factors are grouped by their sources (see Figure 6):

– the system missions / tasks imposed on the system;
– the personnel interfacing with the system;
– the process/machine connected to the system;
– the infrastructures serving the system;
– the environment in which the system is placed;
– the external systems connected to the system.

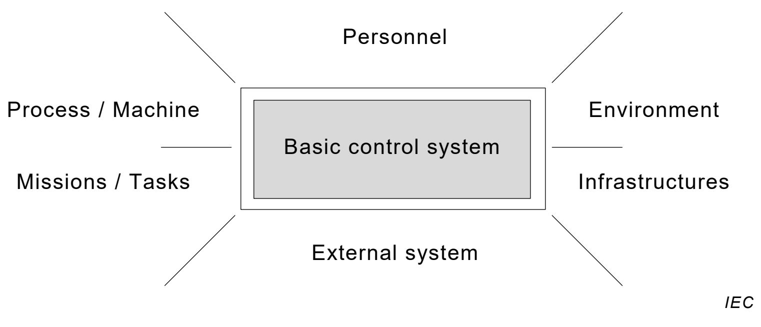


Figure 6 – Sources of influencing factors

For each of the sources given above, there are a number of influencing factors of which examples are shown in Table 1.

Table 1 – Influencing factors examples

Source	Influencing factors
Missions / Tasks	• Nature (e.g. continuous, batch, discrete) • Scope (e.g. single, multiple) • Mode of operation (e.g. start-up, shut-down, normal, emergency) • Mode of supervision (e.g. continuous, semi-continuous, unmanned)
Personnel	• Commands (authorized, unauthorized, false) • Task (definition) • Training • Presence (continuous) • Internal security threats • Technical assistance • Maintenance activity • Knowledge and skill
Process	• Input/output • Noise • Materials in the process
Infrastructures	• Voltage • Frequency • Interruption • Transients • Insulation • Distortion • Noise
Environment	• Climatic conditions (e.g. temperature, humidity, atmospheric air pressure, weather, icing) • Time (e.g. drift, ageing) • Time of operation (e.g. expected life, duty time) • Extreme climatic conditions (e.g. water immersion, saline water, corrosive substances, dust) • Mechanical conditions (e.g. physical space, mounting method, mechanical force (e.g. shock, vibration, acceleration)) • Electromagnetic interference (e.g. electrostatic discharge, radio-frequency electromagnetic field) • Mechanical force (e.g. shock, vibration, acceleration) • Biological hazard (e.g. vermin infestation, fungi)
External systems	• Commands (authorized, unauthorized, false) • Interference (electrical noise) • External security threats

Apart from the above-mentioned external influencing factors, the behaviour of the system is also affected by:

– faults or errors existing in or arising within the system itself; and
– the system’s limitations and characteristics, e.g., licensing, installation, operating guidelines, etc.

These behaviours are dealt with under the system properties of dependability and other system properties.

It is rarely cost effective to assess the effect of all influencing factors.

Therefore a judgement as to the depth of evaluation necessary shall be made. This judgement should take into consideration the expected sensitivity of the system to the various influencing factors, the criticality of the system mission, and the resources available for the assessment.Annex A describes some examples of influence factor.

Annex A
(informative)

Examples of Influencing factors (information from IEC TS 62603-1)

A.1 General

Annex A provides some examples about Influencing factors related to this part of IEC 61069 which were extracted from IEC TS 62603-1.

The classifications of values of properties described in this document are only examples.

A.2 influencing factors

A.2.1 Installation environment

This chapter describes the general characteristics of the environment in which the BPCS and its components are installed.

The operating conditions for the BPCS components are divided into four main categories, according to the classification made by the IEC 60654 series of standards:

- the climatic conditions of the location in which the components are installed (i.e. temperature, humidity, etc.);
- the power supply to which the components are connected: electrical specification of the power supply and the EMC requirements in terms of immunity and emission;
- mechanical influences to which the components are exposed during their operation (i.e. vibration, shock, etc.);
- corrosive and erosive influences to which the components are exposed during their operation (i.e. sand, gases, corrosive liquids, etc.).

A.2.2 Corrosive and erosive influences

A.2.2.1 General

There is a broad distribution of contaminant concentrations and reactivity levels existing within industries using process measurement and control equipment. Some environments are severely corrosive while others are mildly corrosive. Thus, as reported in IEC 60654-4, there are four different classes of environment according to the contaminant severity levels:

– Class 1: industrial clean air: an environment sufficiently well controlled that corrosion is not a factor in determining equipment reliability,
– Class 2: moderate contamination: an environment in which the effects of corrosion are measurable and may be a factor in determining equipment reliability,
– Class 3: heavy contamination: an environment in which there is a high probability that corrosive attack will occur. These harsh levels should prompt further evaluation resulting in environmental controls or specially designed and packaged equipment,
– Class 4: special: an environment in which the levels of contaminants are higher than in all the other classes.

A.2.2.2 Gases and vapours

The classes in Table A.1 recognize that average concentrations and peak values shall both be considered to properly classify an environment. Peak values are integrated on a ½ h basis.

Chemical agents (e.g. SO2 or HF) may vary greatly in their reactivity rate over a ½ h period. Therefore, the relationship of peak value to average value may vary with each contaminant. The classification of environment by category should be determined by the highest class if average and peak values are not in the same category.

