Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and application programming Requirements

EESTI STANDARDIKESKUS
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NATIONAL FOREWORD

See Eesti standard EVS-EN 61511-1:2017 sisaldab Euroopa standardi EN 61511-1:2017 ingliskeelset teksti.	This Estonian standard EVS-EN 61511-1:2017 consists of the English text of the European standard EN 61511-1:2017.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 21.04.2017.	Date of Availability of the European standard is 21.04.2017.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 13.110, 25.040.01

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61511-1

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ICS 13.110; 25.040.01

Supersedes EN 61511-1:2004

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.

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.

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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

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European foreword

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.

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 61511-1:2016 + COR1:2016 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 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).

CONTENTS

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.

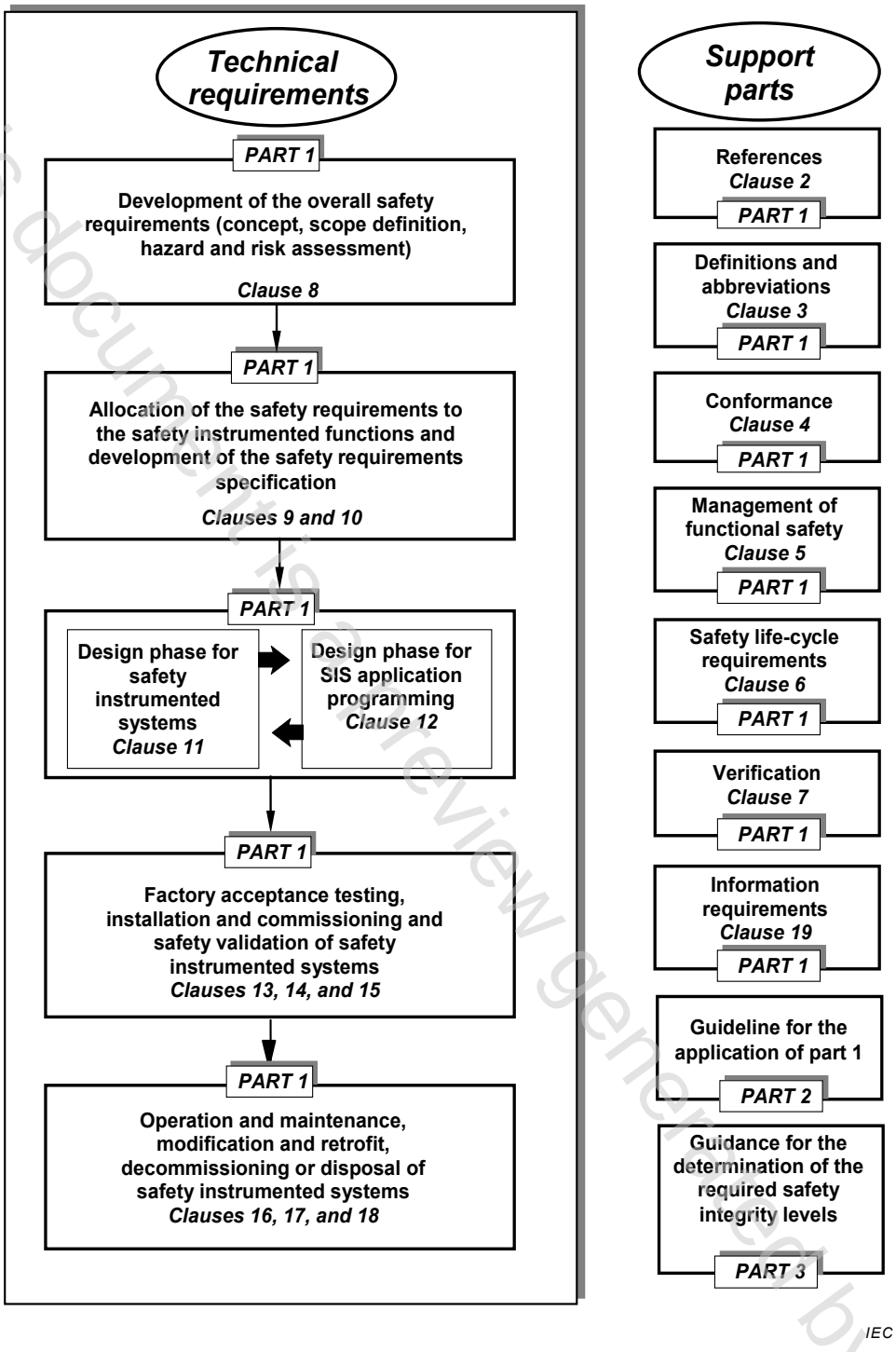

Figure 1 – Overall framework of the IEC 61511 series

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;

n) 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 means.

o) establishes numerical targets for average probability of failure on demand (in demand mode) and average frequency of dangerous failures (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) 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:

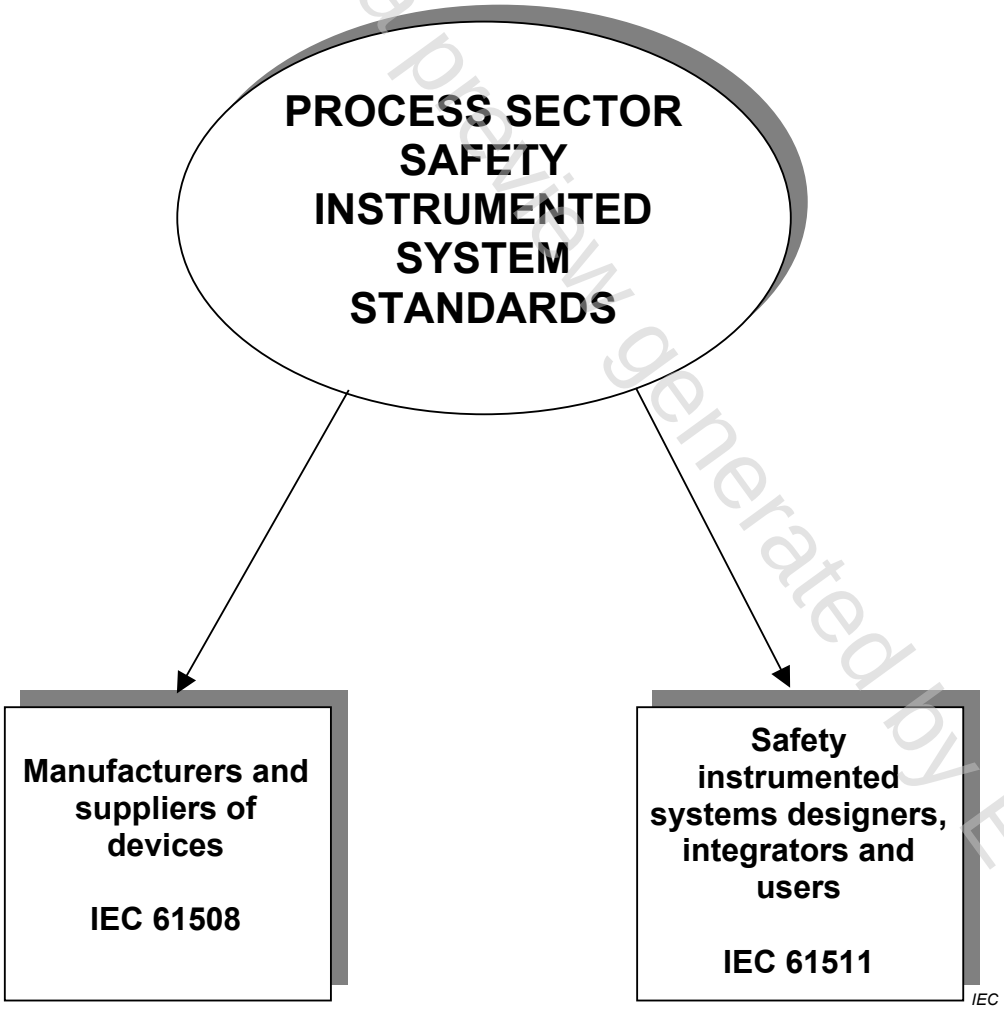

Figure 2 – Relationship between IEC 61511 and IEC 61508

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

