

Electromagnetic compatibility (EMC)

Part 6-1: Generic standards —
Immunity for residential, commercial
and light-industrial environments

The European Standard EN 61000-6-1:2007 has the status of a
British Standard

ICS 33.100.20

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 61000-6-1:2007. It is identical with IEC 61000-6-1:2005. It supersedes BS EN 61000-6-1:2001, which will be withdrawn on 1 December 2009.

The UK participation in its preparation was entrusted by Technical Committee GEL/210, EMC — Policy committee, to Subcommittee GEL/210/12, EMC — Basic and generic standards.

A list of organizations represented on GEL/210/12 can be obtained on request to its secretary.

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**Electromagnetic compatibility (EMC) -
Part 6-1: Generic standards -
Immunity for residential, commercial
and light industrial environments
(IEC 61000-6-1:2005)**

Compatibilité électromagnétique (CEM) -
Partie 6-1: Normes génériques -
Immunité pour les environnements
résidentiels, commerciaux
et de l'industrie légère
(CEI 61000-6-1:2005)

Elektromagnetische Verträglichkeit
(EMV) -
Teil 6-1: Fachgrundnormen -
Störfestigkeit für Wohnbereich,
Geschäfts- und Gewerbebereiche
sowie Kleinbetriebe
(IEC 61000-6-1:2005)

This European Standard was approved by CENELEC on 2006-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the International Standard IEC 61000-6-1:2005, prepared by IEC TC 77, Electromagnetic compatibility, was submitted to the formal vote and was approved by CENELEC as EN 61000-6-1 on 2006-12-01 without any modification.

This European Standard supersedes EN 61000-6-1:2001 + IS1:2005.

Specific technical changes have been introduced to Tables 1 to 4. The frequency range for tests according to EN 61000-4-3 has been extended above 1 GHz according to technologies used in this frequency area. The use of TEM waveguide testing according to EN 61000-4-20 has been introduced for certain products and the testing requirements according to EN 61000-4-11 have been amended significantly.

The following dates were fixed:

- | | | |
|------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2007-12-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2009-12-01 |

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directives EMC (89/336/EEC), EMC (2004/108/EC) and RTTED (1999/5/EC). See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61000-6-1:2005 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INTRODUCTION 4

1 Scope and object..... 5

2 Normative references 6

3 Terms and definitions 7

4 Performance criteria 8

5 Conditions during testing 8

6 Product documentation 9

7 Applicability 9

8 Immunity test requirements 9

Annex ZA (normative) Normative references to international publications with their
corresponding European publications..... 16

Annex ZZ (informative) Coverage of Essential Requirements of EC Directives 17

Bibliography 15

Figure 1 – Examples of ports 7

Table 1 – Immunity – Enclosure port 11

Table 2 – Immunity – Signal ports 12

Table 3 – Immunity – Input and output DC power ports 13

Table 4 – Immunity – Input and output AC power ports 14

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INTRODUCTION

IEC 61000 is published in separate parts according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)

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 the 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

Each part is further subdivided into several parts, published either as International Standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example: 61000-6-1).

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments

1 Scope and object

This part of IEC 61000 for EMC immunity requirements applies to electrical and electronic apparatus intended for use in residential, commercial and light-industrial environments. Immunity requirements in the frequency range 0 Hz to 400 GHz are covered. No tests need to be performed at frequencies where no requirements are specified.

This generic EMC immunity standard is applicable if no relevant dedicated product or product-family EMC immunity standard exists.

This standard applies to apparatus intended to be directly connected to a low-voltage public mains network or connected to a dedicated DC source which is intended to interface between the apparatus and the low-voltage public mains network. This standard applies also to apparatus which is battery operated or is powered by a non-public, but non-industrial, low-voltage power distribution system if this apparatus is intended to be used in the locations described below.

The environments encompassed by this standard are residential, commercial and light-industrial locations, both indoor and outdoor. The following list, although not comprehensive, gives an indication of locations which are included:

- residential properties, for example houses, apartments;
- retail outlets, for example shops, supermarkets;
- business premises, for example offices, banks;
- areas of public entertainment, for example cinemas, public bars, dance halls;
- outdoor locations, for example petrol stations, car parks, amusement and sports centres;
- light-industrial locations, for example workshops, laboratories, service centres.

