International Electrotechnical Commission

Electromagnetic compatibility

The role and contribution of IEC standards

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GLOSSARY

The following abbreviations and acronyms appear in Part 1 of this brochure. A separate glossary is included with the tables in Part 2.

AC	Alternating current
ACEC	Advisory Committee on Electromagnetic Compatibility (IEC)
ANSI	American National Standards Institute
APEC	Asia-Pacific Economic Cooperation
BSI	British Standards Institution
CENELEC	European Committee for Electrotechnical Standardization
CIGRE	International Conference on Large High-voltage Electric Systems
CISPR	International Special Committee on Radio Interference
DC	Direct current
ECMA	European Computer Manufacturers' Association
EFTA	European Free Trade Association
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
EU	European Union
FCC	Federal Communications Commission (US)
HEMP	High-altitude nuclear electromagnetic pulse
HV	High voltage
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEC	International Electrotechnical Commission
IRPA	International Radiation Protection Association
ISO	International Organization for Standardization
ISM	Industrial, scientific and medical
ITE	Information technology equipment
ITU	International Telecommunication Union
LV	Low voltage
MERCOSUR	Southern Common Market
MV	Medium voltage
NAFTA	North American Free Trade Association
OIML	International Organization of Legal Metrology
SEV	Association of Swiss Electrical Engineers
TC	Technical Committee
UNIPEDE	International Union of Producers and Distributors of Electric Energy
VDE	Association of German Electrical Engineers
WG	Working Group
WHO	World Health Organization
WTO	World Trade Organization

EMC concerns all of us*

The development of electromagnetic compatibility (EMC) is closely linked with that of the whole field of electrical and electronic engineering.

Miniaturized structures as well as increasing complexity, integration and interconnection all make electronic installations and components more vulnerable. The higher currents, voltages and power levels of power installations increase the potential for disturbance, and the integration and interpenetration of the components of the power and information sectors bring the sources of disturbance and the equipment that is sensitive to it even closer together.

Generally speaking, the aim of EMC is to ensure the reliability and safety of all types of equipment and systems wherever they are used. Thus, EMC concerns all of us. Consider, for example, the omnipresent electronic elements in pacemakers, ABS braking systems, aircraft and air traffic control.

Achieving EMC requires us to deal with two different aspects: electrical aspects with respect to power systems, and electronic aspects where control or communication systems are concerned.

This issue is not just academic. For example, the entire functioning of numerous industrial plants and the electricity supply of whole regions depend on information technology systems, so the reliability of electronic systems is also an economic factor of primary importance.

This explains why standards and requirements relating to EMC, worldwide or harmonized at regional level, are welcomed by manufacturers and users of electrical and electronic equipment, whereas other standards are sometimes seen as hindering the operation of the enterprise.

EMC standards are a prerequisite to ensuring that numerous items of electronic equipment do not put each other out of action or, still worse, give rise to malfunctioning of the equipment. They lay down requirements for equipment as regards both the maximum permissible emission of parasitic radiated and conducted electromagnetic disturbances as well as the availability of the equipment under the influence of these disturbances.

Standards are only one aspect of the problems associated with EMC. They lay down the performance requirements to be met by the products but leave it to the manufacturers to achieve them. The requirements of the standards can only be met, however, if the necessary technical know-how and solutions adapted to EMC are available.

Purpose of this publication

The main task of the IEC is to prepare standards for industry in the widest sense. This brochure serves different purposes:

– to explain the targets of IEC with regard to EMC standardization;
– to describe how this work is organized;
– to provide an overview on the existing standards and projects under consideration;
– to show that EMC standardization may be horizontal, product-oriented or a combination of both.

* Hans Teichmann, IEC Central Office.

Who can benefit from this publication?

Interest in this publication will not be limited to a single group and, in preparing it, IEC has kept several target audiences in mind. The more important ones are:

a) Standardizers within IEC

Many IEC experts are concerned with EMC. They already are, or may soon become, involved in the development of EMC standards. CISPR[1)] and TC 77[2)] have already prepared, and continue to prepare, a large number of Basic EMC standards for general application.

On the other hand, to many "product" committees the EMC issue may look somewhat exotic. They are nevertheless expected to deal with EMC problems insofar as their products are concerned. Their experts therefore have to understand the relationship between Basic, Generic and Product/Product Family standards. They also must learn which elements make up a typical EMC Product standard.

b) Other international organizations

Other international organizations with an interest in EMC usually deal with a large variety of technical problems, of which EMC is one.

Examples: ISO (International Organization for Standardization)
ITU (International Telecommunication Union)

These organizations need to be informed about the EMC activities in IEC. They should also refer to IEC standards, particularly the Basic ones, in their own reports and standards, and may in turn provide inputs to IEC work.

c) Regional organizations

These organizations also generally deal with a wide variety of problems, EMC being one.

Examples: APEC (Asia-Pacific Economic Cooperation)
CENELEC (European Committee for Electrotechnical Standardization)

Such organizations also need to be informed about the EMC activities in IEC. Information on IEC's co-operation with CENELEC is given in Chapter 1, "The approach of IEC in international standardization on EMC". Certainly, it would be very advantageous for all parties involved to have identical (worldwide) Basic EMC standards; inputs should be forwarded to IEC where appropriate.

d) International professional organizations

Example: ECMA (European Computer Manufacturers' Association)

These organizations may be interested in Basic EMC publications of the IEC (for the development of their own specific application-oriented publications) or in EMC Product standards (for direct application). The same recommendations apply as for other international and regional organizations.

e) National organizations

Examples: BSI (British Standards Institution)
ANSI (American National Standards Institute)

f) Users from industry

Those users from industry who are not involved in standardization must be puzzled about the large number of EMC publications from different committees. This brochure therefore explains the different types of document, and several tables provide comprehensive information on the IEC's existing EMC publications as well as ongoing work.

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1) International Special Committee on Radio Interference.

2) IEC Technical Committee 77 (Electromagnetic Compatibility).

g) Test laboratories

It almost goes without saying that different test laboratories all over the world require common references. International EMC standards provide the basis for meaningful certification.

The borderline between these target audiences is often blurred. For instance, an expert can very well be a “standardizer within IEC” and be active in one or more of the following ways:

– participate in ISO work;
– be an expert in a regional organization;
– be a staff member in a professional organization (international or national);
– work in industry;
– be responsible for testing in a laboratory.

Sources and presentation

Attention is drawn to the regulations already published in its *Guide 107: Guide to the drafting of electromagnetic compatibility publications*. The examples and explanations in the present brochure amplify and complement this guide.

This publication is based on six papers previously presented at EMC seminars by Messrs. Georges Goldberg, Past Chairman of the IEC Advisory Committee on Electromagnetic Compatibility (ACEC), or Hans Teichmann from IEC Central Office. The contents of the original papers have been revised and coordinated.

The publication is split up for practical reasons into two parts.

– **Part 1** contains chapters on the approach of IEC in international EMC standardization, Basic EMC publications, Generic EMC standards, EMC Product standards (including their layout) and a look at some trends. It is expected that this information will remain valid for several years.
– **Part 2** contains tables on EMC Basic publications, Generic standards and Product standards. As a result of ongoing work, all these tables are subject to change (existing publications may be amended or withdrawn and new projects will be added as existing projects move towards publication). In order for these tables to remain useful, it is intended that they be regularly updated.

Further information

Readers seeking further information on any of the topics considered in this publication are invited to contact the IEC Central Office direct (details on back cover) or to visit the IEC World Wide Web site:

http://www.iec.ch

CHAPTER 1

The approach of IEC in international standardization on EMC*

This chapter first describes the approach to and the organization of work on EMC (electromagnetic compatibility) within IEC, as well as the relationship of IEC with other organizations. It then explains the general structure of this work:

– the different kinds of EMC publications;
– the different kinds of electromagnetic disturbances;
– the different product categories;
– the application of IEC's EMC publications.

The different kinds of publication are described in detail in the chapters that follow.

1.1 The IEC's approach to EMC standardization

IEC in principle prepares two categories of EMC publications:

1. background reference publications dedicated to general matters applicable to all products (description of the environment, measurement techniques, testing techniques and the like);
2. standards for application to products: generic or specific product standards.

For the first category, the IEC approach is to prepare a comprehensive set of basic publications covering all aspects of the problem. Some of these publications are more important than others but this "preventive" approach is intended to make the necessary documents available to all interested parties if and when they need them. It contrasts with a "palliative" approach that would consist of developing standards, particularly emission limiting or immunity testing standards, once the urgent need arose. Development of these Basic EMC standards is in principle carried out by committees with horizontal functions, i.e. Technical Committee 77 (TC 77) and CISPR.

The development of specific EMC Product standards is allocated to the relevant "product committees" since it is they that know best the functional requirements for and operating conditions of their components, subsystems and systems. It must be pointed out that they do not have to apply the whole series of Basic standards but that they are responsible for making the appropriate choice according to the prevailing conditions and economic/technical constraints.

1.2 The International Electrotechnical Commission (IEC)

1.2.1 The IEC mission

The mission of the IEC is to promote and coordinate international standardization and related matters, such as the assessment of conformity to standards, in the fields of electricity, electronics and related technologies. It deals with these questions in a general way and leaves certain specific fields such as telecommunications and motor vehicles to specialized organizations.

The IEC was founded in 1906 and its present membership comprises the national electrotechnical committees of more than 50 countries, including all industrialized and a growing number of industrializing countries.

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* G. Goldberg, Past Chairman of the IEC Advisory Committee on Electromagnetic Compatibility (ACEC).

For its technical work, the IEC comprises some 200 committees and subcommittees, of which about 50 are concerned with EMC to varying degrees. These committees and subcommittees present the results of their work in the form of standards or technical reports.

