



NSAI
Standards

Irish Standard
I.S. EN 16590-3:2014

Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 3: Series development, hardware and software (ISO 25119-3:2010 modified)

I.S. EN 16590-3:2014

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN 16590-3:2014

Published:

2014-04-23

This document was published under the authority of the NSAI and comes into effect on:

2014-05-03

ICS number:

35.240.99

65.060.01

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

EUROPEAN STANDARD

EN 16590-3

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2014

ICS 35.240.99; 65.060.01

English Version

Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 3: Series development, hardware and software (ISO 25119-3:2010 modified)

Tracteurs et matériels agricoles et forestiers - Parties des systèmes de commande relatives à la sécurité - Partie 3: Développement en série, matériels et logiciels (ISO 25119-3:2010 modifié)

Sicherheit von Land- und Forstmaschinen - Sicherheitsbezogene Teile von Steuerungen - Teil 3: Serienentwicklung, Hardware, Software (ISO 25119-3:2010 modifiziert)

This European Standard was approved by CEN on 23 February 2014.

CEN 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 CEN 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 CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents	Page
Foreword.....	4
Introduction	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	7
4 Abbreviated terms	7
5 System design.....	8
5.1 Objectives	8
5.2 General.....	8
5.3 Prerequisites	9
5.4 Requirements	9
5.4.1 Structuring safety requirements	9
5.4.2 Functional safety concept	10
5.4.3 Technical safety concept	11
6 Hardware.....	13
6.1 Objectives	13
6.2 General.....	13
6.3 Prerequisites	14
6.4 Requirements	14
6.5 Hardware categories	15
6.6 Work products.....	16
7 Software.....	16
7.1 Software development planning	16
7.1.1 Objectives	16
7.1.2 General.....	17
7.1.3 Prerequisites	17
7.1.4 Requirements	17
7.1.5 Work products.....	20
7.2 Software safety requirements specification	20
7.2.1 Objectives	20
7.2.2 General.....	20
7.2.3 Prerequisites	20
7.2.4 Requirements	21
7.2.5 Work products.....	24
7.3 Software architecture and design	24
7.3.1 Objectives	24
7.3.2 General.....	24
7.3.3 Prerequisites	24
7.3.4 Requirements	24
7.3.5 Work products.....	27
7.4 Software module design and implementation	27
7.4.1 Objectives	27
7.4.2 General.....	27
7.4.3 Prerequisites	27
7.4.4 Requirements	27
7.4.5 Work products.....	36
7.5 Software module testing	36

7.5.1	Objectives	36
7.5.2	General	36
7.5.3	Prerequisites	36
7.5.4	Requirements	36
7.5.5	Work products	44
7.6	Software integration and testing	44
7.6.1	Objectives	44
7.6.2	General	44
7.6.3	Prerequisites	45
7.6.4	Requirements	45
7.6.5	Work products	46
7.7	Software safety validation	47
7.7.1	Objectives	47
7.7.2	General	47
7.7.3	Prerequisites	47
7.7.4	Requirements	47
7.7.5	Work products	49
7.8	Software-based parameterisation	49
7.8.1	Objective	49
7.8.2	General	49
7.8.3	Prerequisites	49
7.8.4	Requirements	50
7.8.5	Work products	50
Annex A (informative) Example of agenda for assessment of functional safety at AgPL = e		52
A.1	Functions of system	52
A.2	Hardware	52
A.3	Safety concept	52
A.4	Safety analysis and safety data	52
A.5	Safety design process for phases of life cycle	52
A.6	Software development	53
A.7	Verification and testing	53
A.8	Documentation and safety documentation	53
A.9	Summary and assessment	53
Annex B (informative) Independence by software partitioning		54
B.1	General	54
B.2	Terms, definitions and abbreviated terms	54
B.3	Objectives	56
B.4	General	57
B.5	Requirements	57
B.5.1	General requirements	57
B.5.2	Several partitions within a single microcontroller	57
B.5.3	Several partitions within the scope of a micro-controller network	60
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Machinery Directive 2006/42/EC		63
Bibliography		64

EN 16590-3:2014 (E)

Foreword

This document (EN 16590-3:2014) has been prepared by Technical Committee CEN/TC 144 "Tractors and machinery for agriculture and forestry", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2014, and conflicting national standards shall be withdrawn at the latest by October 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

EN 16590 *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems* consists of the following parts:

- *Part 1: General principles for design and development*
- *Part 2: Concept phase*
- *Part 3: Series development, hardware and software*
- *Part 4: Production, operation, modification and supporting processes*

The modifications to ISO 25119-3:2010 are indicated by a vertical line in the margin.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

EN 16590 sets out an approach to the design and assessment, for all safety life cycle activities, of safety-relevant systems comprising electrical and/or electronic and/or programmable electronic systems (E/E/PES) on tractors used in agriculture and forestry, and on self-propelled ride-on machines and mounted, semi-mounted and trailed machines used in agriculture. It is also applicable to municipal equipment. It covers the possible hazards caused by the functional behaviour of E/E/PES safety-related systems, as distinct from hazards arising from the E/E/PES equipment itself (electric shock, fire, nominal performance level of E/E/PES dedicated to active and passive safety, etc.).

