IEC 61000-3-2

Edition 5.0 2018-01
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Electromagnetic compatibility (EMC) –
Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

IEC 61000-3-2:2018-01 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 33.100.10

ISBN 978-2-8322-5332-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

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 61000-3-2 has been prepared by sub-committee 77A: EMC – Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms part 3-2 of the IEC 61000 series. It has the status of a product family standard.

This fifth edition cancels and replaces the fourth edition published in 2014. This edition constitutes a technical revision.

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

a) an update of the emission limits for lighting equipment with a rated power ≤ 25 W to take into account new types of lighting equipment;
b) the addition of a threshold of 5 W under which no emission limits apply to all lighting equipment;
c) the modification of the requirements applying to the dimmers when operating non-incandescent lamps;
d) the addition of test conditions for digital load side transmission control devices;
e) the removal of the use of reference lamps and reference ballasts for the tests of lighting equipment;
f) the simplification and clarification of the terminology used for lighting equipment;
g) the classification of professional luminaires for stage lighting and studios under Class A;
h) a clarification about the classification of emergency lighting equipment;
i) a clarification for lighting equipment including one control module with an active input power ≤ 2 W;
j) an update of the test conditions for television receivers;
k) an update of the test conditions for induction hobs, taking also into account the other types of cooking appliances;
l) for consistency with IEC 61000-3-12, a change of the scope of IEC 61000-3-2 from equipment with an input current ≤ 16 A to equipment with a rated input current ≤ 16 A.

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

FDIS	Report on voting
77A/986/FDIS	77A/990/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 web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

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 document 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 levels

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far 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 sections which are to be published either as international standards, technical specifications, or as technical reports.~~

~~These standards and reports will be published in chronological order and numbered accordingly (for example, 61000-6-1).~~

~~This part is an international standard which gives emission limits for harmonic currents from equipment having an input current up to and including 16 A per phase.~~

~~This part is a Product Family Standard.~~

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 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

1 Scope

This part of IEC 61000 deals with the limitation of harmonic currents injected into the public supply system.

It specifies limits of harmonic components of the input current which ~~may~~ can be produced by equipment tested under specified conditions.

~~Harmonic components are measured according to Annexes A and B.~~

This part of IEC 61000 is applicable to electrical and electronic equipment having a~~n~~ rated input current up to and including 16 A per phase, and intended to be connected to public low-voltage distribution systems.

Arc welding equipment which is not professional equipment, with a rated input current up to and including 16 A per phase, is included in this document. Arc welding equipment intended for professional use, as specified in IEC 60974-1, is excluded from this document and ~~may~~ can be subject to installation restrictions as indicated in ~~IEC/TR 61000-3-4 or~~ IEC 61000-3-12.

The tests according to this document are type tests. ~~Test conditions for particular equipment are given in Annex C.~~

For systems with nominal voltages less than but not equal to 220 V (line-to-neutral), the limits have not yet been considered.

NOTE The words apparatus, appliance, device and equipment are used throughout this document. They have the same meaning for the purposes of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60050-131, *International Electrotechnical Vocabulary (IEV) – Part 131: Electric and magnetic circuits*~~

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

~~IEC 60107-1, *Methods of measurement on receivers for television broadcast transmissions – Part 1: General considerations – Measurements at radio and video frequencies*~~

IEC 60155, *Glow-starters for fluorescent lamps*

~~IEC 60268-1:1985, *Sound system equipment – Part 1: General*~~

IEC 60268-3, *Sound system equipment – Part 3: Amplifiers*

~~IEC 60335-2-2, *Household and similar electrical appliances – Safety – Part 2-2: Particular requirements for vacuum cleaners and water-suction cleaning appliances*~~

~~IEC 60335-2-14, *Household and similar electrical appliances – Safety – Part 2-14: Particular requirements for kitchen machines*~~

IEC 60335-2-24:2010, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers*

~~IEC 60335-2-79, *Household and similar electrical appliances – Safety – Part 2-79: Particular requirements for high pressure cleaners and steam cleaners*~~

~~IEC 60974-1, *Arc welding equipment – Part 1: Welding power sources*~~

~~IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*~~

~~IEC/TR 61000-3-4, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*~~

~~IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*~~

IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*
IEC 61000-4-7:2002/AMD1:2008

~~Recommendation ITU-R BT.471-1, *Nomenclature and description of colour bar signals*~~

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
portable tool
electrical tool which is hand-held during normal operation and used for a short time (a few minutes) only

Note 1 to entry: Hand-held means that no part of the tool, except the power cord, rests on the floor during normal operation.

3.2
lamp
source ~~for producing light~~ intended to produce an optical radiation, usually visible

Note 1 to entry: For the purposes of this document, a lamp can also be a solid state lighting module which can contain further components, for example optical, electrical, mechanical and/or electronic components.

3.3
self-ballasted lamp
unit which cannot be dismantled without being permanently damaged, is provided with a lamp cap and ~~incorporating~~ incorporates a light source and ~~any additional element~~ the lighting control gear necessary for ~~starting and stable~~ the operation of the light source

3.4
luminaire
apparatus ~~(other than a lamp)~~ which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all the parts necessary for ~~supporting,~~ fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply

[SOURCE: IEC 60050-845:1987, 845-10-01, modified – the existing notes have been removed]

~~**3.5**~~
~~**ballast**~~
~~device connected between the supply and one or more discharge lamps which serves mainly to limit the current of the lamp(s) to the required value. It may include means for transforming the supply voltage and/or frequency, correcting the power factor and, either alone or in combination with a starting device, provide the necessary conditions for starting the lamp(s)~~

~~**3.6**~~
~~**step-down converter for lighting equipment**~~
~~unit inserted between the supply and one or more tungsten halogen or other filament lamps which serves to supply the lamp(s) with its (their) rated voltage, generally at high frequency. The unit may consist of one or more separate components. It may include means for dimming, correcting the power factor and suppressing radio interference~~

~~**3.7**~~
~~**reference lamp**~~
~~lamp selected for testing ballasts which, when associated with a reference ballast, has electrical characteristics that are close to the objective values given in the relevant lamp specification~~

~~**3.8**~~
~~**reference ballast**~~
~~special inductive type ballast designed for the purpose of providing comparison standards for use in testing ballasts and for the selection of reference lamps. It is essentially characterized by a stable voltage-to-current ratio, which is relatively uninfluenced by variations in current, temperature, and the magnetic surroundings~~

3.5
input current
current directly supplied to an equipment or a part of equipment by the AC distribution system

3.6
circuit power factor
~~the circuit power factor is the~~ ratio of the measured active input power to the product of the RMS supply voltage and the RMS supply current

3.7
active power
mean value~~, taken over one period,~~ of the instantaneous power, taken over 10 (50 Hz systems) or 12 (60 Hz systems) fundamental periods and measured in accordance with IEC 61000-4-7

Note 1 to entry: The active input power is the active power measured at the input supply terminals of the equipment under test.

~~[SOURCE: IEC 60050-131:2013, 131-11-42]~~

3.8
balanced three-phase equipment
equipment having rated line current modules which differ by no more than 20 %

3.9
professional equipment
equipment for use in trades, professions or industries and which is not intended for sale to the general public~~. The designation shall be specified~~, as designated by the manufacturer.

[SOURCE: IEC 60050-161:1990, 161-05-05, modified – the existing Note has been replaced by the text added at the end of the definition]

~~**3.14**~~
~~**total harmonic**~~

3.10
total harmonic current
THC
total RMS value of the harmonic current components of orders 2 to 40, expressed as:

$$\sqrt{\sum_{n=2}^{40} I_n^2} \qquad THC = \sqrt{\sum_{h=2}^{40} I_h^2}$$

Note 1 to entry: This note applies to the French language only.

3.11
total harmonic distortion
THD
ratio of the RMS value of the sum of the harmonic components (in this context, harmonic current components I_h of orders 2 to 40) to the RMS value of the fundamental component, expressed as:

$$THD = \sqrt{\sum_{h=2}^{40} \left(\frac{I_h}{I_1} \right)^2}$$

Note 1 to entry: This note applies to the French language only.

3.12
partial odd harmonic current
POHC
total RMS value of the odd harmonic current components of orders 21 to 39, expressed as:

$$\sqrt{\sum_{n=21,23}^{39} I_n^2} \qquad POHC = \sqrt{\sum_{h=21,23}^{39} I_h^2}$$

Note 1 to entry: This note applies to the French language only.

3.13
lighting equipment
equipment with a primary function of generating and/or regulating and/or distributing optical radiation ~~by means of incandescent lamps, discharge lamps or LED's~~

~~Included are:~~

- ~~lamps and luminaires;~~
- ~~the lighting part of multi-function equipment where one of the primary functions of this is illumination;~~
- ~~independent ballasts for discharge lamps and independent incandescent lamp transformers;~~
- ~~ultraviolet (UV) and infrared (IR) radiation equipment;~~
- ~~illuminated advertising signs;~~
- ~~dimmers for lamps other than incandescent.~~

~~Excluded are:~~

- ~~lighting devices built in equipment with another primary purpose such as photocopiers, overhead projectors and slide projectors or employed for scale illuminating or indication purposes;~~
- ~~household appliances whose primary function is not for generating and/or regulating and/or distributing optical radiation but which contain one or more lamps with or without separate switch (e.g. a range hood with a built-in lamp);~~
- ~~dimmers for incandescent lamps.~~

Note 1 to entry: See also 5.2.

3.14
stand-by mode
~~**sleep-mode**~~
non-operational, low power consumption mode (usually indicated in some way on the equipment) that can persist for an indefinite time

3.15
repeatability
<results of measurements> closeness of the agreement between the results of measurements of harmonic currents on the same equipment under test, carried out with the same test system, at the same location, under identical test conditions

~~[SOURCE: IEC 60050-394:2007, 394-40-38, modified[1)]]~~

3.16
reproducibility
<results of measurements> closeness of the agreement between the results of measurements of harmonic currents on the same equipment under test, carried out with different test systems under conditions of measurement intended to be the same in each case

Note 1 to entry: The test system and test conditions are assumed to fulfil all normative requirements in the applicable standards.

~~[SOURCE: IEC 60050-394:2007, 394-40-39, modified]~~

~~1) IEC 60050-394:2007, *International Electrotechnical Vocabulary – Part 394: Nuclear instrumentation – Instruments, systems, equipment and detectors*~~

3.17
variability
<results of measurements> closeness of the agreement between the results of measurements of harmonic currents on different samples of the same type of equipment under test, having no intentional differences, carried out with different test systems under conditions of measurement intended to be the same in each case

Note 1 to entry: The test system and test conditions are assumed to fulfil all normative requirements in the applicable standards.

Note 2 to entry: In the context of this document, the meaning of the terms can be summarized as follows:

Term	Meaning
Repeatability	Same equipment under test (EUT), same test system, same test conditions, repeated tests
Reproducibility	Same equipment under test (EUT), different but normative test systems, different but normative test conditions
Variability	Different equipments under test (EUTs) of the same type, having no intentional differences, different but normative test systems, different but normative test conditions

3.18
variable speed drive
VSD
equipment, based on power electronics, which enables the speed and/or torque of a motor to be continuously controlled

3.19
lighting control gear
device connected between the supply and one or more lamps, enabling the lamp(s) to operate as intended

Note 1 to entry: The lighting control gear can consist of one or more separate components. It can include means for dimming, correcting the power factor and suppressing radio interference, and further control functions.

Note 2 to entry: The lighting control gear can be partly or totally integrated in some lamps, such as in the case of self-ballasted lamps. Any references to lighting control gear include any such integrated lamps.

Note 3 to entry: Examples of lighting control gear are ballasts or electronic control gear for discharge lamps, step-down converters for incandescent lamps, drivers for solid state lighting modules.

Note 4 to entry: For the purposes of this document, independent phase control dimmers as defined in 3.23 and 3.24 are not considered to be lighting control gear.

Note 5 to entry: Mechanical switches and relays, and other simple devices providing on/off control only, do not produce distorted currents and are not considered to be lighting control gear.

3.20
digital load side transmission lighting control device
DLT control device
device to control lighting parameters of electronic lighting equipment, such as light level and light colour, using data transmission over its load side mains wiring in accordance with IEC 62756-1

Note 1 to entry: A DLT control device is wired like a phase control dimmer, but does not directly make the supply power delivered to the connected dedicated lighting equipment vary. It transmits digital signals over the power cable on the load side to the dedicated lighting equipment, which contains means for receiving and interpreting control signals as well as built-in means for dimming, colour variation, etc.

Note 2 to entry: This note applies to the French language only.