Table A.1 – Concentration of gas and vapour contaminants (in cm^3/m^3)

	Class 1		**Class 2**		**Class 3**		**Class 4**	
Chemically active contaminants in air	**Industrial clean air**		**Moderate contamination**		**High contamination**		**Special**	
	Mean Value	**Peak Value**	**Mean Peak**	**Value Value**	**Mean Peak**	**Value Value**	**Mean Value**	**Peak Value**
Hydrogen sulphide (H_2S)	< 0,003	< 0,01	< 0,05	< 0,5	< 10	< 50	≥ 10	≥ 50
Sulphur dioxide (SO_2)	< 0,01	< 0,03	< 0,1	< 0,3	< 5	< 15	≥ 5	≥ 15
Wet chlorine (Cl_2)relative humidity > 50 %	< 0,000 5	< 0,001	< 0,005	< 0,03	< 0,05	< 0,3	≥ 0,05	≥ 0,3
Dry chlorine (Cl_2) relative humidity < 50 %	< 0,002	< 0,01	< 0,02	< 0,10	< 0,2	< 1,0	≥ 0,2	≥ 1,0
Hydrogen fluoride (HF)	< 0,001	< 0,005	< 0,01	< 0,05	< 0,1	< 1,0	≥ 0,1	≥ 1,0
Ammonia (NH_3)	< 1	< 5	< 10	< 50	< 50	< 250	≥ 50	≥ 250
Nitrogen oxides (NO_3)	< 0,05	< 0,1	< 0,5	< 1,0	< 5	< 10	≥ 5	≥ 10
Ozone (O_3) or other oxidants	< 0,002	< 0,005	< 0,025	< 0,05	< 0,1	< 1,0	≥ 0,1	≥ 1,0
Solvents Trichlorethylene	–	–	< 5	–	< 20	–	≥ 20	–
Special (other non-specified)	–	–	–	–	–	–	–	–
NOTE Solvent vapours can precipitate to form puddles which can become corrosive, especially to electrical parts of instruments.								

A.2.2.3 Aerosols

Aerosols are liquids carried in gas or air in the form of small droplets generating mists. Two common examples of aerosols are classified “oils in air” and “sea salt mists”.

For oils in air, the classes are defined as reported in Table A.2.

Table A.2 – Aerosol contaminants

	Class 1	**Class 2**	**Class 3**	**Class 4**
Oils (μg/kg-dry air)	< 5	< 50	< 500	> 500

For sea salt mists the classes are defined as listed below:

- Class 1: location near sea coasts more than 0,5 km away from the sea
- Class 2: on the sea coast (less than 0,5 km away)
- Class 3: off-shore installations

A.2.2.4 Solid substances

There is no possibility to classify the environments according to the levels of solid substances that are affecting the installation. For such a reason, the way to define the contamination of the environment by means of solid substance is to answer a list of questions:

- nature of solid substances in the environment which could affect the instruments and BPCS components (i.e. sand, cement dust, textile fibres, etc.);

- frequency of occurrence: i.e. continuous, occasional, unusual, etc.;
- average particle size: i.e. < 3 μm, between 3 μm and 30 μm, more than 0,3 mm, etc.;
- concentration in mg/kg of dry air: this applies only to airborne solid particles.

A.2.2.5 Liquids

There is no possibility to classify the environments according to the levels of liquid substances that are affecting the installation. For such a reason, the way to define the contamination of the environment by means of liquid substances is to answer a list of questions:

- nature of liquid substances in the environment which could affect the instruments and BPCS components;
- frequency of occurrence: i.e. continuous, occasional, unusual, etc.;
- electrical conductivity.

A.2.3 Integration of sub-systems

Integration of subsystems needs a procedure for combining separately developed modules of components so that they work together as a unique system. A subsystem is a set of components that operates as a part of a system and that is capable of performing a specific task within a system. A subsystem could be an existing system, which means that an already installed and operating system should be included in a new (larger) system.

Another option is that a subsystem has been provided by other suppliers and manufactures (i.e. third party subsystem).

A.2.4 Earth connection

IEC TS 61149 defines three classes of earth connections for electrical devices or control panels. These classes are related to the type of protection against electric shocks that is required, as reported below:

- Class I: these appliances shall have their chassis connected to electrical earth (ground) by an earth conductor. A fault in the appliance which causes a live conductor to contact the casing will cause a current flow in the earth conductor. The current should trip either an over current device or a residual current circuit breaker, which will cut off the supply of electricity to the appliance.
- Class II: a Class 2 or double insulated electrical appliance is designed in such a way that it does not require (and shall not have) a safety connection to electrical earth (ground).
- Class III: designed to be supplied from a safety extra low voltage (SELV) power source. The voltage from a SELV supply is low enough that under normal conditions a person can safely come into contact with it without risk of electric shock. The extra safety features built into Class 1 and Class 2 appliances are therefore not required.

A.2.5 Power supply

A.2.5.1 AC power supply

A.2.5.1.1 General

The values of the nominal voltages of the power supply are in accordance with the requirements of IEC 60038. The allowed frequencies are 50 Hz and 60 Hz and the nominal voltages applicable to PCSs are:

- 120/240 V for single phase systems (60 Hz),
- 230/400 V for three phase systems (50 Hz),
- 277/480 V for three phase systems (60 Hz).

The AC power supply characteristics are: voltage, frequency, harmonic distortion and switching time between the power supply and the back-up power supply. For each characteristic a set of different classes is defined, according to IEC 60654-2.