1.2.2 Organization of the work

The first work in the EMC field can be traced back to when the International Special Committee on Radio Interference (CISPR, an organization that is now part of IEC) was established in 1934. Today, EMC work is organized as follows (see Figure 1):

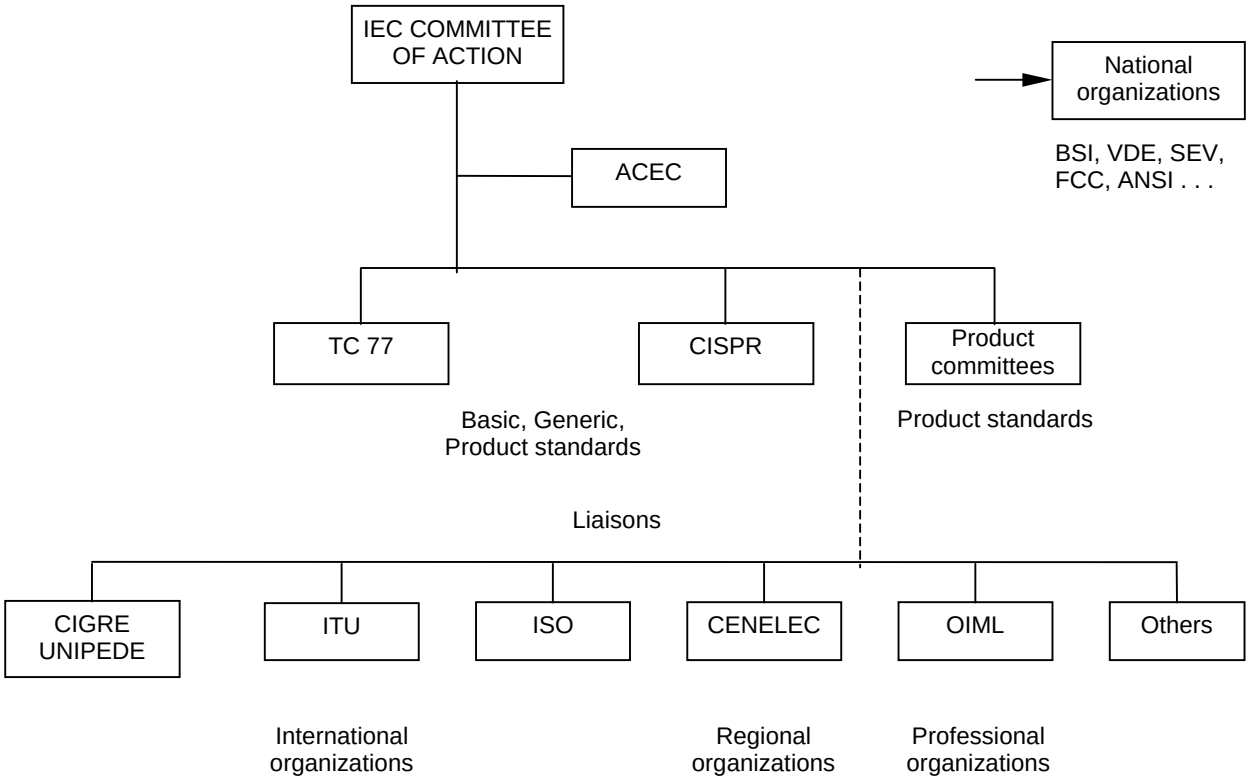

Figure 1: Organization of EMC work in IEC

TC 77, created in 1973, is a committee with horizontal functions and is responsible – together with other committees to some extent – for Basic EMC standards having general application and for Generic EMC standards (see definitions, clause 1.5).

CISPR, established in 1934, is also a committee with horizontal functions and is responsible primarily for the protection from interference of radio and television broadcasting, but it has extended its field of activity to EMC Product standards, e.g. for household equipment and information technology equipment (ITE).

Numerous **product committees** have the task of developing standards specific to their products.

The **Advisory Committee on Electromagnetic Compatibility (ACEC)** was established to ensure coordination between all these special committees and with the outside world, as well as to provide advice to the product committees.

In most IEC member countries, bodies corresponding to TC 77, CISPR or the product committees take care of EMC matters at the national level.

1.3 Other organizations for EMC standardization

EMC-related international standardization work is not limited to IEC. Indeed, numerous other organizations take part. Some of the main ones are:

– ISO (International Organization for Standardization);
– CIGRE (International Conference on Large High Voltage Electric Systems);
– UNIPEDE (International Union of Producers and Distributors of Electrical Energy);
– ITU (International Telecommunication Union);
– OIML (International Organization for Legal Metrology).

These organizations develop standards that are specific to their fields of interest but which, insofar as they concern EMC, may also serve as a basis for IEC standardization documents.

EMC work is also carried out in regional organizations like CENELEC, the European Committee for Electrotechnical Standardization.

1.4 Co-operation agreements (e.g. with CENELEC)

IEC can conclude co-operation agreements with other organizations. One important such agreement is that with CENELEC, the regional electrotechnical standards harmonization body of the European Union. Concluded in 1991 to avoid duplication of work, to speed up the production of documents and to ensure as far as possible the consistency of international and European standards, this agreement sets a good example for efficient coordination of work, particularly in the EMC field.

At present, the main task of CENELEC as regards EMC is preparation of the standards necessary to implement the EMC Directive of the European Union. It has established an organization that is somewhat simpler than that of the IEC.

CENELEC Technical Committee 210, previously TC 110, is responsible for basic and generic standards (in this respect it corresponds to IEC TC 77 and CISPR) and for supervision of the product standards. There are a number of product committees in parallel with some, but not all, IEC committees.

According to the 1991 agreement, the IEC is in principle primarily responsible for the development of standards. When CENELEC sees the need for a particular standard, for example in the EMC field, it asks the IEC to develop it. Only if the IEC is not in a position to meet the requirements of CENELEC – for instance if the deadline is too short – will CENELEC carry out the work itself. IEC international standards are offered to CENELEC for parallel voting and may be adopted and published as European standards (EN), with some amendments if appropriate. The agreement also applies in the other direction. Thus the IEC may adopt standards prepared in CENELEC, with amendments again being possible.

Generally, from the technical point of view, IEC and CENELEC standards are equivalent or closely similar.

1.5 Different kinds of EMC standards

Recent developments have led to distinguishing three kinds of EMC-related publications: Basic EMC standards and technical reports, Generic EMC standards and EMC Product/Product Family standards.

1.5.1 Basic EMC publications (*see Chapter 2*)

These documents specify the general conditions or rules necessary for achieving electromagnetic compatibility applicable to all products and to which the product committees may refer. Basic publications are, by definition, independent of any specific product and are applicable to all products. They may be standards or technical reports.

The subjects dealt with by Basic EMC publications are reflected in the structure of the IEC 61000 series (formerly IEC 1000) developed by TC 77. Essentially, they concern:

– general subjects like terminology and safety;
– descriptions of the electromagnetic environment: phenomena and levels;
– recommendations for the limitation of emission of electromagnetic disturbances;
– guidance values for immunity tests;
– measurement techniques;
– testing techniques;
– installation guidelines;
– mitigation methods.

Basic EMC publications are mostly produced by two committees with horizontal functions, TC 77 and CISPR. Other TCs may also occasionally produce Basic documents.

1.5.2 Generic EMC standards (see Chapter 3)

In the case of EMC, generic standards are “simplified” product standards relating to a given environment and are applicable to all equipment installed in this environment when there is no EMC standard specific to the equipment.

Two sets of standards, each comprising two publications, have been developed. The first set is for residential, commercial and light industry environments, the second set for industrial environments. Each includes an emission and an immunity standard.

They specify only a limited number of requirements and tests so as to ensure an optimum balance between technological and economic considerations.

1.5.3 EMC standards for products or product families (see Chapter 4)

EMC Product standards specify the requirements and tests specific to the products considered. A Product Family standard relates to a group of similar products to which the same rules may be applied.

These standards must:

– apply only the Basic standards (apart from fully justified exceptions);
– be coordinated as far as possible with the Generic standards relating to the environment in which the products are installed;
– keep to the emission limits specified by TC 77 or CISPR in the “horizontal“ emission standards. The reason is that the share of individual sources of disturbance must be coordinated such that none assumes too great an importance with respect to the others. A product committee has no freedom in this regard; in the case of special conditions, it must consult the relevant horizontal committee.

The requirements and tests relating to immunity should in principle be specified by the product committees, in the light of their knowledge of the products and the environment in which they are used.

Generic EMC standards have been designed for cases where specific product standards do not yet exist. It should be noted however that a product committee may decide that a generic standard can meet the needs of the product and that a specific product standard is therefore unnecessary.

1.6 The different kinds of electromagnetic disturbances

To allow a systematic approach, IEC TC 77 has established a classification of electromagnetic phenomena, listed in detail in Table 1 on the facing page. This list has also been adopted by CENELEC TC 210.

Conducted low-frequency phenomena Harmonics, interharmonics Signalling systems Voltage fluctuations Voltage dips and interruptions Voltage unbalance Power frequency variations Induced low-frequency voltages DC in AC networks
Radiated low-frequency field phenomena Magnetic fields • continuous • transient Electric fields
Conducted high-frequency phenomena Directly coupled or induced voltages or currents • continuous wave • modulated waves Unidirectional transients[1)] Oscillatory transients[1)]
Radiated high-frequency field phenomena Magnetic fields Electric fields Electromagnetic fields • continuous waves • modulated waves • transients
Electrostatic discharge phenomena (ESD)
High-altitude nuclear electromagnetic pulse (HEMP)

[1)] single or repetitive (bursts)

Table 1: Overview of the principal electromagnetic disturbance phenomena

A number of points should be noted.

– the term EMC is no longer restricted to the high-frequency region but applies to the whole spectrum of phenomena from 0 Hz to the GHz range;
– for practical reasons (different characteristics of the phenomena, experience of the respective experts and TCs) it has been considered appropriate to divide the spectrum into low-frequency and high-frequency phenomena. The borderline has been set in principle at 9 kHz (according to the scope of CISPR);
– the disturbances with which CISPR is concerned are included in the conducted or radiated high-frequency phenomena;
– the programme of work of TC 77 also includes the electromagnetic effects of high-altitude nuclear explosions (HEMP) but this subject is not in the programme of work of other organizations, e.g. CENELEC TC 210.

1.7 The different product categories

For practical reasons, it has been found convenient to distinguish four product categories: components, apparatus, systems and installations, according to their range of application and their certification conditions in the market. They also correspond in a general manner to the application of the European EMC Directive.

Component

An electrical or electronic unit which does not itself have a final function but which is intended for incorporation in an apparatus.

Examples: passive components: resistors, capacitors, integrated circuits;
active components: certain types of motor, power supply units.

EMC Product standards may be developed for some types of component, particularly active ones. They can serve for certification purposes.

Apparatus

A single finished product with (a) direct function(s) intended for final use.

Examples: domestic appliances, medical equipment, tools, circuit-breakers, certain motor types.

In principle, EMC Product standards have to be developed for all these kinds of product. They can serve for certification purposes.

System

In the EMC context, a combination of apparatus and/or (active) components constituting a single functional unit and intended to be installed and operated to perform a specific task.

Example: a computer system consisting of a CPU, keyboard, printer, monitor, etc.

For the purposes of EMC standardization there are two options:

– either an EMC standard may be developed as mentioned above for each component or apparatus, particularly with regard to "intrasystem" compatibility;

– or an overall EMC standard may be considered for the whole system, particularly with regard to "external" compatibility. This second standard can serve for certification purposes.

Installation

In the EMC context, a combination of apparatus, components and systems assembled and/or erected (individually) in a given area. For physical reasons (e.g. long distances between individual items) it is in many cases not possible to test the installation as a unit.

Examples: industrial plants, electricity substations, telecontrol systems for large areas.

For EMC standardization purposes, requirements may in some cases be specified for the whole installation. This may happen in particular for emission limitations (e.g. harmonics, radio-frequency disturbances) but it necessitates *in situ* measurements.