3.21
dimmer
device to control the light output level of lighting equipment

3.22
built-in dimmer
dimmer~~, including the user control,~~ which is ~~entirely~~ either contained within the enclosure of a luminaire or mounted in its supply cable

3.23
independent dimmer
dimmer other than a built-in dimmer

3.24
phase control dimmer
electronic switch producing a leading edge (forward phase) or a trailing edge (reverse phase) AC waveform

Note 1 to entry: This AC waveform is supplied to one or more loads and its conduction angle is adjustable.

3.25
universal phase control dimmer
phase control dimmer which is capable of switching, automatically or manually, between producing a leading edge or a trailing edge AC waveform

3.26
professional luminaire for stage lighting and studios
luminaire (outdoor or indoor) for stage lighting or for television, film or photographic studios within the scope of IEC 60598-2-17 and which is professional equipment

4 General

The objective of this document is to set limits for harmonic emissions of equipment within its scope, so that, with due allowance for the emissions from other equipment, compliance with the limits ensures that harmonic disturbance levels do not exceed the compatibility levels defined in IEC 61000-2-2.

Professional equipment that does not comply with the requirements of this document ~~may~~ can be permitted to be connected to certain types of low voltage supplies, if the instruction manual contains a requirement to ask the supply utility for permission to connect. Recommendations concerning this aspect are contained in ~~IEC/TR 61000-3-4 or~~ IEC 61000-3-12.

5 Classification of equipment

5.1 General

For the purpose of harmonic current limitation, equipment is classified as follows:

Class A:

Equipment not specified ~~in one of the three other classes~~ as belonging to Class B, C or D shall be considered as Class A equipment.

Some examples of Class A equipment are:

– balanced three-phase equipment;
– household appliances, excluding ~~equipment identified~~ those specified as belonging to Class B, C or D;
– vacuum cleaners;
– high pressure cleaners;

– tools, excluding portable tools;
– independent phase control dimmers ~~for incandescent lamps~~;
– audio equipment;
– professional luminaires for stage lighting and studios.

NOTE 1 Equipment that can be shown to have a significant effect on the supply system ~~may~~ might be reclassified in a future edition of this document, taking into account the following factors:

– number of pieces of equipment in use;
– duration of use;
– simultaneity of use;
– power consumption;
– harmonic spectrum, including phase.

Class B:

– portable tools;
– arc welding equipment which is not professional equipment.

Class C:

– lighting equipment.

Class D:

Equipment having a specified power according to 6.3.2, less than or equal to 600 W, of the following types:

– personal computers and personal computer monitors;
– television receivers;
– refrigerators and freezers having one or more variable-speed drives to control compressor motor(s).

NOTE 2 Class D limits are reserved for equipment that, by virtue of the factors listed in note 1, can be shown to have a pronounced effect on the public electricity supply system.

5.2 Description of lighting equipment

In this document, lighting equipment as defined in 3.13 includes:

– lamps and luminaires;
– the lighting part of multi-function equipment where one of the primary functions of this is illumination;
– independent lighting control gear;
– ultraviolet (UV) and infrared (IR) radiation equipment;
– illuminated advertising signs;
– independent dimmers, other than phase control types, for lighting equipment;
– DLT control devices.

In this document, lighting equipment as defined in 3.13 excludes:

– lighting devices built in equipment with another primary purpose, such as photocopiers, overhead projectors and slide projectors, or employed for scale illumination or indication purposes;
– household appliances whose primary function is not for generating and/or regulating and/or distributing optical radiation but which contain one or more lamps with or without a separate switch (e.g. a range hood with a built-in lamp);
– independent phase control dimmers;

– professional luminaires for stage lighting and studios;

– emergency luminaires that emit light only during emergency mode.

6 General requirements

6.1 General

The restrictions specified in 6.2 also apply ~~even~~ to the categories of equipment listed in 7.1 for which no harmonic current limits apply.

The requirements and limits specified in this document are applicable to the power input terminals of equipment intended to be connected to 220/380 V, 230/400 V and 240/415 V systems operating at 50 Hz or 60 Hz. Requirements and limits for other cases are not yet ~~considered~~ specified.

A simplified test method is permitted for equipment that undergoes minor changes or updates, provided that, in previous full compliance tests, it has been shown to have current emissions below 60 % of the applicable limits and the THD of the supply current is less than 15 %. The simplified test method consists of verifying that the updated equipment has an active input power within ±20 % of that of the originally tested product, and that the THD of the supply current is less than 15 %. Products that fulfill these requirements are deemed to comply with the applicable limits, but in case of doubt the result of a full compliance test according to Clauses 6 and 7 takes precedence over this simplified method.

6.2 Control methods

Asymmetrical controls according to IEC 60050-161:1990, 161-07-12, and half-wave rectification directly on the mains supply may only be used in the following circumstances:

a) where they are the only practical solution permitting the detection of unsafe conditions, or

b) where the controlled active input power is less than or equal to 100 W, or

c) where the controlled appliance is a portable equipment fitted with a two-core flexible cord and is intended for use for a short period of time, i.e. for a few minutes only.

If one of these three conditions is fulfilled, half-wave rectification may be used for any purpose, whereas asymmetrical controls may only be used for the control of motors.

NOTE 1 Such equipment includes, but is not limited to, hair dryers, electrical kitchen appliances and portable tools.

Symmetrical control methods which ~~are prone to~~ can produce harmonics ~~of low~~ up to the 40th order ~~($n \leq 40$)~~ in the input current may be used for the control of the power supplied to heating elements provided that the full sine-wave input power is less than or equal to 200 W, or that the limits of Table 3 are not exceeded.

Such symmetrical control methods are also allowed for professional equipment provided that either

a) one of the above conditions is fulfilled, or

b) the relevant emission limits according to Clause 7 are not exceeded when tested at the supply input terminals and in addition both the following conditions are fulfilled:

   1) it is necessary to control precisely the temperature of a heater whose thermal time constant is less than 2 s, and

   2) there is no other technique economically available.

Professional equipment whose primary purpose, considered as a whole, is not for heating, shall be tested against the relevant emission limits according to Clause 7.

NOTE 2 An example of a product whose primary purpose is not heating is a photocopier, whereas a cooker is considered to have heating as its primary purpose.

Domestic equipment with symmetrical control used for a short time (for example hair dryers) shall be tested under Class A.

Even though asymmetrical controls and half-wave rectification are permitted under the conditions given above, the equipment shall still comply with the harmonic requirements of this document.

NOTE 3 ~~The use of asymmetrical controls and half-wave rectification is allowed in the above circumstances; however, in case of fault, the d.c. component of the supplied current may disturb certain types of protection devices. In the same way, this may also happen with the use of symmetrical controls.~~
When using asymmetrical controls or half-wave rectification under the above circumstances, the input current has a DC component that can disturb certain types of protection devices in case of an earth fault. See IEC TR 60755.

6.3 Harmonic current measurement

6.3.1 Test configuration

Harmonic components shall be measured in accordance with the requirements given in Annex A for the test circuit and the supply source.

Specific test conditions for the measurement of harmonic currents associated with some types of equipment are given in Annex B.

For equipment not mentioned in Annex B, emission tests shall be conducted with the user's operation controls or automatic programs set to the mode expected to produce the maximum total harmonic current (THC) under normal operating conditions. This defines the equipment set-up during emission tests and not a requirement to measure THC or to conduct searches for worst-case emissions.

The harmonic current limits specified in Clause 7 apply to line currents and not to currents in the neutral conductor. Nevertheless, for single-phase equipment, it is permissible to measure the currents in the neutral conductor instead of the currents in the line.

The equipment is tested as presented by, and in accordance with information provided by, the manufacturer. Preliminary operation of motor drives by the manufacturer ~~may~~ can be needed before the tests are undertaken to ensure that results correspond with normal use.

6.3.2 Measurement procedure

The test shall be conducted according to the general requirements given in 6.3.3. The test duration shall be as defined in 6.3.4.

The measurement of harmonic currents shall be performed as follows:

– for each harmonic order, measure the 1,5 s smoothed RMS harmonic current in each discrete Fourier transform (DFT) time window as defined in ~~Annex B~~ IEC 61000-4-7;

– calculate the arithmetic average of the measured values from the DFT time windows, over the entire observation period as defined in 6.3.4.

The value of the input power to be used for the calculation of limits shall be determined as follows:

– measure the 1,5 s smoothed active input power in each DFT time window;

– determine the maximum of the measured values of power from the DFT time windows over the entire duration of the test.

NOTE The active input power supplied to the smoothing section of the measuring instrument as defined in ~~Annex B~~ IEC 61000-4-7 is the active input power in each DFT time window.

The harmonic currents and the active input power shall be measured under the same test conditions but need not be measured simultaneously.

~~In order not to use a value of power at which limits change abruptly, thus giving rise to doubt as to which limits apply,~~ The manufacturer may specify any value of power which is within ±10 % of the actual measured value and use it for determining the limits for the original manufacturer's conformity assessment test. The measured and specified values of power, as defined in 6.3.2, shall be documented in the test report.

If the value of the power found by measurement during emission tests other than the original manufacturer's conformity assessment test, measured according to the terms of 6.3.2, is not less than 90 % nor greater than 110 % of the value for power specified by the manufacturer in the test report (see 6.3.3.5), the specified value shall be used to establish the limits. If the measured value is outside of this tolerance band around the specified value, the measured power shall be used to establish the limits.

For Class C equipment, the fundamental current and power factor, specified by the manufacturer, shall be used for the calculation of limits (see 3.6). The fundamental component of the current and the power factor are measured and specified by the manufacturer in the same way as the power is measured and specified for the calculation of Class D limits. The value used for the power factor shall be obtained from the same DFT measurement window as the value for the fundamental component of current.

6.3.3 General requirements

6.3.3.1 Repeatability

The repeatability (see 3.15) of the average value for the individual harmonic currents over the entire test observation period shall be better than ±5 % of the applicable limit, when the following conditions are met:

– the same equipment under test (EUT) (not another of the same type, however similar);
– the same test system;
– the same location;
– identical test conditions;
– identical climatic conditions, if relevant.

~~NOTE~~ This repeatability requirement serves the purpose of defining the necessary observation period, see 6.3.4. It is not intended to serve as a pass/fail criterion for the assessment of compliance with the requirements of this document.

6.3.3.2 Reproducibility

The reproducibility (see 3.16) of measurements on the same EUT with different test systems cannot be definitively calculated so as to apply to all possible combinations of EUT, harmonics meter and test supply, but can be estimated to be better than ± (1 % + 10 mA), where the 1 % is 1 % of the average value of the total input current taken over the entire test observation period. Therefore, differences in results which are less than that value of current are deemed negligible, but in some cases a higher value ~~may~~ can occur.

For the avoidance of doubt in such cases, test results, obtained at different locations or on different occasions, that show that all the relevant limits are met shall be accepted as demonstrating compliance, even though the results ~~may~~ can differ more than the values for repeatability and reproducibility, given above.

NOTE The variability (see 3.17) of measurements on different EUTs of the same type, having no intentional differences, can be increased by practical component tolerances and other effects, such as possible interactions between the characteristics of the EUT and the measuring instrument or the power supply. The results of these

effects cannot be quantified in this document, for the same reasons as for reproducibility. The second paragraph of 6.3.3.2 also applies in the case of variability.

A ~~regulatory~~ concession in respect of limit values to allow for possible variability is ~~recommended but~~ outside the scope of this document.

6.3.3.3 Starting and stopping

When a piece of equipment is brought into operation or is taken out of operation, manually or automatically, harmonic currents and power are not taken into account for the first 10 s following the switching event.

The equipment under test shall not be in stand-by mode (see 3.14) for more than 10 % of any observation period.

6.3.3.4 Application of limits

The average values for the individual harmonic currents, taken over the entire test observation period shall be less than or equal to the applicable limits.

For each harmonic order, all 1,5 s smoothed RMS harmonic current values, as defined in 6.3.2, shall be either:

a) less than or equal to 150 % of the applicable limits, or

b) less than or equal to 200 % of the applicable limits under the following conditions, which apply all together:

   1) the EUT belongs to Class A for harmonics,

   2) the excursion beyond 150 % of the applicable limits lasts less than 10 % of the test observation period or in total 10 min (within the test observation period), whichever is smaller, and

   3) the average value of the harmonic current, taken over the entire test observation period, is less than 90 % of the applicable limits.

Harmonic currents less than 0,6 % of the input current measured under the test conditions, or less than 5 mA, whichever is greater, are disregarded.

