

REDLINE VERSION



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

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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This Redline version provides you with a quick and easy way to compare all the changes between this standard and its 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.

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.

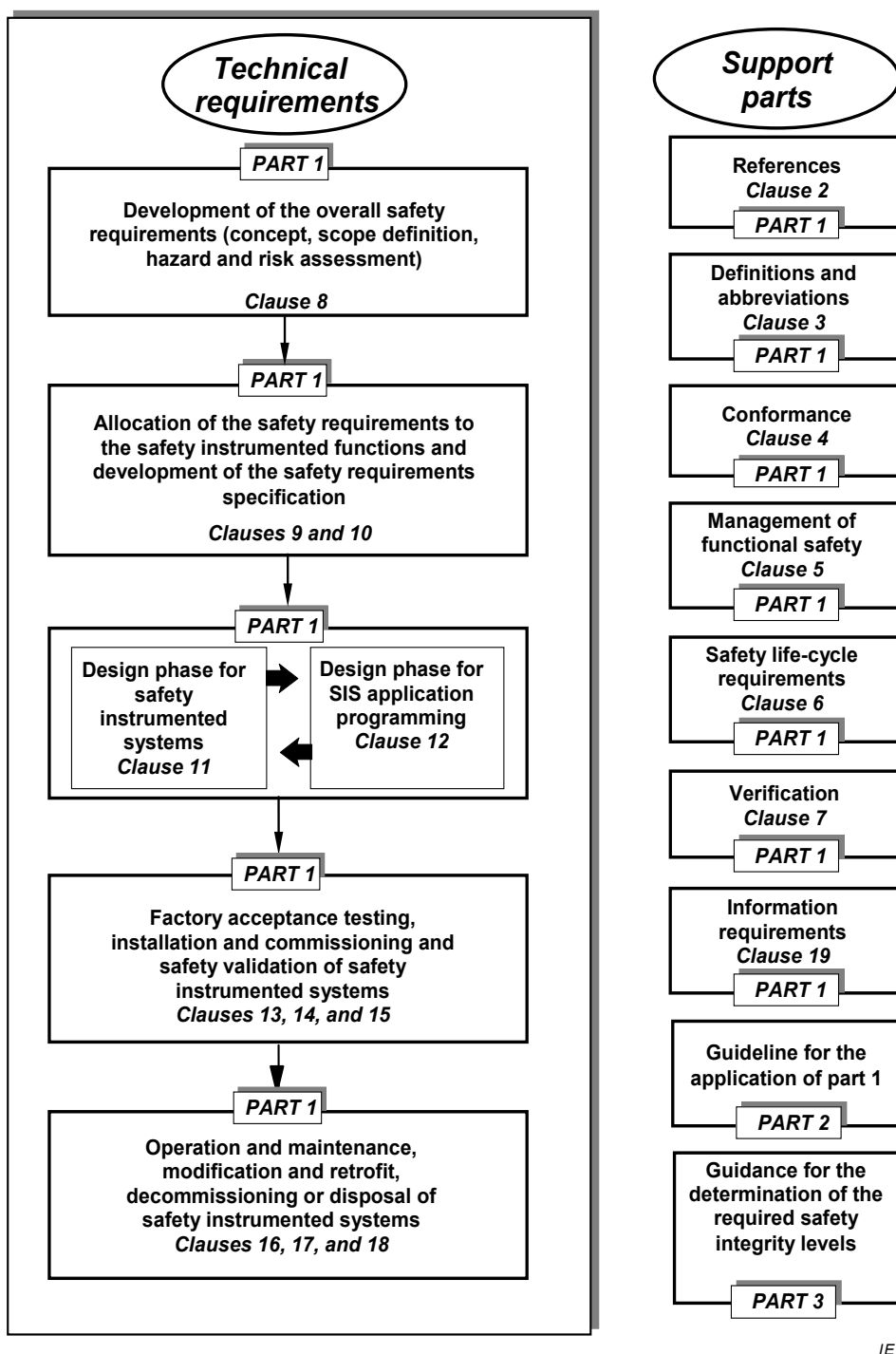


Figure 1 – Overall framework of the IEC 61511 series

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

Part 1: Framework, definitions, system, hardware and ~~software~~ 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 ~~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;