Locations which are characterised by being supplied directly at low voltage from the public mains network are considered to be residential, commercial or light-industrial.

The object of this standard is to define the immunity test requirements for apparatus specified in the scope in relation to continuous and transient, conducted and radiated disturbances including electrostatic discharges.

The immunity requirements have been selected to ensure an adequate level of immunity for apparatus at residential, commercial and light-industrial locations. The levels do not, however, cover extreme cases, which may occur at any location, but with an extremely low probability of occurrence. Not all disturbance phenomena have been included for testing purposes in this standard but only those considered as relevant for the equipment covered by this standard. These test requirements represent essential electromagnetic compatibility immunity requirements.

NOTE 1 Information on other disturbance phenomena is given in IEC 61000-4-1.

Test requirements are specified for each port considered.

NOTE 2 Safety considerations are not covered by this standard.

NOTE 3 In special cases, situations will arise where the levels of disturbances may exceed the test levels specified in this standard; for example where a hand-held transmitter is used in proximity to an apparatus. In these instances, special mitigation measures may have to be employed.

2 Normative references

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

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

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

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

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

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

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

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

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

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

3 Terms and definitions

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

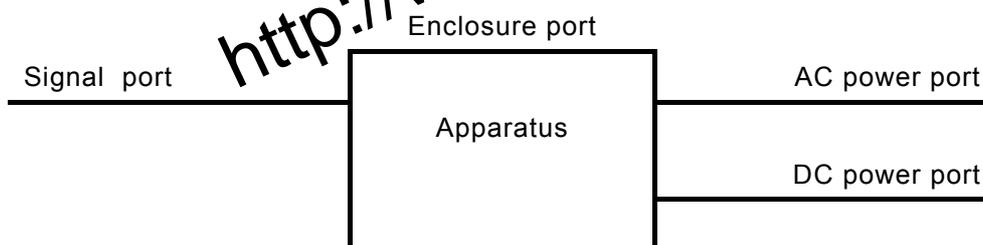
NOTE Additional definitions related to EMC and to relevant phenomena are given in other IEC and CISPR publications.

3.1

port

particular interface of the specified apparatus with the external electromagnetic environment (see Figure 1)

NOTE In some cases different ports may be combined.



IEC 457/05

Figure 1 – Examples of ports

3.2

enclosure port

physical boundary of the apparatus which electromagnetic fields may radiate through or impinge on

3.3

cable port

port at which a conductor or a cable is connected to the apparatus

NOTE Examples are signal and power ports.

3.4

signal port

port at which a conductor or cable intended to carry signals is connected to the apparatus

NOTE Examples are analog inputs, outputs and control lines; data busses; communication networks etc.

3.5

power port

port at which a conductor or cable carrying the primary electrical power needed for the operation (functioning) of an apparatus or associated apparatus is connected to the apparatus

3.6

public mains network

electricity lines to which all categories of consumers have access and which are operated by an electrical power supply and/or distribution organization for the purpose of supplying electrical energy

3.7

long distance lines

lines connected to a signal port and which inside a building are longer than 30 m, or which leave the building (including lines of outdoor installations)

3.8

low voltage

voltage having a value below a conventionally adopted limit

(see IEC 60384-14)

4 Performance criteria

The variety and the diversity of the apparatus within the scope of this standard makes it difficult to define precise criteria for the evaluation of the immunity test results.

If, as a result of the application of the tests defined in this standard, the apparatus becomes dangerous or unsafe, the apparatus shall be deemed to have failed the test.

A functional description and a definition of performance criteria, during or as a consequence of the EMC testing, shall be provided by the manufacturer and noted in the test report, based on one of the following criteria for each test as specified in Tables 1 to 4.

- a) **Performance criterion A:** The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.
- b) **Performance criterion B:** The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.
- c) **Performance criterion C:** Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

5 Conditions during testing

The equipment under test (EUT) shall be tested in the expected most susceptible operating mode e.g. identified by performing limited pre-tests. This mode shall be consistent with normal applications. The configuration of the test sample shall be varied to achieve maximum susceptibility consistent with typical applications and installation practice.

If the apparatus is part of a system, or can be connected to auxiliary apparatus, the apparatus shall be tested while connected to the minimum representative configuration of auxiliary apparatus necessary to exercise the ports in a similar manner to that described in CISPR 22.