For the 21st and higher odd order harmonics, the average value obtained for each individual odd harmonic over the full observation period, calculated from the 1,5 s smoothed RMS values according to 6.3.2, may exceed the applicable limits by 50 % provided that the following conditions are met:

- the measured partial odd harmonic current does not exceed the partial odd harmonic current which can be calculated from the applicable limits;
- all 1,5 s smoothed RMS individual harmonic current values shall be less than or equal to 150 % of the applicable limits.

~~NOTE~~ These exemptions (the use of the partial odd harmonic current for the average values and the 200 % short term limit for single 1,5 s smoothed values) are mutually exclusive and ~~cannot~~ shall not be used together.

6.3.3.5 Test report

The test report may be based on information supplied by the manufacturer to a testing facility, or be a document recording details of the manufacturer's own tests. It shall include all relevant information for the test conditions, the test observation period, and, when applicable for establishing the limits, the active power or fundamental current and power factor.

6.3.4 Test observation period

Observation periods (T_{obs}) for four different types of equipment behaviour are considered and described in Table 4.

6.4 Equipment in a rack or case

Where individual self-contained items of equipment are installed in a rack or case, they are regarded as being individually connected to the mains supply. The rack or case need not be tested as a whole.

7 Harmonic current limits

7.1 General

The procedure for applying the limits and assessing the results is shown in Figure 1.

For the following categories of equipment, limits are not specified in this document:

NOTE 1 Limits ~~may~~ might be defined in a future amendment or revision of the document.

– lighting equipment with a rated power less than but not equal to 5 W;

– equipment with a rated power of 75 W or less, other than lighting equipment;

NOTE 2 This value ~~may~~ might be reduced from 75 W to 50 W in the future, subject to approval by National Committees at that time.

– professional equipment with a total rated power greater than 1 kW;

– symmetrically controlled heating elements with a rated power less than or equal to 200 W;

– independent phase control dimmers ~~for incandescent lamps~~

- with a rated power less than or equal to 1 kW when operating incandescent lamps;
- with a rated power less than or equal to 200 W for trailing edge dimmers, and universal phase control dimmers with the default mode set to trailing edge, when operating lighting equipment other than incandescent lamps;
- with a rated power less than or equal to 100 W for leading edge dimmers, and universal phase control dimmers without default mode set to trailing edge, when operating lighting equipment other than incandescent lamps.

Clarification: For independent phase control dimmers labelled for use with incandescent lamps and other types of lighting equipment and with a rated power higher than 100 W or 200 W (depending on the type of phase control dimmer) and lower than or equal to 1 000 W, no limits apply to the dimmer when operating incandescent lamps, but limits apply when operating lighting equipment other than incandescent lamps.

NOTE 3 The lower bound for leading edge dimmers, and universal phase control dimmers without default mode set to trailing edge, is lower than the lower bound for trailing edge dimmers because the higher order harmonic emissions of leading edge dimmers are significantly higher when loaded with lamps other than incandescent lamps.

~~NOTE See also C.5.3.~~

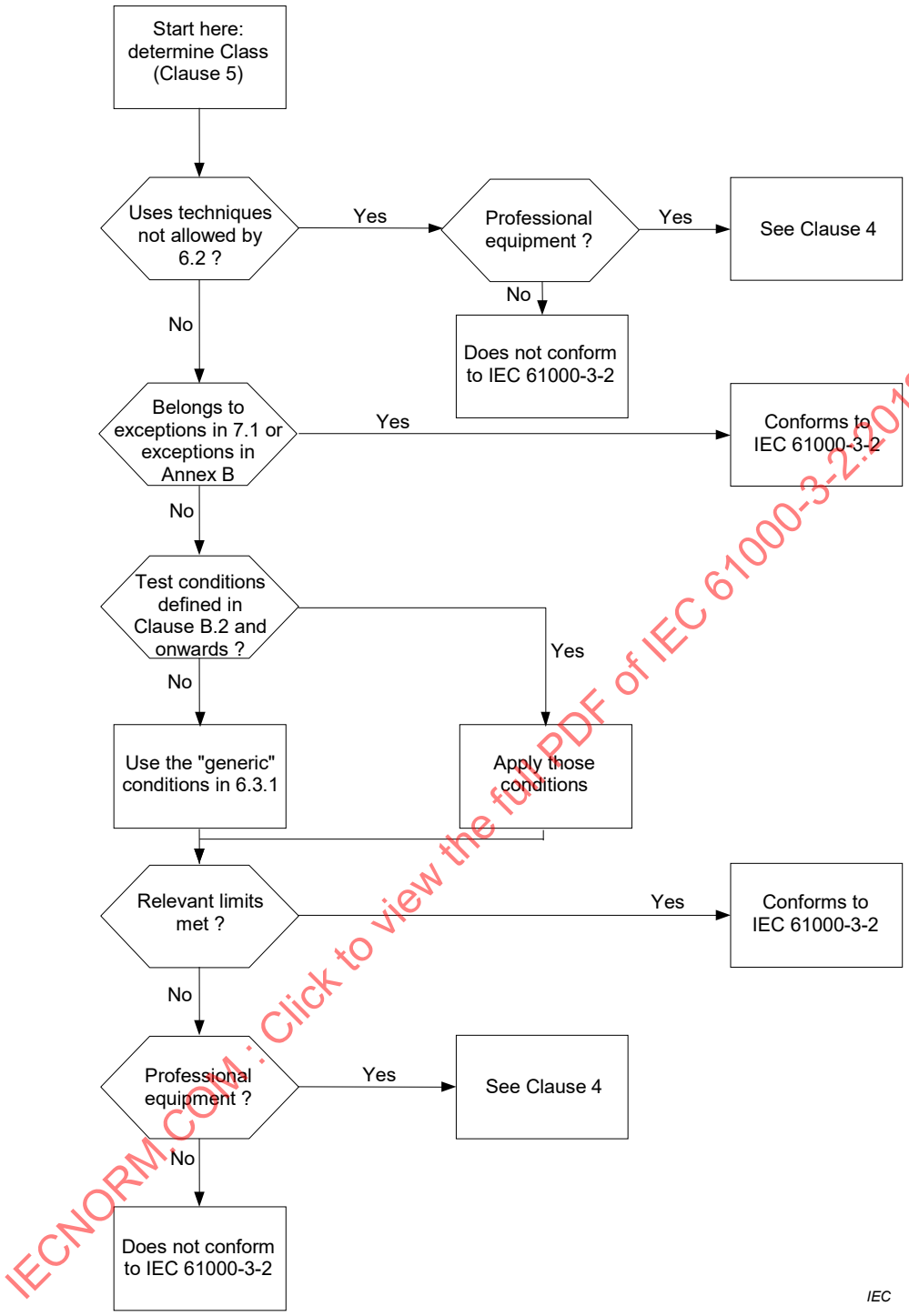


Figure 1 – Flowchart for determining conformity

7.2 Limits for Class A equipment

For Class A equipment, the harmonics of the input current shall not exceed the values given in Table 1.

Audio amplifiers shall be tested according to Clause B.3. Independent phase control dimmers for ~~incandescent lamps~~ lighting equipment shall be tested according to Clause B.6.

7.3 Limits for Class B equipment

For Class B equipment, the harmonics of the input current shall not exceed the values given in Table 1 multiplied by a factor of 1,5.

7.4 Limits for Class C equipment

~~a) Active input power > 25 W~~

~~For lighting equipment having an active input power greater than 25 W, the harmonic currents shall not exceed the relative limits given in Table 2.~~

~~However, the limits given in Table 1 apply to incandescent lighting equipment that has built-in dimmers or consists of dimmers built in an enclosure.~~

~~For discharge lighting equipment that has built-in dimmers or consists of independent dimmers or dimmers built in an enclosure, the following conditions apply:~~

- ~~the harmonic current values for the maximum load condition derived from the percentage limits given in Table 2 shall not be exceeded;~~
- ~~in any dimming position, the harmonic current shall not exceed the value of current allowed in the maximum load condition;~~
- ~~the equipment shall be tested according to the conditions given in Clause C.5 (see the last paragraph of C.5.3).~~

~~b) Active input power ≤ 25 W~~

~~Discharge lighting equipment having an active input power smaller than or equal to 25 W shall comply with one of the following two sets of requirements:~~

- ~~the harmonic currents shall not exceed the power-related limits of Table 3, column 2, or:~~
- ~~the third harmonic current, expressed as a percentage of the fundamental current, shall not exceed 86 % and the fifth harmonic current shall not exceed 61 %. Also, the waveform of the input current shall be such that it reaches the 5 % current threshold before or at 60°, has its peak value before or at 65° and does not fall below the 5 % current threshold before 90° referenced to any zero crossing of the fundamental supply voltage. The current threshold is 5 % of the highest absolute peak value that occurs in the measurement window, and the phase angle measurements are made on the cycle that includes this absolute peak value. See Figure 2.~~

~~If the discharge lighting equipment has a built-in dimming device, measurement is made only in the full load condition.~~

7.4.1 General

Lighting equipment shall be tested according to Clause B.5.

If the lighting equipment does not comply with the requirements of 7.4.2 or 7.4.3 due to the harmonic contribution of one control module with an active input power ≤ 2 W, the contribution of that control module may be disregarded provided that it is possible to measure the supply currents of the control module and the rest of the equipment separately, and the rest of the equipment draws the same current during emission tests as under normal operating conditions.

7.4.2 Rated power > 25 W

For luminaires with incandescent lamps and built-in phase control dimming having a rated power greater than 25 W, the harmonics of the input current shall not exceed the limits given in Table 1.

For any other lighting equipment having a rated power greater than 25 W, the harmonics of the input current shall not exceed the relative limits given in Table 2. For those types that include means for control (e.g. dimming, colour), the harmonics of the input current shall not

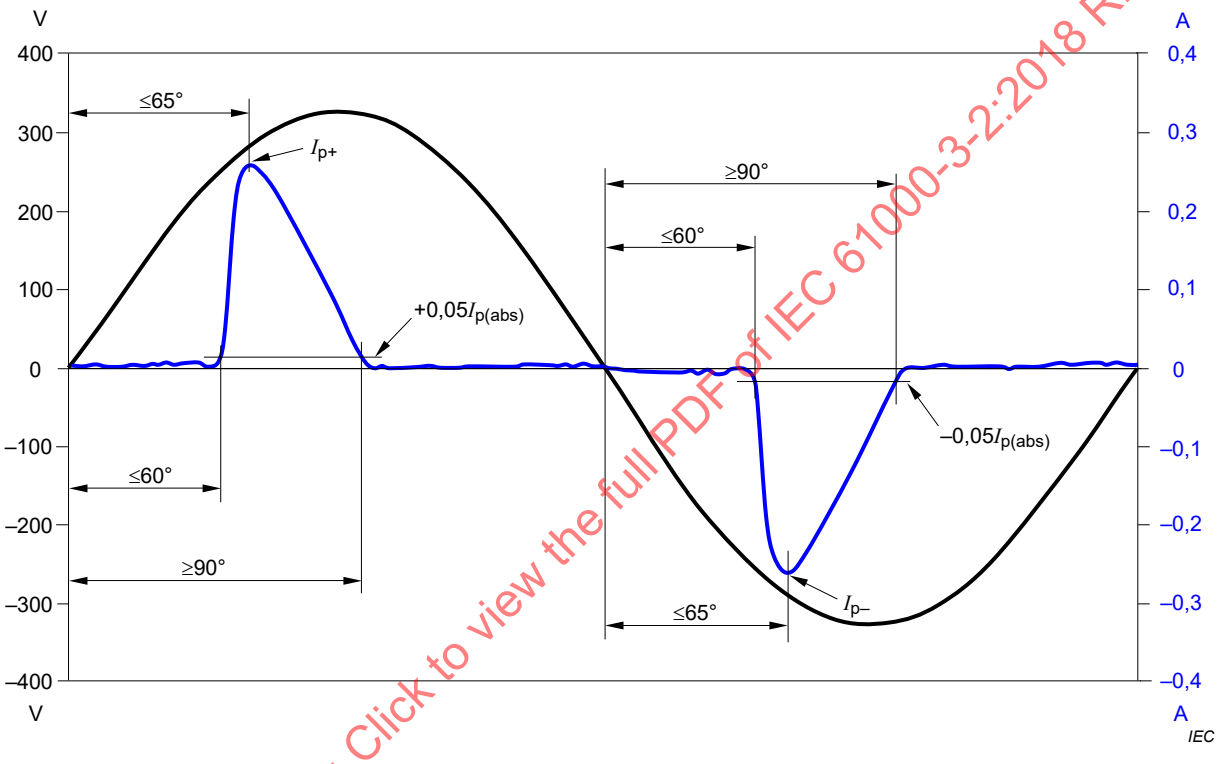
exceed the harmonic current values derived from the percentage limits given in Table 2 for the maximum active input power (P_{max}) condition when tested in both following conditions:

– with the means for control set to obtain P_{max};

– with the means for control set to the position expected to produce the maximum total harmonic current (THC) within the active input power range [P_{min}, P_{max}], where

- P_{min} = 5 W, if P_{max} ≤ 50 W;
- P_{min} = 10 % of P_{max}, if 50 W < P_{max} ≤ 250 W;
- P_{min} = 25 W, if P_{max} > 250 W.