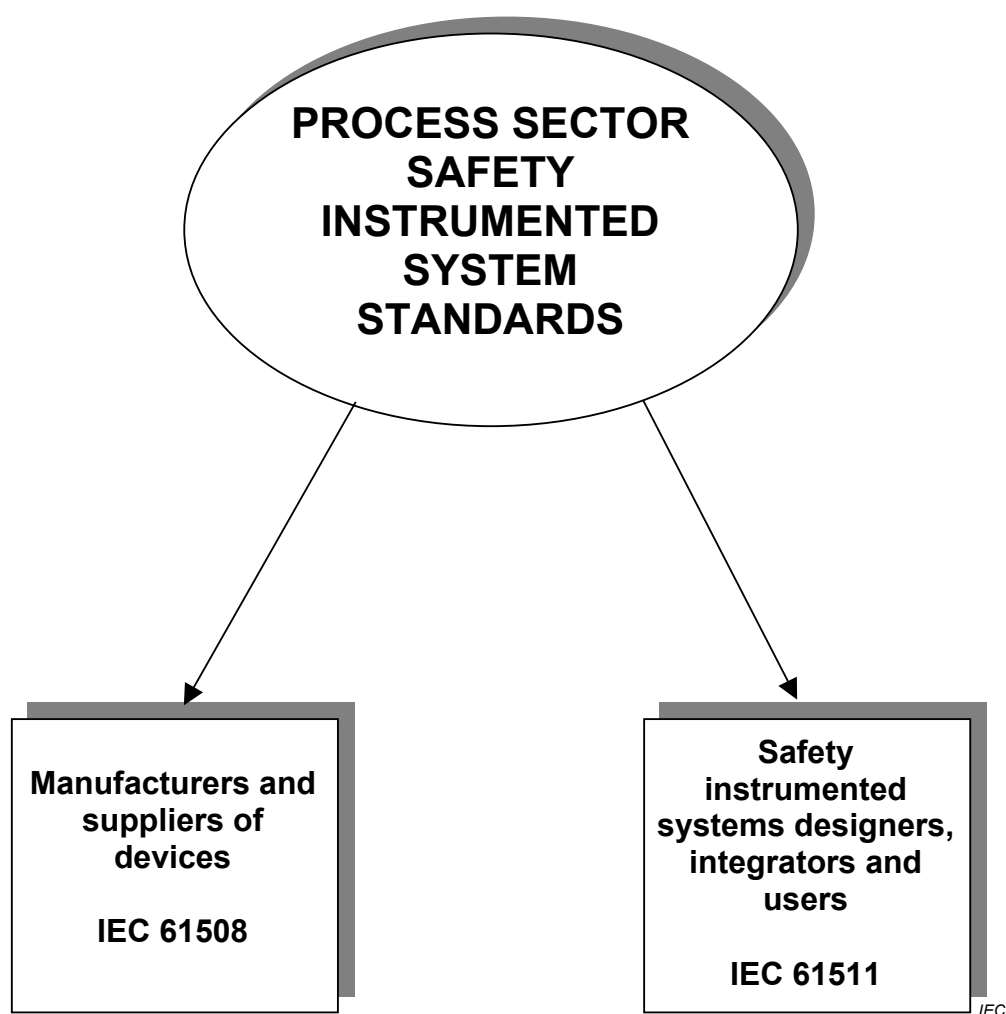


Figure 2 – Relationship between IEC 61511 and IEC 61508

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

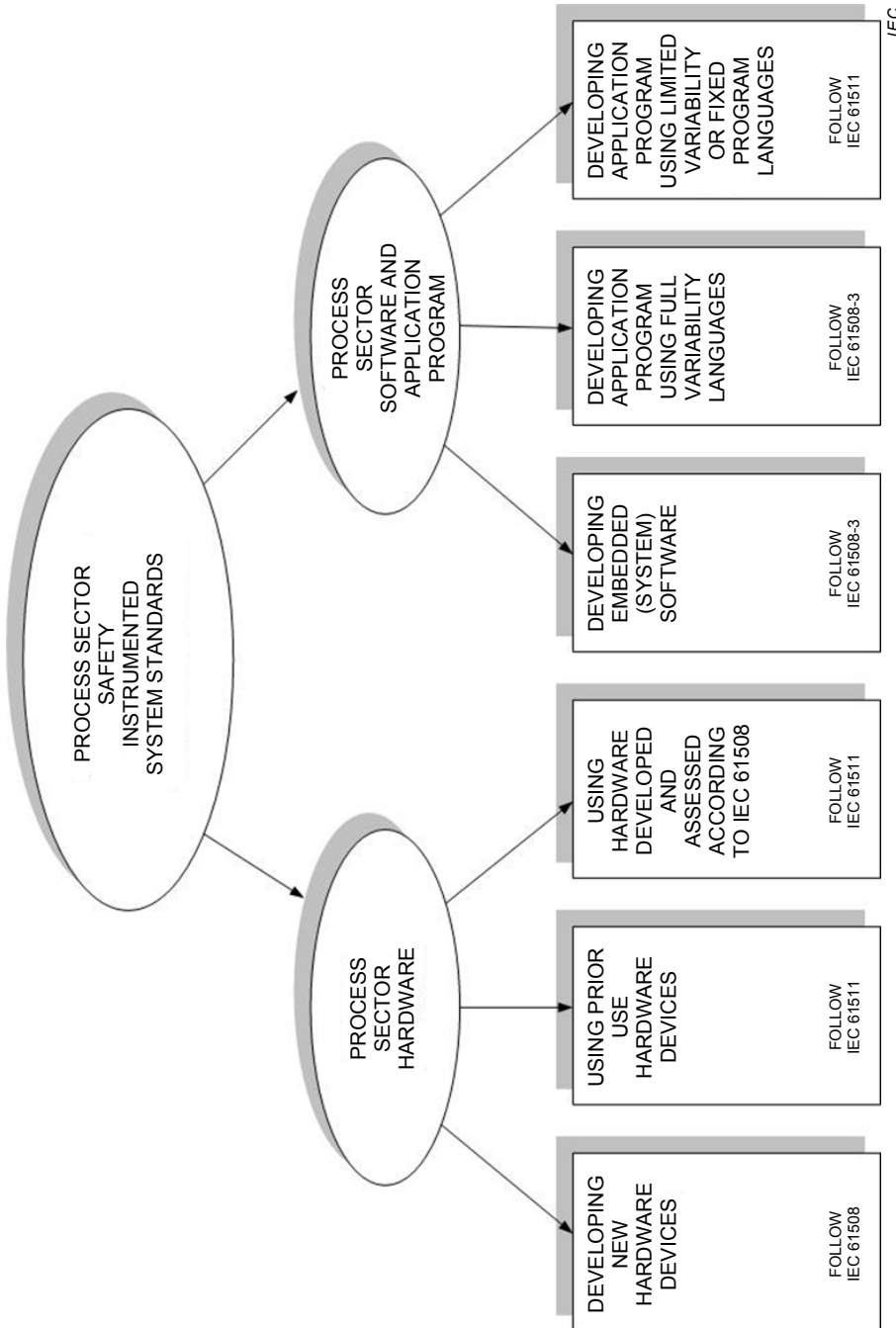
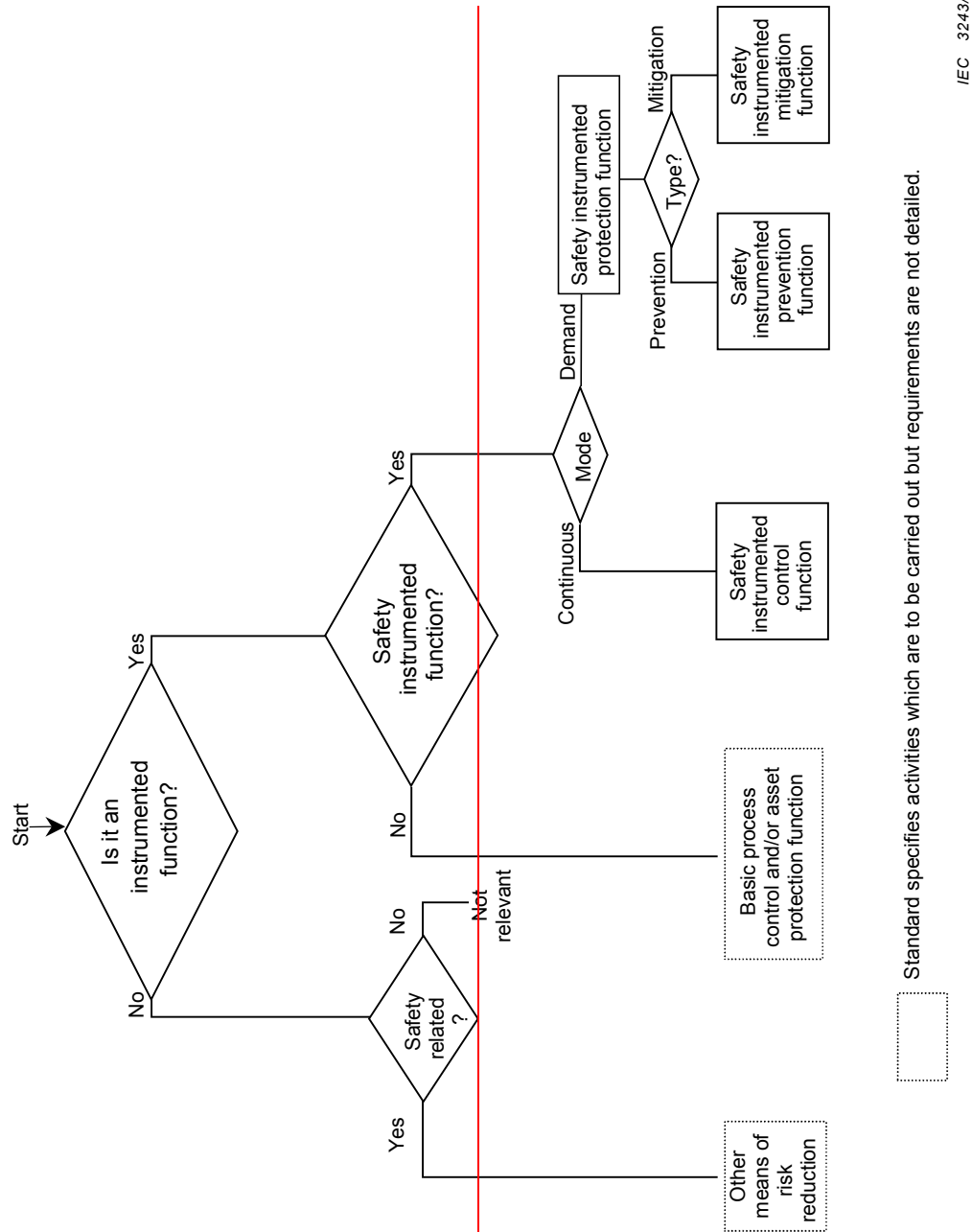


Figure 3 – Detailed relationship between IEC 61511 and IEC 61508 ~~(see clause 4)~~

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.).