In cases where a manufacturer's specification requires external protection devices or measures which are clearly specified in the user's manual, the test requirements of this standard shall be applied with the external protection devices or measures in place.

The configuration and mode of operation during the tests shall be precisely noted in the test report. It is not always possible to test every function of the apparatus; in such cases the most critical mode(s) of operation shall be selected.

If the apparatus has a large number of similar ports or ports with many similar connections, a sufficient number shall be selected to simulate actual operating conditions and to ensure that all the different types of termination are covered.

The tests shall be carried out at one single set of parameters within the operating ranges of temperature, humidity and atmospheric pressure specified for the product and at the rated supply voltage, unless otherwise indicated in the basic standard.

6 Product documentation

If the manufacturer is using his own specification for an acceptable level of EMC performance or degradation of EMC performance during or after the testing required by this standard, this fact shall be stated in the user documentation. This specification itself shall be made available upon request.

7 Applicability

The application of tests for evaluation of immunity depends on the particular apparatus, its configuration, its ports, its technology and its operating conditions.

Tests shall be applied to the relevant ports of the apparatus according to Tables 1 to 4. Tests shall only be carried out where the relevant ports exist.

It may be determined from consideration of the electrical characteristics and usage of a particular apparatus that some of the tests are inappropriate and therefore unnecessary. In such a case it is required that the decision and justification not to test shall be recorded in the test report.

8 Immunity test requirements

The immunity test requirements for apparatus covered by this standard are given on a port by port basis.

Tests shall be conducted in a well-defined and reproducible manner.

The tests shall be carried out individually as single tests in sequence. The tests may be performed in any order.

The description of the test, relevant generator, appropriate methods, and the set-up to be used are given in basic standards, which are referred to in the following tables.

The contents of these basic standards are not repeated here, however modifications or additional information needed for the practical application of the tests are given in this standard.

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Table 1 – Immunity – Enclosure port

Environmental phenomena	Test specifications	Units	Basic standards	Remarks	Performance criterion
1.1 Power-frequency magnetic field	50, 60 3	Hz A/m	IEC 61000-4-8	The test shall be carried out at the frequencies appropriate to the power supply frequency. Equipment intended for use in areas supplied only at one of these frequencies need only be tested at that frequency. ^a	A ^b
1.2 Radio-frequency electromagnetic field. Amplitude modulated	80 to 1 000 3 80	MHz V/m % AM (1 kHz)	IEC 61000-4-3 ^c	The test level specified is the r.m.s. value of the unmodulated carrier.	A
1.3 Radio-frequency electromagnetic field. Amplitude modulated	1,4 to 2,0 3 80	GHz V/m % AM (1 kHz)	IEC 61000-4-3 ^c	The test level specified is the r.m.s. value of the unmodulated carrier. ^d	A
1.4 Radio-frequency electromagnetic field. Amplitude modulated	2,0 to 2,7 1 80	GHz V/m % AM (1 kHz)	IEC 61000-4-3 ^c	The test level specified is the r.m.s. value of the unmodulated carrier.	A
1.5 Electrostatic discharge	Contact discharge	kV	IEC 61000-4-2	See basic standard for applicability of contact and/or air discharge test.	B
	Air discharge	kV			B

^a Applicable only to apparatus containing devices susceptible to magnetic fields.

^b For CRTs, the acceptable jitter depends upon the character size and is calculated for a test level of 1 A/m as follows:

$$J \leq \frac{3C+1}{40}$$

where jitter J and character size C are in millimetres.

As jitter is linearly proportional to the magnetic field strength, tests can be carried out at other test levels extrapolating the maximum jitter level appropriately.

^c IEC 61000-4-20 may be used for small EUTs as defined in IEC 61000-4-20 subclause 6.1.

^d The frequency range has been selected to cover the frequencies with the highest potential risk of a disturbance.