In other cases, EMC requirements must be specified for each item, in particular for immunity. The supplier of each unit must then indicate the installation conditions for his products (wiring, earthing) that ensure correct functioning of the whole installation.

It is evidently difficult and sometimes even impossible to carry out emission or immunity tests on a set of units dispersed over a wide area. It is also necessary to take account of the fact that the tests may be influenced by environmental conditions and may not be appropriate for certification purposes.

1.8 Legal or contractual status of EMC standards

This question is of importance both in view of the certification of compliance with EMC requirements and in the event of a dispute.

IEC standards are in principle only recommendations representing the state of the art and in this sense may serve as reference. They may acquire a legal status, however, if they are introduced into the legislation of a country by law or decree (this is often the case with CISPR standards for the protection of radiocommunications). They also may have a contractual role in commercial documents.

Note:

In certain cases, EMC standards may have a more binding character, e.g. in CENELEC where they are published as European standards (EN) and are the basis for "the harmonization of standardization" in all EU member countries. They must be transferred into the framework of national standards, where they replace all other standards on the same subject. They then assume the status of either a recommendation or a law. CENELEC standards also may have a contractual role in commercial documents.

For implementation of the European EMC Directive, only the harmonized Generic or EMC Product standards notified in the Official Journal of the European Union are to be referred to.

1.9 EMC standardization with regard to human safety

The effect of electromagnetic fields on people – or living beings in general – is the subject of a considerable number of studies in scientific and medical institutes and in relevant national or international organizations (e.g. WHO, IRPA/ICNIRP, CIGRE and ITU). The main matters for concern are the possible effects on physiological and mental functions. Apart from the basic biological investigations, there are two kinds of problem that could be considered in the IEC context: the setting of exposure limits and the standardization of measurement methods.

The IEC has decided not to deal with the setting of limits but to rely on the above-mentioned specialized organizations. It has, however, initiated work on the standardization of measurement methods, which should allow a fair comparison of the results obtained by the various organizations concerned.

1.10 The status of EMC standards development in IEC

The tables in Part 2 of this brochure give comprehensive lists of the Basic, Generic and EMC Product standards either already published or in preparation. As the situation is continuously evolving, they will be updated from time to time by IEC Central Office.

Basic EMC publications

Almost all the high-priority basic publications in IEC have now been or will soon be published. Some less urgent ones are also nearly complete. The next step will be to update some documents in order to take into account technical progress and experience gained since their publication.

To simplify the work world wide, it would clearly be advantageous if at least the basic standards for measuring and testing were adopted by the other international, regional or professional organizations, with only small amendments if these were unavoidable.

Generic EMC standards

These were first developed by CENELEC TC 210. The emission standards have been taken over by CISPR for application in IEC and the immunity standards will be aligned in IEC and CENELEC. The final aim is to have the same Generic EMC standards world wide and regionally (e.g. in CENELEC), all under the IEC's responsibility.

EMC Product standards

Numerous product committees have already developed or are in the process of developing their specific EMC Product standards, but this task may still require a long time. High-priority EMC Product Family standards, e.g. for ITE and medical equipment, have already been published or are well advanced.

It should be noted, however, that quite a large number of EMC Product standards are developed by other organizations like ISO, ITU and CENELEC.

CHAPTER 2

Basic EMC publications[1]*

Following the definition of the term "Basic EMC publications", the committees responsible for their development are introduced. The structure of IEC Publication 61000, Electromagnetic compatibility, is then presented. Part 2 of this brochure includes six tables relating to Basic EMC publications (either printed or under consideration). Their titles are listed and the underlying philosophy is commented on.

2.1 General

Basic EMC publications give the general and fundamental conditions or rules for the achievement of EMC, which are related or applicable to all (or for many) product families, products, systems or installations, and serve as reference documents for the product committees (IEC Guide 107).

Basic EMC publications may concern in particular (but not exclusively):

– terminology;
– descriptions of the electromagnetic phenomena;
– descriptions and classification of the environment;
– specification of compatibility levels;
– general requirements for the limitation of emission of disturbances;
– recommendations for severity test levels with regard to the immunity of the equipment;
– measurement techniques, test techniques and their applicability;
– installation and mitigation guidelines.

Basic EMC publications

– may be standards or technical reports;
– are by definition not dedicated to specific product families, products, systems or installations. They are, on the contrary, intended for general application.

Basic EMC standards will not include prescribed emission limits and related performance, which should be covered by Generic, Product Family or Product standards.

However, certain emission standards developed for large product families in fact assume the role of Basic emission standards (some of the 61000-3 series and some CISPR standards, see Part 2, Table I.3).

2.2 Committees responsible for the development of Basic EMC publications

Most of the existing Basic EMC publications were prepared by IEC/TC 77: Electromagnetic compatibility. These publications are parts of the IEC 61000 series on EMC, the structure of which is given below.

CISPR/A and some other committees are also active in the field of Basic EMC publications. Product Family standards with a wide application are prepared by TC 77, CISPR/A through G, and some other committees. They deal mainly with emission limits and measurement techniques.

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1) In this context, publications and projects which are not formally designated "Basic EMC publications" but which have a similar function are also considered.

* Hans Teichmann, IEC Central Office.

2.3 Structure of IEC 61000

This large and considerably subdivided series of standards and technical reports will eventually consist of nine parts. Since the titles of Parts 7 and 8 are still open, the present structure is as follows:

Part 1: General
General considerations (introduction, fundamental principles, safety)
Definitions, terminology

Part 2: Environment
Description of the environment
Classification of the environment
Compatibility levels

Part 3: Limits
Emission limits
Immunity limits (insofar as they do not fall under the responsibility of product committees)

Part 4: Testing and measurement techniques
Measurement techniques
Testing techniques

Part 5: Installation and mitigation guidelines
Installation guidelines
Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

2.4 Tables of Basic EMC publications

See Part 2, Tables I.1 through I.6. These tables will be updated from time to time and have therefore been separated from Part 1.

In these tables, Basic (and equivalent) EMC publications are grouped according to the relevant disturbance phenomena as listed in Chapter 1, "The Approach of IEC in International Standardization on EMC".

Table I.1: General
Table I.2: Environment – Compatibility levels
Table I.3: Emission
Table I.4: Measurement techniques – Emission
Table I.5: Testing techniques – Immunity tests
Table I.6: Installation and mitigation guidelines

2.5 Some comments

2.5.1 Environment

The EM environment is defined as “the totality of EM phenomena existing at a given location.” To provide optimum EMC specifications, knowledge is required of the EM environment (emissions) and well defined EMC test and measurement standards (they are all Basic standards). The intended protection of the EM environment (emissions) and the intended quality (immunity) of the equipment, including cost aspects, are boundary conditions when seeking optimum solutions. A key quantity in EMC planning is the compatibility level, defined as “the specified electromagnetic disturbance level used as a reference level for coordination in the setting of emission and immunity limits. By convention, the compatibility level is chosen so that there is only a small probability that it will be exceeded by the actual disturbance level.”

The probability distribution depends entirely on the method used for evaluating the levels (samples of time, location and intervals, etc.). Frequently, the 95% probability level is defined as compatibility level.

The environmental parameters are of a statistical nature. In many cases only a rough approximation can be given. Fortunately, practical experience of using the equipment has given fair guidelines for reasonable immunity specifications.

2.5.2 Emission publications

As already mentioned, the standards available for specifying emission limits are EMC Product standards because they refer to specific products or conditions. Those that are referenced by Generic standards and other Product standards are marked by “Ref” in the Note column of Table I.3: Emission.

Immunity test levels are specified in Generic or Product standards as they mainly refer to equipment quality.

2.5.3 Testing and measurement

The expressions “testing” and “measurement” are sometimes used indiscriminately. However, testing refers more often to immunity (usually a go/no-go test) and measurement is likely to refer to emission (normally the emission level is measured and recorded as a function of the frequency). Table I.4: Measurement techniques – Emission, and Table I.5: Testing techniques – Immunity tests, reflect this concept. The immunity test table is the interesting one for product committees, since it is they who are responsible for specifying the immunity of their products. For emission, Tables I.3 and I.4 are relevant.

2.5.4 Installation guidelines

These publications are also needed to achieve optimum EMC requirements and performance, but even greater coordination with the publications of TC 64 (Electrical installations of buildings), TC 81 (Lightning protection) and other committees would be appropriate.

CHAPTER 3

Generic EMC standards*

Generic EMC standards are general and somewhat simplified EMC Product standards applicable to products for which no specific EMC standards yet exist. They serve as general reference for product standards. This chapter explains the concept, different types, content and application of Generic EMC standards. For general information, tables are appended showing typical EM levels and the immunity test levels or emission limits specified by the Generic standards.

3.1 Concept and definition of Generic EMC standards

A final aim would be for each family of products or each specific product to have a dedicated EMC Product standard (or EMC clauses in a general product standard). This clearly is a long-term and difficult task where optimum technical and economic requirements may conflict.

The idea of using Generic EMC standards as general EMC Product standards first arose as a means to avoid having to wait for EMC Product standards to be developed for each specific case. In the future, as explained in clause 3.4 below, Generic EMC standards may even have a permanent status in their own right.

According to the definition in IEC Guide 107: Guide to the drafting of EMC Publications, “Generic EMC standards apply to products operating in a particular environment for which no dedicated product standard exists. They specify a set of essential requirements, test procedures and generalized performance criteria applicable to such products or systems operating in this environment.” The following rules apply:

a) Generic EMC standards do not include detailed measurement and test methods, etc., but refer for that purpose to the Basic EMC standards.
b) They concern requirements and tests relating to emission and immunity, possibly in separate documents.
c) They specify a limited number of essential emission and immunity tests, as well as minimum test levels, in order to ensure adequate compatibility while achieving a technical/economic optimum.
d) They should be identified on the front page by the indication “GENERIC EMC Standard”.

3.2 Types of Generic EMC standard

Generic EMC standards were first developed in CENELEC TC 210 (previously TC 110) in order to implement the EMC Directive of the European Union. In view of the advantages they offer to product committees for the preparation of their EMC Product standards – providing technical background and reducing pressure on development time – IEC's ACEC considered that it would be useful also to have Generic EMC standards in IEC.

Because of the general nature of these publications, their preparation in IEC has been allocated to committees with horizontal functions, namely CISPR S/WG 1 for emission standards and TC 77/WG 13 for immunity standards.

It has been found appropriate to develop only two sets of Generic EMC standards, each set for two types of environment:

– Residential, Commercial, Light industry environments;
– Industrial environments.

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* G. Goldberg, Past Chairman of the IEC Advisory Committee on Electromagnetic Compatibility (ACEC).

Each set includes an emission standard and an immunity standard. Table II in Part 2 shows the references of the four Generic EMC standards in IEC.

It is also considered appropriate to have the same Generic EMC standards on a world-wide basis, if necessary with some common modifications in a given region (Europe for example).