7.4.3 Rated power ≥ 5 W and ≤ 25 W



NOTE $I_{p(abs)}$ is the higher absolute value of I_{p+} and I_{p-}.

Figure 2 – Illustration of the relative phase angle and current parameters described in 7.4.3

Lighting equipment having a rated power greater than or equal to 5 W and less than or equal to 25 W shall comply with one of the following three sets of requirements:

– the harmonic currents shall not exceed the power-related limits of Table 3, column 2;

– the third harmonic current, expressed as a percentage of the fundamental current, shall not exceed 86 % and the fifth harmonic current shall not exceed 61 %. In addition, the waveform of the input current shall be such that it reaches the 5 % current threshold before or at 60°, has its peak value before or at 65° and does not fall below the 5 % current threshold before 90°, referenced to any zero crossing of the fundamental supply voltage. The current threshold is 5 % of the highest absolute peak value that occurs in the measurement window, and the phase angle measurements are made on the cycle that includes this absolute peak value (see Figure 2). Components of current with frequencies above 9 kHz shall not influence this evaluation (a filter similar to the one described in 5.3 of IEC 61000-4-7:2002 and IEC 61000-4-7:2002/AMD1:2008 may be used);

– the THD shall not exceed 70 %. The third order harmonic current, expressed as a percentage of the fundamental current, shall not exceed 35 %, the fifth order current shall

not exceed 25 %, the seventh order current shall not exceed 30 %, the ninth and eleventh order currents shall not exceed 20 % and the second order current shall not exceed 5 %.

If the lighting equipment includes means for control (e.g. dimming, colour), or is specified to drive multiple loads, then the measurement is made only at the control setting and the load of lamps that gives the maximum active input power.

NOTE The preceding requirement is based on the assumption that, for lighting equipment using control other than phase control, the THC decreases when the input power is reduced.

7.5 Limits for Class D equipment

For Class D equipment, the harmonic currents and the power shall be measured as defined in 6.3.2. The input currents at harmonic frequencies shall not exceed the values that can be derived from Table 3 according to the requirements specified in 6.3.3 and 6.3.4.

Table 1 – Limits for Class A equipment

Harmonic order ~~n~~ h	Maximum permissible harmonic current A
Odd harmonics	
3	2,30
5	1,14
7	0,77
9	0,40
11	0,33
13	0,21
$15 \le$ ~~n~~ $h \le 39$	$0{,}15\frac{15}{n}$ $0{,}15\frac{15}{h}$
Even harmonics	
2	1,08
4	0,43
6	0,30
$8 \le$ ~~n~~ $h \le 40$	$0{,}23\frac{8}{n}$ $0{,}23\frac{8}{h}$

Table 2 – Limits for Class C equipment [a]

Harmonic order ~~n~~ h	Maximum permissible harmonic current expressed as a percentage of the input current at the fundamental frequency %
2	2
3	$30 \cdot \lambda$ [b]
5	10
7	7
9	5
$11 \leq$ ~~n~~ $h \leq 39$ (odd harmonics only)	3

[a] For some Class C products, other emission limits apply (see 7.4).

[b] λ is the circuit power factor.

Table 3 – Limits for Class D equipment

Harmonic order ~~n~~ h	Maximum permissible harmonic current per watt mA/W	Maximum permissible harmonic current A
3	3,4	2,30
5	1,9	1,14
7	1,0	0,77
9	0,5	0,40
11	0,35	0,33
$13 \leq$ ~~n~~ $h \leq 39$ (odd harmonics only)	$\frac{3,85}{n}$ $\frac{3,85}{h}$	See Table 1

Table 4 – Test observation period

Type of equipment behaviour	Observation period
Quasi-stationary	T_{obs} of sufficient duration to meet the requirements for repeatability in 6.3.3.1
Short cyclic ($T_{cycle} \leq 2,5$ min)	$T_{obs} \geq 10$ cycles (reference method) or T_{obs} of sufficient duration or synchronization to meet the requirements for repeatability in 6.3.3.1 [a]
Random	T_{obs} of sufficient duration to meet the requirements for repeatability in 6.3.3.1
Long cyclic ($T_{cycle} > 2,5$ min)	Full equipment program cycle (reference method) or a representative 2,5 min period considered by the manufacturer as the operating period with the highest THC

[a] 'Synchronization' means that the total observation period is sufficiently close to including an exact integral number of equipment cycles such that the requirements for repeatability in 6.3.3.1 are met.

Annex A
(normative)

Measurement circuit and supply source

A.1 Test circuit

The measured harmonic values shall be compared with the limits given in Clause 7. The harmonic currents of the equipment under test (EUT) shall be measured in accordance with the circuits given in the following figures:

– Figure A.1 for single-phase equipment;

– Figure A.2 for three-phase equipment.

Measurement equipment complying with ~~Annex B~~ IEC 61000-4-7 shall be used. Specific test conditions for ~~the EUT~~ some types of equipment are given in Annex B.

A.2 Supply source

While the measurements are being made, the test voltage (U) at the terminals of the equipment under test~~, when operated according to Annex C,~~ shall meet the following requirements.

a) The test voltage (U) shall be the rated voltage of the equipment. In the case of a voltage range, the test voltage shall be 230 V or 400 V for single-phase or three-phase supplies respectively. The test voltage shall be maintained within ±2,0 % and the frequency within ±0,5 % of the nominal value.

b) In the case of a three-phase supply, the angle between the fundamental voltage on each pair of phases of a three-phase source shall be 120° ± 1,5°.

c) The harmonic ratios of the test voltage (U) shall not exceed the following values with the EUT connected as in normal operation:

   0,9 % for harmonic of order 3;

   0,4 % for harmonic of order 5;

   0,3 % for harmonic of order 7;

   0,2 % for harmonic of order 9;

   0,2 % for even harmonics of order from 2 to 10;

   0,1 % for harmonics of order from 11 to 40.

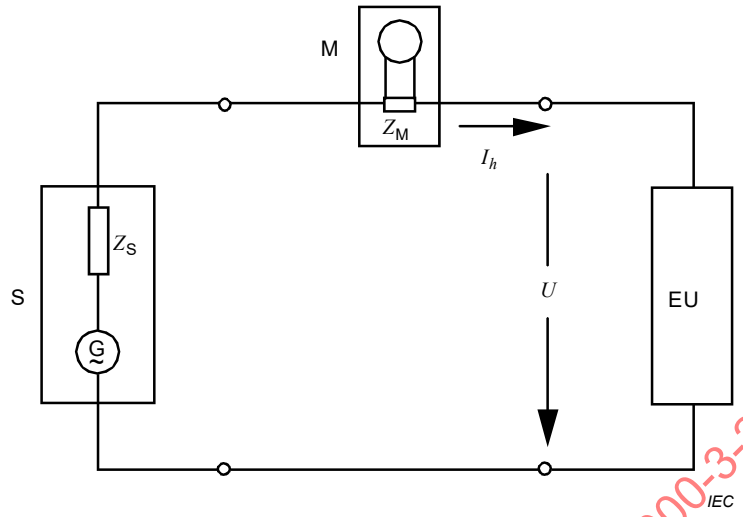
d) The peak value of the test voltage shall be within 1,40 times and 1,42 times its RMS value and shall be reached within 87° to 93° after the zero crossing. This requirement does not apply when Class A or B equipment is tested.

~~NOTE 1~~ The values of impedances Z_S and Z_M in Figures A.1 and A.2 are not specified, but ~~must~~ shall be sufficiently low for the requirements of Clause A.2 to be met. This is checked by measuring the properties of the supply voltage at the point of connection of the EUT to the measurement equipment. More information can be found in IEC 61000-4-7.

~~NOTE 2~~ In some special cases, particular care ~~may~~ can be necessary to avoid resonance between the internal inductance of the source and the capacitances of the equipment under test.

~~NOTE 3~~ For some types of equipment, such as single-phase uncontrolled rectifiers, ~~the~~ some harmonic amplitudes vary greatly with the supply voltage. To minimize variability, it is recommended to maintain the voltage at the point of connection of the EUT to the

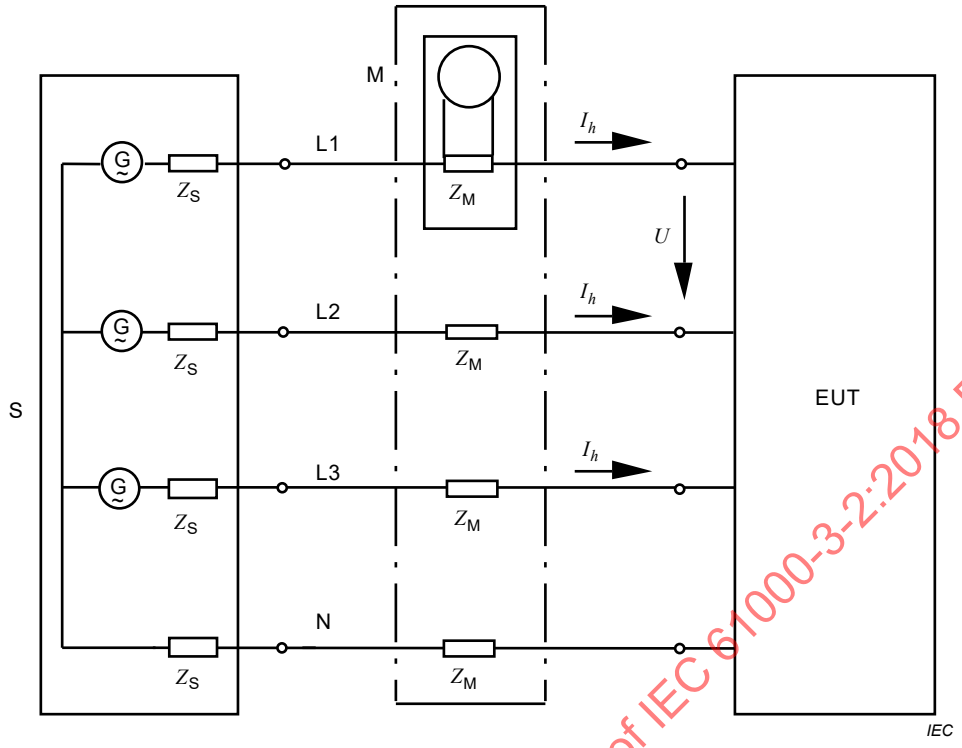
measurement equipment to 230 V or 400 V within ±1,0 V, evaluated over the same 200 ms observation window, used for harmonic assessment.



Key

S	power supply source	Z_M	input impedance of measurement equipment
M	measurement equipment	Z_S	internal impedance of the supply source
EUT	equipment under test	I_h	harmonic component of order h of the line current
U	test voltage	G	open-loop voltage of the supply source

Figure A.1 – Measurement circuit for single-phase equipment



Key

S power supply source
M measurement equipment
EUT equipment under test
G open-loop voltage of the supply source
Z_M input impedance of the measurement equipment
Z_S internal impedance of the supply source
~~I_n~~ I_h harmonic component of order h of the line current
U test voltage (shown as an example between phases L1 and L2)

Figure A.2 – Measurement circuit for three-phase equipment

~~**Annex B**~~
~~(normative)~~

~~**Requirements for measurement equipment**~~

~~The requirements for measurement equipment are defined in IEC 61000-4-7.~~

Annex B
(normative)

Type test conditions

B.1 General

The test conditions for the measurement of harmonic currents associated with some types of equipment are given Clauses B.2 to B.16.

NOTE Product committees are invited to submit proposals for defined test conditions for specific products to IEC SC 77A, for inclusion in Annex B.

B.2 Test conditions for television receivers (TV)

B.2.1 General ~~conditions~~ requirements

Measurements shall include the loading of any auxiliary circuits included in the receiver, but exclude the loading of any peripheral equipment powered from the receiver.

The TV shall be fed by an input signal in accordance with B.2.2.1 and the image level adjustments, sound level adjustments and energy-saving functions shall be set in accordance with B.2.2.2 to B.2.2.4. Settings for which no specific requirements have been defined in B.2.2 shall be set to the default conditions under which the TV is delivered to the customer for home use.