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Table 2 – Immunity – Signal ports

	Environmental phenomena	Test specifications	Units	Basic standards	Remarks	Performance criterion
2.1	Radio-frequency common mode	0,15 to 80 3 80	MHz V % AM (1 kHz)	IEC 61000-4-6	The test level specified is the r.m.s. value of the unmodulated carrier ^{a, b}	A
2.2	Fast transients	±0,5 5/50 5	kV (open circuit test voltage) Tr/Th ns Repetition frequency kHz	IEC 61000-4-4	Capacitive clamp used ^b	B
<p>^a The test level can also be defined as the equivalent current into a 150 Ω load.</p> <p>^b Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.</p>						

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Table 3 – Immunity – Input and output DC power ports

Environmental phenomena	Test specifications	Units	Basic standards	Remarks	Performance criterion
3.1 Radio-frequency common mode	0,15 to 80 3 80	MHz V % AM (1 kHz)	IEC 61000-4-6	The test level specified is the r.m.s. value of the unmodulated carrier ^{a, b}	A
3.2 Surges line-to-earth line-to-line	1,2/50 (8/20) ±0,5 ±0,5	Tr/Th µs kV (open circuit test voltage) kV (open circuit test voltage)	IEC 61000-4-5	For application to input ports ^c	B
3.3 Fast transients	±0,5 5/50 5	kV (open circuit test voltage) Tr/Th ns Repetition frequency kHz	IEC 61000-4-4	For application to input ports ^d	B

a The test level can also be defined as the equivalent current into a 150 Ω load.

b Applicable only to ports interfacing with cables whose total length according to the manufacturers functional specification may exceed 3 m.

c Not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the apparatus for recharging. Apparatus with a DC power input port intended for use with an AC - DC power adaptor shall be tested on the AC power input of the AC- DC power adaptor specified by the manufacturer or, where none is so specified, using a typical AC - DC power adaptor. DC ports which are not intended to be connected to a DC distribution network are treated as signal ports.

d Not applicable to input ports intended for connection to a battery or a rechargeable battery which must be removed or disconnected from the apparatus for recharging. Apparatus with a DC power input port intended for use with an AC - DC power adaptor shall be tested on the AC power input of the AC- DC power adaptor specified by the manufacturer or, where none is so specified, using a typical AC - DC power adaptor. The test is applicable to DC power input ports intended to be connected permanently to cables longer than 3 m.

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Table 4 – Immunity – Input and output AC power ports

Environmental phenomena	Test specifications	Units	Basic standards	Remarks	Performance criterion
4.1 Radio-frequency common mode	0,15 to 80 3 80	MHz	IEC 61000-4-6	The test level specified is the r.m.s. value of the unmodulated carrier ^a	A
		V			
		% AM (1 kHz)			
4.2 Voltage dips	0 0,5 0 1 70 25/30 at 50/60Hz	% residual voltage	IEC 61000-4-11	Voltage shift at zero crossing ^b	B
		cycle			
		% residual voltage			
		cycle			
		% residual voltage			
4.3 Voltage interruptions	0 250/300 at 50/60Hz	% residual voltage	IEC 61000-4-11	Voltage shift at zero crossing ^b	C
		cycle			
4.4 Surges line-to-earth line-to-line	1,2/50 (8/20) ±2 ±1	Tr/Th µs	IEC 61000-4-5		B
		kV (open circuit test voltage)			
		kV (open circuit test voltage)			
4.5 Fast transients	±1 5/50 5	kV (open circuit test voltage)	IEC 61000-4-4		B
		Tr/Th ns			
		Repetition frequency kHz			
<p>^a The test level can also be defined as the equivalent current into a 150 Ω load.</p> <p>^b Applicable only to input ports.</p>					

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Bibliography

IEC 61000-4-1, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*

NOTE Harmonized as EN 61000-4-1:2000 (not modified).

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

NOTE Harmonized as EN 61000-4-20:2003 (not modified).

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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-161	- ¹⁾	International Electrotechnical Vocabulary Chapter 161: Electromagnetic compatibility	-	-
IEC 61000-4-2	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995 ²⁾
IEC 61000-4-3	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006 ²⁾
IEC 61000-4-4	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2004 ²⁾
IEC 61000-4-5	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2006 ²⁾
IEC 61000-4-6	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	-	-
IEC 61000-4-8	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	EN 61000-4-8	1993 ²⁾
IEC 61000-4-11	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004 ²⁾
CISPR 22 (mod)	- ¹⁾	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55022	2006 ²⁾

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

Annex ZZ
(informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers the essential requirements as given in Article 4(b) of the EC Directive 89/336/EEC and Annex I Article 1(b) of the EC Directive 2004/108/EC, and the essential requirements of Article 9.1(b) (immunity only) of the EC Directive 1999/5/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directives concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

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