



BSI Standards Publication

Functional safety - Safety instrumented systems for the process industry sector

Part 1: Framework, definitions, system, hardware and application programming requirements (IEC 61511-1:2016 + COR1:2016)

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National foreword

This British Standard is the UK implementation of EN 61511-1:2017. It is identical to IEC 61511-1:2016, incorporating corrigendum September 2016. It supersedes BS EN 61511-1:2004, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/65/1, System considerations.

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

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

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Amendments/corrigenda issued since publication

Date	Text affected
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English Version

Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and application programming Requirements (IEC 61511-1:2016 + COR1:2016)

Sécurité fonctionnelle - Systèmes instrumentés de sécurité pour le secteur des industries de transformation - Partie 1: Cadre, définitions, exigences pour le système, le matériel et la programmation d'application (IEC 61511-1:2016 + COR1:2016)

Funktionale Sicherheit - Sicherheitstechnische Systeme für die Prozessindustrie - Teil 1: Allgemeines, Begriffe, Anforderungen an Systeme, Hardware und Anwendungsprogrammierung (IEC 61511-1:2016 + COR1:2016)

This European Standard was approved by CENELEC on 2016-03-30. 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.

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European Committee for Electrotechnical Standardization
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The text of document 65A/777/FDIS, future edition 2 of IEC 61511-1, 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 61511-1:2017.

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) 2017-10-21
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2020-04-21

This document supersedes EN 61511-1:2004.

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

IEC 60300-3-2:2004	NOTE	Harmonized as EN 60300-3-2:2005 (not modified).
IEC 61025	NOTE	Harmonized as EN 61025.
IEC 61131-3:2013	NOTE	Harmonized as EN 61131-3:2013 (not modified).
IEC 61131-6:2012	NOTE	Harmonized as EN 61131-6:2012 (not modified).
IEC 61508-4:2010	NOTE	Harmonized as EN 61508-4:2010 (not modified).
IEC 61508-6:2010	NOTE	Harmonized as EN 61508-6:2010 (not modified).
IEC 61511-2	NOTE	Harmonized as EN 61511-2.
IEC 61511-3	NOTE	Harmonized as EN 61511-3.
IEC 61784-3:2010	NOTE	Harmonized as EN 61784-3:2010 (not modified).
IEC 62682:2014	NOTE	Harmonized as EN 62682:2015 (not modified).
ISO 9000:2005	NOTE	Harmonized as EN ISO 9000:2005 ¹⁾ (not modified).
ISO 9001:2008	NOTE	Harmonized as EN ISO 9001:2008 ²⁾ (not modified).
ISO 13849-1:2006	NOTE	Harmonized as EN ISO 13849-1:2006 ³⁾ (not modified).
ISO 13849-2:2012	NOTE	Harmonized as EN ISO 13849-2:2012 (not modified).
ISO 14224:2006	NOTE	Harmonized as EN ISO 14224:2006 (not modified).

¹⁾ Superseded by EN ISO 9000:2015 (ISO 9000:2015).

²⁾ Superseded by EN ISO 9001:2015 (ISO 9001:2015).

³⁾ Superseded by EN ISO 13849-1:2015 (ISO 13849-1:2015).

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(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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61508-1	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements	EN 61508-1	2010
IEC 61508-2	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems	EN 61508-2	2010
IEC 61508-3	2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements	EN 61508-3	2010

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INTERNATIONAL STANDARD

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Part 1: Framework, definitions, system, hardware and application programming requirements

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

Partie 1: Cadre, définitions, exigences pour le système, le matériel et la programmation d'application

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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	9
2 Normative references.....	12
3 Terms, definitions and abbreviations	13
3.1 Terms	13
3.2 Terms and definitions	13
3.3 Abbreviations	31
4 Conformance to the IEC 61511-1:2016.....	33
5 Management of functional safety.....	33
5.1 Objective	33
5.2 Requirements.....	33
5.2.1 General	33
5.2.2 Organization and resources.....	33
5.2.3 Risk evaluation and risk management.....	34
5.2.4 Safety planning	34
5.2.5 Implementing and monitoring.....	34
5.2.6 Assessment, auditing and revisions	35
5.2.7 SIS configuration management.....	37
6 Safety life-cycle requirements	37
6.1 Objectives.....	37
6.2 Requirements.....	38
6.3 Application program SIS safety life-cycle requirements	40
7 Verification	43
7.1 Objective	43
7.2 Requirements.....	43
8 Process H&RA.....	45
8.1 Objectives.....	45
8.2 Requirements.....	45
9 Allocation of safety functions to protection layers	46
9.1 Objectives.....	46
9.2 Requirements of the allocation process	46
9.3 Requirements on the basic process control system as a protection layer	49
9.4 Requirements for preventing common cause, common mode and dependent failures	50
10 SIS safety requirements specification (SRS).....	50
10.1 Objective	50
10.2 General requirements.....	50
10.3 SIS safety requirements	50
11 SIS design and engineering	53
11.1 Objective	53
11.2 General requirements.....	53
11.3 Requirements for system behaviour on detection of a fault.....	54
11.4 Hardware fault tolerance	55
11.5 Requirements for selection of devices.....	56

