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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Electromagnetic compatibility (EMC) –
Part 6-2: Generic standards – Immunity standard for industrial environments

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 6-2: Generic standards – Immunity standard for industrial environments

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 61000-6-2 has been prepared by IEC technical committee 77: Electromagnetic compatibility.

This third edition cancels and replaces the second edition published in 2005. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) improvement of the environmental description;
b) extension of the frequency range for the radio-frequency electromagnetic field test according to IEC 61000-4-3;
c) amended test levels at particular frequencies for the radio-frequency electromagnetic field test according to IEC 61000-4-3;
d) change of the repetition frequency for the fast transients immunity test according to IEC 61000-4-4;
e) introduction of requirements according to IEC 61000-4-34;
f) revision of the test levels;
g) consideration of measurement uncertainty;
h) addition of Annex A.

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

FDIS	Report on voting
77/521/FDIS	77/523/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61000 series, published under the general title *Electromagnetic compatibility (EMC)*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

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 these limits 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: IEC 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 6-2: Generic standards – Immunity standard for industrial environments

1 Scope ~~and object~~

This part of IEC 61000 for EMC immunity requirements applies to electrical and electronic ~~apparatus~~ equipment intended for use in industrial ~~environments~~ locations, as described below. 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 connected to a power network supplied from a high or medium voltage transformer dedicated to the supply of an installation feeding manufacturing or similar plant, and~~ electrical and electronic equipment intended to be operated in ~~or in proximity to~~ industrial locations, as ~~described below~~ defined in 3.7, both indoor and outdoor.

This standard applies also to ~~apparatus~~ equipment intended to be directly connected to a DC distribution network or which is battery operated, and intended to be used in industrial locations.

~~The environments encompassed by this standard are industrial, both indoor and outdoor.~~

~~Industrial locations are in addition characterised by the existence of one or more of the following:~~

~~– industrial, scientific and medical (ISM) apparatus (as defined in CISPR 11);~~

~~– heavy inductive or capacitive loads are frequently switched;~~

~~– currents and associated magnetic fields are high.~~

~~The object of~~ This standard ~~is to~~ defines the immunity test requirements for ~~apparatus defined~~ equipment 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~~ equipment operating within 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. They are specified for each port considered.

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

NOTE 2 Safety considerations are not covered by this standard.

NOTE 3 In special cases, situations will arise where the level of disturbances may exceed the levels specified in this standard, for example where ~~an apparatus~~ equipment is installed in proximity to industrial, scientific and medical equipment as defined in CISPR 11 or where a hand-held transmitter is used in close proximity to ~~an apparatus~~ equipment. In these instances, special mitigation measures may have to be employed.

~~NOTE 4~~ The industrial environment may be changed by special mitigation measures. Where such measures can be shown to produce an electromagnetic environment equivalent to the residential, commercial or light-industrial environment, then the generic standard for this environment, or the relevant product standard, ~~should~~ may be applied.

2 Normative references

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

IEC 60050-161, *International Electrotechnical Vocabulary – Part 161: Electromagnetic compatibility* (available at: www.electropedia.org)

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

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

IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61000-4-21:2011, *Electromagnetic compatibility (EMC) – Part 4-21: Testing and measurement techniques – Reverberation chamber test methods*

IEC 61000-4-22:2010, *Electromagnetic compatibility (EMC) – Part 4-22: Testing and measurement techniques – Radiated emissions and immunity measurements in fully anechoic rooms (FARs)*

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009

~~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 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~~ equipment which couples this equipment with or is influenced by the external electromagnetic environment ~~(see Figure 1)~~

Note 1 to entry: ~~In some cases different ports may be combined.~~ Examples of ports of interest are shown in Figure 1. The enclosure port is the physical boundary of the equipment (e.g. enclosure). The enclosure port provides for radiated and electrostatic discharge (ESD) energy transfer, whereas the other ports provide for conducted energy transfer, either by direct injection or by induction.

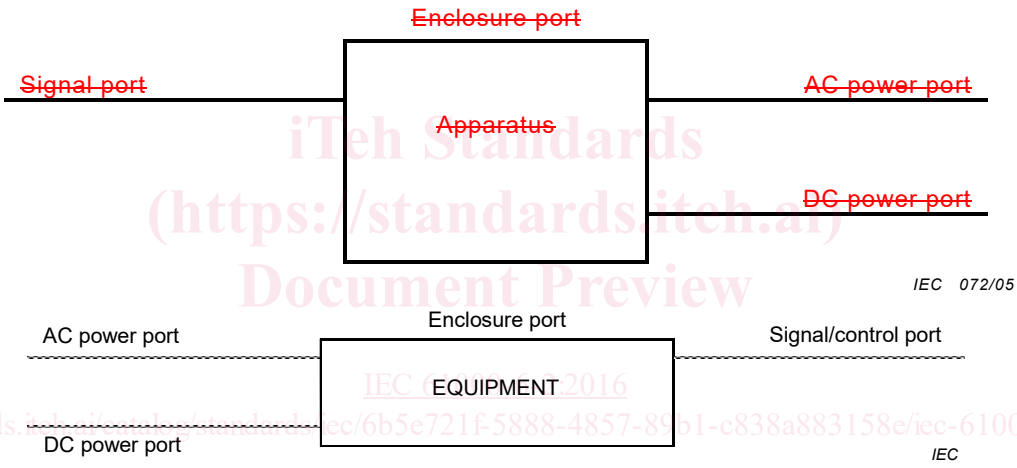

Figure 1 – ~~Example of~~ Equipment ports

3.2
enclosure port
physical boundary of the ~~apparatus~~ equipment through which electromagnetic fields may radiate ~~through~~ or on which they may 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.~~

3.3
signal/control port
port at which a conductor or cable intended to carry signals is connected to the ~~apparatus~~ equipment

~~NOTE~~ EXAMPLE Analog inputs, outputs and control lines; data buses; communication ~~networks~~ lines, etc.