A.2.5.1.2 AC power voltage classes

Power voltages are classified in accordance with the percentage of variation of the voltage from its nominal value. Four classes are defined:

- Class AC1: ± 1 % V_{nom},
- Class AC2: ± 10 % V_{nom},
- Class AC3: from 10 % V_{nom} to -15 % V_{nom},
- Class AC4: from 15 % V_{nom} to -20 % V_{nom}.

A special class exists for the cases where the power supply voltages are not included in the requirements of the above listed classes.

A.2.5.1.3 AC power frequency classes

The frequency variation is stated as a percent deviation from the nominal frequency value. Three classes are defined:

- Class F1: ± 0,2 % F_{nom}
- Class F2: ± 1 % F_{nom}
- Class F3: ± 5 % F_{nom}

A special class exists for the cases where the power supply frequency is not included in the requirements of the above listed classes.

A.2.5.1.4 Harmonic content

The total harmonic distortion is defined as the percentage of the square root of the sum of square the harmonic voltages divided by the fundamental power supply frequency voltage (r.m.s.), as reported in the following Formula.

$$THD = \frac{\sqrt{\sum_{h=2}^{h=10} V_h^2}}{V_{1N}}$$

Where:

h is the harmonic order;

V_k is the RMS value of the voltage harmonic component of order h;

V_{1N} is the RMS value of the fundamental voltage component.

Four classes are defined:

- H1: harmonic content is less than 2 %,
- H2: harmonic content is less than 5 %,
- H3: harmonic content is less than 10 %,
- H4: harmonic content is less than 20 %.

A special class exists for all the cases where the harmonic content is not included in the above listed classes.

A.2.5.1.5 Switching time

For a system with an auxiliary or back-up power supply, switching time is the time interval between the deviation of voltage in the primary supply that initiates switching, and the restoration of normal voltage by the auxiliary supply. After the switching time, the voltage has to be within the limit values for the specified class of power. The value of deviation required to initiate switching is, in general, a characteristic of the switching system.

Five classes for the switching time are defined:

- ST1: switching time less than 3 ms;
- ST2: switching time less than 10 ms;
- ST3: switching time less than 20 ms;
- ST4: switching time less than 200 ms;
- ST5: switching time less than 1 s.

A special class exists for all the case where the switching time is not included in the above listed classes.

A.2.5.2 DC power supply

A.2.5.2.1 General

In accordance with the requirements of IEC 60038 the values of the nominal voltages of the DC power supply are: 12 / 48 / 110 / 220 V.

The DC power supply characteristics are: voltage, ripple and switching time between the power supply failure and an auxiliary power supply taking over. For each characteristic a set of different classes is defined, according to IEC 60654-2.

A.2.5.2.2 DC power voltage classes

DC power voltages are classified by their percent variation of the voltage from the nominal value. Four classes are defined:

- DC1: ±1 % V_{nom},
- DC2: from 10 % V_{nom} to -15 % V_{nom},
- DC3: from 15 % V_{nom} to -20 % V_{nom},
- DC4: from 30 % V_{nom} to -25 % V_{nom}.

A special class exists for all the cases where the voltage variations are not included in the above listed classes.

A.2.5.2.3 DC power voltage ripple classes

Ripple voltage is defined as the percentage of the peak-to-peak value of the total AC component of the power supply voltage to the measured (average) power supply voltage, as measured at rated load. Four classes are defined:

- DC1: ripple voltage less than 0,2 %,
- DC2: ripple voltage less than 1 %,
- DC3: ripple voltage less than 5 %,
- DC4: ripple voltage less than 15 %.

A special class exists for all the cases where the power supply ripple is not included in the above listed classes.

A.2.5.2.4 Switching time

For a system with an auxiliary or back-up power supply, switching time is the time interval between the deviation of voltage in the primary supply which initiates switching, and the restoration of normal voltage by the auxiliary supply. After the switching time, the voltage has to be within the limit values for the specified class of power.

Five classes for the switching time are defined:

- STDC1: switching time less than 1 ms;
- STDC2: switching time less than 5 ms;
- STDC3: switching time less than 20 ms;
- STDC4: switching time less than 200 ms;
- STDC5: switching time less than 1 s.

A special class exists for all the cases where the switching time is not included in the above listed classes.

A.2.5.2.5 Earth connection

One of the following three possibilities for grounding DC power supply shall be specified:

- Positive to earth,
- Negative to earth,
- Floating.

A.2.6 Climatic conditions

Considered climatic conditions are air temperature, humidity and barometric pressure in the specific location where the system and its components are installed. Location classes are classified into four severity levels that define the expected climatic conditions of the site. Location classes apply for operation, storage and transportation. Specific classes may apply for storage and transportation as stated in IEC 60721-3-1 and in IEC 60721-3-2.

Location classes are:

- Class A: weather-protected locations, air-conditioned locations. In these locations both air temperature and humidity are controlled within specified limits;
- Class B: weather-protected locations, heated and/or cooled enclosed locations. In these locations only air temperature is controlled within specified limits;
- Class C: weather-protected locations, sheltered and/or unheated enclosed locations. In these locations neither air temperature nor humidity is controlled and equipment is protected against direct exposure to such climatic elements as direct solar radiation, rainfall, full wind pressure, etc.
- Class D: non weather-protected locations, outdoor locations. In these locations neither air temperature nor humidity are controlled and the equipment is exposed to atmospheric conditions such as direct solar radiation, rainfall, full wind pressure, etc.