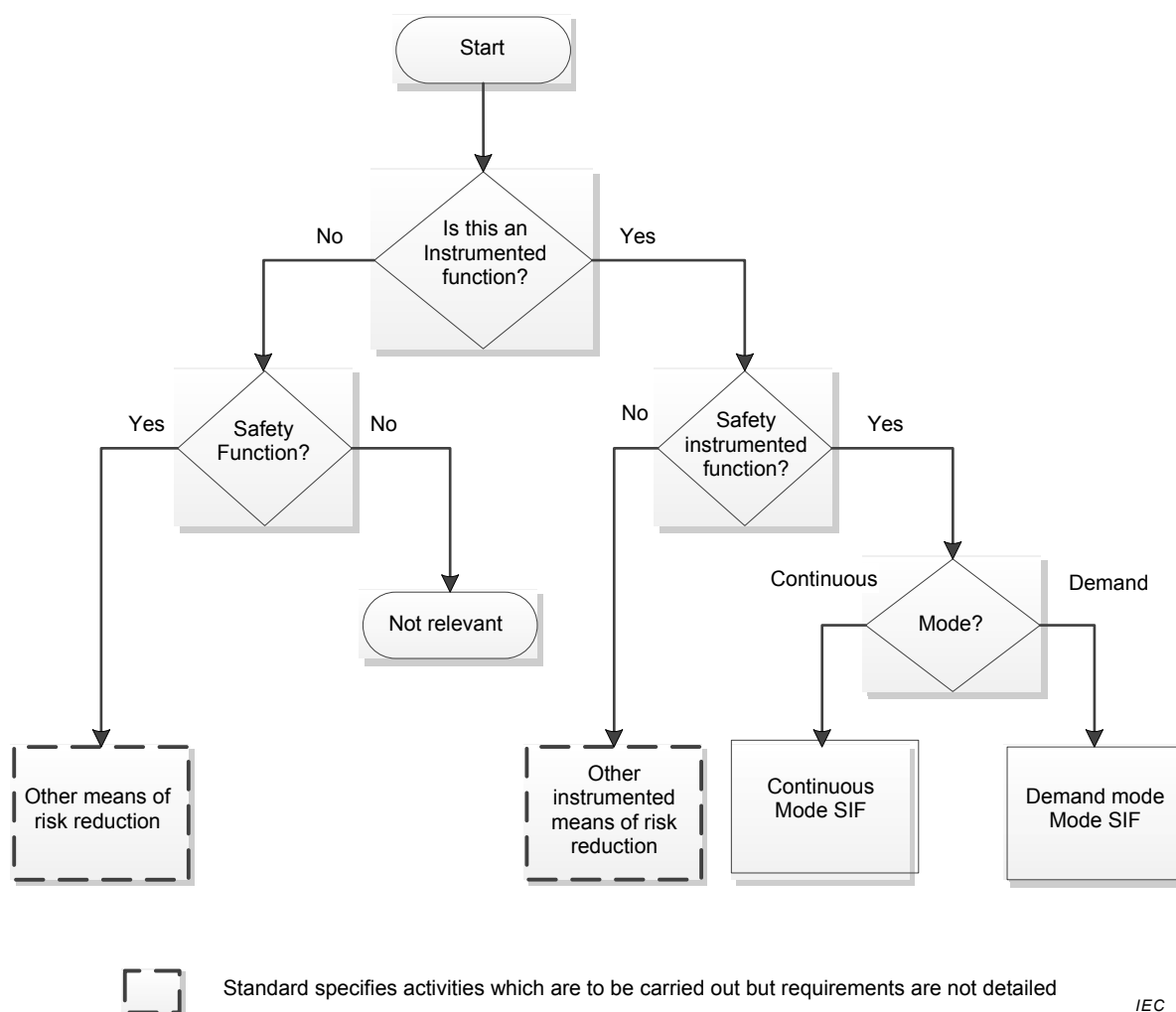


Figure 4 – Relationship between safety instrumented functions and other functions

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 60654-1:1993, Industrial-process measurement and control equipment — Operating conditions — Part 1: Climatic conditions~~

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

~~IEC 60654-3:1998, Industrial-process measurement and control equipment — Operating conditions — Part 3: Mechanical influences~~

~~IEC 61326-1:Electrical equipment for measurement, control and laboratory use — EMC 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*

~~IEC 61511-2: Functional safety – Safety instrumented systems for the process industry sector – Part 2: Guidelines in the application of IEC 61511-1~~

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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;

- 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.

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:

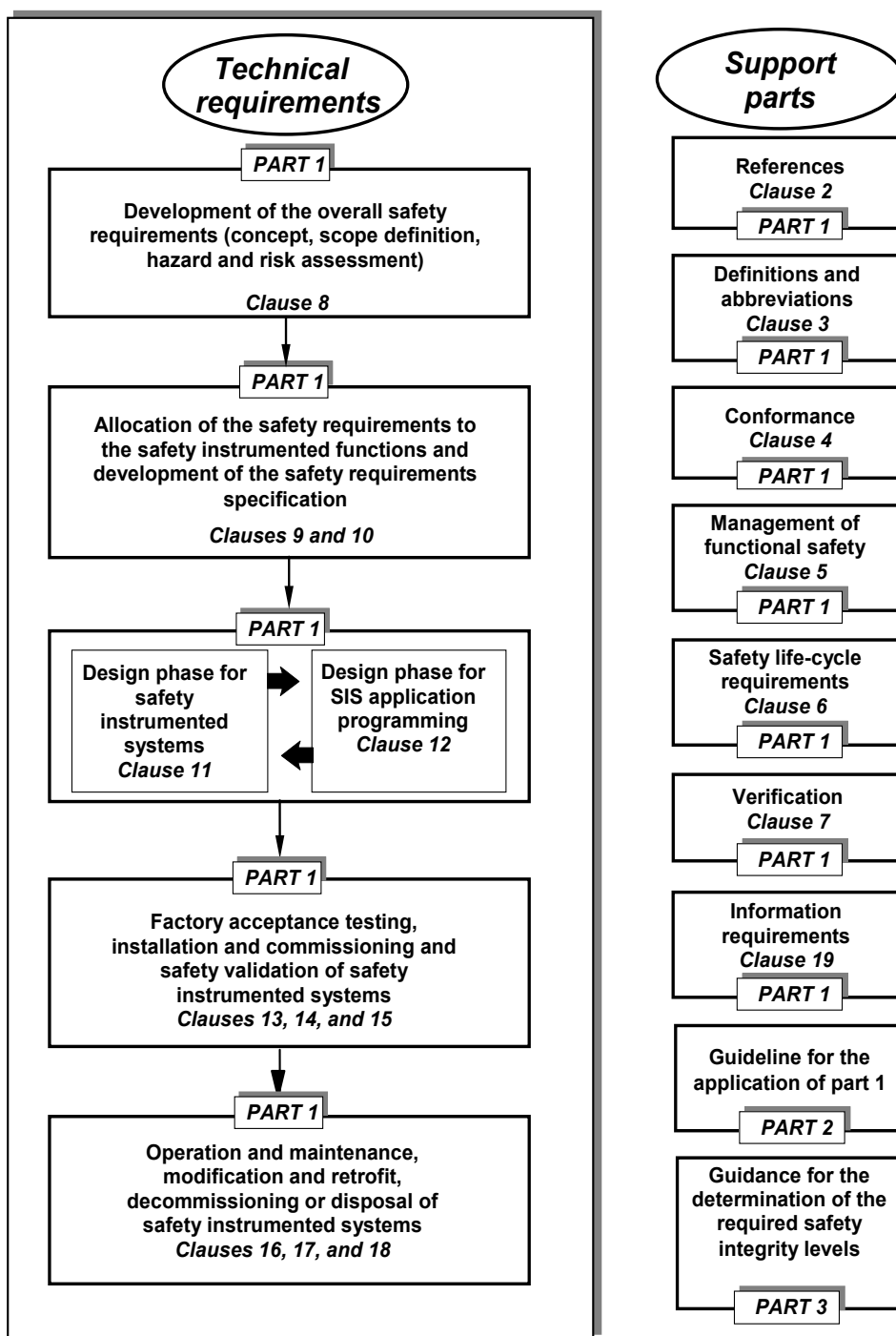
- addresses that a H&RA is carried out to identify the overall safety requirements;
- addresses that an allocation of the safety requirements to the SIS is carried out;
- works within a framework which is applicable to all instrumented means of achieving functional safety;
- details the use of certain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



IEC

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:

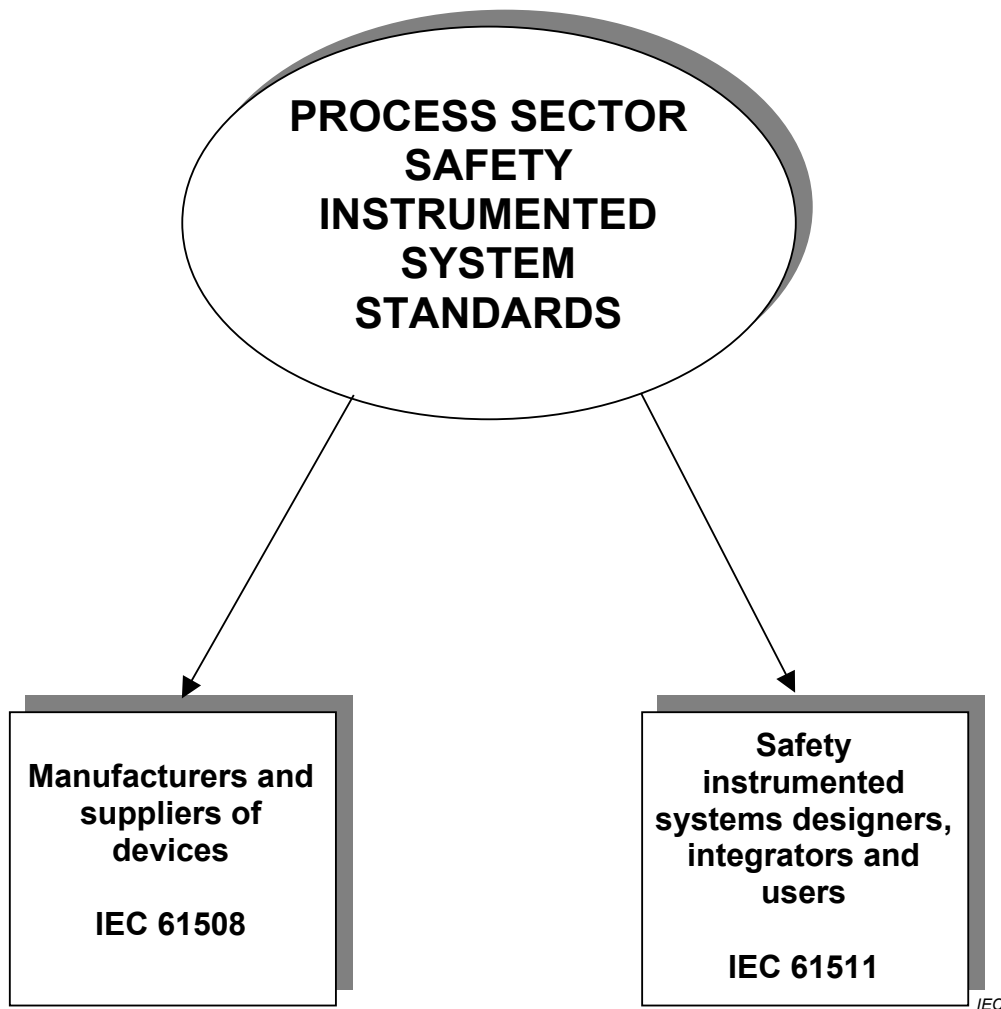


Figure 2 – Relationship between IEC 61511 and IEC 61508

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

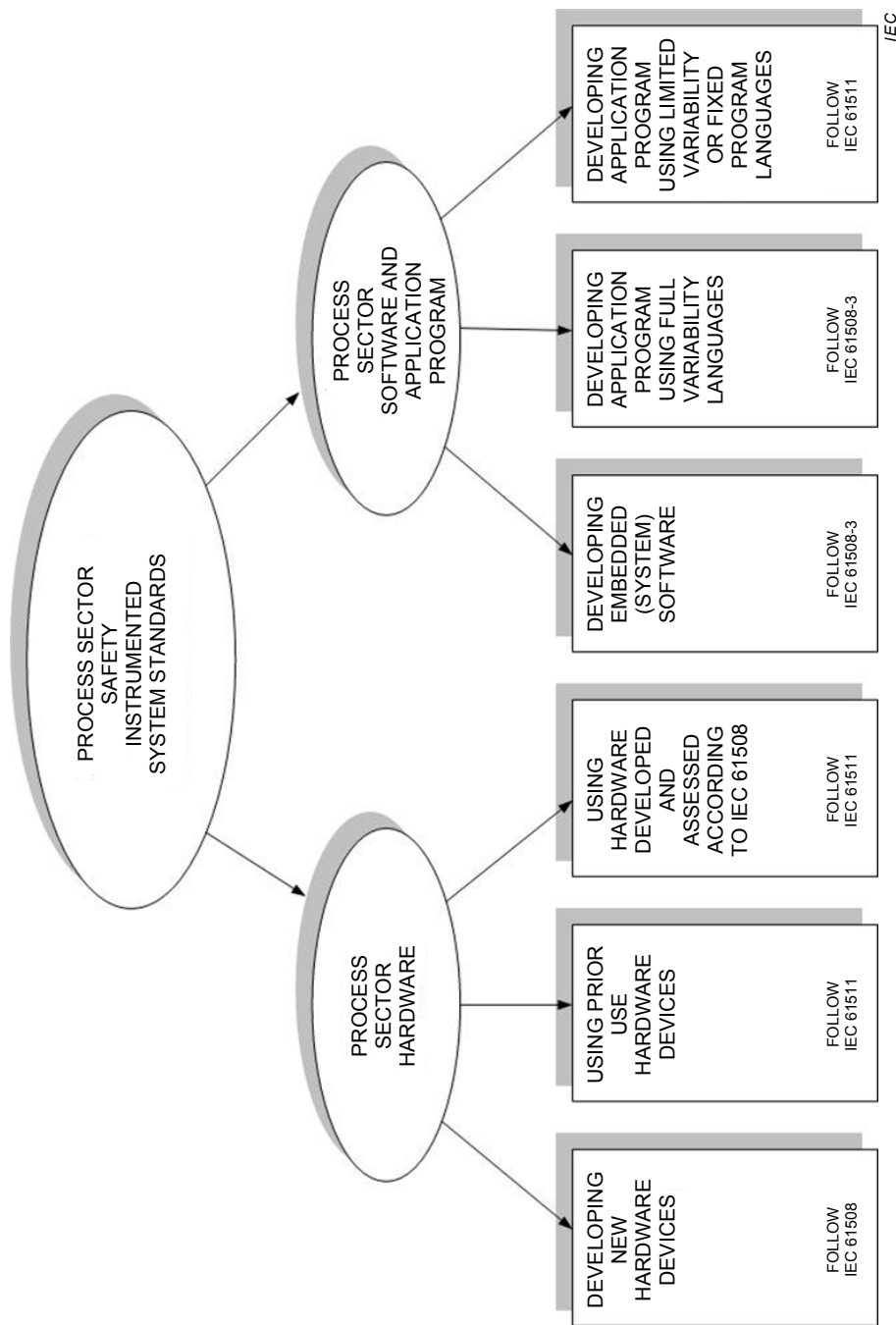
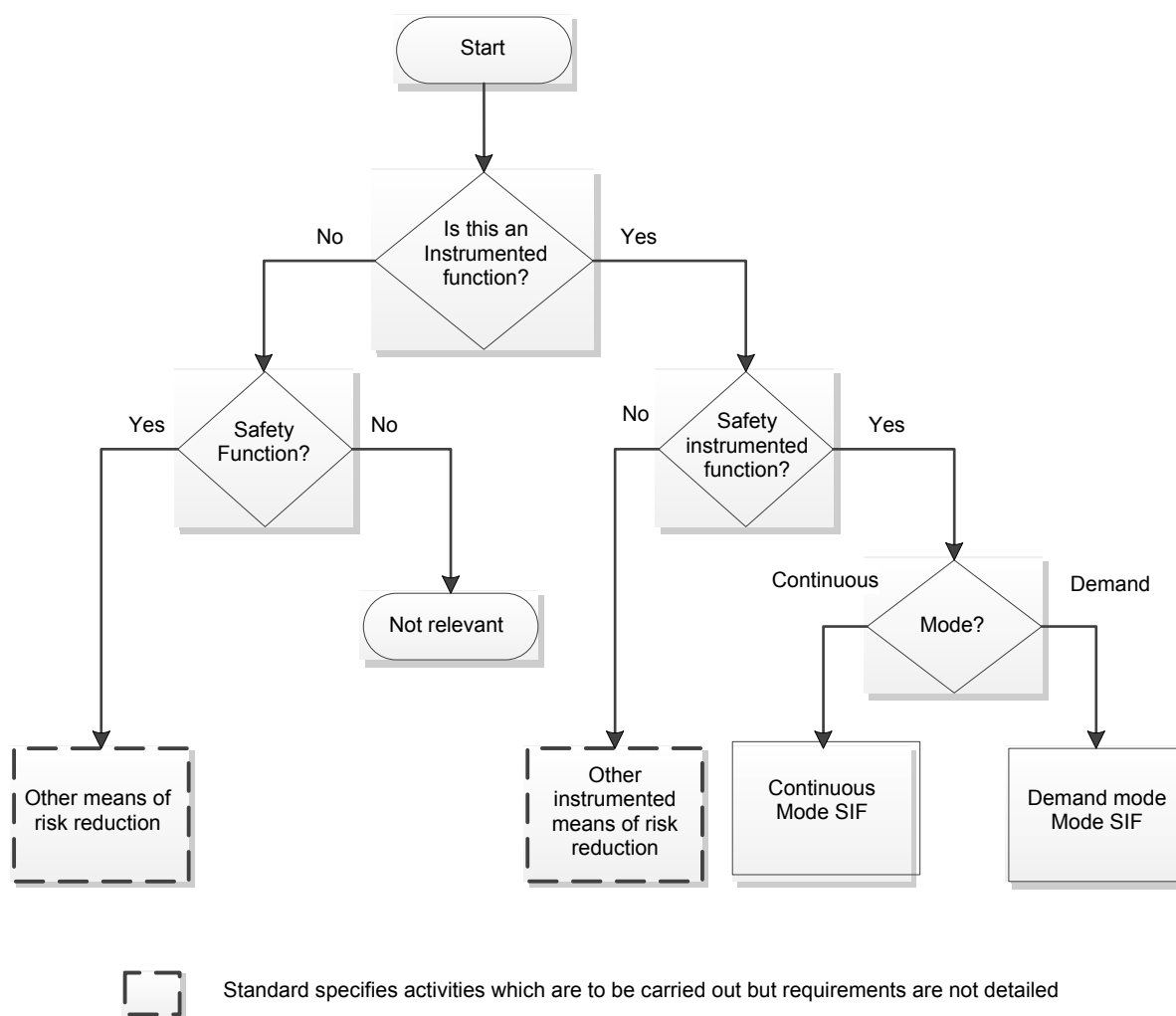


