IEC 61326-3-1

Edition 1.0 2008-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical equipment for measurement, control and laboratory use – EMC requirements –
Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications

Matériel électrique de mesure, de commande et de laboratoire – Exigences relatives à la CEM –
Partie 3-1: Exigences d'immunité pour les systèmes relatifs à la sécurité et pour les matériels destinés à réaliser des fonctions relatives à la sécurité (sécurité fonctionnelle) – Applications industrielles générales

IEC 61326-3-1:2008

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FOREWORD

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International Standard IEC 61326-3-1 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement and control.

The IEC 61326 series cancels and replaces IEC 61326:2002 and constitutes a technical revision.

IEC 61326-3-1 is to be read in conjunction with IEC 61326-1.

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

FDIS	Report on voting
65A/500/FDIS	65A/505/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 the parts of the IEC 61326 series, under the general title *Electrical equipment for measurement, control and laboratory use – EMC requirements*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site 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- withdrawn,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 2008 have been included in this copy.

INTRODUCTION

Functional safety is that part of the overall safety relating to the equipment under control (EUC) and the EUC control system which depends on the correct functioning of the electrical safety-related systems. To achieve this all items of equipment of the safety-related system which are involved in the performance of the safety functions must behave in a specified manner under all relevant conditions.

The IEC basic safety publication for functional safety of electrical/electronic/programmable electronic safety-related systems is IEC 61508. It sets the overall requirements to achieve functional safety. Sufficient immunity to electromagnetic disturbances is one of those requirements.

The concept of IEC 61508 distinguishes between the consideration of the application and the design of safety-related electrical and electronic systems. The interface between both is the safety requirements specification (SRS). It specifies all relevant requirements of the intended application, as follows.

a) Definition of the safety function, based on a risk assessment of the intended application (which function is intended to reduce risk).

b) Appropriate safety integrity level (SIL) for each safety-function based on a risk assessment of the intended application.

c) Definition of the environment in which the system is intended to work including the electromagnetic environment as required by IEC 61508-2.

Hence, with regard to immunity against electromagnetic phenomena, the essential starting point is that the electromagnetic environment and its phenomena are considered in the SRS, as required by IEC 61508. The safety-related system intended to implement the specified safety function has to fulfil the SRS, and, from it, corresponding immunity requirements have to be derived for the items of equipment, which results in an equipment requirement specification. With respect to the electromagnetic environment, the SRS and the equipment requirement specification should be based on a competent assessment of the foreseeable electromagnetic threats in the real environment over the whole operational life of the equipment. Hence, immunity requirements for the equipment depend on the characteristics of the electromagnetic environment in which the equipment is intended to be used.

The equipment manufacturer, therefore, has to prove that the equipment fulfils the equipment requirement specification and the system integrator must prove that the system fulfils the SRS. Evidence has to be produced by application of appropriate methods. They do not need to consider any other aspects of the application, for example, risk of the application associated to any failure of the safety-related system. The objective is for all equipment in the system to comply with particular performance criteria taking into account functional safety aspects (for example, the performance criterion FS) up to levels specified in the SRS independent of the required safety integrity level (SIL).

There are basically two approaches on how to deal with the electromagnetic environments and to conclude on immunity requirements.

(A) To consider a general electromagnetic environment with no specific restrictions, for example, an industrial environment, and to take into account all the electromagnetic phenomena that can occur as well as their maximum amplitudes when deriving appropriate immunity levels for the system and the equipment. This approach has been used to determine the levels specified within this part of IEC 61326 leading to increased immunity levels for some electromagnetic phenomena compared to immunity levels which are derived without functional safety considerations.

(B) To control the electromagnetic environment, for example, by the application of particular installation and mitigation practices, in such a way that electromagnetic phenomena and their amplitudes could occur only to a certain extent. These phenomena and restricted amplitudes are then taken into account by appropriate

immunity levels. These levels are not necessarily higher than those derived without functional safety considerations because it is ensured by corresponding means that higher amplitudes are not normally expected. This approach is considered in IEC 61326-3-2.