Table A.3 is extracted from IEC 60654-1, and reports the limit values of the climatic conditions for each location class.

Table A.3 – Climatic condition parameters and severities for classes of location

Environmental parameter	Unit	Class of location (Notations in brackets are climatic classes of IEC 60721-3-1, IEC 60721-3-3 and IEC 60721-3-4)												
		A1[a] (3K1) /	Ax[b] / /	B1 (3K2) /	B2 (3K3) (1K2)	B3 (3K4) /	Bx[b] / /	C1 (3K5) (1K3)	C2 (3K6) /	C3 (3K7) (1K5)	Cx[b] / /	D1 (4K2) (1K8)	D2 (4K3) /	Dx2) / /
Low air temperature	°C	+20		+15	+5	+5		-5	-25	-40		-33	-50	
High air temperature	°C	+25		+30	+40	+40		+45	+55	+70		+40	+40	
Low relative humidity	%	20		10	5	5		5	10	10		15	15	
High relative humidity	%	75		75	85	95		95	100	100		100	100	
Low absolute humidity	g/m^3	4		2	1	1		1	0,5	0,1		0,26	0,03	
High absolute humidity	g/m^3	15		22	25	29		29	29	35		25	36	
Solar radiation	W/m^2	500		700	700	700		700	1 120	1 120		1 120	1 120	
Rate of change of temperature[c]	°C/min	0,1		0,5	0,5	0,5		0,5	0,5	0,1		0,5	0,5	
Condensation		No		No	No	Yes		Yes	Yes	Yes		Yes	Yes	
Wind-driven precipitation (rain, snow, hail, etc.)		No		No	No	No		No	Yes	Yes		Yes	Yes	
Formation of ice		No		No	No	No		Yes	Yes	Yes		Yes	Yes	
Low air pressure	kPa	86[d]		86[d]	86[d]	86[d]		86[d]	86[d]	86[d]		86[d]	86[d]	
High air pressure	kPa	106		106	106	106		106	106	106		106	106	

a) Tolerance of ± 2 °C on stated temperature values.

b) For “special” Classes Ax, Bx, Cx e Dx, values should be selected from IEC 60721-3-1, IEC 60721-3-2, IEC 60721-3-3 and IEC 60721-3-4.

c) To be considered when significant.

d) 70 kPa for high altitude and/or transportation.

For each location class A,B,C or D, several levels are defined (i.e. B1, B2, C1, C2, etc.) according to different values of the environmental parameters defining the class of location.

A.2.7 EMC requirements

A.2.7.1 General

The requirements for immunity and emission levels regarding electromagnetic compatibility (EMC) are referred to electrical equipment operating with a voltage level lower than 1 000 V(alternating current) or 1 500 V (direct current).

A.2.7.2 Immunity

A.2.7.2.1 General

The general performance criteria for the evaluation of the immunity of the devices are as listed below:

- Class A: normal operation, within the specification limits, during the exposure to the EM disturbance;
- Class B: during the EM exposure temporary degradation, or loss of function or performance which is self-recovering;
- Class C: during the EM exposure temporary degradation, or loss of function or performance which requires operator intervention or system reset.

The performance criteria should be applied to each single disturbance to which the device can be exposed. The limit values for every disturbance are reported in A.2.7.2.2 to A.2.7.2.10.

The immunity requirements for a generic application are given in IEC 61326-1:2012, Table 1.

Particular immunity requirements for equipment intended for use in industrial locations are given in IEC 61326-1:2012, Table 2.

A.2.7.2.2 Electrostatic discharge (ESD)

See IEC 61000-4-2:2008 for ESD immunity testing requirements.

A.2.7.2.3 Radiated radio-frequency electromagnetic field

IEC 61000-4-3 defines five classes of environments, as listed below:

- Class 1: low-level electromagnetic radiation environment. Levels typical for local radio/television stations located at more than 1 km, and transmitters/receivers with low power;
- Class 2: moderate electromagnetic radiation environment. Low power portable transceivers (typically less than 1 W rating) are in use, but with restrictions on use in close proximity to the equipment (typical commercial environment);
- Class 3: severe electromagnetic radiation environment. Portable transceivers (2 W rating or more) are in use relatively close to the equipment but not less than 1 m. High power broadcast transmitters are in close proximity to the equipment and ISM equipment may be located close by (typical industrial environment);
- Class 4: portable transceivers are in use within less than 1 m of the equipment. Other sources of significant interference may be within 1 m of the equipment;
- Class x: x is an open level which might be negotiated and specified in the product standard or equipment specification.

The installation classes are related to the test levels, which give a quantitative measure of the stress to which the device is exposed (see Table A.4).