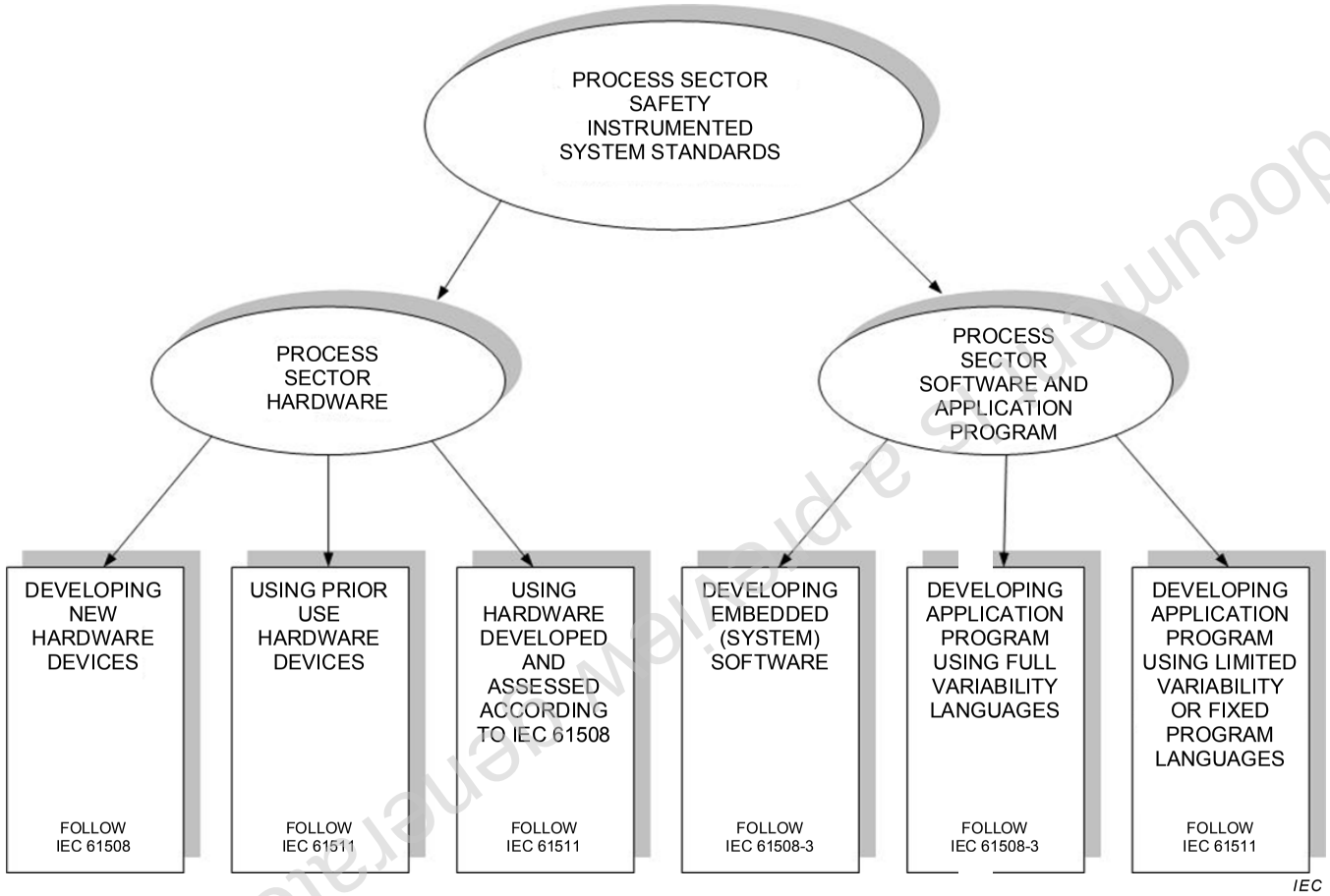

Figure 3 – Detailed relationship between IEC 61511 and IEC 61508

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.).