3.4
power port
port at which a conductor or cable, carrying the ~~primary~~ electrical input/output power needed for the operation (functioning) ~~of an apparatus or associated apparatus~~ is connected to the ~~apparatus~~ equipment

3.5
long distance line~~s~~
line~~s~~ connected to a signal/control port and which inside a building ~~are~~ is longer than 30 m, or which leaves the building (including ~~lines of outdoor installations~~ a line installed outdoors)

3.6
DC distribution network
local DC electricity supply network in the infrastructure of a certain site or building intended for flexible use by one or more different types of equipment and ensuring continuous power supply independently from the conditions of the public mains network

Note 1 to entry: Connection to a remote local battery is not regarded as a DC distribution network, if such a link comprises only power supply for a single piece of equipment.

3.7
industrial location
location characterized by a separate power network, supplied from a high- or medium-voltage transformer, dedicated for the supply of the installation

EXAMPLE Metalworking, pulp and paper, chemical plants, car production, farm building, high-voltage areas of airports.

Note 1 to entry: Industrial locations can generally be described by the existence of an installation with one or more of the following characteristics:

– items of equipment installed and connected together and working simultaneously;
– significant amount of electrical power generated, transmitted and/or consumed;
– frequent switching of heavy inductive or capacitive loads;
– high currents and associated magnetic fields;
– presence of industrial, high power scientific and medical (ISM) equipment (for example, welding machines).

The electromagnetic environment at an industrial location is predominantly produced by the equipment and installation present at the location. There are types of industrial locations where some of the electromagnetic phenomena appear in a more severe degree than in other installations.

Note 2 to entry: The connection between location and electromagnetic environment is given in 3.8.

3.8
electromagnetic environment
totality of electromagnetic phenomena existing at a given location

Note 1 to entry: In general, the electromagnetic environment is time-dependent and its description may need a statistical approach.

Note 2 to entry: It is very important not to confuse the electromagnetic environment and the location itself.

[SOURCE: IEC 60050-161:1990, 161-01-01, modified – Note 2 to entry has been added.]

3.9
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

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 specific performance criteria, during or as a consequence of ~~the EMC~~ immunity testing of equipment under test (EUT), shall be provided by the manufacturer and noted in the test report~~, based on~~. They shall be consistent with one of the following general criteria for each test as specified in Table 1 to Table 4:

a) Performance criterion A: The ~~apparatus~~ EUT 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~~ EUT 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~~ this may be derived from the product description and documentation and what the user may reasonably expect from the ~~apparatus~~ equipment if used as intended.

b) Performance criterion B: The ~~apparatus~~ EUT 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~~ EUT is used as intended. The performance level may be replaced by a permissible loss of performance. However, during the test, degradation of performance is allowed but 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~~ equipment if used as intended.

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

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

5 Conditions during testing

The equipment under test (EUT) shall be tested in the expected most susceptible operating mode, for example 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. The configuration and mode of operation during the tests shall be precisely noted in the test report.

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

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~~ equipment 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. Justification for the selection of the tested ports shall be included in the test report.

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 ~~specification~~ fact shall be ~~provided~~ stated in the ~~product~~ user documentation ~~available to the user~~. This specification itself shall be made available upon request.

7 Applicability

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

Tests shall be applied to the relevant ports of the ~~apparatus~~ equipment according to Table 1 to Table 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~~ equipment 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 Measurement uncertainty

Where guidance for the assessment of the instrumentation uncertainty of an immunity test is specified in IEC TR 61000-1-6 or in the corresponding basic standard, this should be followed.

9 Immunity test requirements

The immunity test requirements for ~~apparatus~~ equipment covered by this standard are given on a port by port basis and listed in Table 1 to Table 4.

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. Identical units may be used for testing in parallel, and this information shall be recorded in the test report.

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 Table 1 to Table 4.

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.

Table 1 – Immunity requirements – Enclosure ports

	Environmental phenomena		Test specifications	Units	Basic standards	Remarks	Performance criterion
1.1	Power-frequency magnetic field		50, 60 30	Hz A/m	IEC 61000-4-8	~~a~~ Applicable only to equipment containing devices susceptible to magnetic fields. 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 ~~b~~
1.2	Radio-frequency electromagnetic field. Amplitude modulated		80 to 1 000 10 [d] 80	MHz V/m % AM (1 kHz)	IEC 61000-4-3 [a, b, c]	~~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~~ 6,0 3 [d] 80	GHz V/m % AM (1 kHz)	IEC 61000-4-3 [a, b, c]	~~e~~ The test level specified is the r.m.s. value of the unmodulated carrier.	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 d~~	~~e~~ ~~The test level specified is the r.m.s. value of the unmodulated carrier~~	~~A~~
1.4	Electrostatic discharge	Contact discharge	±4 (charge voltage)	kV	IEC 61000-4-2	See the basic standard for applicability of contact and/or air discharge tests	B
		Air discharge	±8 (charge voltage)	kV			B