Table A.4 – Test levels for RF fields

Class	**Test field strength** [V/m]
1	1
2	3
3	10
4	30
X	Special

A.2.7.2.4 Electrical Fast Transient/Burst immunity test

IEC 61000-4-4 defines five classes of environment, as listed below:

- Class 1: well-protected environment

- The installation is characterized by the following attributes:
  - suppression of all EFT/B in the switched power supply and control circuits;
  - separation between power supply lines (AC and DC) and control and measurement circuits coming from other environments belonging to higher severity levels;
  - shielded power supply cables with the screens earthed at both ends on the reference earthing of the installation, and power supply protection by filtering.
- A computer room may be representative of this environment.
- The applicability of this level to testing of equipment is limited to the power supply circuits for type tests, and to the earthing circuits and equipment cabinets for post-installation tests.
- Class 2: protected environment
- The installation is characterized by the following attributes:
  - partial suppression of EFT/B in the power supply and control circuits which are switched only by relays (no contactors);
  - poor separation of the industrial circuits belonging to the industrial environment from other circuits associated with environments of higher severity levels;
  - physical separation of unshielded power supply and control cables from signal and communication cables.
- The control room or terminal room of industrial and electrical plants may be representative of this environment.
- Class 3: typical industrial environment
- The installation is characterized by the following attributes:
  - no suppression of EFT/B in the power supply and control circuits which are switched only by relays (no contactors);
  - poor separation of the industrial circuits from other circuits associated with environments of higher severity levels;
  - dedicated cables for power supply, control, signal and communication lines;
  - poor separation between power supply, control, signal and communication cables;
  - availability of earthing system represented by either conductive pipes or earth conductors in the cable trays connected to the protective earth system.
- Heavy industrial processes may be representative of this environment.
- Class 4: severe industrial environment
- The installation is characterized by the following attributes:
  - no suppression of EFT/B in the power supply and control and power circuits which are switched by relays and contactors;
  - no separation of the industrial circuits belonging to the severe industrial environment from other circuits associated with environments of higher severity levels;
  - no separation between power supply, control, signal and communication cables;
  - use of multicore cables in common for control and signal lines.
- The outdoor area of industrial process equipment where no specific installation practice has been adopted, power plants, the relay rooms of open-air H.V. substations and gas insulated substations of up to 500 kV operating voltage (with typical installation practice) may be representative of this environment.
- Class 5: special situations to be analyzed
- The minor or major electromagnetic separation of disturbance sources from equipment circuits, cables, lines etc., and the quality of the installations may require the use of a higher or lower environmental level than those described above. It should be noted that equipment lines of a higher environmental level can penetrate a lower severity environment.

Table A.5 reports the installation classes and the corresponding test levels, which give a quantitative measure of the stress the device is exposed to:

Table A.5 – Test levels for electrical fast transient/burst

Open circuit output test voltage and repetition rate of the impulses				
Level	On power port, PE		On I/O (input/output) signal, data and control ports	
	Voltage peak kV	Repetition rate kHz	Voltage peak kV	Repetition rate kHz
1	0,5	5 or 100	0,25	5 or 100
2	1	5 or 100	0,5	5 or 100
3	2	5 or 100	1	5 or 100
4	4	5 or 100	2	5 or 100
X [a)]	Special	Special	Special	Special
Use of 5 kHz repetition rates is traditional; however, 100 kHz is closer to reality. Product committees should determine which frequencies are relevant for specific products or product types. With some products, there may be no clear distinction between power ports and I/O ports, in which case it is up to product committees to make this determination for test purposes.				
a) "X" is an open level. The level has to be specified in the dedicated equipment specification.				

A.2.7.2.5 Surge

IEC 61000-4-5 defines seven classes of environment, as listed below:

- Class 0: well-protected electrical environment, often within a special room
  – All incoming cables are provided with overvoltage (primary and secondary) protection. The units of the electronic equipment are interconnected by a well designed grounding system, which is not significantly influenced by the power installation or lightning. The electronic equipment has a dedicated power supply (see Table A.6). Surge voltage may not exceed 25 V.
- Class 1: partly protected electrical environment
  – All incoming cables to the room are provided with overvoltage (primary) protection. The units of the equipment are well-interconnected by a ground connection network, which is not significantly influenced by the power installation or lightning. The electronic equipment has its power supply completely separated from the other equipment. Switching operations can generate interference voltages within the room. Surge voltage may not exceed 500 V.
- Class 2: electrical environment where the cables are well-separated, even at short runs
  – The installation is grounded via a separate connection to the grounding system of the power installation which can be subjected to interference voltages generated by the installation itself or by lightning. The power supply to the electronic equipment is separated from other circuits, usually by a dedicated transformer for the mains power supply. Non-protected circuits are present in the installation, but well-separated and in restricted numbers. Surge voltages may not exceed 1 kV.
- Class 3: electrical environment where power and signal cables run in parallel
  – The installation is grounded to the common grounding system of the power installation which can be subjected to interference voltages generated by the installation itself or by lightning. Current due to ground faults, switching operations and lightning in the power installation may generate interference voltages with relatively high amplitudes in the grounding system. Protected electronic equipment and less sensitive electric equipment are connected to the same power supply network. The interconnection cables can be partly outdoor cables, but close to the grounding network.

Unsuppressed inductive loads are present in the installation and usually there is no separation of the different field cables. Surge may not exceed 2 kV.

- Class 4: Electrical environment where the interconnections are running as outdoor cables along with power cables, and cables are used for both electronic and electric circuits
  - The installation is connected to the grounding system of the power installation which can be subjected to interference voltages generated by the installation itself or by lightning. Currents in the kA range due to ground faults, switching operations and lightning in the power supply installation may generate interference voltages with relatively high amplitudes in the grounding system. The power supply network can be the same for both the electronic and the other electrical equipment. The interconnection cables are run as outdoor cables, even to the high-voltage equipment. A special case of this environment is when the electronic equipment is connected to the telecommunication network within a densely populated area. There is no systematically constructed grounding network outside the electronic equipment, and the grounding system consists only of pipes, cables, etc. Surge voltage may not exceed 4 kV.
- Class 5: Electrical environment for electronic equipment connected to telecommunication cables and overhead power lines in a non-densely populated area
  - All these cables and lines are provided with overvoltage (primary) protection. Outside the electronic equipment there is no widespread grounding system (exposed plant). The interference voltages due to ground faults (currents up to 10 kA) and lightning (currents up to 100 kA) can be extremely high. The requirements of this class are covered by the test level 4
- Class x: Special conditions specified in the product specifications

The installation classes are related to the test levels reported in Table A.6, which give a quantitative measure of the stress to which the device is exposed.