B.2.2 ~~Conditions for~~ Measurement conditions

~~A radio-frequency signal modulated in accordance with C.2.2.1 shall be supplied by a test generator, and the receiver shall be adjusted to display a picture with appropriate settings for brightness, contrast and sound level in accordance with C.2.2.2.~~

~~**C.2.2.1** The TV receiver is fed by an r.f. TV input signal with a level of 65 dB(μV) across 75 Ω and with the following test modulations.~~

~~a) Color television~~

~~Radio-frequency signal: a full TV signal with modulated picture chrominance and sound carrier:~~

~~– the sound modulation factor is 54 % at 1 000 Hz;~~

~~– the picture modulation content is a color bar test pattern according to Recommendation ITU-R BT.471-1:~~

~~• 100 % reference white level bar;~~

~~• 0 % reference black level bar;~~

~~• 75 % amplitude (reference made to the white level); and~~

~~• 100 % saturation.~~

~~b) Monochrome television~~

~~Radio-frequency signal: a full TV signal with modulated picture and sound carrier:~~

~~– sound modulation: see item a) above;~~

~~– the picture modulation is a monochrome test pattern with a black and white level according to item a) and an average overall picture content of 50 % of the reference white level.~~

~~**C.2.2.2** The receiver shall be tuned according to IEC 60107-1.~~

~~The white reference level corresponds to 80 cd/m^2 and the black level to less than 2 cd/m^2.~~

~~The magenta bar corresponds to 30 cd/m^2.~~

~~The volume control is set in such a manner that one-eighth of rated output power is obtained, measured at the loudspeaker terminals, at a frequency of 1 000 Hz. In the case of stereophonic equipment, this output shall be present at both outputs.~~

~~NOTE For devices that operate on base-band signals, suitable video and audio input signals should be used, and the same settings made for brightness, contrast and volume controls.~~

B.2.2.1 Input signal

Any input signal (RF or baseband), containing video and audio as specified in B.2.2.1, may be used. The television receiver is set to reproduce the content of the input signal. The signal level shall be high enough, so that the full screen display image has no noise and no bit error.

The video signal is the colour bar signal, as defined in IEC 60107-1:1997, 3.2.1.2.

The audio signal is a 1 kHz sinusoidal signal.

B.2.2.2 Image level adjustments

Contrast, brightness, backlight and other functions (if they exist) of the TV shall be set to the default conditions under which the TV is delivered to the customer for home use.

B.2.2.3 Sound level adjustments

The volume control shall be adjusted between 8 % and 12 % of the maximum of the on-screen audio display. All other audio functions shall be kept in the default conditions under which the TV is delivered to the customer for home use.

B.2.2.4 Energy-saving function

Ambient light control, dynamic backlight control and other similar functions shall be switched off. If they cannot be deactivated, use lighting equipment with illuminance ≥ 300 lx directly irradiating the light sensor while testing, and indicate this in the test report. Any lighting functions that are included in the TV and illuminate the environment of the TV shall be switched on.

B.2.3 Test report

The test report shall indicate the input signal and settings of the television receiver.

B.3 Test conditions for audio amplifiers

B.3.1 Conditions

Audio amplifiers which draw a supply current which varies less than 15 % of the maximum current with input signal voltages between zero and a rated source e.m.f. (as defined in IEC 60268-3) shall be tested with no input signal.

Other audio amplifiers shall be tested under the following conditions:

- rated supply voltage;
- normal position of user controls. In particular, any controls affecting the frequency response set to give the widest flat response achievable;
- input signals and loads as given in B.3.2.

B.3.2 Input signals and loads

The following test procedure applies.

a) Connect suitable resistors, equal to the rated load impedance(s), to each amplifier output for supplying loudspeakers. To monitor the output voltage waveform of the audio amplifier of a powered loudspeaker, the audio analyzer/oscilloscope is connected to internal wiring at a point representing the electrical output of the amplifier.

NOTE 1 In the case of powered loudspeakers with internal audio amplifiers, the load is the loudspeaker and associated crossover network.

b) Apply a sinusoidal signal at 1 kHz (see note 2) to a suitable input. For multi-channel amplifiers in which the surround sound channel amplifiers cannot be alternatively used as a second set of left and right channel amplifiers, set the controls so that the surround sound channel amplifiers are supplied with signal at a level 3 dB lower than the signal applied to the left and right channels.

NOTE 2 For products not intended to reproduce 1 kHz signals, a frequency geometrically centred within the reproducing bandwidth of the amplifier is applied.

c) Adjust the input signal and/or amplifier gain control(s) so as to obtain an output signal for the left and right channels having 1 % total harmonic distortion, simultaneously. If 1 % total harmonic distortion cannot be obtained, adjust the signal voltage and/or gain controls to obtain the highest achievable power output at each output simultaneously. Confirm that the output signals of the surround sound channel amplifiers are 3 dB lower than the output signal at the outputs of the left and right channels.

d) Measure the output voltages of all channels and then readjust the input signal voltage and/or controls to obtain voltages of 0,354 ($1/\sqrt{8}$) times the voltages obtained at the end of step c) above.

e) In the case of products with provision for connection to external loudspeakers, proceed as specified in 6.3.

f) For products with internal loudspeakers and without provision for connection to external loudspeakers, note the RMS output voltage of the sinusoidal signal at the output of each amplifier. Substitute the sinusoidal signal by a pink noise signal, bandwidth-limited as specified in 6.1 of IEC 60268-1:1985. Confirm the RMS value of the pink noise signal as it appears at the output of each amplifier output is equal to the RMS value of the sinusoidal waveform for that channel set as in step d) above. Proceed as specified in 6.3.

B.4 Test conditions for video-cassette recorders

Measurements shall be made in the playback mode with the standard tape speed.

B.5 Test conditions for lighting equipment

B.5.1 General conditions

Measurements shall be made in a draught-free atmosphere and at an ambient temperature within the range from 20 °C to 27 °C. During measurement the temperature shall not vary by more than 1 K.

B.5.2 Lamps

Discharge lamps shall be aged for at least 100 h at rated voltage. Discharge lamps shall be operated for at least 15 min before a series of measurements is made. Some lamp types require a stabilization period exceeding 15 min. Information given in the relevant IEC lamp performance standard shall be observed.

During ageing, stabilization and measurement, lamps shall be installed as in normal use. Self-ballasted lamps shall be operated in cap-up position.

B.5.3 Luminaires

The luminaire is measured as manufactured. ~~It shall be tested with reference lamps, or with lamps having electrical characteristics close to their nominal values. In case of doubt measurements are made with reference lamps. When the luminaire incorporates more than one lamp, all lamps are connected and operated during the test. When the luminaire is assigned for use with more than one type of lamp, measurements shall be made with all the types and the luminaire shall comply each time. In the case where the luminaire is equipped with a glow starter, a starter in accordance with IEC 60155, shall be used.~~

~~Incandescent lamp luminaires which do not incorporate an electronic transformer or a dimming device are deemed to fulfil the harmonic current requirements and need not be tested.~~

~~If separate tests with reference lamps have proved that ballasts for fluorescent or other discharge lamps or step-down converters for tungsten halogen or other filament lamps, comply with the requirements, the luminaire is deemed to comply with these requirements and need not be checked. Where these components have not been approved separately, or do not comply, the luminaire itself shall be tested and shall comply.~~

~~If a luminaire has a built-in dimming device, the harmonic currents shall be measured at the maximum load of the lamps as specified by the manufacturer. The setting of the dimming device is varied in five equidistant steps between the minimum and the maximum power in order to obtain comprehensive results.~~

It shall be tested with lamps (or artificial loads) having electrical characteristics close to those of the type of lamps specified for use with the luminaire. If the luminaire incorporates more than one lamp, all lamps are connected and operated during the test. If the luminaire is specified for use with more than one type of lamp, measurements shall be made with all the types and the luminaire shall comply each time. In the case where the luminaire is equipped with a glow starter, a starter in accordance with IEC 60155 shall be used.

Incandescent lamp luminaires which incorporate no lighting control gear and no control device, excluding a mechanical switch, are deemed to fulfil the harmonic current requirements and need not be tested.

If separate tests with each type of lamps (or artificial loads) specified for use with the luminaire – the lamps (or artificial loads) having electrical characteristics close to those of the type of lamps considered – have proved that the lighting control gear which is built into the luminaire complies with the requirements, the luminaire is deemed to comply with these requirements and need not be checked. If this is not the case, the luminaire itself shall be tested and shall comply.

~~**C.5.4 Ballasts and step-down converters**~~

~~Ballast for fluorescent or other discharge lamps or step-down converters for tungsten halogen or other filament lamps shall be tested with reference lamps, or with lamps having electrical characteristics close to their nominal values. In case of doubt, measurements are made with reference lamps.~~

~~In the case where a ballast can be used, with or without a series capacitor, or where a ballast or step-down converter is designed for several types of lamps, the manufacturer shall indicate in his catalogue for which type of circuit and lamps the ballast fulfils the harmonic requirements, and the ballast shall be tested accordingly.~~

B.5.4 Lighting control gear

Lighting control gear shall be tested with lamps (or artificial loads) having electrical characteristics close to the objective lamp values given in the lighting control gear

specification and being representative of the type of lamps intended to be used with the lighting control gear.

In the case where the lighting control gear can be used with or without a series capacitor, or where the lighting control gear is designed for several types of lamps, the manufacturer shall specify in its catalogue for which type of circuit and lamps the lighting control gear fulfils the harmonic requirements, and the lighting control gear shall be tested for each corresponding type of circuit and lamps and shall comply each time.

B.5.5 DLT control devices

The DLT control device shall be tested with a resistive load or a lighting load having the maximum power allowed for the DLT control device.

B.6 Test conditions for independent ~~and built-in incandescent lamp~~ phase control dimmers for lighting equipment

~~The dimmer is tested with incandescent lamps having the maximum power allowed for the dimmer.~~

If the phase control dimmer is specified for use with one or more types of lighting equipment, the dimmer shall be tested with one representative sample of each type of lighting equipment and shall comply each time. In each case, the measurements shall be made with a lighting load having the maximum power allowed for the dimmer. The setting of the dimmer is set to the position expected to produce the maximum total harmonic current (THC).

The dimmer is deemed to comply when used with other lighting equipment substantially similar to the representative types up to the declared power.

When a phase control dimmer is tested with an incandescent lamp load, the control is set to a firing-angle of 90° ± 5°, or if controlled by steps, to that step closest to 90°.

B.7 Test conditions for vacuum cleaners

The air inlet of the vacuum cleaner is adjusted according to normal operation as defined in IEC 60335-2-2.

Vacuum cleaners with ~~electronic control~~ variable input power shall be tested in three modes of operation, each for an identical time interval that is at least 2 min long, with the control adjusted:

– to maximum input power,
– to 50 % ± 5 % of the maximum active input power, or, if that is not possible (e.g. controlled in steps), to the point closest to 50 % that is supported by the equipment design, and
– to minimum input power.

If the active input power at minimum input power is higher than 50 % of the maximum active input power, the above requirements imply that the vacuum cleaner is tested for three identical time intervals: one time interval with the control adjusted to maximum input power and two time intervals with the control adjusted to minimum input power.

These three time intervals need not be consecutive, but the application of limits according to 6.3.3.4 is done as if the intervals were consecutive. In that case, the entire test observation period is made up of the three identical time intervals, without taking into account harmonic current values outside these three intervals.

If the vacuum cleaner includes a control to select a temporary high-power ('booster') mode of operation, which automatically returns to a lower power mode, this high-power mode is not considered for the calculation of the average values. This mode shall be tested only against the limits for single 1,5 s smoothed RMS values (see 6.3.3.4).

B.8 Test conditions for washing machines

The washing machine shall be tested during a complete laundry program incorporating the normal wash-cycle, filled with the rated load of double hemmed, pre-washed cotton cloths, size approximately 70 cm × 70 cm, dry weight from 140 g/m^2 to 175 g/m^2. The cloths shall be loaded into the washing machine in a way to avoid an unrealistic unbalance of the weight.

NOTE Loading the cloths one-by-one is one way to achieve this.

The temperature of the fill water shall be

- 65 °C ± 5 °C for washing machines without heating elements and intended for connection to a hot water supply;
- from 10 °C to 25 °C for other washing machines.

For washing machines with a programmer, the 60 °C cotton programme without pre-wash, if available, shall be used, otherwise the regular wash programme without pre-wash shall be used. If the washing machine contains heating elements which are not controlled by the programmer, the water shall be heated to 65 °C ± 5 °C before starting the first wash period.

If the washing machine contains heating elements and does not incorporate a programmer, the water shall be heated to 90 °C ± 5 °C or lower if steady conditions are established, before starting the first wash period.

