
Funkcijska varnost - Sistemi z varnostnimi instrumenti za sektor procesne industrije - 1. del: Okvirno, definicije, sistem, zahteve za strojno in programsko opremo (IEC 61511-1:2003 + popravek 2004)

(istoveten EN 61511-1:2004)

Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements (IEC 61511-1:2003 + corrigendum 2004)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 61511-1:2007](https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61511-1:2007

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007>

EUROPEAN STANDARD

EN 61511-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2004

ICS 13.110; 25.040.01

English version

**Functional safety –
Safety instrumented systems for the process industry sector
Part 1: Framework, definitions, system,
hardware and software requirements
(IEC 61511-1:2003 + corrigendum 2004)**

Sécurité fonctionnelle –
Systèmes instrumentés de sécurité
pour le secteur des industries
de transformation
Partie 1: Cadre, définitions, exigences
pour le système, le matériel et le logiciel
(CEI 61511-1:2003 + corrigendum 2004)

Funktionale Sicherheit -
Sicherheitstechnische Systeme
für die Prozessindustrie
Teil 1: Allgemeines, Begriffe,
Anforderungen an Systeme,
Software und Hardware
(IEC 61511-1:2003 + Corrigendum 2004)

[SIST EN 61511-1:2007](https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbc-4469f04b43db/sist-en-61511-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbc-4469f04b43db/sist-en-61511-1-2007>

This European Standard was approved by CENELEC on 2004-10-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 61511-1:2003, prepared by SC 65A, System aspects, of IEC TC 65, Industrial-process measurement and control, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 61511-1 on 2004-10-01 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2005-10-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-10-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61511-1:2003 + corrigendum November 2004 was approved by CENELEC as a European Standard without any modification.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 61511-1:2007](https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007>

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60654-1	1993	Industrial-process measurement and control equipment - Operating conditions Part 1: Climatic conditions	EN 60654-1	1993
IEC 60654-3	1983	Part 3: Mechanical influences	EN 60654-3	1997
IEC 61326	- ¹⁾	Electrical equipment for measurement, control and laboratory use - EMC requirements	EN 61326	1997 ²⁾
IEC 61508-2	- ¹⁾	Functional safety of electrical/electronic/programmable electronic safety-related systems Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems	EN 61508-2	2001 ²⁾
IEC 61508-3	- ¹⁾	Part 3: Software requirements	EN 61508-3	2001 ²⁾
IEC 61511-2	- ¹⁾	Functional safety - Safety instrumented systems for the process industry sector Part 2: Guidelines for the application of IEC 61511-1	EN 61511-2	2004 ²⁾

1) Undated reference.

2) Valid edition at date of issue.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61511-1:2007

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007>

NORME
INTERNATIONALE
INTERNATIONAL
STANDARD

CEI
IEC

61511-1

Première édition
First edition
2003-01

**Sécurité fonctionnelle –
Systèmes instrumentés de sécurité pour
le secteur des industries de transformation –**

Partie 1:

**Cadre, définitions, exigences pour le système,
le matériel et le logiciel**

(standards.iteh.ai)

**Functional safety –
Safety instrumented systems
for the process industry sector –**

Part 1:

**Framework, definitions, system,
hardware and software requirements**

© IEC 2003 Droits de reproduction réservés — Copyright - all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE XC

Pour prix, voir catalogue en vigueur
For price, see current catalogue

CONTENTS

FOREWORD.....	9
INTRODUCTION.....	13
1 Scope.....	19
2 Normative references	31
3 Abbreviations and definitions.....	31
3.1 Abbreviations	31
3.2 Definitions	33
4 Conformance to this International Standard.....	65
5 Management of functional safety	65
5.1 Objective.....	65
5.2 Requirements.....	65
6 Safety life-cycle requirements.....	75
6.1 Objective.....	75
6.2 Requirements.....	75
7 Verification	81
7.1 Objective.....	81
8 Process hazard and risk analysis.....	81
8.1 Objectives	81
8.2 Requirements.....	83
9 Allocation of safety functions to protection layers.....	85
9.1 Objective.....	85
9.2 Requirements of the allocation process.....	85
9.3 Additional requirements for safety integrity level 4.....	87
9.4 Requirements on the basic process control system as a protection layer.....	89
9.5 Requirements for preventing common cause, common mode and dependent failures.....	91
10 SIS safety requirements specification	91
10.1 Objective.....	91
10.2 General requirements.....	91
10.3 SIS safety requirements	91
11 SIS design and engineering.....	95
11.1 Objective.....	95
11.2 General requirements.....	95
11.3 Requirements for system behaviour on detection of a fault.....	97
11.4 Requirements for hardware fault tolerance	101
11.5 Requirements for selection of components and subsystems	103
11.6 Field devices	111
11.7 Interfaces	111
11.8 Maintenance or testing design requirements.....	115
11.9 SIF probability of failure	117