Figure 3 – Detailed relationship between IEC 61511 and IEC 61508

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.).



IEC

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*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**SÉCURITÉ FONCTIONNELLE –
SYSTÈMES INSTRUMENTES DE SÉCURITÉ
POUR LE SECTEUR DES INDUSTRIES DE TRANSFORMATION –****Partie 1: Cadre, définitions, exigences pour le système,
le matériel et la programmation d'application****AVANT-PROPOS**

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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- 9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 61511-1 a été établie par le sous-comité 65A: Aspects systèmes, du comité d'études 65 de l'IEC: Mesure, commande et automation dans les processus industriels.

Cette deuxième édition annule et remplace la première édition parue en 2003. Cette édition constitue une révision technique. Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- remplacement des références et exigences logiciel par des références et exigences de programmation d'application;
- exigences d'évaluation de la sécurité fonctionnelle décrites avec plus de détails pour améliorer la gestion de la sécurité fonctionnelle.
- ajout de la gestion des exigences de changement;
- ajout des exigences d'évaluation du risque de sécurité;
- extension des exigences au système de base de contrôle de processus comme couche de protection;
- modification des exigences relatives à la tolérance de panne matérielle et réexamen minutieux pour comprendre les options utilisateurs/intégrateurs.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
65A/777/FDIS	65A/784/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61511, publiées sous le titre général *Sécurité fonctionnelle – Systèmes instrumentés de sécurité pour le secteur des industries de transformation*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

INTRODUCTION

Les systèmes instrumentés de sécurité (SIS, Safety Instrumented System) sont utilisés dans les industries de transformation depuis de nombreuses années pour remplir des fonctions instrumentées de sécurité (SIF, Safety Instrumented Function). Si l'instrumentation doit être effectivement utilisée pour réaliser des SIF, il est essentiel que cette instrumentation satisfasse à certaines normes et certains niveaux de performance minimaux.

La série IEC 61511 concerne l'application des SIS aux industries de transformation. La série IEC 61511 porte également sur la réalisation d'une analyse de danger et de risque relative au processus (H&RA) visant à en déduire la spécification relative aux SIS. D'autres contributions du système de sécurité sont uniquement prises en compte eu égard aux exigences de performance du SIS. Le SIS inclut tous les appareils nécessaires à l'acheminement de la SIF entre le capteur et l'élément terminal.

La série IEC 61511 aborde deux concepts essentiels à son application: le cycle de vie de sécurité des SIS et les niveaux d'intégrité de sécurité (SIL).

La série IEC 61511 concerne les SIS reposant sur l'utilisation d'une technologie électrique/électronique/électronique programmable. Si d'autres technologies sont utilisées pour les unités logiques, il convient d'appliquer les principes de base de la série IEC 61511 pour garantir que les exigences de sécurité fonctionnelle soient satisfaites. La série IEC 61511 concerne également les capteurs et les éléments terminaux des SIS, quelle que soit la technologie utilisée. La série IEC 61511 est propre aux industries de transformation, dans le cadre de la série IEC 61508.

La série IEC 61511 définit une approche concernant les activités relatives au cycle de vie de sécurité des SIS dans le but de satisfaire à ces principes minimaux. Cette approche a été adoptée afin de mettre en œuvre une politique technique cohérente et rationnelle.

Dans la plupart des cas, la sécurité est obtenue de la meilleure façon par une conception de processus à sécurité intrinsèque. Toutefois, dans certains cas, cela s'avère impossible ou peu pratique. Si nécessaire, cette approche peut être combinée à un ou plusieurs systèmes de protection afin de couvrir les risques résiduels identifiés éventuels. Les systèmes de protection peuvent reposer sur différentes technologies (chimique, mécanique, hydraulique, pneumatique, électrique, électronique, électronique programmable). Pour faciliter cette approche, la série IEC 61511:

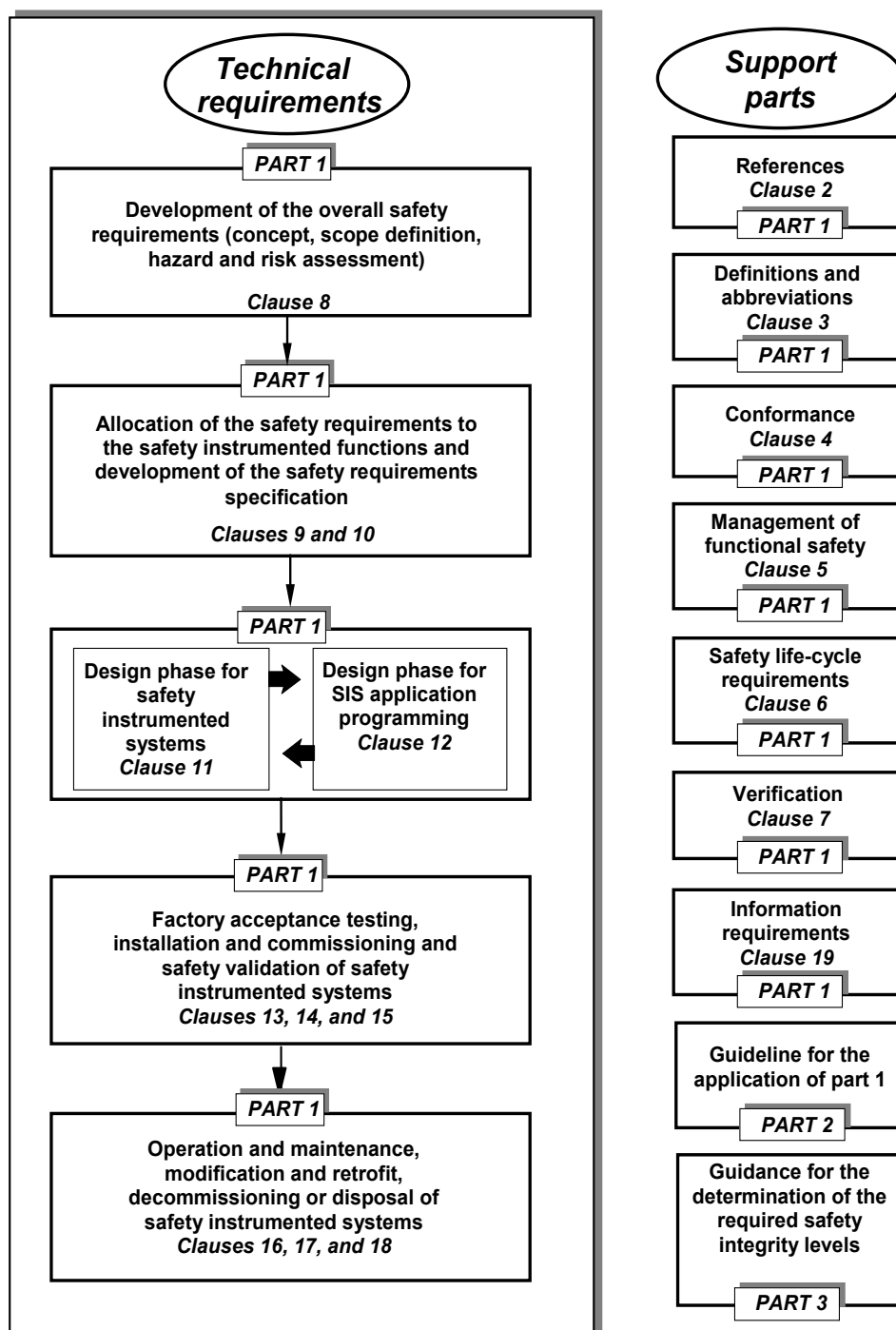
- aborde la réalisation d'une analyse de danger et de risque pour identifier les exigences de sécurité globales;
- prend en compte l'affectation des exigences de sécurité aux SIS;
- s'inscrit dans un cadre applicable à tous les moyens instrumentés qui permettent d'obtenir la sécurité fonctionnelle;
- détaille l'utilisation de certaines activités, telles que la gestion de la sécurité, qui peuvent être applicables à toute méthode permettant d'obtenir la sécurité fonctionnelle.