Table A.6 – Test levels for surge protection

Installation class	Test levels (kV)											
	AC power supply and AC I/O directly connected to the mains network Coupling mode		AC power supply and AC I/O not directly connected to the mains network Coupling mode		DC power supply and DC I/O directly connected thereto Coupling mode		Unsymmetrical operated d), f) circuits/lines Coupling mode		Symmetrical operated d),f) circuits/lines Coupling mode		Shielded I/O and communication lines f) Coupling mode	
	Line-to-line	Line-to-ground	Line-to-line	Line-to-ground	Line-to-line	Line-to-ground	Line-to-line	Line-to-ground	Line-to-line	All lines-to-ground	Line-to-line	Line-to-ground
0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	NA	0,5	NA	NA	NA	NA	NA	0,5	NA	0,5	NA	NA
2	0,5	1,0	NA	NA	NA	NA	0,5	1,0	NA	1,0	NA	0,5
3	1,0	2,0	1,0 e)	2,0 b),e)	1,0 e)	2,0 b),e)	1,0 c)	2,0 b),c)	NA	2,0 b),c)	NA	2,0 c)
4	2,0	4,0 b)	2,0 e)	4,0 b),e)	2,0 e)	4,0 b),e)	2,0 c)	4,0 b),c)	NA	2,0 b),c)	NA	4,0 c)
5	a)	a)	2,0	4,0 b)	2,0	4,0 b)	2,0	4,0 b)	NA	4,0 b)	NA	4,0 c)

a) Depends on the class of the local power supply system.

b) Normally tested with primary protection.

c) The test level may be lowered by one level if the cable length is shorter or equal to 10 m.

d) No test is advised at data connections intended for cables shorter than 10 m.

e) If protection is specified upstream from the EUT, the test level should correspond to the protection level when the protection is not in place.

f) High speed communications lines could be included under unsymmetrical, symmetrical, shielded I/O and/or communications lines.

A.2.7.2.6 Conducted disturbances induced by radio-frequency fields

IEC 61000-4-6 defines four classes of environment, as listed below:

- Class 1: Low-level electromagnetic radiation environment. Typical level where radio/television stations are located at a distance of more than 1 km and typical level for low-power transceivers.
- Class 2: Moderate electromagnetic radiation environment. Low-power portable transceivers (typically less than 1 W rating) are in use, but with restrictions on use in close proximity to the equipment (typical commercial environment).
- Class 3: Severe electromagnetic radiation environment. Portable transceivers (2 W and more) are in use relatively close to the equipment but at a distance not less than 1 m. High-powered broadcast transmitters are in close proximity to the equipment and ISM equipment may be located close by (typical industrial environment).
- Class x: x is an open level which may be negotiated and specified in the dedicated equipment specifications or equipment standards.

Table A.7 reports the installation classes and the corresponding test levels that represent a quantitative measure of the stress to which the device is exposed:

Table A.7 – Test levels for RF induced disturbances

Frequency range 150 kHz – 80 MHz		
Level	Voltage level (e.m.f.)	
	U_0 dB(μV)	U_0 V
1	120	1
2	130	3
3	140	10
X [a]	Special	
[a] X is an open level.		

A.2.7.2.7 Power frequency magnetic field

IEC 61000-4-8 defines six classes of environment, as listed below:

a) Class 1: Environmental level where sensitive device using electron beam can be used.

   Monitors, electron microscope, etc., are representative of these devices.

b) Class 2: Well protected environment
   - The environment is characterized by the following attributes:
     - i) absence of electrical equipment like power transformers that may give rise to leakage fluxes;
     - ii) areas not subjected to the influence of H.V. bus-bars.
   - Household, office, hospital protected areas far away from earth protection conductors, areas of industrial installations and H.V. sub-stations may be representative of this environment.

c) Class 3: Protected environment
   - The environment is characterized by the following attributes:
     - i) electrical equipment and cables that may give rise to leakage fluxes or magnetic field;
     - ii) proximity of earth conductors of protection systems;
     - iii) M.V. circuits and H.V. bus-bars far away (a few hundred metres) from equipment concerned.
   - Commercial areas, control building, field of not heavy industrial plants, computer room of H.V. sub-stations may be representative of this environment.

d) Class 4: Typical industrial environment
   - The environment is characterized by the following attributes:
     - i) short branch power lines as bus-bars, etc.;
     - ii) high power electrical equipment that may give rise to leakage fluxes;
     - iii) ground conductors of protection system;
     - iv) M.V. circuits and H.V. bus-bars at relative distance (a few tens of metres) from equipment concerned.
   - Fields of heavy industrial and power plants and the control room of H.V. sub-stations may be representative of this environment.

e) Class 5: Severe industrial environment
   - The environment is characterized by the following attributes:
     - i) conductors, bus-bars or M.V., H.V. lines carrying tens of kA;
     - ii) ground conductors of the protection system;

iii) proximity of M.V. and H.V. bus-bars;

iv) proximity of high power electrical equipment.