Applying approach (A) with regard to a general industrial environment requires appropriate knowledge of the electromagnetic phenomena and the amplitudes to be expected there. For this purpose and as it is also requested by IEC 61508, electromagnetic environment data of IEC 61000-2-5 are to be used. This IEC publication gives information about electromagnetic phenomena to be expected and describes their amplitudes in terms of compatibility levels. Since they can be considered as disturbance levels at which an acceptable electromagnetic compatibility should exist, these levels are used as the basis for normal immunity requirements as given in non-safety-related standards such as IEC 61326-1, IEC 61326-2-X or the generic standard IEC 61000-6-2. This normal approach applied to achieve electromagnetic compatibility is based on a technical/economical compromise allowing a certain amount of harmful interference cases. This approach, however, is not sufficient in the case of safety-related systems and the equipment used in them. Immunity levels have to be determined which take into account all electromagnetic phenomena and the maximum levels to be expected in the electromagnetic environment under consideration and hence for many electromagnetic phenomena these levels are increased compared to the normal ones.

Following approach (A), IEC 61326-3-1 gives specific electromagnetic immunity requirements that apply to safety-related systems and equipment intended to be used in safety-related systems. These requirements supplement certain requirements of IEC 61326-1, and the selected electromagnetic phenomena and defined immunity test levels are expected to match with the environmental conditions of most industrial applications.

The correlation between the standards IEC 61326-1, IEC 61326-2-X, IEC 61326-3-1 and IEC 61326-3-2 is described in the diagram of Figure 1.

The increased specified test levels in this standard are derived from the highest levels to be expected in the environment of most industrial applications. These increased test levels are related to the electromagnetic environment (that can occur). They cannot be related in an analytical way to the SIL required for the safety-related system because there is no practically provable relationship between test level and probability of failure during use. The influences of electromagnetic phenomena are considered as systematic effects and by their nature often result in common cause events.

Design features of equipment must take into account the required SIL and must be designed to avoid dangerous systematic failures. Sufficient immunity against electromagnetic disturbances can only be ensured by design, mitigation and construction techniques which take into account electromagnetic aspects, which, however, are not within the scope of this standard.

It is therefore recommended that the approach to achieve the capability for the required SIL should be through the adoption of design features on the one hand and through appropriate test performance parameters in order to increase the level of confidence in the test results on the other hand.