La série IEC 61511 relative aux SIS pour les industries de transformation:

- prend en compte toutes les phases relatives au cycle de vie de sécurité des SIS (concept initial, conception, mise en œuvre, fonctionnement, maintenance et déclassement);
- permet d'harmoniser les normes des industries de transformation nationales existantes ou nouvelles par rapport à la série IEC 61511.

L'IEC 61511 vise à obtenir un haut niveau de cohérence (p. ex.: des principes sous-jacents, de la terminologie et de l'information) dans le secteur des industries de transformation. Il convient de noter que cela présente des avantages tant du point de vue de la sécurité que du point de vue économique. La Figure 1 ci-dessous présente un cadre général de la série IEC 61511.

Dans les juridictions où les autorités compétentes (p. ex.: nationales, fédérales, étatiques, provinciales, cantonales, municipales) ont défini des réglementations relatives à la conception de la sécurité des processus, la gestion de la sécurité des processus ou autres, ces réglementations sont prioritaires par rapport aux exigences définies dans la série IEC 61511.



Anglais	Français
Technical requirements	Exigences techniques
PART 1	PARTIE 1
PART 2	PARTIE 2
PART 3	PARTIE 3
Development of the overall safety requirements (concept, scope definition, hazard and risk assessment) Clause 8	Développement des exigences de sécurité globales (concept, définition du domaine d'application, analyse de danger et de risque) Article 8
Allocation of the safety requirements to the safety instrumented functions and development of the safety requirements specification Clauses 9 and 10	Allocation des exigences de sécurité aux fonctions instrumentées de sécurité et développement de la spécification des exigences de sécurité Articles 9 et 10
Design phase for safety instrumented systems Clause 11	Phase de conception pour les systèmes instrumentés de sécurité Article 11
Design phase for SIS application programming Clause 12	Phase de conception pour la programmation d'application du SIS Article 12
Factory acceptance testing, installation and commissioning and safety validation of safety instrumented systems Clauses 13, 14, and 15	Essais de réception en usine, installation et mise en service, et validation de la sécurité des systèmes instrumentés de sécurité Articles 13, 14, et 15
Operation and maintenance, modification and retrofit, decommissioning or disposal of safety instrumented systems Clauses 16,17, and 18	Fonctionnement et maintenance, modification et remise à niveau, déclassement ou mise au rebut des systèmes instrumentés de sécurité Articles 16, 17, et 18
Support parts	Parties de prise en charge
References Clause 2	Références Article 2
Definitions and abbreviations Clause 3	Définitions et abréviations Article 3
Conformance Clause 4	Conformité Article 4
Management of functional safety Clause 5	Gestion de la sécurité fonctionnelle Article 5
Safety life-cycle requirements Clause 6	Exigences relatives au cycle de vie de sécurité Article 6
Verification Clause 7	Vérification Article 7
Information requirements Clause 19	Exigences relatives aux informations Article 19
Guideline for the application of part 1	Ligne directrice pour l'application de la partie 1
Guidance for the determination of the required safety integrity levels	Ligne directrice pour la détermination des niveaux d'intégrité de sécurité exigés

Figure 1 – Cadre général de la série IEC 61511

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

1 Domaine d'application

La présente partie de l'IEC 61511 décrit les exigences relatives à la spécification, la conception, l'installation, au fonctionnement et à la maintenance d'un système instrumenté de sécurité (SIS, Safety Instrumented System) de manière à ce qu'il puisse être mis en œuvre en toute confiance pour établir ou maintenir le processus dans un état de sécurité convenable. L'IEC 61511-1 a été conçue pour être une mise en œuvre de l'IEC 61508:2010 dans le secteur des industries de transformation.

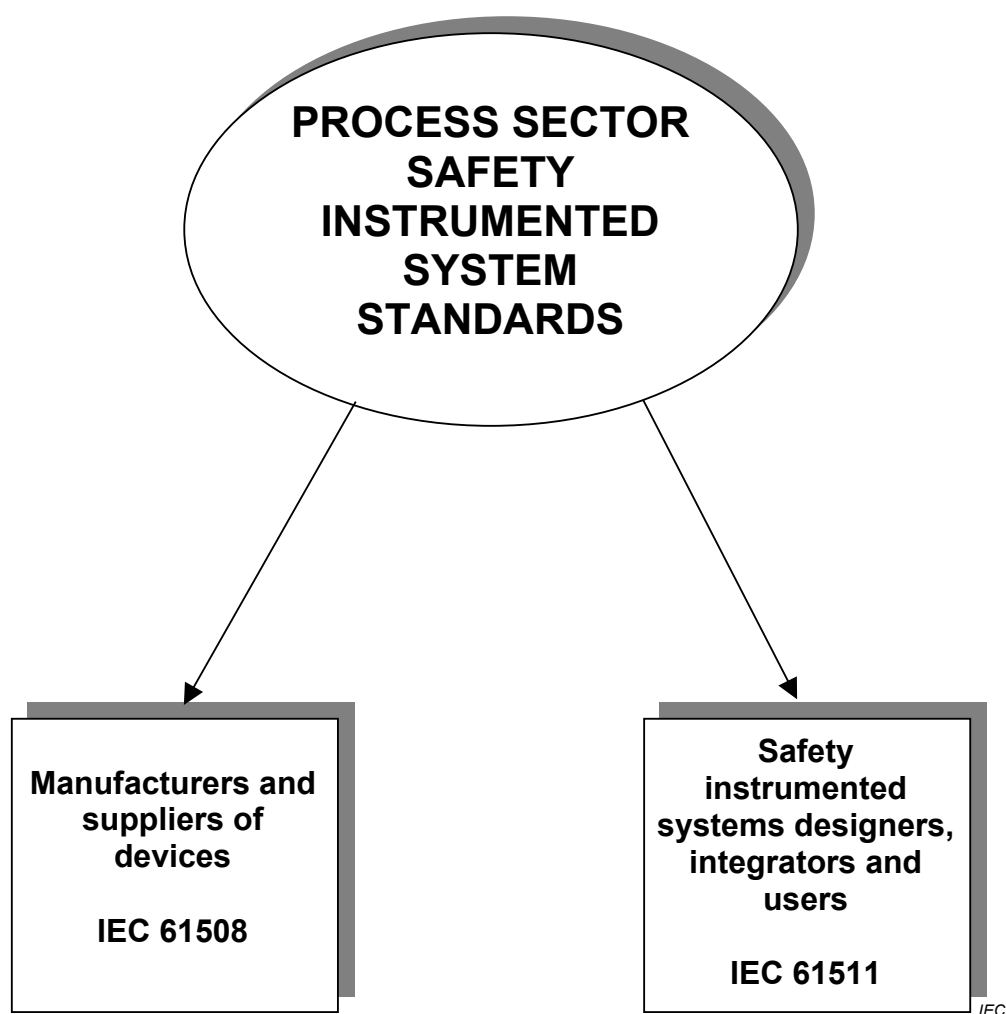
En particulier, l'IEC 61511-1:

- a) spécifie les exigences permettant d'obtenir la sécurité fonctionnelle, mais ne spécifie pas la responsabilité de la mise en œuvre des exigences (p. ex.: les concepteurs, les fournisseurs, la société propriétaire/exploitante, l'entrepreneur). Cette responsabilité sera assignée aux différentes parties selon la planification de la sécurité, la planification et la gestion de projets, ainsi que les règlements nationaux;
 - b) s'applique lorsque des appareils satisfaisant aux exigences de la série IEC 61508 parue en 2010 ou de l'IEC 61511-1:2016 [11.5] sont intégrés dans un système qui doit être utilisé pour une application du secteur des industries de transformation. Elle ne concerne pas les fabricants qui souhaitent revendiquer la possibilité d'utiliser ces appareils dans les SIS du secteur des industries de transformation (voir l'IEC 61508-2:2010 et l'IEC 61508-3:2010);
 - c) définit les relations entre les normes IEC 61511 et IEC 61508 (voir Figures 2 et 3);
 - d) s'applique lorsque des programmes d'application sont développés pour des systèmes possédant un langage de variabilité limitée ou lors de l'utilisation d'appareil à langage de programmation figé, mais ne s'applique pas aux fabricants, concepteurs, intégrateurs et utilisateurs du SIS qui développent des logiciels intégrés (logiciels système) ou utilisent des langages de variabilité totale (voir l'IEC 61508-3:2010);
 - e) s'applique à de nombreuses industries de transformation (p. ex.: produits chimiques, pétrole et gaz, pâte à papier et papier, produits pharmaceutiques, produits alimentaires et boissons, production d'électricité non-nucléaire);
- NOTE 1 Dans le secteur des industries de transformation, certaines applications peuvent faire l'objet d'exigences supplémentaires qui doivent être satisfaites.
- f) met en évidence les relations entre les SIF et d'autres fonctions instrumentées (voir Figure 4);
 - g) aboutit à l'identification des exigences fonctionnelles et des exigences concernant l'intégrité de sécurité relatives aux SIF en tenant compte de la réduction de risque obtenue par d'autres méthodes;
 - h) spécifie les exigences relatives au cycle de vie de l'architecture du système et la configuration du matériel, ainsi que de la programmation d'application et de l'intégration du système;
 - i) spécifie les exigences relatives à la programmation d'application pour les intégrateurs et utilisateurs de SIS;

- j) s'applique lorsque la sécurité fonctionnelle est obtenue en utilisant une ou plusieurs SIF pour la protection du personnel, la protection du grand public ou la protection de l'environnement;
- k) peut s'appliquer dans des applications non liées à la sécurité (la protection de biens, par exemple);
- l) définit les exigences pour la mise en œuvre des SIF dans le cadre des dispositions globales permettant d'obtenir la sécurité fonctionnelle;
- m) utilise le cycle de vie de sécurité d'un SIS (voir Figure 7) et définit une liste des activités devant être réalisées pour déterminer les exigences fonctionnelles, ainsi que les exigences concernant l'intégrité de sécurité relatives au SIS;
- n) spécifie qu'une H&RA doit être réalisée pour définir les exigences de sécurité fonctionnelle et les niveaux d'intégrité de sécurité (SIL) de chaque SIF;

NOTE 2 Pour avoir une vue d'ensemble des moyens de réduction de risque, voir la Figure 9.

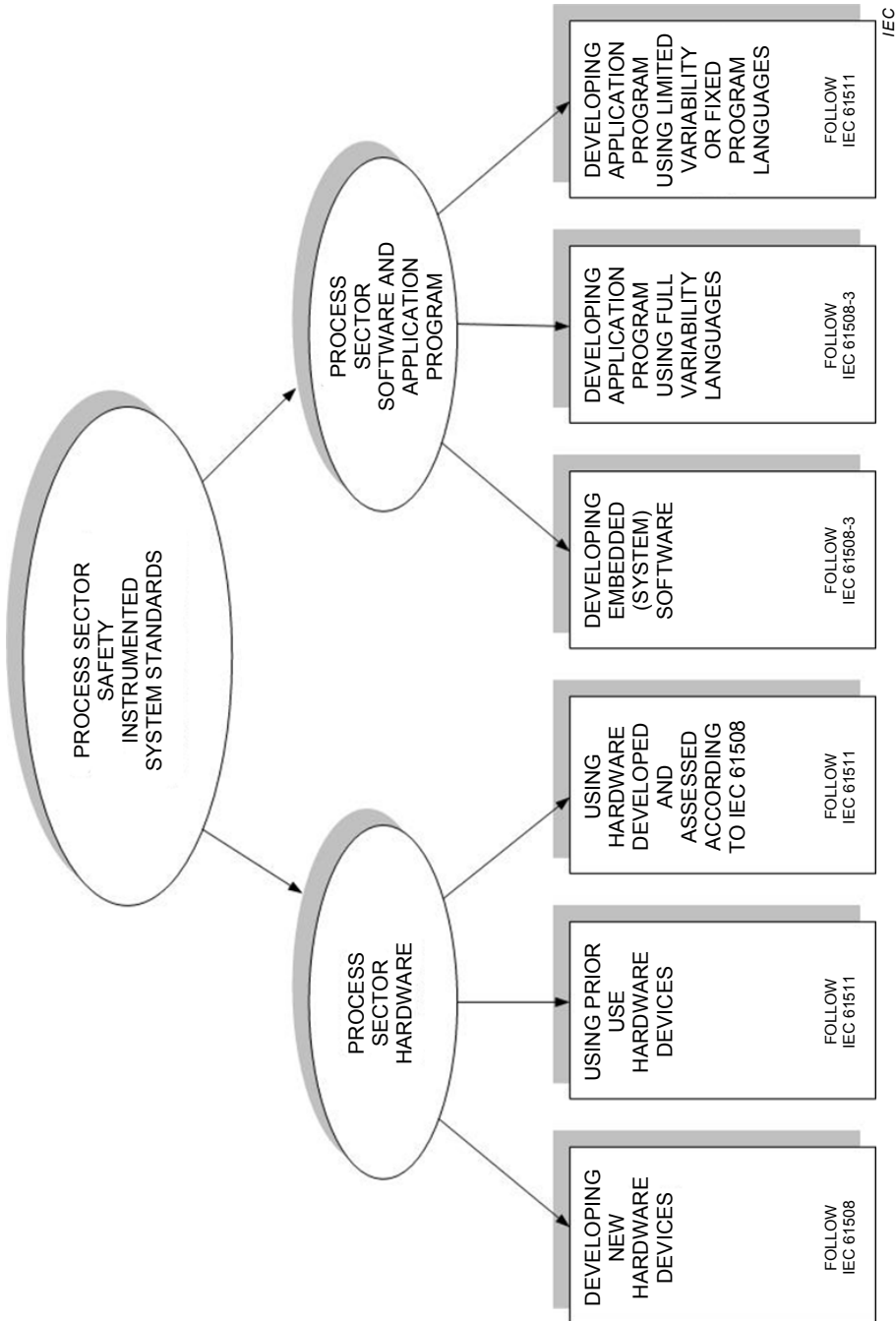
- o) établit des objectifs quantitatifs relatifs à la probabilité moyenne de défaillance en cas de sollicitation (en mode sollicitation) et à la fréquence moyenne de défaillance dangereuse (en mode sollicitation ou en mode continu) pour chaque SIL;
- p) spécifie des exigences minimales pour la tolérance aux défauts du matériel (HFT);
- q) spécifie les mesures et techniques exigées pour obtenir le SIL indiqué;
- r) définit un niveau maximal de performance de sécurité fonctionnelle (SIL 4) qui peut être atteint pour une SIF mise en œuvre conformément à l'IEC 61511-1;
- s) définit un niveau minimal de performance de sécurité fonctionnelle (SIL 1) au-dessous duquel l'IEC 61511-1 ne s'applique pas;
- t) fournit un cadre pour l'établissement du SIL, mais ne spécifie pas le SIL exigé pour les applications spécifiques (qu'il convient d'établir sur la base de la connaissance de l'application particulière et par rapport à la réduction de risque globale souhaitée);
- u) spécifie les exigences pour toutes les parties du SIS, depuis le capteur jusqu'à l'élément terminal ou jusqu'aux éléments terminaux;
- v) définit les informations qui sont nécessaires pendant le cycle de vie de sécurité du SIS;
- w) spécifie que la conception du SIS tient compte des facteurs humains;
- x) n'applique aucune exigence directe relative à l'opérateur individuel ou au technicien de maintenance.