– Switchyard areas of heavy industrial plants, M.V., H.V. and power stations may be representative of this environment.

f) Class x: Special environment

The installation classes are related to the test levels defined in Table A.8, which give a quantitative measure of the stress to which the device is exposed.

Table A.8 – Test levels for power frequency magnetic fields

Level	**Magnetic field strength** (A/m)
1	1
2	3
3	10
4	30
5	100
X [a)]	special
[a)] “X” is an open level. This level can be given in the product specification.	

A.2.7.2.8 Pulse magnetic field

IEC 61000-4-9 defines six classes of environment, but only four are applicable to industrial application. The useful classes are listed below:

a) Class 3: Protected environment

– The environment is characterized by the proximity of earth conductors of lightning protection systems and metallic structures. Commercial areas, control building, field of not heavy industrial plants provided with lightning protection system or metallic structures in the proximity, computer room of H.V. sub-stations may by representative of this environment.

b) Class 4: Typical industrial environment

– The environment is characterized by the down conductors of the lightning protection system or structures. Fields of heavy industrial and power plants and the control room of H.V. sub-stations may be representative of this environment.

c) Class 5: Severe industrial environment

– The environment is characterized by the following attributes:

i) conductors, bus-bars or M.V., H.V. lines carrying tens of kA;

ii) ground conductors of the lightning protection system or high structures like the line towers carrying the whole lightning current.

– Switchyard areas of heavy industrial plants, M.V., H.V. and power stations may be representative of this environment.

d) Class x: Special environment

The installation classes are related to the test levels reported in Table A.9, which give a quantitative measure of the stress the device is exposed to.

Table A.9 – Test levels for pulse magnetic field

Class	Pulse magnetic field strength [A/m]
3	100
4	300
5	1 000
X	special

A.2.7.2.9 Damped oscillatory magnetic field

IEC 61000-4-10 defines four classes that are applicable to the industrial environment in which the devices of the BPCS are installed:

- Class 3: protected environment,
- Class 4: typical industrial environment,
- Class 5: severe industrial environment,
- Class x: special environment.

Each environmental class is related to test levels that give a quantitative measure of the stress applied to the device, as Table A.10 demonstrates:

Table A.10 – Test levels for damped oscillatory magnetic field

Level	Damped oscillatory magnetic field strength [A/m]
3	10
4	30
5	100
X	special

A.2.7.2.10 Voltage dips and short interruptions

IEC 61000-4-11 defines three classes of environment, as listed below:

- Class 1: This class applies to protected supplies and has compatibility levels lower than public network levels. It relates to the use of equipment very sensitive to disturbances in the power supply, for instance the instrumentation of technological laboratories, some automation and protection equipment, some computers, etc. Class 1 environments normally contain equipment which requires protection by such apparatus as uninterruptible power supplies (UPS), filters, or surge suppressers.
- Class 2: This class applies to points of common coupling (PCC for consumer systems) and in-plant points of coupling (IPC) in the industrial environment in general. The compatibility levels in this class are identical to those of public networks; therefore components designed for application in public networks may be used in this class of industrial environment.
- Class 3: This class applies only to IPCs in industrial environments. It has higher compatibility levels than those of Class 2 for some disturbance phenomena. For instance, this class should be considered when any of the following conditions are met:
  - a major part of the load is fed through converters;
  - welding machines are present;
  - large motors are frequently started;
  - loads vary rapidly.

The installation classes are related to the test levels in Table A.11 and Table A.12, which give a quantitative measure of the stress to which the device is exposed.

The voltage used as a basis for the specification of the test levels is the rated voltage of the equipment (U_T).

Table A.11 – Test levels for voltage dips

Class [a)]	**Test level and durations for voltage dips (t_s) (50 Hz/60 Hz)**				
Class 1	Case-by-case according to the equipment requirements				
Class 2	0 % during ½ cycle	0 % during 1 cycle	70 % during 25/30 [c)] cycles		
Class 3	0 % during ½ cycle	0 % during 1 cycle	40 % during 10/12 [c)] cycles	70 % during 25/30 [c)] cycles	80 % during 250/300 [c)] cycles
Class x [b)]	X	X	X	X	X

a) Classes as per IEC 61000-2-4.

b) To be defined by product committee. For equipment connected directly or indirectly to the public network, the levels shall not be less severe than Class 2.

c) "25/30 cycles" means "25 cycles for 50 Hz test" and "30 cycles for 60 Hz test".

Table A.12 – Test levels for short interruptions

Class [a)]	**Test level and durations for short interruptions (t_s) (50 Hz/60 Hz)**
Class 1	Case-by-case according to the equipment requirements
Class 2	0 % during 250/300 [c)] cycles
Class 3	0 % during 250/300 [c)] cycles
Class x [b)]	X

a) Classes as per IEC 61000-2-4.

b) To be defined by product committee. For equipment connected directly or indirectly to the public network, the levels shall not be less severe than Class 2.

c) "250/300 cycles" means "250 cycles for 50 Hz test" and "300 cycles for 60 Hz test".

A.2.7.3 Emission

IEC 61000-6-4 defines the EMC emission requirements that apply to electrical and electronic apparatus intended for use in industrial environments. The frequency range is between 0,15 MHz and 6 GHz.