The control system parts of the machines concerned are frequently assigned to provide the critical functions of the *safety-related parts of control systems* (SRP/CS). These can consist of hardware or software, can be separate or integrated parts of a control system, and can either perform solely critical functions or form part of an operational function.

In general, the designer (and to some extent, the user) will combine the design and validation of these SRP/CS as part of the risk assessment. The objective is to reduce the risk associated with a given hazard (or hazardous situation) under all conditions of use of the machine. This can be achieved by applying various protective measures (both SRP/CS and non-SRP/CS) with the end result of achieving a safe condition.

EN 16590 allocates the ability of safety-related parts to perform a critical function under foreseeable conditions into five performance levels. The performance level of a controlled channel depends on several factors, including system structure (category), the extent of fault detection mechanisms (diagnostic coverage), the reliability of components (mean time to dangerous failure, common-cause failure), design processes, operating stress, environmental conditions and operation procedures. Three types of failures are considered: systematic, common-cause and random.

In order to guide the designer during design, and to facilitate the assessment of the achieved performance level, EN 16590 defines an approach based on a classification of structures with different design features and specific behaviour in case of a fault.

The performance levels and categories can be applied to the control systems of all kinds of mobile machines: from simple systems (e.g. auxiliary valves) to complex systems (e.g. steer by wire), as well as to the control systems of protective equipment (e.g. interlocking devices, pressure sensitive devices).

EN 16590 adopts a risk-based approach for the determination of the risks, while providing a means of specifying the required performance level for the safety-related functions to be implemented by E/E/PES safety-related channels. It gives requirements for the whole safety life cycle of E/E/PES (design, validation, production, operation, maintenance, decommissioning), necessary for achieving the required functional safety for E/E/PES that are linked to the performance levels.

The structure of safety standards in the field of machinery is as follows.

- a) Type-A standards (basic safety standards) give basic concepts, principles for design and general aspects that can be applied to machinery.
- b) Type-B standards (generic safety standards) deal with one or more safety aspect(s), or one or more type(s) of safeguards that can be used across a wide range of machinery:
 - type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);
 - type-B2 standards on safeguards (e.g. two-hands controls, interlocking devices, pressure sensitive devices, guards).
- c) Type-C standards (machinery safety standards) deal with detailed safety requirements for a particular machine or group of machines.

EN 16590-3:2014 (E)

This part of EN 16590 is a type-B1 standard as stated in EN ISO 12100.

For machines which are covered by the scope of a machine specific type-C standard and which have been designed and built according to the provisions of that standard, the provisions of that type-C standard take precedence over the provisions of this type-B standard.

1 Scope

This part of EN 16590 provides general principles for the series development, hardware and software of safety-related parts of control systems (SRP/CS) on tractors used in agriculture and forestry, and on self-propelled ride-on machines and mounted, semi-mounted and trailed machines used in agriculture. It can also be applied to municipal equipment (e.g. street-sweeping machines). It specifies the characteristics and categories required of SRP/CS for carrying out their safety functions.

This part of EN 16590 is applicable to the safety-related parts of electrical/electronic/programmable electronic systems (E/E/PES), as these relate to mechatronic systems. It does not specify which safety functions, categories or performance levels are to be used for particular machines.

Machine specific standards (type-C standards) can identify performance levels and/or categories or they should be determined by the manufacturer of the machine based on risk assessment.

It is not applicable to non-E/E/PES systems (e.g. hydraulic, mechanic or pneumatic).

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.

EN 16590-1:2014, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 1: General principles for design and development*

EN 16590-2:2014, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 2: concept phase*

EN 16590-4:2014, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 4: Production, operation, modification and supporting processes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16590-1:2014 apply.