With regard to emission standards, CISPR has decided to adopt the two CENELEC documents in IEC, at least for the time being. As a result of future experience, it may either amend these standards or develop new ones.

As far as immunity is concerned, TC 77 also has referred to CENELEC standards but has adapted them for world-wide application (e.g. 50 Hz and 60 Hz).

In future, it should be the IEC that deals with Generic EMC standards and any amendments should be subject to parallel voting.

3.3 Content of Generic EMC standards

The requirements of the standards refer to Figure 1: Examples of ports.

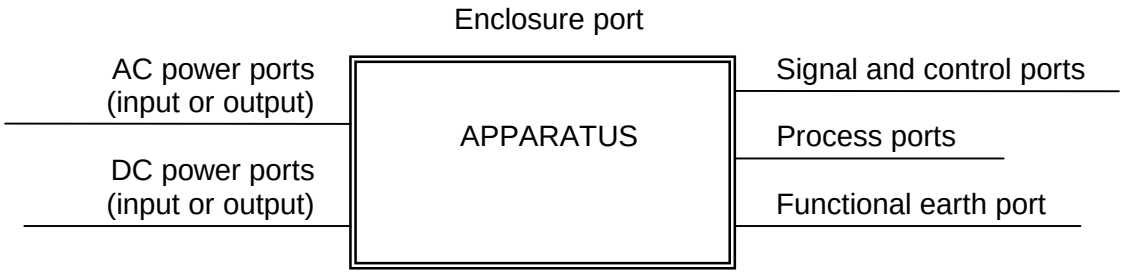

Figure 1: Examples of ports

For each kind of port the standards show a table with:

a) the disturbances to consider;
b) the relevant Basic standards;
c) the prescribed emission limits or immunity test levels;
d) the performance criteria;
e) application notes, if necessary.

As stated earlier and in line with the purpose of Generic EMC standards, the disturbances to consider are limited to the most essential ones. They include (or may include)

with regard to emission limits:

– harmonics of the supply voltage	
– fluctuations of the supply voltage	
– conducted radio-frequency voltages	0,15 to 30 MHz
– radiated radio-frequency fields	30 to 1000 MHz

with regard to immunity tests:

– harmonics of the supply voltage	
– voltage fluctuations, dips, interruptions	
– magnetic fields at power frequency	
– conducted radio-frequency voltages	0,15 to 80 MHz
– radiated radio-frequency fields	26 to 1000 MHz (in CENELEC only above 80 MHz)
– radio fields from mobile telephones	around 900 MHz
– voltage surges	
– fast transient voltages	
– electrostatic discharges	

With regard to immunity, the performance criteria are essential: according to the importance of the phenomenon and the relevant port, three criteria have been defined.

Performance criterion A: the apparatus shall continue to operate as intended during and after the test.

B: the apparatus shall continue to operate as intended after the test. During the test, a certain degradation of performance is allowed, as specified by the manufacturer.

C: temporary loss of function is allowed during and after the test, provided the function is self-recoverable or can be restored by operating the controls.

3.4 Application of Generic EMC standards

3.4.1 Purpose

As already stated in the introduction, the initial purpose of Generic EMC standards was to provide provisional, easy-to-apply EMC Product standards applicable to products for which no specific EMC standard yet existed. In fact, in the course of time the importance of these generic publications has increased in two directions:

– they can serve as a background reference for specific product standards (reference for the disturbances and, in particular, the relevant emission limits or immunity test levels);
– for certain products, the relevant committees can declare these standards as sufficient and directly applicable to their products.

3.4.2 Definitions of the environment

The definitions of the environments, “Residential, Commercial, Light industry” and “Industrial”, are not very clear and have been explained by examples of locations (the following lists give some such examples and are not exhaustive).

Residential, Commercial and Light industry environments

– Residential properties, e.g. houses and apartments
– Retail outlets, e.g. shops and supermarkets
– Business premises, e.g. offices and banks
– Areas of public entertainment, e.g. cinemas and bars
– Outdoor locations, e.g. petrol stations, car parks, amusement and sports centres
– Light industrial locations, e.g. workshops and laboratories

Industrial environments

– Locations with industrial, scientific and medical (ISM) apparatus
– Heavy inductive or capacitive loads that are frequently switched
– High currents and associated magnetic fields

The equipment manufacturer has to declare for which environment his product is intended.

3.5 Final remarks

Generic EMC standards are an important intermediate step in the development of specific EMC Product standards. Until the completion of such specific standards, Generic EMC standards may be used for certification purposes.

Part 2 includes Table II: Generic EMC standards.

ANNEX

Generic EMC standards – requirements and tests

In order to provide general information on the range of magnitude of the requirements or test values that may need to be considered in EMC Product standards, the requirements and test values of the Generic standards are summarized in Tables 1 and 2. It should be kept in mind that Generic EMC standards are simplified Product standards for general application where no specific EMC Product standard exists, and that they therefore specify only essential requirements. They can serve as reference for product committees but the latter may consider further phenomena or other (higher or lower) immunity test levels where appropriate. The emission levels specified by TC 77 and CISPR must not be exceeded.

Table 1 refers to immunity testing:

The left columns show the disturbance phenomena that are taken into consideration, the corresponding Basic EMC standards and the ports to which the tests apply.

The right columns relate to the two typical environments addressed in the Generic EMC standards: residential, commercial, light industry environments; and industrial environments.

For each of these environment classes, they show:

– "typical" environment levels for information, but **not** maximum levels, as indicated in the environment publications (61000-2-x) or the immunity test standards (61000-4-y);
– the test values as specified in the Generic standards.

Table 2 refers to emission limits:

Again, the left columns show which disturbance phenomena are taken into consideration.

The right columns show the specified emission limits for the two typical environments and the relevant Basic EMC standards.

The tables are structured differently from the Generic standards, namely according to the types of disturbance and the corresponding test standards rather than according to the ports. They allow comparison both of the test levels and of the immunity performance criteria in each of the two environments. They show those phenomena that in principle are considered essential.

Table 1: Typical EM disturbance levels – Immunity test levels in EMC immunity Generic standards

This table is given **for information purposes only**. With regard to the test levels and testing conditions, users are referred to the latest versions of the Generic standards.

Status as of 1997-09-30

			Residential, commercial, light industrial environments			Industrial environments			Remarks
Basic standard	Phenomena and ports	Units	Typical disturbance levels	Test levels Generic standard 61000-6-1	Performance criteria	Typical disturbance levels	Test levels Generic standard 61000-6-2*	Performance criteria	* still in development 77/.../FDIS
IEC 61000-4-13	Harmonics: Thd	% U_n	8	no test	-	10	no test		
	5th	% U_n	6	no test	-	8	no test		
IEC 61000-4-11	A.C. voltage dips	Δ% U_n	10 to 95	30 | 60	B/C	10 to 95	30 | 60	B/C	
		per.	0,5 to 150	0,5 | 5		0,5 to 300	0,5 | 50		
IEC 61000-4-11	A.C. volt. interruptions >95%	per.	2500	250	C	2500	250	C	
IEC 61000-4-14	A.C. volt. fluctuations	ΔU_n%	+10, -10	no test	-	+10, -15	no test	-	
IEC 61000-4-8	Magnetic fields power frequency	A/m	0,5 to 5	3	A	10 to 30	30	A	
IEC 61000-4-6	Conducted h.f. disturbances 0,15 MHz to 80 MHz	V mod							specified test levels = rms value of
	- A.C. power cm								
	- D.C. power cm		1 to 10	3	A	1 to 10	10	A	unmodulated carrier
	- control/signal cm		1 to 10	3	A	1 to 10	10	A	
	- functional earth		1 to 10	3	A	1 to 10	10	A	
			-	3	A	-	10	A	mod ≡ 1 kHz, 80%
IEC 61000-4-3	R.F. Fields ≤80 MHz to 1000 MHz	V/m mod	3 to 5	3	A	10	10	A	
IEC 61000-4-3 Amendment	R.F. fields digit.teleph. * 0,9 (1,8) GHz	V/m mod	3 to 10	3 *	A	-	no test	-	* only EU

IEC 61000-4-5	Surges 1,2/50 (8/20)	kV							
	- A.C. power L→G								
	- A.C. power L→L		1 to 2	±2	B	2 to 4	±4	B	
	- D.C. power L→G		0,5 to 1	±1	B	0,5 to 2	±2	B	
	- D.C. power L→L			±0,5	B		±0,5	B	
	- control/signal L→G			±0,5	B		±0,5	B	
	- control/signal L→L		1	-	-	1 to 2	±1	B	
			0,5	-	-	0,5 to 1	±1	B	
IEC 61000-4-4	Fast transients	kV							
	- A.C. power		1 to 2	±1	B	2 to 4	±2	B	test with
	- D.C. power			±0,5	B	2 to 4	±2	B	capacitive clamp
	- control/signal		0,5 to 1	±0,5	B	1 to 2	±1*	B	* lines directly
	- functional earth			±0,5	B		±1	B	involved in process control
IEC 61000-4-12	Oscillatory transients	kV							
	- 0,1 MHz (A.C. power)		1 to 4	no test	-	1 to 4	no test	-	
	- 1 to 5MHz (control)			no test	-	0,5 to 2	no test	-	
IEC 61000-4-2	ESD air	kV	4 to 8 *	±8 *	B	4 to 8 *	±8 *	B	* charge
	contact			±4 *	B		±4 *	B	voltage

Notes:

Thd = Total harmonic distortion
5th = Example 5th harmonic

RF= Radio Frequency

cm = common mode
dm = differential mode

L→G = Line to Ground
L→L = Line to Line

Performance criteria

A: Apparatus shall continue to operate as intended during and after the test.

B: Apparatus shall continue to operate as intended after the test. During the test, a certain degradation of performance is allowed as specified by the manufacturer.

C: Temporary loss of function is allowed during and after the test, provided the function is self-recoverable or can be restored by operation of the controls.

Table 2: EMC emission limits specified in EMC emission Generic standards

This table is simplified and given for **information purposes only**. Users are referred to the latest versions of the Generic standards with regard to the test levels and conditions of application.