12	Requirements for application software, including selection criteria for utility software ...	119
12.1	Application software safety life-cycle requirements	119
12.2	Application software safety requirements specification	131
12.3	Application software safety validation planning	135
12.4	Application software design and development	135
12.5	Integration of the application software with the SIS subsystem	147
12.6	FPL and LVL software modification procedures	149
12.7	Application software verification	149
13	Factory acceptance testing (FAT)	151
13.1	Objectives	151
13.2	Recommendations	153
14	SIS installation and commissioning	155
14.1	Objectives	155
14.2	Requirements	155
15	SIS safety validation	157
15.1	Objective	157
15.2	Requirements	157
16	SIS operation and maintenance	163
16.1	Objectives	163
16.2	Requirements	163
16.3	Proof testing and inspection	167
17	SIS modification	169
17.1	Objective	169
17.2	Requirements	169
18	SIS decommissioning	171
18.1	Objectives	171
18.2	Requirements	171
19	Information and documentation requirements	171
19.1	Objectives	171
19.2	Requirements	173
	Annex A (informative) Differences	175
	Bibliography	177
	Figure 1 – Overall framework of this standard	17
	Figure 2 – Relationship between IEC 61511 and IEC 61508	23
	Figure 3 – Relationship between IEC 61511 and IEC 61508 (see 1.2)	25
	Figure 4 – Relationship between safety instrumented functions and other functions	27
	Figure 5 – Relationship between system, hardware, and software of IEC 61511-1	29
	Figure 6 – Programmable electronic system (PES): structure and terminology	49
	Figure 7 – Example SIS architecture	55
	Figure 8 – SIS safety life-cycle phases and functional safety assessment stages	71
	Figure 9 – Typical risk reduction methods found in process plants	89

Figure 10 – Application software safety life cycle and its relationship to the SIS safety life cycle	121
Figure 11 – Application software safety life cycle (in realization phase)	125
Figure 12 – Software development life cycle (the V-model)	125
Figure 13 – Relationship between the hardware and software architectures of SIS	131
Table 1 – Abbreviations used in IEC 61511.....	31
Table 2 – SIS safety life-cycle overview	77
Table 3 – Safety integrity levels: probability of failure on demand	85
Table 4 – Safety integrity levels: frequency of dangerous failures of the SIF	87
Table 5 – Minimum hardware fault tolerance of PE logic solvers	101
Table 6 – Minimum hardware fault tolerance of sensors and final elements and non-PE logic solvers	103
Table 7 – Application software safety life cycle: overview	127

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[SIST EN 61511-1:2007](https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FUNCTIONAL SAFETY –
SAFETY INSTRUMENTED SYSTEMS
FOR THE PROCESS INDUSTRY SECTOR –****Part 1: Framework, definitions, system,
hardware and software requirements**

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 61511-1 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement and control.

This bilingual version (2003-12) replaces the English version.

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

FDIS	Report on voting
65A/368/FDIS	65A/372/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.

The French version of this standard has not been voted upon.

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

IEC 61511 consists of the following parts, under the general title *Functional safety: Safety instrumented systems for the process industry sector* (see Figure 1):

Part 1: Framework, definitions, system, hardware and software requirements

Part 2: Guidelines in the application of IEC 61511-1

Part 3: Guidance for the determination of the required safety integrity levels

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61511-1:2007

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbc-4469f04b43db/sist-en-61511-1-2007>

The contents of the corrigendum of November 2004 have been included in this copy.

INTRODUCTION

Safety instrumented systems have been used for many years to perform safety instrumented functions in the process industries. If instrumentation is to be effectively used for safety instrumented functions, it is essential that this instrumentation achieves certain minimum standards and performance levels.

This standard addresses the application of safety instrumented systems for the process industries. It also requires a process hazard and risk assessment to be carried out to enable the specification for safety instrumented systems to be derived. Other safety systems are only considered so that their contribution can be taken into account when considering the performance requirements for the safety instrumented systems. The safety instrumented system includes all components and subsystems necessary to carry out the safety instrumented function from sensor(s) to final element(s).

This standard has two concepts which are fundamental to its application; safety lifecycle and safety integrity levels.

This standard addresses safety instrumented systems which are based on the use of electrical/electronic/programmable electronic technology. Where other technologies are used for logic solvers, the basic principles of this standard should be applied. This standard also addresses the safety instrumented system sensors and final elements regardless of the technology used. This standard is process industry specific within the framework of IEC 61508 (see Annex A).

iTeh STANDARD PREVIEW

This standard sets out an approach for safety life-cycle activities to achieve these minimum standards. This approach has been adopted in order that a rational and consistent technical policy is used.

[SIST EN 61511-1:2007](https://standards.itih.ai/catalog/standards/sist/ab981cf0-3e29-4b11-9f8e-446904b43db/sist-en-61511-1-2007)

In most situations, safety is best achieved by an inherently safe process design. If necessary, this may be combined with a protective system or systems to address any residual identified risk. Protective systems can rely on different technologies (chemical, mechanical, hydraulic, pneumatic, electrical, electronic, programmable electronic). To facilitate this approach, this standard

- requires that a hazard and risk assessment is carried out to identify the overall safety requirements;
- requires that an allocation of the safety requirements to the safety instrumented system(s) is carried out;
- works within a framework which is applicable to all instrumented methods of achieving functional safety;
- details the use of certain activities, such as safety management, which may be applicable to all methods of achieving functional safety.