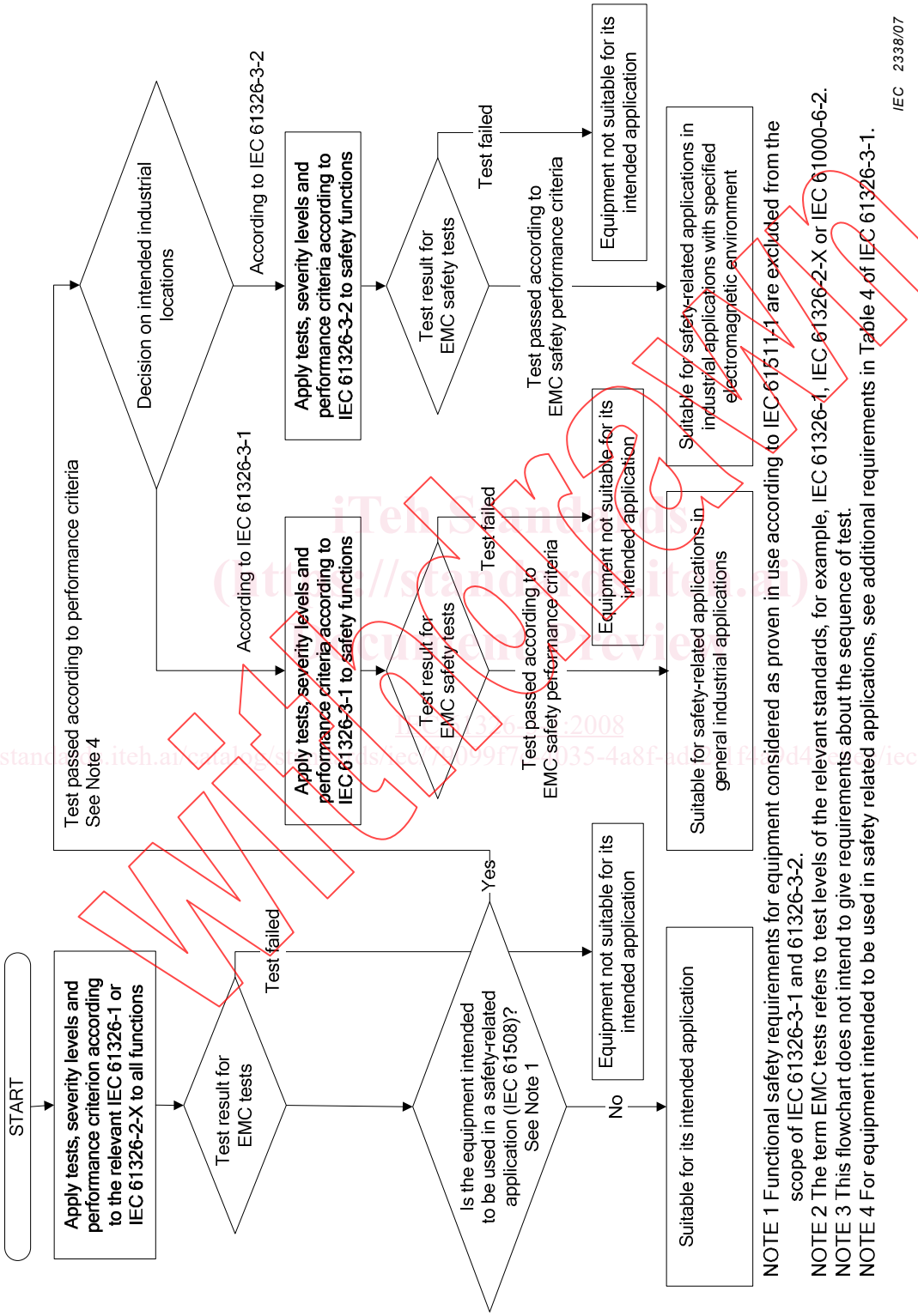

Figure 1 – Correlation between the standards IEC 61326-1, IEC 61326-2-X, IEC 61326-3-1 and IEC 61326-3-2

NOTE 1 Functional safety requirements for equipment considered as proven in use according to IEC 61511-1 are excluded from the scope of IEC 61326-3-1 and 61326-3-2.
NOTE 2 The term EMC tests refers to test levels of the relevant standards, for example, IEC 61326-1, IEC 61326-2-X or IEC 61000-6-2.
NOTE 3 This flowchart does not intend to give requirements about the sequence of test.
NOTE 4 For equipment intended to be used in safety related applications, see additional requirements in Table 4 of IEC 61326-3-1.

ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL AND LABORATORY USE – EMC REQUIREMENTS –

Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications

1 Scope

The scope of IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1. Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Equipment and systems considered as "proven-in-use" according to IEC 61508 or IEC 61511 are excluded from the scope of IEC 61326-3-1.

Fire alarm systems and security alarm systems intended for protection of buildings are excluded from the scope of IEC 61326-3-1.

2 Normative references

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

IEC 60050-161, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

IEC 61000-4-2:2001, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2004, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:1993, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*[1]

Amendment 1 (2000)

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques –Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-16:1998, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*

Amendment 1 (2001)

IEC 61000-4-29:2000, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

IEC 61000-6-2:2005, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61326-1:2005, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61326-2-1:2005, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-1: Particular requirements – Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications*

IEC 61326-2-2:2005, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-2: Particular requirements – Test configurations, operational conditions and performance criteria for portable test, measuring and monitoring equipment used in low-voltage distribution systems*

IEC 61326-2-3:2006, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3: Particular requirements – Test configurations, operational conditions and performance criteria for transducers with integrated or remote signal conditioning*

IEC 61326-2-4:2006, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-4: Particular requirements – Test configurations, operational conditions and performance criteria for insulation monitoring devices according to IEC 61557-8 and for equipment for insulation fault location according to IEC 61557-9*

IEC 61326-2-5:2006, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-5: Particular requirements – Test configurations, operational conditions and performance criteria for field devices with interfaces according to IEC 61784-1, CP 3/2*

IEC 61326-3-2:2008, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-2: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – Industrial applications with specified EM environment*

[1] There exists a consolidated edition 1.1 (2001) that includes edition 1.0 and its amendment.