Status as of 1997-09-30

Phenomena Frequency range	Ports	Residential, commercial, light industry environments IEC 61000-6-3			Industrial environments IEC 61000-6-4		
		Limits		Reference standards	Limits		Reference standards
Harmonics 0 kHz to 2 kHz	A.C. mains	n = 2 to 40	see Reference standard	IEC 61000-3-2	n = 2 to 40	under consideration IA	IEC 61000-3-2
Voltage fluctuations		50/s to 0,7/min	see Reference standard	IEC 61000-3-3	50/s to 0,7/min	under consideration IA	IEC 61000-3-3
Radiofrequency conducted disturbances 0,15 MHz to 30 MHz		0,15 MHz to 0,5 MHz limit decreases linearly with log of frequency	QP 66 dB(µV) to 56 dB(µV) A 56 dB(µV) to 46 dB(µV)	CISPR 22, Class B	0,15 MHz to 0,5 MHz	QP 79 dB(µV) A 66 dB(µV)	CISPR 11
		0,5 MHz to 5 MHz	QP 56 dB(µV) A 46 dB(µV)		0,5 MHz to 5 MHz	QP 73 dB(µV) A 60 dB(µV)	
		5 MHz to 30 MHz	QP 60 dB(µV) A 50 dB(µV)		5 MHz to 30 MHz	QP 73 dB(µV) A 60 dB(µV)	
		0,15 MHz to 30 MHz	discontinuous interference: see Reference standard	CISPR 14	0,15 MHz to 30 MHz	Impulse noise (clicks): see Generic standard	CISPR 14
	Signal, IA control, D.C. power, input/output, A.C. output, other	0,15 MHz to 0,5 MHz limit decreases linearly with log of frequency	QP 40 dB(µA) to 30 dB(µA) A 30 dB(µA) to 20 dB(µA)	CISPR 22 Amend. 1, Add.3, Class B	0,15 MHz to 0,5 MHz	refer to Basic standard under revision	under consideration
		0,5 MHz to 30 MHz	QP 30 dB(µA) A 20 db(µA)		0,5 MHz to 30 MHz		
Radiofrequency radiated disturbances 30 MHz to 1000 MHz	Enclosure	30 MHz to 230 MHz	QP 30 dB(µV/m) at 10 m	CISPR 22, Class B	30 MHz to 230 MHz	QP 30 dB(µV/m) at 30 m	CISPR 11
		230 MHz to 1000 MHz	QP 37 dB(µV/m) at 10 m		230 MHz to 1000 MHz	QP 37 dB(µV/m) at 30 m	

QP = Quasi-peak limit
A = Average limit
IA ≡ Informative Annex

CHAPTER 4

EMC Product standards in IEC*

This chapter explains the aims and structure of the EMC Product/Product Family standards developed in IEC, provides short guidelines as to their content.

4.1 Definition and application of EMC Product standards

4.1.1 Definition

EMC Product standards define the specific electromagnetic requirements and test procedures applicable to a particular product.

When an EMC Product standard is applicable to a group of products that have common general characteristics, that may operate in the same environment and that have neighbouring fields of application, it becomes a Product Family standard.

Two kinds of Product Family standard may be considered: those with a very wide field of application covering several product committees (to be developed by CISPR or TC 77), and specific Product Family standards (normally to be prepared by the relevant product committees).

Examples of particular products are

– washing machines;
– electricity meters;
– monitors;
– printed boards.

Examples of product families are

– LV household equipment;
– information technology equipment;
– medical equipment.

For brevity only the term EMC Product standard will be used in this paper to cover both types of document.

4.1.2 Types of standard

There are two forms of EMC Product standard:

1. **A stand-alone publication**. This is particularly appropriate for complicated products or special environmental conditions.

   Example:
   CISPR 24: Limits and methods of measurement of immunity characteristics of information technology equipment.

2. **A special EMC clause in a general product standard** which also includes mechanical, climatic, functional and other clauses. Such EMC clauses can be considered for products of a more simple nature and are sometimes prepared as amendments to existing standards.

   Example:
   IEC 1036: Alternating current static watt-hour meters for active energy (Classes 1 and 2).

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* G. Goldberg, Past Chairman of the IEC Advisory Committee on Electromagnetic Compatibility (ACEC).

In both cases, all the relevant EMC requirements and test procedures should be considered. The standard can then be used as reference for development of the product and particularly for testing and certification purposes.

4.2 Some important features for drafting EMC Product standards

In the development or application of EMC Product standards, some important rules should be followed which allow a systematic IEC EMC standardization system to be built up.

a) The standards must be comprehensive and their development should systematically take into account all kinds of disturbance with regard both to emission and immunity (see the table of EMC disturbances in Chapter 1). It should be kept in mind, of course, that not all disturbances are relevant for a given product in a given environment.

b) They should refer to the Basic EMC standards as far as possible and therefore
   - not include detailed measurements, test methods, etc.
   - not deviate from the Basic standards (except in particular and justified cases).

c) In particular, product committees are under no circumstances allowed to specify higher emission levels than those laid down in the general emission limiting standards of TC 77 (low frequencies) or CISPR (high frequencies). This is in order to ensure general coordination and to avoid exceeding acceptable disturbance levels originating from a particular source, or mainly from the superposition of several sources. These committees may however specify lower and more stringent values appropriate to a particular environment (e.g. a medical or laboratory environment).

d) Contrary to the case of emission limits, product committees are in principle free to specify immunity requirements and test levels. They are strongly advised, however, to apply the test values recommended in the relevant Basic EMC standards.

e) EMC Product standards should take the Generic standards for their environment into consideration as reference and be coordinated with them as far as possible.

4.3 Content of EMC Product standards

Complete EMC Product standards should cover the following items:

1. Scope
2. Normative references
3. Specification of the product
4. Operation and function of the product
5. Specification of the EM environment in which the product is installed
6. Special requirements
7. Emission limits and emission tests
8. Immunity requirements and immunity tests
9. Overview tables on requirements and tests

4.3.1 Scope

The scope indicates:

- which type(s) of product is (are) the subject of the standard;
- which problems (emission and/or immunity) are dealt with; and
- which frequency ranges (low and/or high) are considered.

4.3.2 Normative references

This list contains all standards to which reference is made:

– Basic EMC standards;
– possibly Generic EMC standards (for coordination);
– EMC Product Family standards (in the case of specific product standards).

Note:

In cases where reference is made to ongoing projects, their stage at the time of approval of the product standard shall be indicated.

4.3.3 Specification of the product

To be defined by the product committee: subject, purpose, users, etc. It should indicate not only what is included but also what is excluded.

Example:
CISPR 22, Information technology equipment (ITE)

"This publication covers all equipment with

a) a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching or control of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer;

b) a rated supply voltage not exceeding 600 V.

It includes for example data processing equipment, office machines, electronic business equipment and telecommunication equipment.

Any equipment (or part of the ITE) which has a primary function of radio transmission and/or reception according to the ITU Regulations is excluded from the scope of this standard."

4.3.4 Operation and function of the product

These also must be defined by the product committee: power supply, conditions of use, etc.

Example:
IEC 61000-3-2, Limits for harmonic current emissions (equipment input current ≤16 A per phase).

"This section of IEC 61000-3 is applicable to electrical and electronic equipment having an input current up to and including 16 A per phase, and intended to be connected to public low-voltage distribution systems. For systems with nominal voltages less than 220 V (line-to-neutral), the limits have not yet been considered."

4.3.5 Specification of the EM environment in which the product is installed

General information on the EM environment can be found in various sections of IEC 61000-2 prepared by TC 77.

In particular cases the product committee itself may characterize the EM environment as "well protected" or "harsh", and indicate if the environment includes special sources of EM disturbances, their levels, etc.

4.3.6 Special requirements

Special requirements like safety requirements, narrow ranges of deviation, performance as a function of time, etc., should be indicated here.

4.3.7 Emission limits and emission tests (see Part 2, Tables I.3 and I.4)

This item covers the emission limits and emission test set-up for the relevant low-frequency and high-frequency phenomena.

As stated above in clause 4.2 and in order to ensure general coordination, the product standards shall not specify higher emission levels than those laid down by the responsible committees, i.e. TC 77 and CISPR.

With regard to measurement techniques, the relevant Basic EMC standards should be applied in order to allow the use of standardized equipment.

4.3.8 Immunity requirements and immunity tests

As also stated in clause 4.2, product committees are in principle free to specify the immunity requirements and test levels for their products but they are strongly advised to apply the test values recommended in the relevant Basic EMC standards.

They should refer as far as possible to the basic standards with regard to measurement and test methods or set-up. Again, the reason is that standardized test equipment should be used. Only in cases of exceptional conditions or requirements may product committees draft their own specifications.

Particular attention should be paid to specifying precise acceptance criteria. In this context, the following procedure is recommended:

a) identify the relevant disturbances for the product considered and the environment where it operates;
b) choose the test levels from the values recommended in the corresponding basic immunity standards; and
c) specify the number and duration of the immunity tests according to the basic standard.

It is, moreover, good practice to provide additional information on the following:

– which functions should continue to operate;
– which functions may be interrupted; and
– which behaviour has to be avoided for safety reasons.

4.3.9 Overview tables on requirements and tests

For more convenience in the application of EMC Product standards, overview tables can be useful to summarize the prescribed emission or immunity tests.

4.4 Categories of products

In Chapter 1, clause 1.6, four categories of products were differentiated:

Components

Product standards will serve mainly as references for design and testing, including for certification purposes.

Apparatus and **Small systems**

Product standards will also serve for design and testing purposes but are the basis for compliance testing and certification.

Large installations of several items

EMC testing of large installations, e.g. large industrial plants, is a problem and *in situ* methods of testing may be specified.

4.5 Organizations involved in the development of EMC Product standards

Several international, regional, national and professional organizations develop EMC Product standards.

– In IEC there are about 50 committees or subcommittees that have published or are preparing such standards. The relevant publications and ongoing projects are listed in Table III of Part 2.
– ISO develops standards in fields where the IEC is not active (e.g. for automotive vehicles).
– CENELEC (for certain products).
– OIML (for measuring equipment).
– Last but not least, EMC product standards are also prepared by some national bodies for their countries (e.g. FCC and ANSI) or by regional professional organizations (e.g. ECMA).

It is virtually impossible to be fully informed on all relevant activities. Interested bodies are therefore advised to contact the organizations involved for detailed information.

4.6 Main product families

In IEC Guide 107 the following main product families have been identified:

– Household and commercial equipment (other than ITE)
– Industrial equipment (other than ITE)
– Information technology equipment (ITE)
– Telecommunication equipment (as far as in the scope of IEC technical committees)
– Radio and TV receivers and associated equipment
– Traffic and transportation equipment
– Utilities equipment (electricity, gas, water. …)
– Equipment connected to the MV and HV public systems
– Medical equipment
– Measuring and test equipment
– Scientific equipment.

Priority should be given to high-volume products.

CHAPTER 5

Some trends in EMC standardization*

This last chapter of the brochure attempts to look at how the development of EMC standards in IEC may evolve in the future. Two aspects will be considered:

– the global approach in the development of EMC standards; and
– the global approach in the application of EMC standards.

EMC has become an area of vigorously expanding activity, making it quite difficult to present a comprehensive view of the coming years even from the particular aspect of standardization.

For this reason, this contribution will be limited to thoughts from the viewpoint of IEC, and will mainly consider the general electrotechnical/electronic and industrial sectors. It may be assumed that the trends outlined may also be valid for other fields, e.g. telecommunication. As regards the increasingly topical subject of globalization/regionalization, developments in the European Union (EU) and CENELEC will be referred to as examples.

5.1 Trends in the development of EMC standards

5.1.1 Background and structure

The development of EMC standards started effectively in 1934 with the creation of CISPR, the International Special Committee for Radio Interference, for the protection of radio services against radio-frequency disturbances.