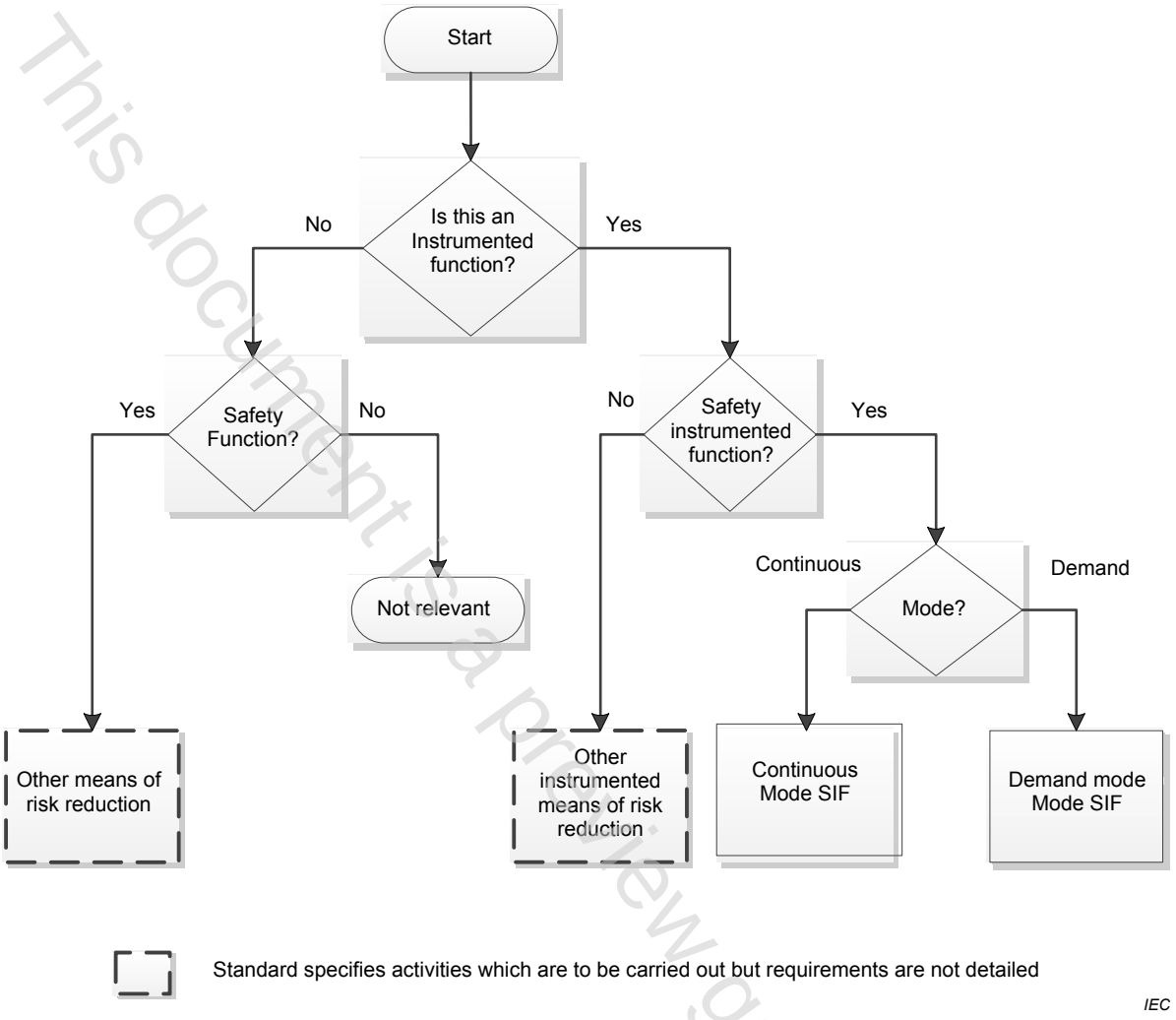

Figure 4 – Relationship between safety instrumented functions and other functions

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 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General Requirements*

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*

IEC 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 3: Software requirements*