IEC 61511-1

Edition 2.0 2016-02
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Functional safety – Safety instrumented systems for the process industry sector –
Part 1: Framework, definitions, system, hardware and ~~software~~ application programming requirements

IEC 61511-1:2016-02 RLV(en)

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

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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;
- 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.

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 publication using a colour printer.

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 ~~requires~~ 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 ~~so that their contribution can be taken into account when considering~~ with respect to the performance requirements for the SIS. The SIS includes all ~~components and subsystems~~ 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 ~~(see Annex A)~~.

The IEC 61511 series sets out an approach for SIS safety life-cycle activities to achieve these minimum ~~standards~~ 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:

- ~~requires~~ addresses that a H&RA is carried out to identify the overall safety requirements;
- ~~requires~~ addresses that an allocation of the safety requirements to the SIS is carried out;
- works within a framework which is applicable to all instrumented ~~methods~~ 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 ~~requirements~~ regulations, these take precedence over the requirements defined in the IEC 61511 series.

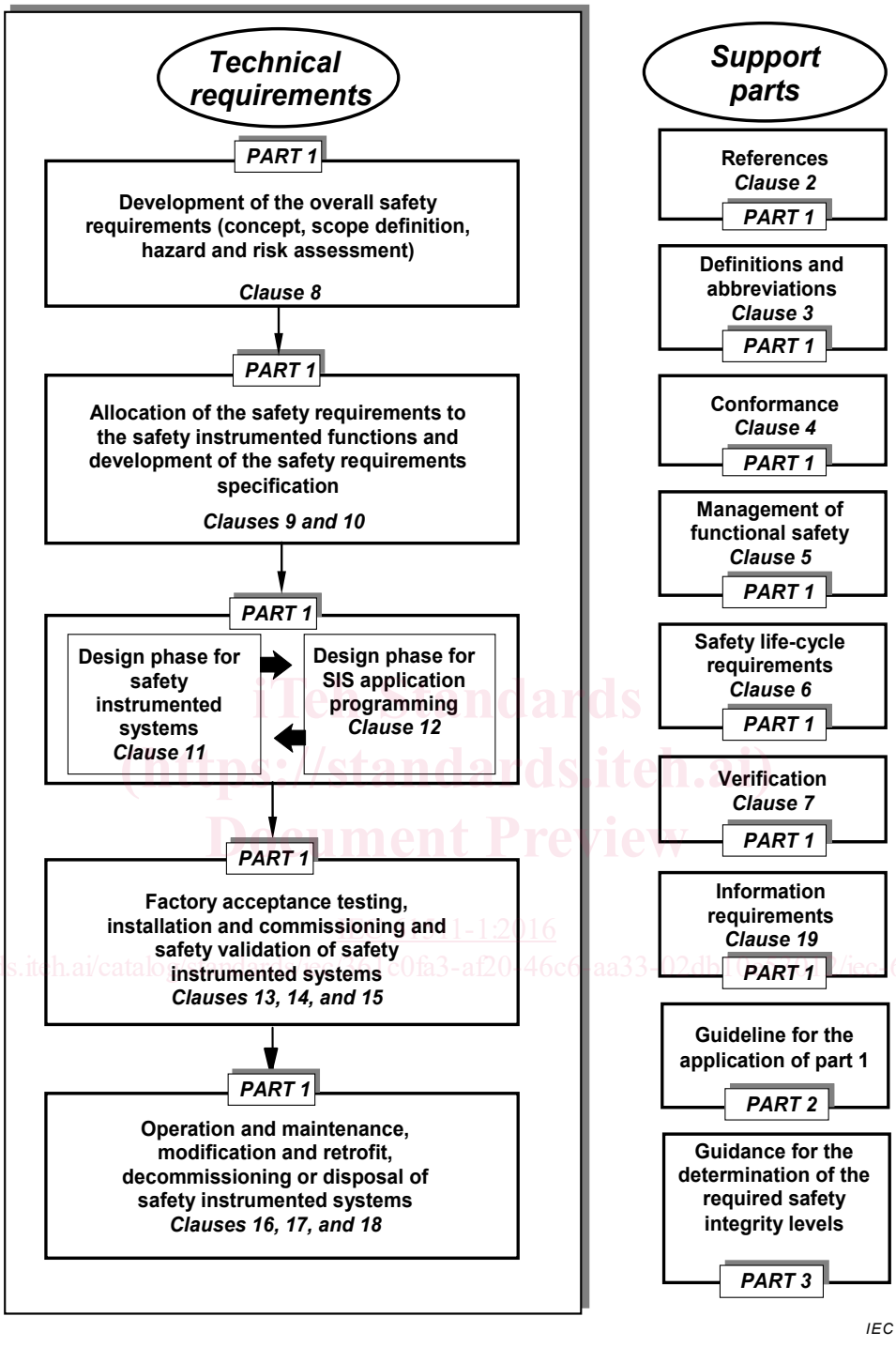

Figure 1 – Overall framework of the IEC 61511 series

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

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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 ~~place and/~~ 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 ~~equipment~~ 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 ~~software is~~ programs are developed for systems having limited variability language or when using fixed ~~programmes~~ 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 refining~~, oil and gas ~~production~~, pulp and paper, pharmaceuticals, food and beverage, and non-nuclear power generation;