IEC TC 77 and CISPR are the two committees with horizontal functions whose main task is to deal with the publications for general application: Basic standards and technical reports, Generic standards and some very important EMC Product Family standards.

Besides these two committees, there are about 50 IEC technical committees and subcommittees responsible for their specific Product or Product Family standards.

In addition, TC 85 is currently dealing with problems related to the exposure of human beings to EM fields, insofar as they are within IEC's scope (i.e. measurement techniques).

This structure of EMC standardization work requires close coordination among the various committees concerned. The coordination between TC 77 and CISPR in the high-frequency domain has recently been improved, although a proposal to merge the two bodies was not accepted. More efficient support of the product committees by these two horizontal committees would however be useful. Overall monitoring of the coordination of EMC work in IEC is one of the main tasks of ACEC (Advisory Committee on Electromagnetic Compatibility).

It therefore seems that the broad organization of EMC work in IEC is suitable to cover the needs in a comprehensive manner. This structure could even serve as a model for regional or national organizations.

5.1.2 Evolution towards a global approach

An important step in EMC standards development has been the move towards a global approach rather than one considering individual items in isolation. Some features of this evolution follow.

For a long time, standardization started with single phenomena, e.g. radio disturbances, harmonics or electrostatic discharges. The term EMC was particularly related to high-frequency

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* G. Goldberg, Past Chairman of the IEC Advisory Committee on Electromagnetic Compatibility (ACEC).

and/or radio-frequency phenomena. Nowadays, the term EMC encompasses all electromagnetic disturbances in the whole frequency range from 0 Hz to GHz (see Chapter 1 of this brochure).

One consequence of this is that IEC develops a comprehensive set of basic standards considering all these disturbances, covering emission as well as immunity (see Part 2, Table I). One could perhaps complain about the proliferation of basic standards, but it should be remembered that as far as IEC is concerned their application is not compulsory (see clause 5.2.1 below). They are simply available to prospective users when needed.

EMC Product standards were also in the past dedicated to certain single disturbances, each of which thus became the subject of a separate publication. When developing such standards nowadays, product committees are strongly advised to consider the entire range of disturbances as regards both emission and immunity.

New EMC Product standards should consequently include all the requirements and tests in a single document. In some cases, this information may be consolidated with the mechanical, climatic, safety and other requirements in a comprehensive overall product standard. Product committees do however have a duty to meet only real needs and to avoid any unnecessary "explosion" in the requirements and tests relating to their equipment.

The IEC's comprehensive method of dealing with the whole subject – i.e. systematically analysing all disturbances, the EMC requirements and necessary tests – constitutes a preventive approach which in the European Commission's view is a significant advance on the previous case-by-case, palliative approach.

5.1.3 Future needs

What does the present status of EMC standardization in IEC (and CENELEC) indicate about needs in the near future?

Basic publications (see Chapter 2)

Practically all the high-priority basic standards and technical reports are now available. The next step is to update these where necessary to take into consideration technical progress and the experience gained in using the first editions.

Better descriptions or specification of the EM environment, in particular statistical information, may also be necessary to improve the basis for specifying immunity test levels. This is quite a difficult task, however, because of continuous evolution of the EM environment.

Generic standards (see Chapter 3)

In IEC, these are either already available or, as this publication goes to press, under final voting. Initially considered as provisional standards, they have acquired a permanent status because of their general reference value. Generic EMC standards for environments other than the present ones are not envisaged, at least for the time being.

Product standards (see Chapter 4)

In general, work on these is progressing satisfactorily although in some cases quite slowly.

In the years to come, a large part of IEC's EMC activity will likely be devoted to the development of Product Family or specific Product standards. This is necessitated in general by the expectations of users with regard to the design, testing and operation of equipment but also in particular, where they exist, by the requirements of regulatory authorities (such as the European EMC Directive – see clause 5.2.2 below).

> Note:
>
> As stated in Chapter 4, it should be kept in mind that EMC product standards are also published by many other organizations, at international, regional and national levels.

5.1.4 Some new subjects for EMC standardization in IEC

Apart from the “regular” work already undertaken as explained above, some important new subjects may require more consideration in future in IEC. For example:

– Extension of the frequency range from the currently assumed upper limit of 1 GHz to higher frequencies in the GHz range (CISPR refers to 400 GHz).
– EMC of large installations. The present standards (particularly on immunity) relate to single items of equipment or to small systems. How should installations spread over large areas be dealt with? How should *in situ* measurements be carried out?
– Power quality, i.e. the characteristics of the supply voltage. Work has now been started.
– Coordination between industrial and telecommunication equipment.

5.2 Trends in the application of EMC standards

It is not sufficient just to develop EMC standards, even if they are (it is hoped) good ones. The ways in which they are applied are also of great importance.

5.2.1 Legal or contractual status of IEC standards

As noted in Chapter 1 of this brochure, IEC standards are in principle only recommendations, although under certain circumstances they may acquire a legal – and therefore mandatory – or a contractual status.

IEC standards are well established as the international reference but in numerous countries national standards exist in parallel. Generally the latter are not really in contradiction with IEC publications, although sometimes they may differ to some extent.

The development of standards is a very costly process and for many countries it may not be economically reasonable to develop their own. It is therefore preferable to adopt international standards prepared by experts who are familiar with all the technical aspects and their implications. This makes it possible to avoid duplication of effort as well as making high-quality standards available more quickly.

Another aspect to consider is the world-wide trend towards the creation of regional associations such as the EU, NAFTA, APEC and MERCOSUR, one aim of which is the building of free trade areas. In order to allow the free circulation of goods in these areas, it is necessary to eliminate technical barriers to trade.

One major way of accomplishing this is for regional associations to unify technical standards and make their application compulsory in all member countries. A very simple way to achieve full coordination of standards in a free trade area can therefore be for all member countries to adopt IEC publications, unchanged or appropriately amended if necessary. CENELEC is an example of just such a regionalization of EMC standardization.

5.2.2 IEC and CENELEC

The European Union (EU) groups 15 West European countries. It has set up an electrotechnical standardization committee, CENELEC, the 18 national members of which also include three countries of the European Free Trade Association (EFTA). As described in Chapter 1 of this brochure, IEC has concluded a co-operation agreement with CENELEC.

In 1989, the European Council issued its so-called EMC Directive 89/336 EWG, which came into force on 1 January 1996. The implementation of this directive is quite complicated so it may be informative here to summarize some main features:

– Application of the relevant standards is compulsory for all EU countries and all other countries that intend to put their products on the EU market.
– The EMC Directive concerns emission from as well as immunity of electrical and electronic devices, and it applies basically to product standards.
– All the products must be tested and certified according to specific rules.

In accordance with its agreement with IEC, CENELEC in principle applies the EMC standards of IEC, although it has developed some interim documents of its own which are intended to be replaced later by the corresponding IEC publications. CENELEC TC 210 agrees with the view that it would be beneficial for all parties to use the same EMC standards all over the world.

As we have seen, CENELEC is an example of the regionalization of EMC standardization. Whether a wider set of agreements – a globalisation in the framework of the World Trade Organization (WTO) – would be advisable or even possible is an open question.

5.2.3 Testing and certification

A substantial development of the market for EMC testing (as well as associated instrumentation) can be expected in view of at least two factors:

1. the increase in EMC problems and the necessity for manufacturers to ensure that their products are acceptable as regards EMC; and
2. the fact that, at least in some countries such as those of the EU, products must be tested for the purpose of certification.

Big companies will tend to install their own, relatively expensive, test laboratories and train their own EMC testing experts. But smaller companies that cannot afford their own test facilities and do not have the experts will turn towards specialized testing houses.

A new EMC testing industry is thus developing.

One important problem that arises is the question of mutual recognition of test results and certification between countries or regions, particularly with the EU.

5.3 Conclusions

In this attempt to assess future trends in EMC standardization the following points can be identified:

- Global approach to EMC phenomena (disturbances)
- Global approach in the drafting of EMC standards (particularly product standards)
- Preventive rather than palliative approach
- Global approach and closer coordination in the organization of work
- Regionalization of EMC standardization
- More mandatory application
- Official testing and certification of compliance
- In consequence, increasing significance of all aspects of EMC and related business activities.

Glossary

In the tables the following abbreviations and symbols are used.

AC	Alternating Current
ACDV	draft Approved for Committee Draft with Vote
Am	being Amended
Amd.	Amendment
AnCD	Approved for nth Committee Draft
ANW	Approved New Work
APUB	Approved for Publication
BWG	Back to Working Group
CD	Committee Draft
CDV	Committee Draft for Voting
DC	Direct Current
DEC	Draft at Editing Check
ESD	Electrostatic Discharge
FDIS	Final Draft International Standard
HEMP	High altitude nuclear EM Pulse
HF	High Frequency
HV	High Voltage
ISM	Industrial, Medical and Scientific radio frequency equipment
ITE	Information Technology Equipment
LF	Low Frequency
LV	Low Voltage
MV	Medium Voltage
NP	New work item Proposal
Pro	Product Standard
PPUB	Publication Published
PWI	Proposed Work Item
Ref	Referenced in generic and product standards
Rev	being Revised
RF	Radio Frequency
TEM	Transverse EM wave
TR	Technical Report

NOTES

1) The information given in the columns "Stage" and "Document" reflects the status of the project on 1st June 1997.

2) The texts under "Subjects" are limited to the concept and do not quote the actual title.

3) Table I.3 includes standards which are in fact Product Family standards. They constitute an important general reference and play a similar role as Basic standards.

INTRODUCTION

Part 2 contains tables on Basic EMC publications, Generic EMC standards and EMC Product/Product family standards prepared by IEC. These tables are subject to change because

- existing publications may be amended or withdrawn
- existing projects move towards publication and therefore obtain new references and stages
- existing projects may be withdrawn
- new projects are added

While it is expected that the five chapters of Part 1 will remain valid for several years, the tables in Part 2 have to be updated regularly. They are therefore printed separately as Part 2 and inserted in the back cover.

The abbreviations and symbols which are used in the tables are explained. The structure of the tables is in line with Chapters 2, 3 and 4 of Part 1.

Table I: Basic EMC Publications, consists of six parts:

1. General
2. Environment - Compatibility levels
3. Emission
4. Measurement techniques - Emission
5. Testing techniques - Immunity tests
6. Installation and mitigation guidelines

Table II: Generic EMC Standards, contains four publications.

Table III: Product/Product family EMC standards, mainly contains the projects and standards prepared by IEC product committees but also includes several from CISPR/B, D, E, F and G.

The projects are presented by order of TC number.