This is a preview of "BS EN 61511-1:2017". [Click here to purchase the full version from the ANSI store.](#)

11.5.1	Objectives.....	56
11.5.2	General requirements.....	56
11.5.3	Requirements for the selection of devices based on prior use	56
11.5.4	Requirements for selection of FPL programmable devices (e.g., field devices) based on prior use	57
11.5.5	Requirements for selection of LVL programmable devices based on prior use	58
11.5.6	Requirements for selection of FVL programmable devices	59
11.6	Field devices.....	59
11.7	Interfaces.....	59
11.7.1	General	59
11.7.2	Operator interface requirements	59
11.7.3	Maintenance/engineering interface requirements	60
11.7.4	Communication interface requirements	60
11.8	Maintenance or testing design requirements	61
11.9	Quantification of random failure	61
12	SIS application program development	63
12.1	Objective	63
12.2	General requirements.....	63
12.3	Application program design	64
12.4	Application program implementation	65
12.5	Requirements for application program verification (review and testing)	66
12.6	Requirements for application program methodology and tools	67
13	Factory acceptance test (FAT)	68
13.1	Objective	68
13.2	Recommendations.....	68
14	SIS installation and commissioning	69
14.1	Objectives.....	69
14.2	Requirements.....	69
15	SIS safety validation	70
15.1	Objective	70
15.2	Requirements.....	70
16	SIS operation and maintenance	73
16.1	Objectives.....	73
16.2	Requirements.....	73
16.3	Proof testing and inspection	75
16.3.1	Proof testing	75
16.3.2	Inspection	76
16.3.3	Documentation of proof tests and inspection.....	76
17	SIS modification	76
17.1	Objectives.....	76
17.2	Requirements.....	77
18	SIS decommissioning	77
18.1	Objectives.....	77
18.2	Requirements.....	78
19	Information and documentation requirements	78
19.1	Objectives.....	78
19.2	Requirements.....	78

This is a preview of "BS EN 61511-1:2017". [Click here to purchase the full version from the ANSI store.](#)

Bibliography	80
Figure 1 – Overall framework of the IEC 61511 series	8
Figure 2 – Relationship between IEC 61511 and IEC 61508.....	10
Figure 3 – Detailed relationship between IEC 61511 and IEC 61508	11
Figure 4 – Relationship between safety instrumented functions and other functions.....	12
Figure 5 – Programmable electronic system (PES): structure and terminology.....	24
Figure 6 – Example of SIS architectures comprising three SIS subsystems	27
Figure 7 – SIS safety life-cycle phases and FSA stages.....	38
Figure 8 – Application program safety life-cycle and its relationship to the SIS safety life-cycle.....	41
Figure 9 – Typical protection layers and risk reduction means.....	49
Table 1 – Abbreviations used in IEC 61511	32
Table 2 – SIS safety life-cycle overview (1 of 2).....	39
Table 3 – Application program safety life-cycle: overview (1 of 2).....	42
Table 4 – Safety integrity requirements: PFD_{avg}	47
Table 5 – Safety integrity requirements: average frequency of dangerous failures of the SIF	47
Table 6 – Minimum HFT requirements according to SIL	55

This is a preview of "BS EN 61511-1:2017". [Click here to purchase the full version from the ANSI store.](#)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FUNCTIONAL SAFETY – SAFETY INSTRUMENTED SYSTEMS FOR THE PROCESS INDUSTRY SECTOR –

Part 1: Framework, definitions, system, hardware and application programming requirements

FOREWORD

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International Standard IEC 61511-1 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 2003. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- references and requirements to software replaced with references and requirements to application programming;
- functional safety assessment requirements provided with more detail to improve management of functional safety.
- management of change requirement added;

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- security risk assessment requirements added;
- requirements expanded on the basic process control system as a protection layer;
- requirements for hardware fault tolerance modified and should be reviewed carefully to understand user/integrator options.