B.9 Test conditions for microwave ovens

The microwave oven is tested with 100 % nominal power. It is operated with a potable water load of initially 1 000 g ± 50 g in a cylindrical borosilicate glass vessel, having a maximum material thickness of 3 mm and an outside diameter of approximately 190 mm. The load is placed at the centre of the shelf.

B.10 Test conditions for information technology equipment (ITE)

B.10.1 General conditions

ITE (including personal computers) which is marketed without “factory-fitted options” and without expansion slot capabilities ~~is~~ shall be tested as supplied. ITE, other than personal computers, which is marketed with “factory-fitted options” or has expansion slots, ~~is~~ shall be tested with additional loads in each expansion slot that result in the maximum power consumption attainable using the “factory-fitted options” specified by the manufacturer.

For the testing of personal computers with up to 3 expansion slots, load cards configured for the maximum permitted power for each expansion slot shall be added to each respective expansion slot. For the testing of personal computers with more than 3 expansion slots, additional load cards shall be installed at the rate of at least one load card for each group of up to 3 additional slots (i.e. for 4, 5 or 6 slots a total of at least 4 load cards shall be added. For 7, 8 or 9 slots a total of at least 5 load cards shall be added, etc.).

In all configurations, the use of additional loads shall not cause the total DC output power available from the ITE power supply to be exceeded.

NOTE Common load cards for expansion slots such as PCI or PCI-2 are configured for 30 W but ~~may~~ might be adjusted as industry standards change.

Modular equipment, such as hard drive arrays and network servers, are tested in their maximum configuration.

~~NOTE~~ This does not mean that multiple options of the same type, such as more than one hard drive, should be fitted, unless that is representative of the user configuration, or the product is of a type (such as redundant arrays of inexpensive disks (RAID)) for which such a configuration is not abnormal.

Emission tests shall be conducted with the user's operation controls or automatic programs set to the mode expected to produce the maximum total harmonic current (THC) under normal operating conditions.

Power saving modes which ~~may~~ can cause large power level fluctuations shall be disabled, so that all, or part, of the equipment does not automatically switch off during the measurements.

For ITE systems designed for use with a manufacturer-supplied power distribution system, such as one or more transformers, uninterruptible power supply (UPS) or a power conditioner, compliance with the limits of this document shall be met at the input supplied from the public low-voltage distribution network.

B.10.2 Optional conditions for measuring emissions of IT equipment with external power supplies or battery chargers

For IT equipment with external power supplies or battery chargers, manufacturers may choose

- either to test the whole equipment according to B.10.1 (General conditions),
- or to test the equipment by measuring the AC input power and the harmonic emissions of the associated power supply or battery charger according to 6.3.2 with the DC output side loaded by a resistive load, provided that, with the resistive load applied, the peak-to-peak ripple voltage across the load is not greater than 5 % of the DC output voltage.

The resistance value of the load shall be such that the active power dissipated in the load is equal to the DC output power rating, or, if that is not available, to the DC output voltage rating multiplied by the DC output current rating marked on the power supply/battery charger unit.

Power supply/battery charger units whose AC input power measured according to 6.3.2 under the above load conditions is 75 W or less are deemed to conform without further testing, as specified in Clause 7.

B.11 Test conditions for ~~induction hobs~~ cooking appliances

~~Induction hobs are operated with an enamelled steel pan which contains approximately half its capacity of water at room temperature, and positioned at the centre of each cooking zone, in turn. Thermal controls are adjusted to their highest setting.~~

~~The diameter of the base of the pan is to be at least the diameter of the cooking zone. The smallest pan complying with this requirement is used. The maximum concavity of the base of the pan is 3D/1 000 where D is the diameter of the flat area of the base of the pan. The base of the pan is not to be convex.~~

~~The concavity is checked at room temperature using an empty pan.~~

B.11.1 Induction hobs and hotplates

Induction hobs and hotplates shall be operated with a steel pan which contains approximately half its maximum capacity of water at room temperature and which is positioned at the centre of each cooking zone. Each cooking zone shall be tested separately in a two-step procedure:

1) The different control levels (including boost mode) are tested at first for a few seconds. If there are no discrete power levels, the control range is divided into 10 approximately equidistant steps. The control level with the highest THC is determined.
2) The measurement for comparison with the harmonic emission limits, as defined in 6.3.2, shall be done with the control level producing the highest THC, as determined in step 1), and with a test observation period according to Table 4.

The diameter of the base of the pan shall be at least the diameter of the cooking zone. The smallest standard cooking vessel complying with this requirement is used.

The nominal diameters of the contact surface of standard cooking vessels are 110 mm, 145 mm, 180 mm, 210 mm, 300 mm.

The vessel bottom shall be concave and shall not deviate from flatness by more than 0,6 % of its diameter at the ambient temperature (20 ± 5) °C.

Cooking zones which are intended for use with vessels having a curved bottom (e.g. wok zones) shall be measured with the vessel provided together with the hob, or with the vessel recommended by the manufacturer.

Side by side cooking zones which can be combined and controlled together shall be measured separately.

Cooking zones with many small coils which are automatically configured to an active heating zone shall be tested with a vessel of 300 mm diameter. The vessel shall be placed centrically in the cooking zone.

B.11.2 Hobs and hotplates other than induction cooking appliances

For equipment with several cooking zones, the measurements as defined in 6.3.2 shall be performed separately on each individual cooking zone.

Each cooking zone shall be operated with the control settings expected to produce the maximum THC. A suitable pan or pot filled with approximately half its maximum capacity of water shall be placed at the centre of the cooking zone.

B.12 Test conditions for air conditioners

If the input power of the air conditioner is controlled by an electronic device so that the revolution speed of the fan or compressor motor is changed in order to get the suitable air temperature, the harmonic currents are measured after the operation becomes steady-state under the following conditions:

– The temperature control shall be set to the lowest value in the cooling mode and to the highest value in the heating mode.

– The ambient temperature for testing shall be 30 °C ± 2 °C in the cooling mode, and 15 °C ± 2 °C in the heating mode. If in the heating mode the rated input power is reached at a higher temperature, the air conditioner shall be tested at this ambient temperature but no higher than 18 °C. The ambient temperature is defined as the temperature of the air inhaled from the indoor and from the outdoor unit of the appliance.

If the heat is not exchanged to the ambient air but to another medium for example water, all settings and temperatures shall be chosen so that the appliance is operated with the rated input power.

If the air conditioner does not contain power electronic elements (e.g. diodes, dimmers, thyristors, etc.), it need not be tested against harmonic current limits.

B.13 Test conditions for kitchen machines as defined in IEC 60335-2-14

Kitchen machines as listed in the scope of IEC 60335-2-14 are deemed to conform to the harmonic current limits of this document without further testing.

B.14 Test conditions for arc welding equipment which is not professional equipment

Testing shall be carried out at an ambient temperature between 20 °C and 30 °C. The test shall be started with the arc welding power source at ambient temperature. The arc welding power source shall be connected to a conventional load. It shall be operated at the rated maximum welding current I_{2max} and conventional load voltage given in Table B.1. The observation period shall be 10 thermal cycles (for short cyclic equipment where the first thermal cycle is less than or equal to 2,5 min) or one full thermal cycle (for long cyclic equipment where the first thermal cycle is greater than 2,5 min). Multi-process arc welding power sources shall be tested using the process which gives the highest input current. The definitions for conventional load, I_{2max}, I_2 and U_2 are given in IEC 60974-1.

Table B.1 – Conventional load for arc welding equipment tests

Welding process	Load voltage V
Manual metal arc welding with covered electrodes	$U_2 = (18 + 0{,}04\ I_2)$
Tungsten inert gas	$U_2 = (10 + 0{,}04\ I_2)$
Metal inert/active gas and flux cored arc welding	$U_2 = (14 + 0{,}05\ I_2)$
Plasma cutting	$U_2 = (80 + 0{,}4\ I_2)$

B.15 Test conditions for high pressure cleaners which are not professional equipment

The high pressure cleaner is adjusted according to normal operation as defined in IEC 60335-2-79 except for the electronic power control.

High pressure cleaners with ~~electronic~~ variable input power ~~control~~ shall be tested in three modes of operation, each for an identical time interval that is at least 2 min long, with the control adjusted:

– to maximum input power,

– to 50 % ± 5 % of the maximum active input power, or, if that is not possible (e.g. controlled in steps), to the point closest to 50 % that is supported by the equipment design, and

– to minimum input power.

NOTE If the active input power at minimum input power is higher than 50 % of the maximum active input power, the above requirements imply that the high pressure cleaner is tested for three identical time intervals: one time interval with the control adjusted to maximum input power and two time intervals with the control adjusted to minimum input power.

These three time intervals need not be consecutive, but the application of limits according to 6.3.3.4 is done as if the intervals were consecutive. In that case, the entire test observation period is made up of the three identical time intervals, without taking into account harmonic current values outside these three intervals.

B.16 Test conditions for refrigerators and freezers

B.16.1 General

Refrigerators and freezers shall be tested with an empty cabinet. The temperature ~~control~~ shall be ~~adjusted~~ set to ~~the~~ its lowest ~~setting~~ value intended for constant use (quick cool down functions are not considered). The measurement shall be started after the internal temperature has been stabilized.

NOTE Stabilization of the temperature can ~~alternatively~~ be deduced, for example, from the input power going into a low power mode.

When the measurement is started, the ambient temperature shall be between 20 °C and 30 °C. During the test the ambient temperature shall be maintained within ±2 °C.

B.16.2 Refrigerators and freezers with VSD

The observation period shall be 1 h. A few seconds after starting the measurement, all doors and further internal compartments shall be fully opened for 60 s and then closed again and kept closed for the rest of the observation period.

NOTE 1 A timing accuracy of ±6 s is ~~deemed~~ assumed to be sufficient for the targeted measurement repeatability, see note 3 below.

Deviating from 6.3.2, the value of the input power to be used for the calculation of limits shall be determined according to the following formula:

$$P_i = 0{,}78 \times I_m \times U_r$$

where

P_i is the active input power in watts, to be used for the calculation of Class D limits (see Table 3);

I_m is the current in amperes of the appliance measured according to IEC 60335-2-24:2010, 10.2;

U_r is the rated voltage in volts of the appliance. If the appliance has a rated voltage range, U_r has the value that has been used for measuring I_m.

NOTE 2 P_i is used for the calculation of limits instead of the measured active input power to eliminate the influence of other loads than the VSD, for example lighting devices or heating elements for defrosting, on the limit calculation. This also increases the repeatability of the measurement.

NOTE 3 The 5 % repeatability, mentioned in 6.3.3.1, can be achieved only if the climatic conditions are strongly controlled and, for each test, the measurement is started at the same point in the control cycle of the EUT. If these conditions are not fulfilled, the repeatability of the average value of the individual harmonic currents over the entire test observation period can be as much as 10 % of the applicable limit.

B.16.3 Refrigerators and freezers without VSD

Refrigerators and freezers without any variable speed drive to control compressor motor(s) are tested according to Class A limits in a representative 2,5 min observation period according to Table 4 for long cyclic equipment.