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

AgPL	agricultural performance level
AgPL _r	required agricultural performance level
CAD	computer-aided design
Cat	hardware category
CCF	common-cause failure
DC	diagnostic coverage
DC _{avg}	average diagnostic coverage
ECU	electronic control unit
ETA	event tree analysis
E/E/PES	electrical/electronic/programmable electronic systems
EMC	electromagnetic compatibility

INTERNATIONAL STANDARD

ISO
25119-3

First edition
2010-06-01

Tractors and machinery for agriculture and forestry — Safety-related parts of control systems —

Part 3: Series development, hardware and software

*Tracteurs et matériels agricoles et forestiers — Parties des systèmes
de commande relatives à la sécurité —*

Partie 3: Développement en série, matériels et logiciels



Reference number
ISO 25119-3:2010(E)

© ISO 2010

ISO 25119-3:2010(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



COPYRIGHT PROTECTED DOCUMENT

© ISO 2010

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	2
5 System design	3
5.1 Objectives	3
5.2 General	3
5.3 Prerequisites	4
5.4 Requirements	4
6 Hardware	8
6.1 Objectives	8
6.2 General	8
6.3 Prerequisites	8
6.4 Requirements	8
6.5 Hardware categories	10
6.6 Work products	10
7 Software.....	11
7.1 Software development planning	11
7.2 Software safety requirements specification	14
7.3 Software architecture and design.....	18
7.4 Software module design and implementation.....	21
7.5 Software module testing.....	30
7.6 Software integration and testing	39
7.7 Software safety validation	41
7.8 Software-based parameterization.....	43
Annex A (informative) Example of agenda for assessment of functional safety at AgPL = e	46
Annex B (informative) Independence by software partitioning.....	48
Bibliography.....	57

ISO 25119-3:2010(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 25119-3 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

ISO 25119 consists of the following parts, under the general title *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems*:

- *Part 1: General principles for design and development*
- *Part 2: Concept phase*
- *Part 3: Series development, hardware and software*
- *Part 4: Production, operation, modification and supporting processes*

Introduction

ISO 25119 sets out an approach to the design and assessment, for all safety life cycle activities, of safety-relevant systems comprising electrical and/or electronic and/or programmable electronic components (E/E/PES) on tractors used in agriculture and forestry, and on self-propelled ride-on machines and mounted, semi-mounted and trailed machines used in agriculture. It is also applicable to municipal equipment. It covers the possible hazards caused by the functional behaviour of E/E/PES safety-related systems, as distinct from hazards arising from the E/E/PES equipment itself (electric shock, fire, nominal performance level of E/E/PES dedicated to active and passive safety, etc.).

The control system parts of the machines concerned are frequently assigned to provide the critical functions of the *safety-related parts of control systems* (SRP/CS). These can consist of hardware or software, can be separate or integrated parts of a control system, and can either perform solely critical functions or form part of an operational function.

In general, the designer (and to some extent, the user) will combine the design and validation of these SRP/CS as part of the risk assessment. The objective is to reduce the risk associated with a given hazard (or hazardous situation) under all conditions of use of the machine. This can be achieved by applying various protective measures (both SRP/CS and non-SRP/CS) with the end result of achieving a safe condition.

ISO 25119 allocates the ability of safety-related parts to perform a critical function under foreseeable conditions into five performance levels. The performance level of a controlled channel depends on several factors, including system structure (category), the extent of fault detection mechanisms (diagnostic coverage), the reliability of components (mean time to dangerous failure, common-cause failure), design processes, operating stress, environmental conditions and operation procedures. Three types of failures are considered: systematic, common-cause and random.

In order to guide the designer during design, and to facilitate the assessment of the achieved performance level, ISO 25119 defines an approach based on a classification of structures with different design features and specific behaviour in case of a fault.

The performance levels and categories can be applied to the control systems of all kinds of mobile machines: from simple systems (e.g. auxiliary valves) to complex systems (e.g. steer by wire), as well as to the control systems of protective equipment (e.g. interlocking devices, pressure sensitive devices).

ISO 25119 adopts a customer risk-based approach for the determination of the risks, while providing a means of specifying the target performance level for the safety-related functions to be implemented by E/E/PES safety-related channels. It gives requirements for the whole safety life cycle of E/E/PES (design, validation, production, operation, maintenance, decommissioning), necessary for achieving the required functional safety for E/E/PES that are linked to the performance levels.

Tractors and machinery for agriculture and forestry — Safety-related parts of control systems —

Part 3: Series development, hardware and software

1 Scope

This part of ISO 25119 provides general principles for the series development, hardware and software of safety-related parts of control systems (SRP/CS) on tractors used in agriculture and forestry, and on self-propelled ride-on machines and mounted, semi-mounted and trailed machines used in agriculture. It can also be applied to municipal equipment (e.g. street-sweeping machines). It specifies the characteristics and categories required of SRP/CS for carrying out their safety functions.

This part of ISO 25119 is applicable to the safety-related parts of electrical/electronic/programmable electronic systems (E/E/PES). As these relate to mechatronic systems, it does not specify which safety functions or categories are to be used in a particular case.

It is not applicable to non-E/E/PES systems (e.g. hydraulic, mechanic or pneumatic).

2 Normative references

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

ISO 25119-1:2010, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 1: General principles for design and development*

ISO 25119-2:2010, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 2: concept phase*

ISO 25119-4:2010, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 4: Production, operation, modification and supporting processes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 25119-1 apply.

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
 - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-