NOTE 1 Within the process sector some applications~~, (for example, off-shore),~~ 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 ~~means~~ methods;

h) specifies life-cycle requirements for system architecture and hardware configuration, application ~~software~~ programming, and system integration;

i) specifies requirements for application ~~software~~ programming for users and integrators of SISs ~~(clause 12)~~.
~~In particular, requirements for the following are specified:~~

~~– safety life-cycle phases and activities that are to be applied during the design and development of the application software (the software safety life-cycle model). These requirements include the application of measures and techniques, which are intended to avoid faults in the software and to control failures which may occur;~~

~~– information relating to the software safety validation to be passed to the organization carrying out the SIS integration;~~

~~— preparation of information and procedures concerning software needed by the user for the operation and maintenance of the SIS;~~

~~— procedures and specifications to be met by the organization carrying out modifications to safety software;~~

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;

n) ~~requires~~ specifies that a H&RA is to be carried out to define the safety functional requirements and safety integrity levels (SIL) of each SIF;

NOTE 2 Figure 9 presents an overview of risk reduction ~~methods~~ means.

o) establishes numerical targets for average probability of failure on demand (in demand mode) and average frequency of dangerous failures ~~per hour for the safety integrity levels~~ (in demand mode or continuous mode) for each SIL;

p) specifies minimum requirements for hardware fault tolerance (HFT);

q) specifies measures and techniques required for achieving the specified SIL;

r) defines a maximum level of functional safety performance (SIL 4) which can be achieved for a SIF implemented according to IEC 61511-1;

s) defines a minimum level of functional safety performance (SIL 1) below which IEC 61511-1 does not apply;

t) provides a framework for establishing the SIL but does not specify the SIL required for specific applications (which should be established based on knowledge of the particular application and on the overall targeted risk reduction);

u) specifies requirements for all parts of the SIS from sensor to final element(s);

v) defines the information that is needed during the SIS safety life-cycle;

w) ~~requires~~ specifies that the design of the SIS takes into account human factors;

x) does not place any direct requirements on the individual operator or maintenance person:

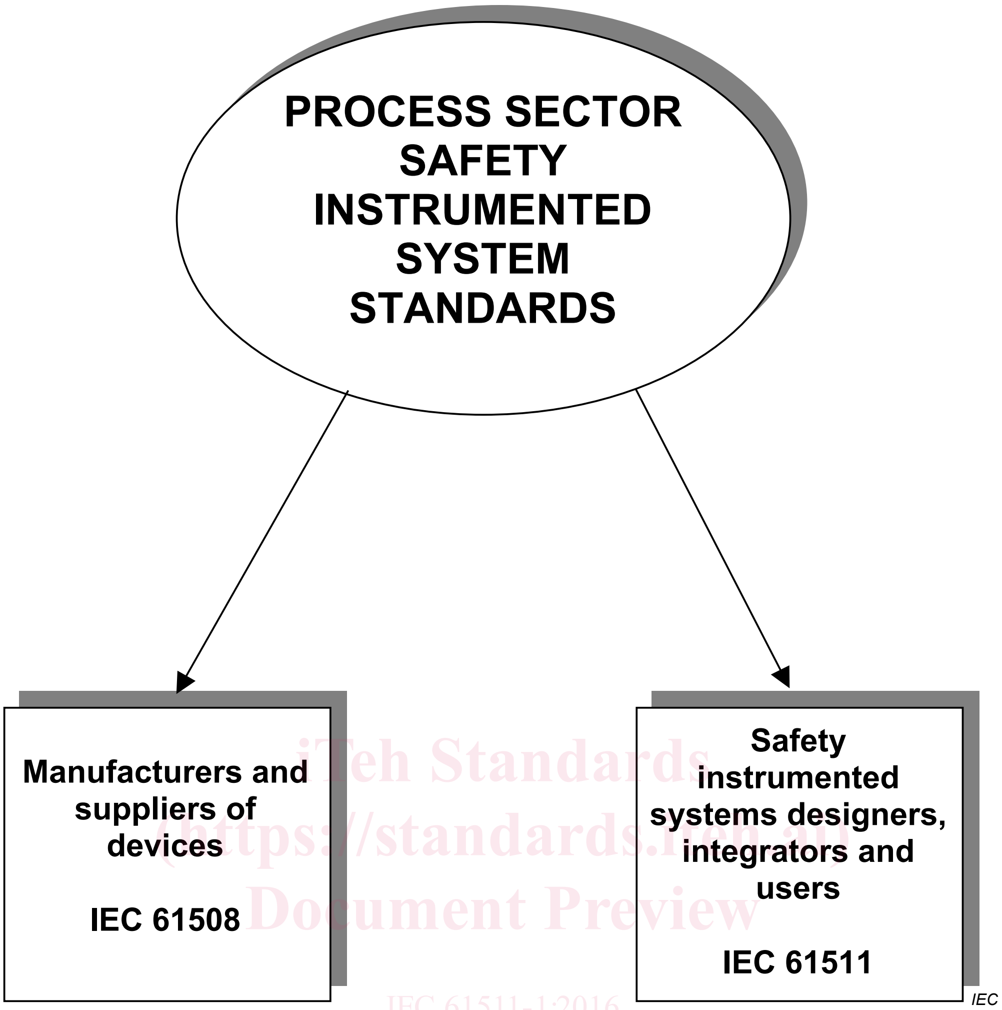

Figure 2 – Relationship between IEC 61511 and IEC 61508

NOTE 3 IEC 61508 is also used by safety instrumented designers, integrators and users where directed in IEC 61511.

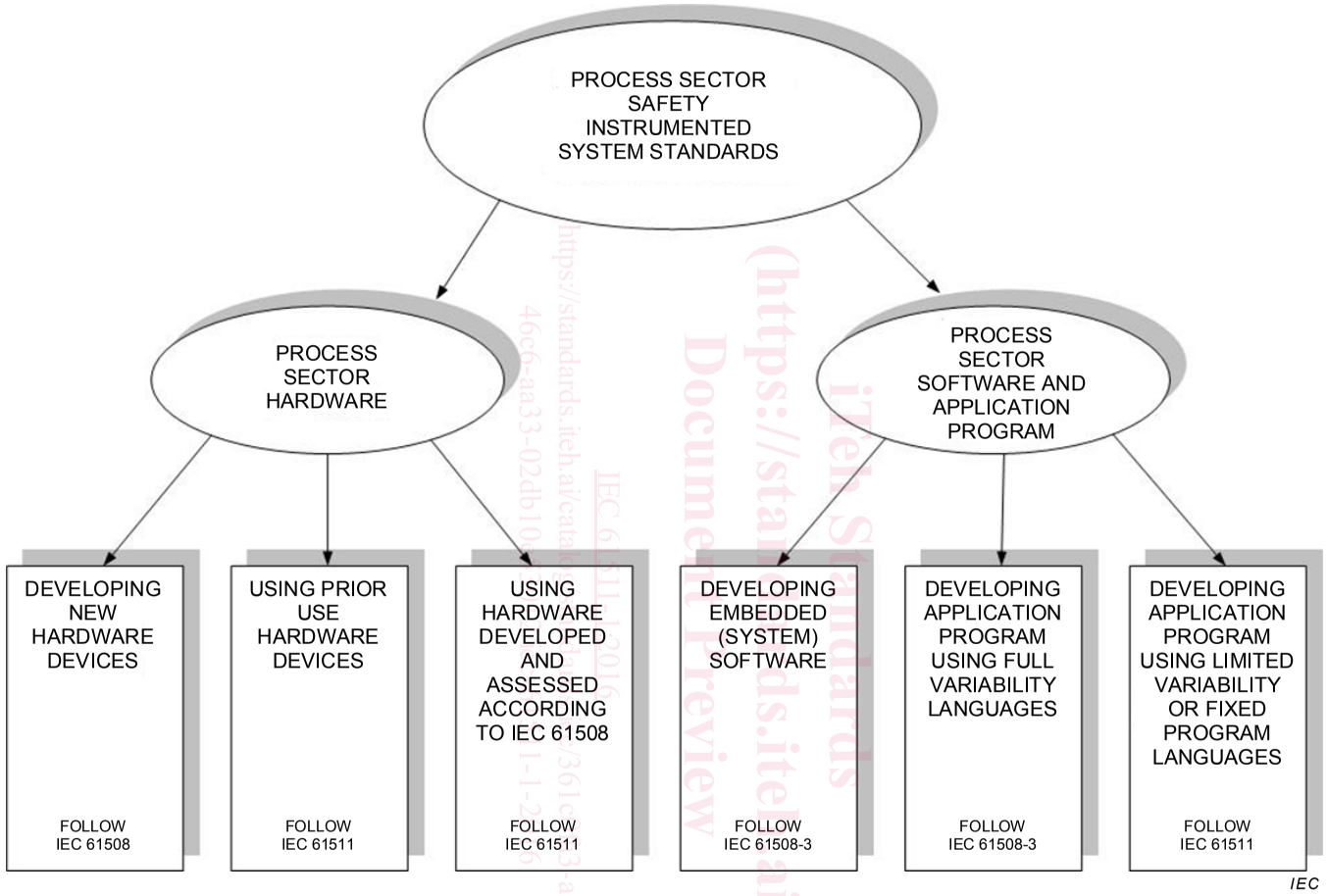

Figure 3 – Detailed relationship between IEC 61511 and IEC 61508 ~~(see clause 1)~~

NOTE 4 Subclause 7.2.2 in IEC 61511-1:2016 and IEC 61511-2:2016 contain guidance on handling integration of sub-systems that comply with other standards (such as machinery , burner, etc.).