Bibliography

IEC 60050-845, *International Electrotechnical Vocabulary (IEV) – Part 845: Lighting* (available at www.electropedia.org)

IEC 60107-1:1997, *Methods of measurement on receivers for television broadcast transmissions – Part 1: General considerations – Measurements at radio and video frequencies*

IEC 60268-1:1985, *Sound system equipment – Part 1: General*
IEC 60268-1:1985/AMD1:1988
IEC 60268-1:1985/AMD2:*1988*

IEC 60335-2-2, *Household and similar electrical appliances – Safety – Part 2-2: Particular requirements for vacuum cleaners and water-suction cleaning appliances*

IEC 60335-2-14, *Household and similar electrical appliances – Safety – Part 2-14: Particular requirements for kitchen machines*

IEC 60335-2-79, *Household and similar electrical appliances – Safety – Part 2-79: Particular requirements for high pressure cleaners and steam cleaners*

IEC 60598-2-17, *Luminaires – Part 2-17: Particular requirements – Luminaires for stage lighting, television and film studios (outdoor and indoor)*

IEC TR 60755, *General requirements for residual current operated protective devices*

IEC 60974-1, *Arc welding equipment – Part 1: Welding power sources*

IEC 60974-6, *Arc welding equipment – Part 6: Limited duty equipment*

IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC 62756-1, *Digital load side transmission lighting control (DLT) – Part 1: Basic requirements*

IEC 61000-3-2

Edition 5.0 2018-01

INTERNATIONAL STANDARD

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Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

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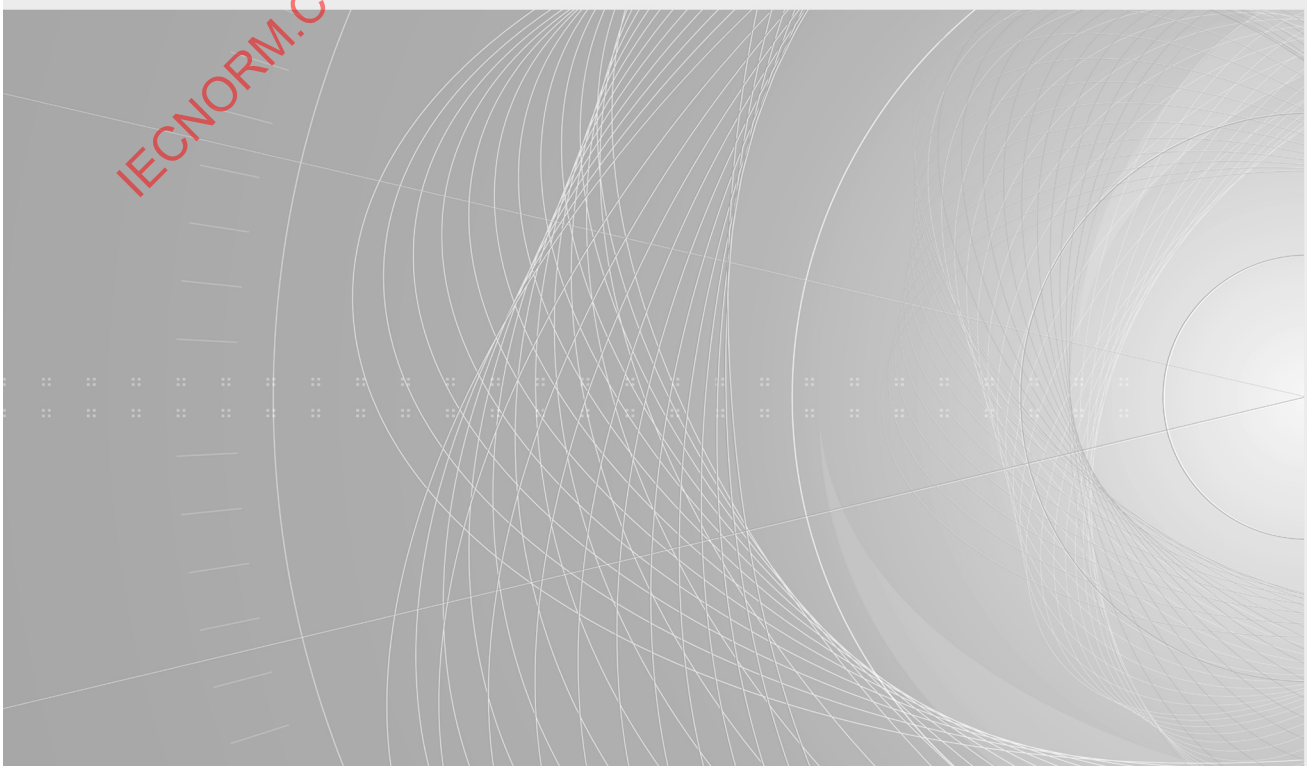

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61000-3-2 has been prepared by sub-committee 77A: EMC – Low frequency phenomena, of IEC technical committee 77: Electromagnetic compatibility.

It forms part 3-2 of the IEC 61000 series. It has the status of a product family standard.

This fifth edition cancels and replaces the fourth edition published in 2014. This edition constitutes a technical revision.

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

a) an update of the emission limits for lighting equipment with a rated power ≤ 25 W to take into account new types of lighting equipment;
b) the addition of a threshold of 5 W under which no emission limits apply to all lighting equipment;

c) the modification of the requirements applying to the dimmers when operating non-incandescent lamps;

d) the addition of test conditions for digital load side transmission control devices;

e) the removal of the use of reference lamps and reference ballasts for the tests of lighting equipment;

f) the simplification and clarification of the terminology used for lighting equipment;

g) the classification of professional luminaires for stage lighting and studios under Class A;

h) a clarification about the classification of emergency lighting equipment;

i) a clarification for lighting equipment including one control module with an active input power ≤ 2 W;

j) an update of the test conditions for television receivers;

k) an update of the test conditions for induction hobs, taking also into account the other types of cooking appliances;

l) for consistency with IEC 61000-3-12, a change of the scope of IEC 61000-3-2 from equipment with an input current ≤ 16 A to equipment with a rated input current ≤ 16 A.

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

FDIS	Report on voting
77A/986/FDIS	77A/990/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 web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

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 document 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 levels

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far 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: IEC 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

1 Scope

This part of IEC 61000 deals with the limitation of harmonic currents injected into the public supply system.

It specifies limits of harmonic components of the input current which can be produced by equipment tested under specified conditions.

This part of IEC 61000 is applicable to electrical and electronic equipment having a rated input current up to and including 16 A per phase, and intended to be connected to public low-voltage distribution systems.

Arc welding equipment which is not professional equipment, with a rated input current up to and including 16 A per phase, is included in this document. Arc welding equipment intended for professional use, as specified in IEC 60974-1, is excluded from this document and can be subject to installation restrictions as indicated in IEC 61000-3-12.

The tests according to this document are type tests.

For systems with nominal voltages less than but not equal to 220 V (line-to-neutral), the limits have not yet been considered.

NOTE The words apparatus, appliance, device and equipment are used throughout this document. They have the same meaning for the purposes of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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) – Part 161: Electromagnetic compatibility* (available at www.electropedia.org)

IEC 60155, *Glow-starters for fluorescent lamps*

IEC 60268-3, *Sound system equipment – Part 3: Amplifiers*

IEC 60335-2-24:2010, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers*

IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto* IEC 61000-4-7:2002/AMD1:2008

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
portable tool
electrical tool which is hand-held during normal operation and used for a short time (a few minutes) only

Note 1 to entry: Hand-held means that no part of the tool, except the power cord, rests on the floor during normal operation.

3.2
lamp
source intended to produce an optical radiation, usually visible

Note 1 to entry: For the purposes of this document, a lamp can also be a solid state lighting module which can contain further components, for example optical, electrical, mechanical and/or electronic components.

3.3
self-ballasted lamp
unit which cannot be dismantled without being permanently damaged, is provided with a lamp cap and incorporates a light source and the lighting control gear necessary for the operation of the light source

3.4
luminaire
apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply

[SOURCE: IEC 60050-845:1987, 845-10-01, modified – the existing notes have been removed]

3.5
input current
current directly supplied to an equipment or a part of equipment by the AC distribution system

3.6
circuit power factor
ratio of the measured active input power to the product of the RMS supply voltage and the RMS supply current

3.7
active power
mean value of the instantaneous power, taken over 10 (50 Hz systems) or 12 (60 Hz systems) fundamental periods and measured in accordance with IEC 61000-4-7

Note 1 to entry: The active input power is the active power measured at the input supply terminals of the equipment under test.

3.8
balanced three-phase equipment
equipment having rated line current modules which differ by no more than 20 %

3.9
professional equipment
equipment for use in trades, professions or industries and which is not intended for sale to the general public, as designated by the manufacturer

[SOURCE: IEC 60050-161:1990, 161-05-05, modified – the existing Note has been replaced by the text added at the end of the definition]

3.10
total harmonic current
THC
total RMS value of the harmonic current components of orders 2 to 40, expressed as:

$$THC = \sqrt{\sum_{h=2}^{40} I_h^2}$$

Note 1 to entry: This note applies to the French language only.

3.11
total harmonic distortion
THD
ratio of the RMS value of the sum of the harmonic components (in this context, harmonic current components I_h of orders 2 to 40) to the RMS value of the fundamental component, expressed as:

$$THD = \sqrt{\sum_{h=2}^{40} \left(\frac{I_h}{I_1} \right)^2}$$

Note 1 to entry: This note applies to the French language only.

3.12
partial odd harmonic current
POHC
total RMS value of the odd harmonic current components of orders 21 to 39, expressed as:

$$POHC = \sqrt{\sum_{h=21,23}^{39} I_h^2}$$

Note 1 to entry: This note applies to the French language only.

3.13
lighting equipment
equipment with a primary function of generating and/or regulating and/or distributing optical radiation

Note 1 to entry: See also 5.2.

3.14
stand-by mode
non-operational, low power consumption mode (usually indicated in some way on the equipment) that can persist for an indefinite time

3.15
repeatability
<results of measurements> closeness of the agreement between the results of measurements of harmonic currents on the same equipment under test, carried out with the same test system, at the same location, under identical test conditions

3.16
reproducibility
<results of measurements> closeness of the agreement between the results of measurements of harmonic currents on the same equipment under test, carried out with different test systems under conditions of measurement intended to be the same in each case

Note 1 to entry: The test system and test conditions are assumed to fulfil all normative requirements in the applicable standards.

3.17
variability
<results of measurements> closeness of the agreement between the results of measurements of harmonic currents on different samples of the same type of equipment under test, having no intentional differences, carried out with different test systems under conditions of measurement intended to be the same in each case

Note 1 to entry: The test system and test conditions are assumed to fulfil all normative requirements in the applicable standards.

Note 2 to entry: In the context of this document, the meaning of the terms can be summarized as follows:

Term	Meaning
Repeatability	Same equipment under test (EUT), same test system, same test conditions, repeated tests
Reproducibility	Same equipment under test (EUT), different but normative test systems, different but normative test conditions
Variability	Different equipments under test (EUTs) of the same type, having no intentional differences, different but normative test systems, different but normative test conditions

3.18
variable speed drive
VSD
equipment, based on power electronics, which enables the speed and/or torque of a motor to be continuously controlled

3.19
lighting control gear
device connected between the supply and one or more lamps, enabling the lamp(s) to operate as intended

Note 1 to entry: The lighting control gear can consist of one or more separate components. It can include means for dimming, correcting the power factor and suppressing radio interference, and further control functions.

Note 2 to entry: The lighting control gear can be partly or totally integrated in some lamps, such as in the case of self-ballasted lamps. Any references to lighting control gear include any such integrated lamps.

Note 3 to entry: Examples of lighting control gear are ballasts or electronic control gear for discharge lamps, step-down converters for incandescent lamps, drivers for solid state lighting modules.

Note 4 to entry: For the purposes of this document, independent phase control dimmers as defined in 3.23 and 3.24 are not considered to be lighting control gear.

Note 5 to entry: Mechanical switches and relays, and other simple devices providing on/off control only, do not produce distorted currents and are not considered to be lighting control gear.

3.20
digital load side transmission lighting control device
DLT control device
device to control lighting parameters of electronic lighting equipment, such as light level and light colour, using data transmission over its load side mains wiring in accordance with IEC 62756-1

Note 1 to entry: A DLT control device is wired like a phase control dimmer, but does not directly make the supply power delivered to the connected dedicated lighting equipment vary. It transmits digital signals over the power cable on the load side to the dedicated lighting equipment, which contains means for receiving and interpreting control signals as well as built-in means for dimming, colour variation, etc.

Note 2 to entry: This note applies to the French language only.

3.21
dimmer
device to control the light output level of lighting equipment

3.22
built-in dimmer
dimmer which is either contained within the enclosure of a luminaire or mounted in its supply cable

3.23
independent dimmer
dimmer other than a built-in dimmer

3.24
phase control dimmer
electronic switch producing a leading edge (forward phase) or a trailing edge (reverse phase) AC waveform

Note 1 to entry: This AC waveform is supplied to one or more loads and its conduction angle is adjustable.

3.25
universal phase control dimmer
phase control dimmer which is capable of switching, automatically or manually, between producing a leading edge or a trailing edge AC waveform

3.26
professional luminaire for stage lighting and studios
luminaire (outdoor or indoor) for stage lighting or for television, film or photographic studios within the scope of IEC 60598-2-17 and which is professional equipment

4 General

The objective of this document is to set limits for harmonic emissions of equipment within its scope, so that, with due allowance for the emissions from other equipment, compliance with the limits ensures that harmonic disturbance levels do not exceed the compatibility levels defined in IEC 61000-2-2.

Professional equipment that does not comply with the requirements of this document can be permitted to be connected to certain types of low voltage supplies, if the instruction manual contains a requirement to ask the supply utility for permission to connect. Recommendations concerning this aspect are contained in IEC 61000-3-12.

5 Classification of equipment

5.1 General

For the purpose of harmonic current limitation, equipment is classified as follows:

Class A:

Equipment not specified as belonging to Class B, C or D shall be considered as Class A equipment.