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

FDIS	Report on voting
65A/777/FDIS	65A/784/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 61511 series, published under the general title *Functional safety – safety instrumented systems for the process industry sector*, 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.

The contents of the corrigendum of September 2016 have been included in this copy.

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INTRODUCTION

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

The IEC 61511 series addresses the application of SISs for the process industries. The IEC 61511 series also addresses a process Hazard and Risk Assessment (H&RA) to be carried out to enable the specification for SISs to be derived. Other safety systems' contributions are only considered with respect to the performance requirements for the SIS. The SIS includes all devices necessary to carry out each SIF from sensor(s) to final element(s).

The IEC 61511 series has two concepts which are fundamental to its application: SIS safety life-cycle and safety integrity levels (SILs).

The IEC 61511 series addresses SISs which are based on the use of electrical/electronic/programmable electronic technology. Where other technologies are used for logic solvers, the basic principles of the IEC 61511 series should be applied to ensure the functional safety requirements are met. The IEC 61511 series also addresses the SIS sensors and final elements regardless of the technology used. The IEC 61511 series is process industry specific within the framework of the IEC 61508 series.

The IEC 61511 series sets out an approach for SIS safety life-cycle activities to achieve these minimum principles. This approach has been adopted in order that a rational and consistent technical policy is used.

In most situations, safety is best achieved by an inherently safe process design. However in some instances this is not possible or not practical. 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, and programmable electronic). To facilitate this approach, the IEC 61511 series:

- addresses that a H&RA is carried out to identify the overall safety requirements;
- addresses that an allocation of the safety requirements to the SIS is carried out;
- works within a framework which is applicable to all instrumented means 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.

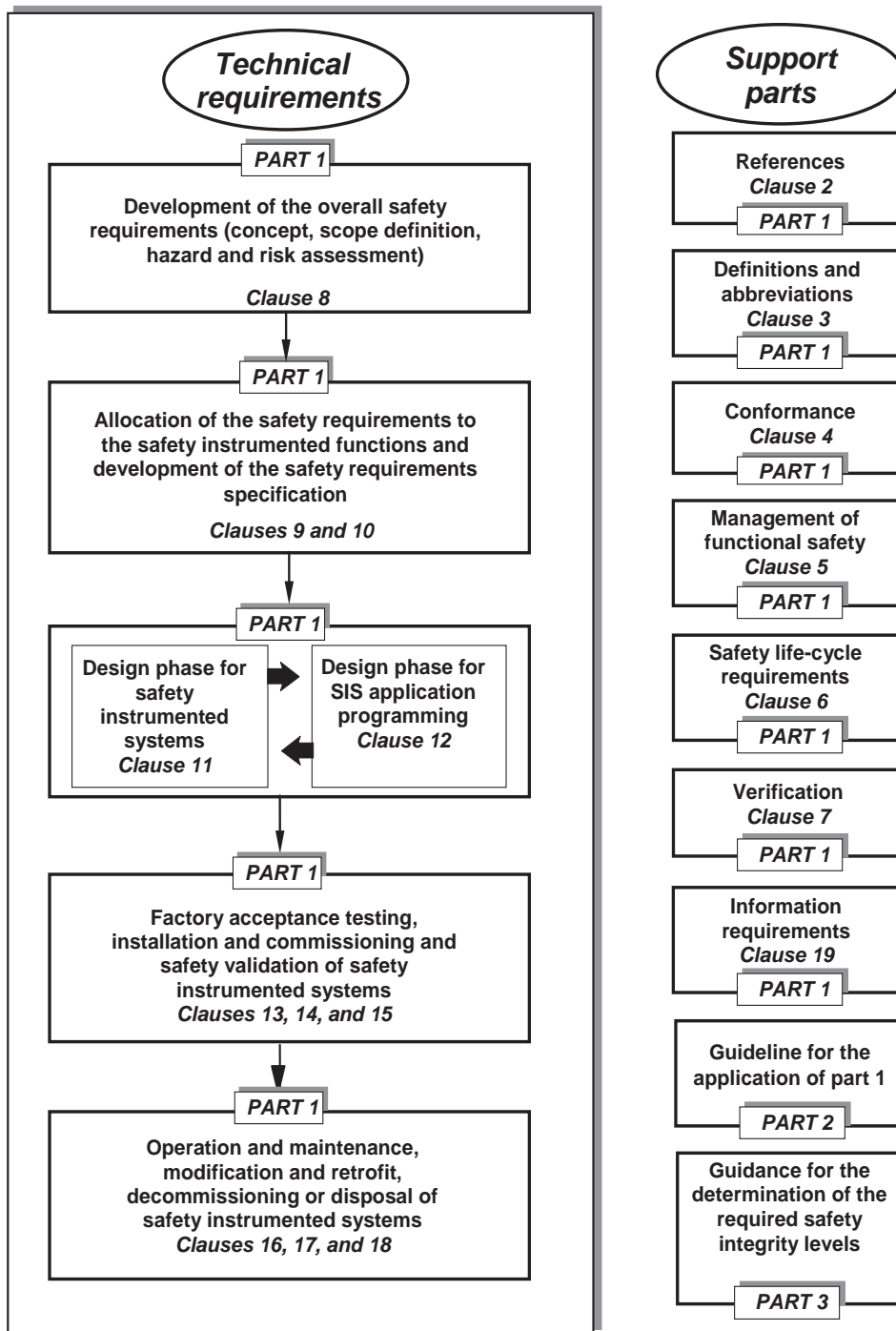
The IEC 61511 series on SIS for the process industry:

- addresses all SIS 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 the IEC 61511 series.

The IEC 61511 series is intended to lead to a high level of consistency (e.g., of underlying principles, terminology, and information) within the process industries. This should have both safety and economic benefits. Figure 1 below shows an overall framework of the IEC 61511 series.

In jurisdictions where the governing authorities (e.g., national, federal, state, province, county, city) have established process safety design, process safety management, or other regulations, these take precedence over the requirements defined in the IEC 61511 series.

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IEC

Figure 1 – Overall framework of the IEC 61511 series

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FUNCTIONAL SAFETY – SAFETY INSTRUMENTED SYSTEMS FOR THE PROCESS INDUSTRY SECTOR –

Part 1: Framework, definitions, system, hardware and application programming requirements

1 Scope

This part of IEC 61511 gives requirements for the specification, design, installation, operation and maintenance of a safety instrumented system (SIS), so that it can be confidently entrusted to achieve or maintain a safe state of the process. IEC 61511-1 has been developed as a process sector implementation of IEC 61508:2010.

In particular, IEC 61511-1:

- a) specifies the requirements for achieving functional safety but does not specify who is responsible for implementing the requirements (e.g., designers, suppliers, owner/operating company, contractor). This responsibility will be assigned to different parties according to safety planning, project planning and management, and national regulations;
- b) applies when devices that meets the requirements of the IEC 61508 series published in 2010, or IEC 61511-1:2016 [11.5], is integrated into an overall system that is to be used for a process sector application. It does not apply to manufacturers wishing to claim that devices are suitable for use in SISs for the process sector (see IEC 61508-2:2010 and IEC 61508-3:2010);
- c) defines the relationship between IEC 61511 and IEC 61508 (see Figures 2 and 3);
- d) applies when application programs are developed for systems having limited variability language or when using fixed programming language devices, but does not apply to manufacturers, SIS designers, integrators and users that develop embedded software (system software) or use full variability languages (see IEC 61508-3:2010);
- e) applies to a wide variety of industries within the process sector for example, chemicals, oil and gas, pulp and paper, pharmaceuticals, food and beverage, and non-nuclear power generation;

NOTE 1 Within the process sector some applications may have additional requirements that have to be satisfied.
- f) outlines the relationship between SIFs and other instrumented functions (see Figure 4);
- g) results in the identification of the functional requirements and safety integrity requirements for the SIF taking into account the risk reduction achieved by other methods;
- h) specifies life-cycle requirements for system architecture and hardware configuration, application programming, and system integration;
- i) specifies requirements for application programming for users and integrators of SISs.
- j) applies when functional safety is achieved using one or more SIFs for the protection of personnel, protection of the general public or protection of the environment;
- k) may be applied in non-safety applications for example asset protection;
- l) defines requirements for implementing SIFs as a part of the overall arrangements for achieving functional safety;
- m) uses a SIS safety life-cycle (see Figure 7) and defines a list of activities which are necessary to determine the functional requirements and the safety integrity requirements for the SIS;