Anglais	Français
PROCESS SECTOR SAFETY INSTRUMENTED SYSTEM STANDARDS	NORMES RELATIVES AUX SYSTEMES INSTRUMENTES DE SECURITE DANS LE SECTEUR DES INDUSTRIES DE TRANSFORMATION
Manufacturers and suppliers of devices	Fabricants et fournisseurs d'appareils
IEC 61508	IEC 61508
Safety instrumented systems designers, integrators and users	Concepteurs, intégrateurs et utilisateurs de systèmes instrumentés de sécurité
IEC 61511	IEC 61511

Figure 2 – Relations entre l'IEC 61511 et l'IEC 61508

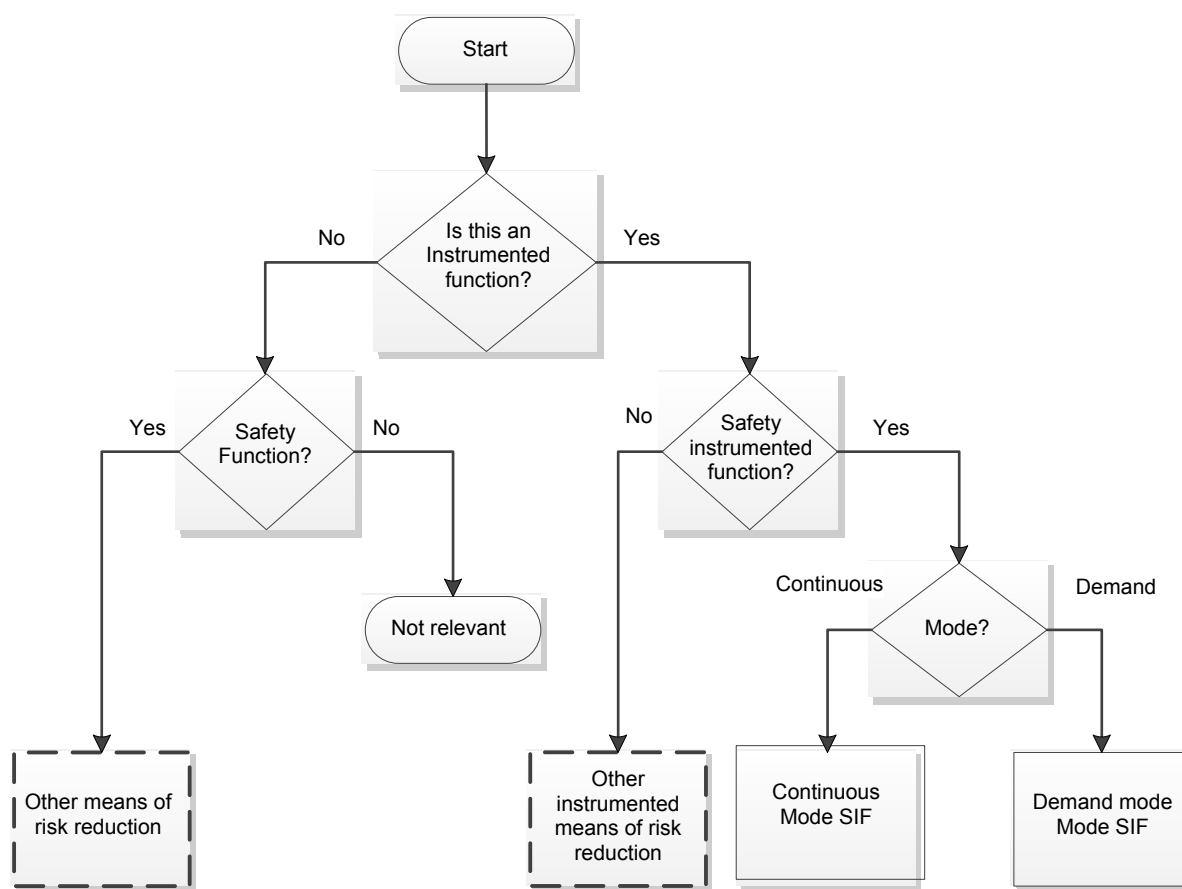
NOTE 3 L'IEC 61508 est également utilisée par les concepteurs, intégrateurs et utilisateurs de SIS lorsque cela est indiqué dans l'IEC 61511.



Anglais	Français
PROCESS SECTOR SAFETY INSTRUMENTED SYSTEM STANDARDS	NORMES RELATIVES AUX SYSTEMES INSTRUMENTES DE SECURITE DANS LE SECTEUR DES INDUSTRIES DE TRANSFORMATION
PROCESS SECTOR HARDWARE	MATERIEL POUR LE SECTEUR DES INDUSTRIES DE TRANSFORMATION
PROCESS SECTOR SOFTWARE & APPLICATION PROGRAM	LOGICIEL ET PROGRAMME D'APPLICATION POUR LE SECTEUR DES INDUSTRIES DE TRANSFORMATION
DEVELOPING NEW HARDWARE DEVICES	DEVELOPPEMENT DE NOUVEAUX APPAREILS MATERIELS
FOLLOW IEC 61508	SUIVRE L'IEC 61508
USING PRIOR USE HARDWARE DEVICES	UTILISATION D'APPAREILS MATERIELS BASES SUR L'UTILISATION ANTERIEURE
FOLLOW IEC 61511	SUIVRE L'IEC 61511
USING HARDWARE DEVELOPED AND ASSESSED ACCORDING TO IEC 61508	UTILISATION DE MATERIEL DEVELOPPE ET EVALUE CONFORMEMENT A L'IEC 61508
DEVELOPING EMBEDDED (SYSTEM) SOFTWARE	DEVELOPPEMENT DE LOGICIELS (SYSTEME) INTEGRES
FOLLOW IEC 61508-3	SUIVRE L'IEC 61508-3
DEVELOPING APPLICATION PROGRAM USING FULL VARIABILITY LANGUAGES	DEVELOPPEMENT DE PROGRAMME D'APPLICATION UTILISANT DES LANGAGES DE VARIABILITE TOTALE
DEVELOPING APPLICATION PROGRAM USING LIMITED VARIABILITY OR FIXED PROGRAM LANGUAGES	DEVELOPPEMENT DE PROGRAMME D'APPLICATION UTILISANT DES LANGAGES DE VARIABILITE LIMITEE OU DES LANGAGES DE PROGRAMME FIGE

Figure 3 – Relations détaillées entre l'IEC 61511 et l'IEC 61508

NOTE 4 Pour connaître les lignes directrices concernant le traitement de l'intégration des sous-systèmes qui satisfont à d'autres normes (machines, brûleur, etc.), voir 7.2.2 de l'IEC 61511-1:2016 et l'IEC 61511-2:2016.



Standard specifies activities which are to be carried out but requirements are not detailed

IEC

Anglais	Français
Start	Démarrage
Is this an Instrumented function?	Est-ce une fonction instrumentée?
No	Non
Yes	Oui
Safety Function?	Fonction de sécurité?
Safety instrumented function?	Fonction instrumentée de sécurité?
Not relevant	Non pertinent
Mode?	Mode?
Continuous	Continu
Demand	Sollicitation
Other means of risk reduction	Autres moyens de réduction de risque
Other instrumented means of risk reduction	Autres moyens instrumentés de réduction de risque
Continuous Mode SIF	SIF en mode continu
Demand mode Mode SIF	SIF en mode sollicitation
Standard specifies activities which are to be carried out but requirements are not detailed	La norme spécifie les activités devant être réalisées, mais les exigences ne sont pas détaillées

Figure 4 – Relations entre les fonctions instrumentées de sécurité et les autres fonctions

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61508-1:2010, *Sécurité fonctionnelle des systèmes électriques/électroniques/électroniques programmables relatifs à la sécurité – Partie 1: Exigences générales*

IEC 61508-2:2010, *Sécurité fonctionnelle des systèmes électriques/électroniques/électroniques programmables relatifs à la sécurité – Partie 2: Exigences pour les systèmes électriques/électroniques/électroniques programmables relatifs à la sécurité*

IEC 61508-3:2010, *Sécurité fonctionnelle des systèmes électriques/électroniques/électroniques programmables relatifs à la sécurité – Partie 3: Exigences concernant les logiciels*