See Tables 1 to 3 of IEC 61000-6-4:2006/AMD1:2010 for requirements.

No specification about EM emission is necessary, if the BPCS components comply with IEC 61000-6-4.

A.2.8 Mechanical vibrations

The classification criteria used for a vibrational environment for a BPCS and its components are very much dependent on the nature of the equipment such as size, mass, wiring, etc. For such a reason the technical approach of IEC 60654-3 is considered here. The stresses on the components are expressed both in terms of vibrational severity and duration of the vibrations.

The vibrational severity is expressed as the velocity expressed in mm/s at which the component is exposed during the vibration. The frequency range of the vibration is considered between 1 Hz and 150 Hz.

There are five classes for vibrational severity:

- V.S.1: velocity $<$ 3 mm/s (i.e. control room and general industrial environment),
- V.S.2: velocity $<$ 10 mm/s (i.e. field equipment),
- V.S.3: velocity $<$ 30 mm/s (i.e. field equipment),
- V.S.4: velocity $<$ 300 mm/s (i.e. field equipment including transportation),
- V.S.X: velocity $>$ 300 mm/s.

The duration of the vibration for the considered device is selected between one the following three classes:

- V.T.1 permanent: 100 % percent of time,
- V.T.2 occasional: 10 % percent of time,
- V.T.3 unusual: 1 % percent of time.

Bibliography

[1] IEC 61069 (all parts), *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment*

[2] IEC TS 62603-1, *Industrial process control systems – Guideline for evaluating process control systems – Part 1: Specifications*

[3] ISO 15513:2000, *Cranes – Competency requirements for crane drivers (operators), slingers, signallers and assessors*

[4] ISO/IEC Guide 2:2004, *Standardization and related activities — General vocabulary*

[5] IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

[6] IEC 60050-192:2015, *International Electrotechnical Vocabulary – Part 192: Dependability*

[7] IEC 61800-7-1:2015, *Adjustable speed electrical power drive systems – Part 7-1: Generic interface and use of profiles for power drive systems – Interface definition*

[8] IEC 60050-351:2013, *International Electrotechnical Vocabulary – Part 351: Control technology*

[9] ISO/IEC 12207:2008, *Systems and software engineering — Software life cycle processes*

[10] IEC TR 61508-0, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 0: Functional safety and IEC 61508*

[11] ISO/IEC Guide 51:2014, *Safety aspects — Guidelines for their inclusion in standards*

[12] ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

[13] IEC 62528:2007, *Standard Testability Method for Embedded Core-based Integrated Circuits*

[14] IEC 61987-1:2006, *Industrial-process measurement and control – Data structures and elements in process equipment catalogues – Part 1: Measuring equipment with analogue and digital output*

[15] IEC 60050-311:2001, *International Electrotechnical Vocabulary – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements*

[16] IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

[17] IEC 82045-1:2001, *Document management – Part 1: Principles and methods*

[18] ISO/IEC Guide 77-2:2008, *Guide for specification of product properties and classes – Part 2: Technical principles and guidance*

[19] IEC 60300-3-1, *Dependability management – Part 3-1: Application guide – Analysis techniques for dependability – Guide on methodology*

[20] IEC TS 62603-1, *Industrial process control systems – Guideline for evaluating process control systems – Part 1: Specifications*

[21] IEC 60654 (all parts), *Industrial-process measurement, control and automation equipment – Operating conditions*

[22] IEC 60654-4, *Operating conditions for industrial-process measurement and control equipment. Part 4: Corrosive and erosive influences*

[23] IEC TS 61149*, Guide for safe handling and operation of mobile radio equipment*

[24] IEC 60038*, IEC standard voltages*

[25] IEC 60654-2, *Operating conditions for industrial-process measurement and control equipment. Part 2: Power*

[26] IEC 60721-3-1, *Classification of environmental conditions – Part 3 Classification of groups of environmental parameters and their severities – Section 1: Storage*

[27] IEC 60721-3-2, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

[28] IEC 60654-1, *Industrial-process measurement and control equipment – Operating conditions – Part 1: Climatic* conditions

[29] IEC 60721-3-3, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations*

[30] IEC 60721-3-4, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations*

[31] IEC 61326-1:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

[32] IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

[33] IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

[34] IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

[35] IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

[36] IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

[37] IEC 61000-4-9, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 9: Pulse magnetic field immunity test. Basic EMC Publication*

[38] IEC 61000-4-10, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 10: Damped oscillatory magnetic field immunity test. Basic EMC Publication*

[39] IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

[40] IEC 61000-2-4, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

[41] IEC 60654-3, *Operating conditions for industrial-process measurement and control equipment – Part 3: Mechanical influences*

[42] ISO 9001:2015, *Quality management systems — Requirements*

[43] IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

[44] IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

[45] IEC 62381, *Automation systems in the process industry – Factory acceptance test (FAT), site acceptance test (SAT), and site integration test (SIT)*

[46] IEC 62443 (all parts), *Industrial communication networks – Network and system security*

[47] ISO/IEC 11581-1:2000, *Information technology – User system interfaces and symbols – Icon symbols and functions – Part 1: Icons – General*

[48] ISO 18435-1:2009, *Industrial automation systems and integration – Diagnostics, capability assessment and maintenance applications integration – Part 1: Overview and general requirements*

____

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services
Tel: +44 345 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 345 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.