Table I.1: Basic EMC Publications: General

IEC Publication	Stage	Document	Note	Subject
Guide 107	PPUB			Drafting of EMC Publications
Terminology				
60050(161)	PPUB		Am	International Electrotechnical Vocabulary, Chapter 161 on EMC
General considerations				
61000-1-1	PPUB		TR	Application and interpretation of fundamental EMC definitions and terms
61000-1-2	ACDV	77/197/CD	TR	EMC and functional safety

Table I.2: Basic EMC Publications: Environment - Compatibility levels

IEC Publication	Stage	Document	Note	Subject
General				
61000-2-5	PPUB		TR	Classification of the EM environments
LF conducted disturbances				
61000-2-1	PPUB		TR	Description of the EM environment in public LV power systems
61000-2-2	PPUB		Am	Compatibility levels in public LV power systems
61000-2-4	PPUB		Am	Compatibility levels in industrial plants
61000-2-6	PPUB		TR	Asessment of emission levels in industrial plants
61000-2-8	ANW	77A/121/NP		Voltage dips, short interruptions
61000-2-12	ACDV	77A/266/CD		Compatibility levels in public MV power systems
60725	PPUB			Reference impedance for LV power lines
LF radiated disturbances				
61000-2-7	PPUB		TR	LF magnetic fields
HF conducted/radiated disturbances, ESD				
61000-2-3	PPUB		TR	Description, radiated and non-network frequency conducted disturbances
HEMP				
61000-2-9	PPUB			Description, radiated disturbance
61000-2-10	PPUB			Description, conducted disturbance
61000-2-11	PPUB			Classification of the environment

Table I.3: Basic EMC Publications: Emission

IEC Publication	Stage	Document	Note	Subject
LF conducted disturbances				
61000-3-2	PPUB		Pro*, Ref*, Am	Limits for harmonic current emissions (n ≤ 40), I ≤ 16A, LV
61000-3-3	PPUB		Pro*, Ref*, Am	Limitation of voltage fluctuations & flicker, I ≤ 16A
61000-3-4	PPUB		Pro, TR	Limits for harmonic current emissions (n ≤ 40), I ≤ 16A, LV
61000-3-5	PPUB		Pro, TR	Limitation of voltage fluctuations & flicker, I > 16A
61000-3-6	PPUB		Pro, TR	Limits for harmonic emissions in MV & HV power systems
61000-3-7	PPUB		Pro, TR	Limitation of voltage fluctuations & flicker in MV & HV power systems
61000-3-8	PPUB			Emission levels, frequency bands and disturbance levels for signalling on LV installations
HF conducted disturbances				
CISPR 11 Amd. 1, 2	PPUB		Pro, Ref	Limits for industrial, scientific and medical RF equipment, 0,15 - 30 MHz
CISPR 14 Amd. 1, 2	PPUB		Pro, Ref	Limits for appliances for household and similar purposes, 0,15 - 30 MHz and clicks
CISPR 22 Amd. 1, 2	PPUB		Pro, Ref	Limits for IT equipment, 0,15 - 30 MHz
HF radiated disturbances				
CISPR 11 Amd. 1, 2	PPUB		Pro, Ref	Limits for industrial, scientific and medical RF equipment, 30 - 1000 MHz
CISPR 14 Amd. 1, 2	PPUB		Pro, Ref	Limits for appliances for household and similar purposes, 30-1000 MHz and clicks
CISPR 22 Amd. 1, 2	PPUB		Pro, Ref	Limits for IT equipment, 30 - 1000 MHz

* Explication of Pro and Ref: see Glossary, in particular Note 3.

Table I.4: Basic EMC Publications: Measurement techniques - Emission

IEC Publication	Stage	Document	Note	Subject
LF conducted disturbances				
61000-4-7	PPUB		Am	Harmonics, interharmonics
61000-4-15	PPUB			Flickermeter
HF conducted/ radiated disturbances				
CISPR 16-1	PPUB		Am	Radio disturbance and immunity measuring apparatus
CISPR 16-2	PPUB			Methods of disturbance and immunity measurement

Table I.5: Basic EMC Publications: Testing techniques - Immunity tests

IEC Publication	Stage	Document	Note	Subject
General				
61000-4-1	PPUB			Overview of immunity tests
LF conducted disturbances				
61000-4-11	PPUB			Voltage dips, short interruptions AC
61000-4-13	3CD	77A/291/CD		Harmonics, interharmonics
61000-4-14	PPUB			Voltage fluctuations
61000-4-16	PPUB		DC	Conducted disturbance, DC - 150 kHz
61000-4-17	CCDV	77A/207/CDV	DC	Ripple on DC power supply
61000-4-27	ADIS	77A/250/CDV		Unbalance of three-phase system
61000-4-28	BPUB			Variation of power frequency
61000-4-29	ADIS	77A/264/CDV	DC	Voltage dips, short interruptions, DC
LF radiated disturbances				
61000-4-8	PPUB			Power frequency magnetic fields
HF conducted disturbances				
61000-4-4	PPUB		Am	Fast transients (bursts), 5/50 ns
61000-4-5	PPUB			Surges 1,2/50 µs / 8/20 µs
61000-4-6	PPUB			Induced currents, 0,15-80 (230) MHz
61000-4-12	PPUB		Am	Oscillatory waves

HF radiated disturbances				
61000-4-3	PPUB			EM fields, 80-1000 MHz
61000-4-9	PPUB			Pulse magnetic field, 6,4/16 µs
61000-4-10	PPUB			Damped oscillatory magnetic field
61000-4-20	CDM	77B/265/CD		TEM cells
61000-4-21	CDM	77B/260/CD		Mode stirred chambers
61000-4-26	PWI	77B/150/NP		Calibration of probes
Electrostatic discharges				
61000-4-2	PPUB			Electrostatic discharge immunity test
HEMP				
61000-4-23	ADIS	77C/68/CDV		Protective devices for HEMP radiated disturbances
61000-4-24	PPUB			Protective devices for HEMP conducted disturbances
61000-4-25	4CD	77C/81/CD		Equipment and systems (including requirements)

Table I.6: Basic EMC Publications: Installation and mitigation guidelines

IEC Publication	Stage	Document	Note	Subject
Installation				
61000-5-1	PPUB		TR	General considerations
61000-5-2	PPUB		TR	Earthing and cabling
61000-5-6	1CD	77C/84/CD	TR	External influences (filters, shielding, surge protection)
HEMP				
61000-5-3	PPUB			Protection concepts against HEMP
61000-5-4	PPUB		TR	Protecting devices against HEMP radiated disturbances
61000-5-5	PPUB			Protecting devices against HEMP conducted disturbances

Table II: Generic EMC Standards

IEC Publication	Stage	Document	Note	Subject
Residential, Commercial, Light industry environment				
61000-6-3	PPUB		(1)	Emission
61000-6-1	PPUB		(2)	Immunity
Industrial environment				
61000-6-4	PPUB		(3)	Emission
61000-6-2	PPUB		(4)	Immunity

NOTES:

(1) Reference CENELEC EN 50081-1 (1992)

(2) Reference CENELEC EN 50082-1 (1997)

(3) Reference CENELEC EN 50081-2 (1993)

(4) Reference CENELEC EN 50082-2 (rejected 1997-05; CENELEC considers parallel vote on IEC document)

Table III - Product/Product Family EMC Standards

IEC/TC/SC	Title of TC/SC	Product	Document	Stage
TC 2	Rotating machinery	Rotating electrical machines - Part 1: Rating and performance IEC 60034-1 f1 Ed. 11: Section 6: Electrical operating conditions	IEC 60034-1 Am.1 2/1020/CD	PPUB 1CD
TC 4	Hydraulic turbines	Guide to specification of hydraulic turbine control systems	IEC 61362	PPUB
TC 9	Electric traction equipment	Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules	IEC 60077-1	PPUB
TC 13	Equipment for electrical energy measurement and load control	AC static Wh meters for active energy (classes 0,2 S and 0,5 S) AC static Wh meters for active energy (classes 1 and 2) Electronic ripple control receivers for tariff and load control Time switches for tariff and load control Pulse output devices for electromechanical and electronic meters (two wires only)	IEC 60687 IEC 61036 IEC 61037 IEC 61038 IEC 62053-31	PPUB PPUB PPUB PPUB PPUB
SC 17A/ SC 17C	HV switchgear and controlgear/ HV enclosed switchgear and controlgear	IEC 60694 Amd.1 Ed. 2.0: Common specifications for high-voltage switchgear and controlgear - Clauses applicable to auxiliary equipment using electronic and associated technologies	17A/541/CDV	CDVM
SC 17B	LV switchgear and controlgear	IEC 60947-2 Amd.3 Ed. 2.0: Circuit-breakers General rules Circuit-breakers Electrotechnical contactors and motor-starters Switches, disconnectors, switch-disconnectors and fuse-combination units AC semiconductor controllers and contactors for non-motor loads Semiconductor motor controllers and starters Control circuit devices and switching elements - Proximity switches Multiple function equipment - Automatic transfer switching equipment Multiple function equipment - Control and protective switching devices (or equipment) (CPS) IEC 60947-4-2 Amd.1 Ed. 2.0: AC Semiconductor motor controllers and starters	17B/932/CD IEC 60947-1 IEC 60947-2 Am.1 IEC 60947-4-1 Am.2 IEC 60947-3 IEC 60947-4-3 IEC 60947-4-2 IEC 60947-5-2 Am.1 IEC 60947-6-1 Am.1 IEC 60947-6-2 Am.1 17B/997/CD	2CD PPUB PPUB PPUB PPUB PPUB PPUB PPUB PPUB PPUB ACDV

SC 17D	LV switchgear and controlgear assemblies	LV switchgear and controlgear assemblies	may be considered as “installations”	
TC 18	Electrical installations of ships and of mobile and fixed offshore units	Electrical and electronic installations in ships - EMC IEC 60092-507: Electrical installations in ships - Part 507: Pleasure craft	IEC 60533 18/873/FDIS	BPUB CDIS
SC 22B	Power electronics	Semiconductor converters - Part 2: Self-commutated semiconductor converters including direct d.c. converters	IEC 60146-2 Ed. 2.0	BPUB
SC 22D	Electronic power converters for rolling stock		See CLC TC 9(x)	
SC 22E	Stabilized power supplies	IEC 61204-3 Ed. 1.0: Low-voltage power supplies, d.c. output - Part 3: Product EMC standard - will replace IEC 60478-3 (1989)	22E/60/CD	ADIS
SC 22F	Converters for high-voltage DC power transmission			
SC 22G	Semiconductor power converters for adjustable speed electric drive systems	IEC 61800-3 Ed. 2.0: Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods	22G/45/NP	ANW
TC 23	Electrical accessories	IEC 61867 Ed. 1.0: Electrical accessories for household and similar use - Electromagnetic compatibility (EMC)	23/247/FDIS	NCD
SC 23B	Plugs, socket-outlets and switches	Electronic switches	IEC 60669-2-1	PPUB
SC 23E	Circuit-breakers and similar equipment for household use	IEC 61008-1: Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses IEC 61009-1: Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses Circuit-breakers for equipment (CBE) IEC 61543 Amd.1 Ed. 1.0: Residual current-operated protective devices (RCDs) for household and similar use - EMC Electrical accessories - Portable residual current devices without integral overcurrent protection for household and similar use (PRCDs)	23E/314/NP 23E/315/NP IEC 60934 Am.2 23E/375/CDV IEC 61540 Am.1	ANW ANW PPUB ADISSB PPUB
SC 23F	Connecting devices	Connecting devices for low voltage circuits for household and similar purposes - Part 1: General requirements	IEC 60998-1 Am.1	PPUB