IEC 61508-2:2000, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61326-1 and IEC 60050-161, as well as the following, apply.

NOTE Other definitions, not included in IEC 60050-161 and in this standard, but nevertheless necessary for the application of the different tests, are given in the EMC basic publications of the IEC 61000 series.

3.1
dangerous failure
failure which has the potential to put the safety-related system in a hazardous or fail-to-function state

NOTE Whether or not the potential is realised may depend on the channel architecture of the system; in systems with multiple channels to improve safety, a dangerous hardware failure is less likely to lead to the overall dangerous or fail-to-function state.

[IEC 61508-4, 3.6.7]

3.2
equipment
the term equipment as used in this document is extremely general and is applied to a wide variety of possible subsystems, apparatus, appliances and other assemblies of products

3.3
equipment under control (EUC)
equipment, machinery, apparatus or plant used for manufacturing, process, transportation, medical or other activities

NOTE The EUC control system is separate and distinct from the EUC.

3.4
functional safety
part of the overall safety relating to the EUC and the EUC control system which depends on the correct functioning of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities

[IEC 61508-4, 3.1.9]

3.5
harm
physical injury or damage to the health of people, or damage to property or the environment

[ISO/IEC Guide 51, 3.3]

3.6
hazard
potential source of **harm**

NOTE The term includes danger to persons arising within a short time scale (for example, fire and explosion) and also those that have a long-term effect on a person's health (for example, release of a toxic substance).

[ISO/IEC Guide 51, 3.5, modified]

3.7
safe failure
failure which does not have the potential to put the safety-related system in a hazardous or fail-to-function state

NOTE Whether or not the potential is realised may depend on the channel architecture of the system; in systems with multiple channels to improve safety, a safe hardware failure is less likely to result in an erroneous shut-down.

[IEC 61508-4, 3.6.8]

3.8
safety function
function to be implemented by an E/E/PE safety-related system, other technology safety-related system or external risk reduction facilities, which is intended to achieve or maintain a safe state for the EUC, in respect of a specific hazardous event (see 3.4.1)

[IEC 61508-4, 3.5.1]

3.9
programmable electronic (PE)
based on computer technology which may be comprised of hardware, software and of input and/or output units

NOTE This term covers microelectronic devices based on one or more central processing units (CPUs) together with associated memories, etc.

EXAMPLE The following are all programmable electronic devices:

– microprocessors;
– micro-controllers;
– programmable controllers;
– application specific integrated circuits (ASICs);
– programmable logic controllers (PLCs);
– other computer-based devices (for example, smart sensors, transmitters, actuators).

[IEC 61508-4, 3.2.5]

3.10
electrical/electronic/programmable electronic (E/E/PE)
based on electrical (E) and/or electronic (E) and/or programmable electronic (PE) technology

NOTE The term is intended to cover any and all devices or systems operating on electrical principles.

EXAMPLE: Electrical/electronic/programmable electronic devices include

– electro-mechanical devices (electrical);
– solid-state non-programmable electronic devices (electronic);
– electronic devices based on computer technology (programmable electronic); see 3.2.5 (of IEC 61326-1).

[IEC 61508-4, 3.2.6]

3.11
d.c. distribution network
local d.c. electricity supply network in the infrastructure of a certain site or building intended for connection of any type of equipment

NOTE Connection to a local or remote battery is not regarded as a d.c. distribution network if such a link comprises only the power supply for a single piece of equipment.

3.12
system (in the context of this document)
combination of apparatus and/or active components constituting a single functional unit and intended to be installed and operated to perform (a) specific task(s)