This standard on safety instrumented systems for the process industry

- addresses all safety life-cycle phases from initial concept, design, implementation, operation and maintenance through to decommissioning;
- enables existing or new country specific process industry standards to be harmonized with this standard.

This International Standard is intended to lead to a high level of consistency (for example, of underlying principles, terminology, information) within the process industries. This should have both safety and economic benefits.

In jurisdictions where the governing authorities (for example, national, federal, state, province, county, city) have established process safety design, process safety management, or other requirements, these take precedence over the requirements defined in this standard.

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN 61511-1:2007

<https://standards.iteh.ai/catalog/standards/sist/ab981cf9-3e29-4b11-9fbe-4469f04b43db/sist-en-61511-1-2007>

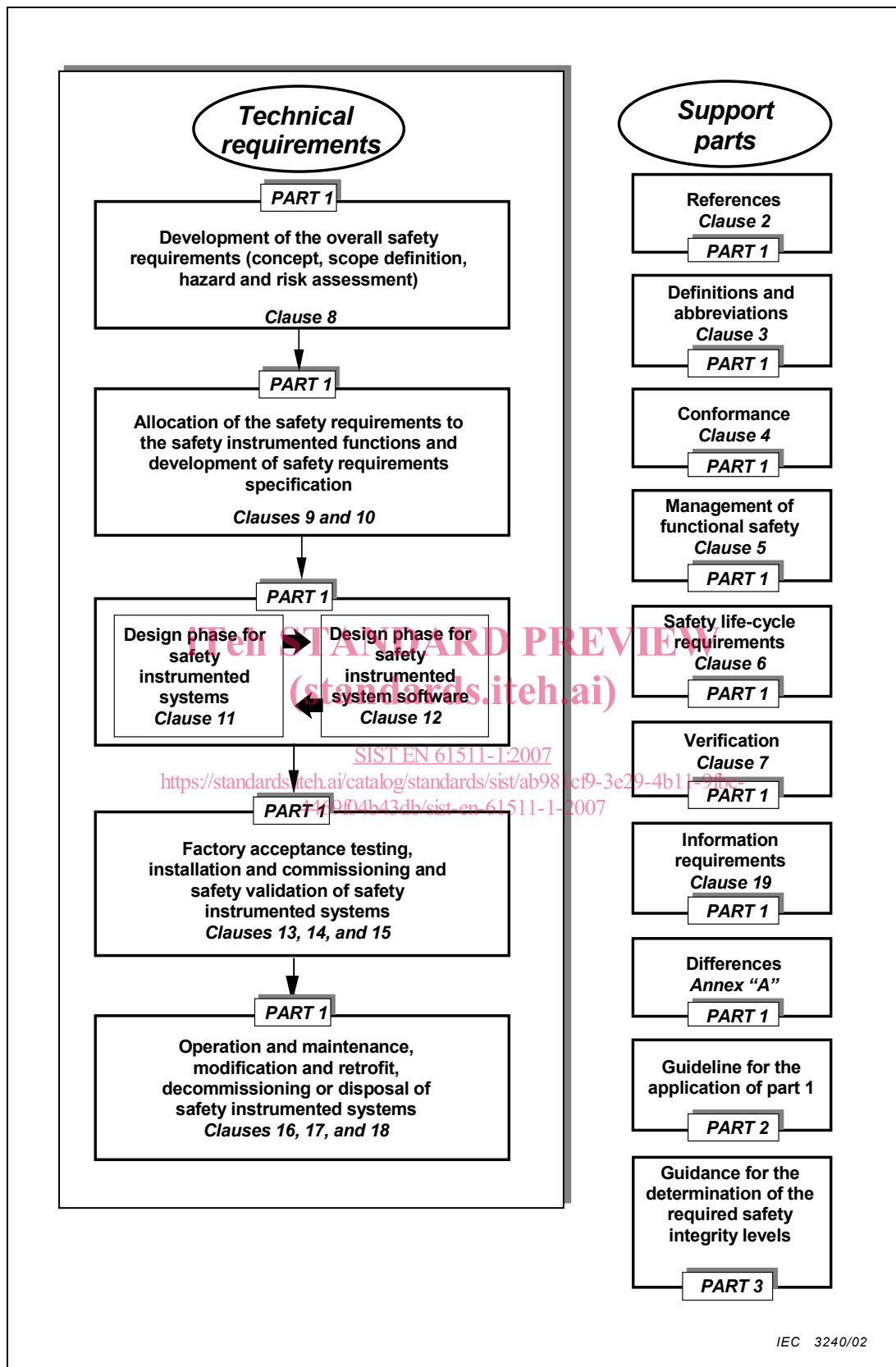


Figure 1 – Overall framework of this standard