SC 23G	Appliance couplers	Electrical accessories - Cord sets and interconnection cord sets	IEC 60799	PPUB
TC 26	Electric welding	IEC 60974-10 Ed. 1.0: Arc welding equipment - Part 10: EMC requirements	26/172/CD	ACDV
TC 27	Industrial electroheat equipment			
TC 29	Electroacoustics	Hearing aids - Part 13: Electromagnetic compatibility (EMC) IEC 60651 Amd.2 Ed. 1.0: Sound level meters - EMC IEC 60804 Amd.3 Ed. 1.0: Integrating-averaging sound level meters - EMC and test procedures IEC 61252 Amd.1 Ed. 1.0: Personal sound exposure meters - EMC	IEC 60118-13 29/407/CDV 29/408/CDV 29/406/CDV	PPUB ADIS ADIS ADIS
SC 32A	HV fuses	IEC 60282-1 Ed. 5.0: High-voltage fuses - Part 1: H-V current-limiting fuses; layout and TD3	32A/198/CDV	CCDV
SC 32B	LV fuses	Low-voltage fuses - Part 1: General requirements	IEC 60269-1	PPUB
TC 33	Power capacitors	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1000 V Filters for power capacitors	IEC 60831-1 IEC 60931-1 Not relevant at present	PPUB PPUB
TC 34	Lamps and related equipment	Equipment for general lighting purposes - EMC immunity requirements	IEC 61547	PPUB
TC 38	Instrument transformers	IEC 61869-1 Ed. 1.0: Common clauses for instrument transformers Instrument transformers - Part 7: Electronic voltage transformers IEC 60044-8 Ed. 1.0: Electronic current transformers	38/222/CD IEC 60044-7 38/225/CD	ACDV BPUB ACDV
TC 40	Capacitors and resistors for electronic equipment	Fixed inductors for EMI suppression - Part 1: Generic specification Fixed inductors for EMI suppression - Part 2: Sectional specification Blank detail specification - Inductors for which safety tests are required. Assessment level D Blank detail specification - Inductors for which safety tests are required (only)	IEC 60938-1 IEC 60938-2 IEC 60938-2-1 IEC 60938-2-2	PPUB PPUB PPUB PPUB

TC 44	Safety of machinery - Electrotechnical aspects	Electrosensitive protective equipment - Part 1: General requirements and tests	IEC 61496-1	PPUB
		Electro-sensitive protective equipment - Part 2: Particular requirements for equipment using AOPDs	IEC 61496-2	PPUB
SC 45A	Reactor instrumentation	Nuclear power plants - EMI testing	45A/249/CDV	CCDV
TC 46	Cables, wires, waveguides, R.F. connectors and accessories for communication and signalling	EMC method of measurement for symmetric data transmission cables	46C(Secretariat)211	ANW
SC 46A	Coaxial cables	Cables, cable assemblies and connectors - Introduction to electromagnetic (EMC) screening measurements	IEC 61917 TR3	PPUB
SC 47A	Integrated circuits	IEC 61967: Integrated circuits - Measurement of electromagnetic emissions, 150 KHz to 1 GHz		
		Part 1: General and definitions	47A/569/CD	2CD
		Part 4: Measurement of conducted emissions, 1 ohm/150 ohm direct coupling method	47A/566/CD	2CD
		Part 5: Measurement of conducted emissions, workbench faraday cage method	47A/567/CD	2CD
		Part 6: Measurement of RF currents, magnetic probe method	47A/568/CD	2CD
SC 48B	Connectors	Cable to board connectors with assessed quality	48B/526/CDV	ADIS
		IEC 61076-4-108 Ed. 1.0: Connectors for use in d.c., low-frequency analogue and digital high speed data applications	48B/849/CDV	CCDV
		IEC 61076-4-110 Ed. 1.0: Detail specification for latched cable connector system with assessed quality with integrated shielding function	48B/741/CD	ACDV
SC 48D	Mechanical structures for electronic equipment	IEC 60297-3 Ed. 2.0: Dimensions of mechanical structures of the 482,6 mm (19 in) series - Part 3: Subracks and associated plug-in units	48D/136/NP	ANW
		Mechanical structures for electronic equipment - Tests for IEC 60917 and IEC 60297 - Part 3: Electromagnetic shielding performance tests for cabinets, racks and subracks	IEC/TS 61587-3	PPUB

TC 57	Power system control and associated communications	Telecontrol equipment and systems - Part 2: Operating conditions - Section 1: Power supply and electromagnetic compatibility	IEC 60870-2-1	PPUB
		Teleprotection equipment of power systems - Performance and testing - Part 1: Command systems	IEC 60834-1	PPUB
		Distribution automation using distribution line carrier systems - Mains signalling requirements - Frequency bands and output levels	IEC 61334-3-1	PPUB
TC 61	Safety of household and similar electrical appliances	Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard	CISPR 14-2	PPUB
		IEC 60335-1 Amd.1 f3 Ed. 4.0: Safety related aspects of electronic circuits, Clauses 2, 19 and 22	61/1735/CD	2CD
SC 62A	Common aspects of electrical equipment used in medical practice	IEC 60601-1-2 Ed. 2.0: Medical electrical equipment - Part 1: General requirements for safety - 2. Collateral standard: Electromagnetic compatibility - Requirements and tests	62A/247/CD	ACDV
TC 64	Electrical installations of buildings	Assessment of general characteristics	IEC 60364-3 Am.2	PPUB
		Selection and erection of electrical equipment - Chapter 51: Common rules	IEC 60364-5-51 Am.1	PPUB
		Protection for safety - Section 444: Protection against EMI	IEC 60364-4-444	PPUB
SC 65A	Safety of measuring, control, and laboratory equipment	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements	IEC 61326-1	PPUB
SC 65B	Industrial process measurement and control : Devices	General methods and procedures for evaluating performance - Part 3: Tests for the effects of influence quantities	IEC 61298-3	PPUB
		Transmitters for use in industrial-process control systems - Part 1: Methods for performance evaluation	IEC 60770-1	PPUB
		Programmable controllers - Part 2 : Equipment requirements and tests	IEC 61131-2	PPUB
TC 69	Electric road vehicles and electric industrial trucks	IEC 61851-2-1 Ed. 1.0: Electrical vehicle requirements for conductive connection to an AC/DC supply	69/115/CDV	CCDV
		IEC 61851-2-2 Ed. 1.0: Electric vehicle conductive charging system - AC electric vehicle charging station	69/116/CDV	CCDV
TC 72	Automatic controls for household use	Automatic electrical controls for household and similar use - Part 1: General requirements	IEC 60730-1	PPUB
TC 74	Safety and energy efficency of ITE	Harmonic emission limits for ITE	74/436/CDV	DEL

TC 80	Maritime navigation and radiocommunication equipment and systems	IEC 60945 Ed. 4.0: General requirements - Methods of testing and required test results	80/155/NP	ACDV
		GMDSS - Survival craft portable two-way VHF radiotelephone apparatus - Operational and performance requirements	IEC 61097-12	PPUB
		GMDSS - Inmarsat-E - Emergency position indicating radio beacon (EPIRB) operating through the Inmarsat system	IEC 61097-5	PPUB
		IEC 61996 Ed. 1.0: Shipborne VDR - Performance requirements	80/223/CDV	CCDV
		GMDSS - Shipborne VHF radiotelephone transmitter and receiver	IEC 61097-7	PPUB
		GMDSS - Shipborne watchkeeping receivers for the reception of DSC in the maritime MF, MF/HF and VHF bands	IEC 61097-8	PPUB
		GMDSS - Shipborne transmitters and receivers for use in the MF and HF bands suitable for telephony, DSC and NBDP	IEC 61097-9	PPUB
TC 85	Measuring equipment for electromagnetic quantities	Measurement of low-frequency magnetic and electric fields with regard to exposure of human beings	IEC 61786	PPUB
		IEC 61983 Ed. 1.0: Measurement and evaluation of HF (9kHz to 300 GHz) electromagnetic fields with regard to human exposure	85/110/NP	ANW
TC 93	Design automation	IEC 62014-1 Ed. 1.0: Electronic behavioural specifications of digital integrated circuits - I/O Buffer Information Specification (IBIS)	93/91/CDV	ADIS
TC 94	All-or-nothing electrical relays	Specified time relays for industrial use - Requirements and tests	IEC 61812-1	PPUB
TC 95	Measuring relays and protection equipment	1 MHz burst disturbance tests	IEC 60255-22-1	PPUB
		Electrostatic discharge tests	IEC 60255-22-2	PPUB
		IEC 60255-22-3 Ed. 2.0: Radiated electromagnetic field disturbance tests	95/77/CDV	DEC
		IEC 60255-22-4 Ed. 2.0: Fast transient/Burst immunity test	95/88/CD	1CD
		IEC 60255-22-6 Ed. 1.0: Immunity to conducted disturbances, induced by radio frequency fields	95/86/CDV	CCDV
		IEC 60255-22-7 Ed. 1.0: Power frequency interference tests	95/89/CD	1CD
		IEC 60255-25 Ed. 1.0: Electromagnetic emission tests for measuring relays and protection equipment	95/87/FDIS	CDIS
TC 99	System engineering and erection of electrical power installations	IEC 61936-1 Ed. 1.0: Power installations exceeding 1 kV a.c. - Part 1: Common rules	99/35/CD	ACDV
SC 100D	Cabled distribution systems	IEC 60728-2 Ed. 1.0: Cabled distribution systems for television and sound signals - Part 2: Electromagnetic compatibility of equipment	100D/30/NP	ACDV

CISPR/B	Interference relating to industrial, scientific and medical radio- frequency apparatus	Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement	CISPR 11	PPUB
CISPR/D	Interference relating to motor engines	Motor vehicles, HF emission	CISPR 12, 21, 25	PPUB
CISPR/E	Interference relating to radio receivers	Sound and television broadcast receivers, HF emission	CISPR 13, 20	PPUB
CISPR/F	Interference relating to household appliances, tools, lighting equipment and similar apparatus	Emission - Product family standard Immunity - Product family standard Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	CISPR 14 CISPR 14-2 CISPR 15	PPUB PPUB PPUB
CISPR/G	Interference relating to information technology equipment	Radio disturbance characteristics - Limits and methods of measurement Immunity characteristics - Limits and methods of measurement	CISPR 22 CISPR 24	PPUB PPUB