Some examples of Class A equipment are:

– balanced three-phase equipment;
– household appliances, excluding those specified as belonging to Class B, C or D;
– vacuum cleaners;
– high pressure cleaners;
– tools, excluding portable tools;
– independent phase control dimmers;
– audio equipment;
– professional luminaires for stage lighting and studios.

NOTE 1 Equipment that can be shown to have a significant effect on the supply system might be reclassified in a future edition of this document, taking into account the following factors:

– number of pieces of equipment in use;
– duration of use;
– simultaneity of use;
– power consumption;
– harmonic spectrum, including phase.

Class B:

– portable tools;
– arc welding equipment which is not professional equipment.

Class C:

– lighting equipment.

Class D:

Equipment having a specified power according to 6.3.2, less than or equal to 600 W, of the following types:

– personal computers and personal computer monitors;
– television receivers;
– refrigerators and freezers having one or more variable-speed drives to control compressor motor(s).

NOTE 2 Class D limits are reserved for equipment that, by virtue of the factors listed in note 1, can be shown to have a pronounced effect on the public electricity supply system.

5.2 Description of lighting equipment

In this document, lighting equipment as defined in 3.13 includes:

– lamps and luminaires;

– the lighting part of multi-function equipment where one of the primary functions of this is illumination;
– independent lighting control gear;
– ultraviolet (UV) and infrared (IR) radiation equipment;
– illuminated advertising signs;
– independent dimmers, other than phase control types, for lighting equipment;
– DLT control devices.

In this document, lighting equipment as defined in 3.13 excludes:

– lighting devices built in equipment with another primary purpose, such as photocopiers, overhead projectors and slide projectors, or employed for scale illumination or indication purposes;
– household appliances whose primary function is not for generating and/or regulating and/or distributing optical radiation but which contain one or more lamps with or without a separate switch (e.g. a range hood with a built-in lamp);
– independent phase control dimmers;
– professional luminaires for stage lighting and studios;
– emergency luminaires that emit light only during emergency mode.

6 General requirements

6.1 General

The restrictions specified in 6.2 also apply to the categories of equipment listed in 7.1 for which no harmonic current limits apply.

The requirements and limits specified in this document are applicable to the power input terminals of equipment intended to be connected to 220/380 V, 230/400 V and 240/415 V systems operating at 50 Hz or 60 Hz. Requirements and limits for other cases are not yet specified.

A simplified test method is permitted for equipment that undergoes minor changes or updates, provided that, in previous full compliance tests, it has been shown to have current emissions below 60 % of the applicable limits and the *THD* of the supply current is less than 15 %. The simplified test method consists of verifying that the updated equipment has an active input power within ±20 % of that of the originally tested product, and that the *THD* of the supply current is less than 15 %. Products that fulfill these requirements are deemed to comply with the applicable limits, but in case of doubt the result of a full compliance test according to Clauses 6 and 7 takes precedence over this simplified method.

6.2 Control methods

Asymmetrical controls according to IEC 60050-161:1990, 161-07-12, and half-wave rectification directly on the mains supply may only be used in the following circumstances:

a) where they are the only practical solution permitting the detection of unsafe conditions, or
b) where the controlled active input power is less than or equal to 100 W, or
c) where the controlled appliance is a portable equipment fitted with a two-core flexible cord and is intended for use for a short period of time, i.e. for a few minutes only.

If one of these three conditions is fulfilled, half-wave rectification may be used for any purpose, whereas asymmetrical controls may only be used for the control of motors.

NOTE 1 Such equipment includes, but is not limited to, hair dryers, electrical kitchen appliances and portable tools.

Symmetrical control methods which can produce harmonics up to the 40th order in the input current may be used for the control of the power supplied to heating elements provided that the full sine-wave input power is less than or equal to 200 W, or that the limits of Table 3 are not exceeded.

Such symmetrical control methods are also allowed for professional equipment provided that either

a) one of the above conditions is fulfilled, or

b) the relevant emission limits according to Clause 7 are not exceeded when tested at the supply input terminals and in addition both the following conditions are fulfilled:

   1) it is necessary to control precisely the temperature of a heater whose thermal time constant is less than 2 s, and

   2) there is no other technique economically available.

Professional equipment whose primary purpose, considered as a whole, is not for heating, shall be tested against the relevant emission limits according to Clause 7.

NOTE 2 An example of a product whose primary purpose is not heating is a photocopier, whereas a cooker is considered to have heating as its primary purpose.

Domestic equipment with symmetrical control used for a short time (for example hair dryers) shall be tested under Class A.

Even though asymmetrical controls and half-wave rectification are permitted under the conditions given above, the equipment shall still comply with the harmonic requirements of this document.

NOTE 3 When using asymmetrical controls or half-wave rectification under the above circumstances, the input current has a DC component that can disturb certain types of protection devices in case of an earth fault. See IEC TR 60755.

6.3 Harmonic current measurement

6.3.1 Test configuration

Harmonic components shall be measured in accordance with the requirements given in Annex A for the test circuit and the supply source.

Specific test conditions for the measurement of harmonic currents associated with some types of equipment are given in Annex B.

For equipment not mentioned in Annex B, emission tests shall be conducted with the user's operation controls or automatic programs set to the mode expected to produce the maximum total harmonic current (THC) under normal operating conditions. This defines the equipment set-up during emission tests and not a requirement to measure THC or to conduct searches for worst-case emissions.

The harmonic current limits specified in Clause 7 apply to line currents and not to currents in the neutral conductor. Nevertheless, for single-phase equipment, it is permissible to measure the currents in the neutral conductor instead of the currents in the line.

The equipment is tested as presented by, and in accordance with information provided by, the manufacturer. Preliminary operation of motor drives by the manufacturer can be needed before the tests are undertaken to ensure that results correspond with normal use.

6.3.2 Measurement procedure

The test shall be conducted according to the general requirements given in 6.3.3. The test duration shall be as defined in 6.3.4.

The measurement of harmonic currents shall be performed as follows:

– for each harmonic order, measure the 1,5 s smoothed RMS harmonic current in each discrete Fourier transform (DFT) time window as defined in IEC 61000-4-7;
– calculate the arithmetic average of the measured values from the DFT time windows, over the entire observation period as defined in 6.3.4.

The value of the input power to be used for the calculation of limits shall be determined as follows:

– measure the 1,5 s smoothed active input power in each DFT time window;
– determine the maximum of the measured values of power from the DFT time windows over the entire duration of the test.

NOTE The active input power supplied to the smoothing section of the measuring instrument as defined in IEC 61000-4-7 is the active input power in each DFT time window.

The harmonic currents and the active input power shall be measured under the same test conditions but need not be measured simultaneously.

The manufacturer may specify any value of power which is within ±10 % of the actual measured value and use it for determining the limits for the original manufacturer's conformity assessment test. The measured and specified values of power, as defined in 6.3.2, shall be documented in the test report.

If the value of the power found by measurement during emission tests other than the original manufacturer’s conformity assessment test, measured according to the terms of 6.3.2, is not less than 90 % nor greater than 110 % of the value for power specified by the manufacturer in the test report (see 6.3.3.5), the specified value shall be used to establish the limits. If the measured value is outside of this tolerance band around the specified value, the measured power shall be used to establish the limits.

For Class C equipment, the fundamental current and power factor, specified by the manufacturer, shall be used for the calculation of limits (see 3.6). The fundamental component of the current and the power factor are measured and specified by the manufacturer in the same way as the power is measured and specified for the calculation of Class D limits. The value used for the power factor shall be obtained from the same DFT measurement window as the value for the fundamental component of current.

6.3.3 General requirements

6.3.3.1 Repeatability

The repeatability (see 3.15) of the average value for the individual harmonic currents over the entire test observation period shall be better than ±5 % of the applicable limit, when the following conditions are met:

– the same equipment under test (EUT) (not another of the same type, however similar);
– the same test system;
– the same location;
– identical test conditions;
– identical climatic conditions, if relevant.

This repeatability requirement serves the purpose of defining the necessary observation period, see 6.3.4. It is not intended to serve as a pass/fail criterion for the assessment of compliance with the requirements of this document.

6.3.3.2 Reproducibility

The reproducibility (see 3.16) of measurements on the same EUT with different test systems cannot be definitively calculated so as to apply to all possible combinations of EUT, harmonics meter and test supply, but can be estimated to be better than ± (1 % + 10 mA), where the 1 % is 1 % of the average value of the total input current taken over the entire test observation period. Therefore, differences in results which are less than that value of current are deemed negligible, but in some cases a higher value can occur.

For the avoidance of doubt in such cases, test results, obtained at different locations or on different occasions, that show that all the relevant limits are met shall be accepted as demonstrating compliance, even though the results can differ more than the values for repeatability and reproducibility, given above.

NOTE The variability (see 3.17) of measurements on different EUTs of the same type, having no intentional differences, can be increased by practical component tolerances and other effects, such as possible interactions between the characteristics of the EUT and the measuring instrument or the power supply. The results of these effects cannot be quantified in this document, for the same reasons as for reproducibility. The second paragraph of 6.3.3.2 also applies in the case of variability.

A concession in respect of limit values to allow for possible variability is outside the scope of this document.

6.3.3.3 Starting and stopping

When a piece of equipment is brought into operation or is taken out of operation, manually or automatically, harmonic currents and power are not taken into account for the first 10 s following the switching event.

The equipment under test shall not be in stand-by mode (see 3.14) for more than 10 % of any observation period.

6.3.3.4 Application of limits

The average values for the individual harmonic currents, taken over the entire test observation period shall be less than or equal to the applicable limits.

For each harmonic order, all 1,5 s smoothed RMS harmonic current values, as defined in 6.3.2, shall be either:

a) less than or equal to 150 % of the applicable limits, or

b) less than or equal to 200 % of the applicable limits under the following conditions, which apply all together:

   1) the EUT belongs to Class A for harmonics,

   2) the excursion beyond 150 % of the applicable limits lasts less than 10 % of the test observation period or in total 10 min (within the test observation period), whichever is smaller, and

   3) the average value of the harmonic current, taken over the entire test observation period, is less than 90 % of the applicable limits.

Harmonic currents less than 0,6 % of the input current measured under the test conditions, or less than 5 mA, whichever is greater, are disregarded.

For the 21st and higher odd order harmonics, the average value obtained for each individual odd harmonic over the full observation period, calculated from the 1,5 s smoothed RMS values according to 6.3.2, may exceed the applicable limits by 50 % provided that the following conditions are met:

- the measured partial odd harmonic current does not exceed the partial odd harmonic current which can be calculated from the applicable limits;
- all 1,5 s smoothed RMS individual harmonic current values shall be less than or equal to 150 % of the applicable limits.

These exemptions (the use of the partial odd harmonic current for the average values and the 200 % short term limit for single 1,5 s smoothed values) are mutually exclusive and shall not be used together.

6.3.3.5 Test report

The test report may be based on information supplied by the manufacturer to a testing facility, or be a document recording details of the manufacturer's own tests. It shall include all relevant information for the test conditions, the test observation period, and, when applicable for establishing the limits, the active power or fundamental current and power factor.

6.3.4 Test observation period

Observation periods (T_{obs}) for four different types of equipment behaviour are considered and described in Table 4.

6.4 Equipment in a rack or case

Where individual self-contained items of equipment are installed in a rack or case, they are regarded as being individually connected to the mains supply. The rack or case need not be tested as a whole.

7 Harmonic current limits

7.1 General

The procedure for applying the limits and assessing the results is shown in Figure 1.

For the following categories of equipment, limits are not specified in this document:

NOTE 1 Limits might be defined in a future amendment or revision of the document.

– lighting equipment with a rated power less than but not equal to 5 W;

– equipment with a rated power of 75 W or less, other than lighting equipment;

NOTE 2 This value might be reduced from 75 W to 50 W in the future, subject to approval by National Committees at that time.

– professional equipment with a total rated power greater than 1 kW;

– symmetrically controlled heating elements with a rated power less than or equal to 200 W;

– independent phase control dimmers

  - with a rated power less than or equal to 1 kW when operating incandescent lamps;
  - with a rated power less than or equal to 200 W for trailing edge dimmers, and universal phase control dimmers with the default mode set to trailing edge, when operating lighting equipment other than incandescent lamps;
  - with a rated power less than or equal to 100 W for leading edge dimmers, and universal phase control dimmers without default mode set to trailing edge, when operating lighting equipment other than incandescent lamps.

  Clarification: For independent phase control dimmers labelled for use with incandescent lamps and other types of lighting equipment and with a rated power higher than 100 W or 200 W (depending on the type of phase control dimmer) and lower than or equal to 1 000 W, no limits apply to the dimmer when operating incandescent lamps, but limits apply when operating lighting equipment other than incandescent lamps.

NOTE 3 The lower bound for leading edge dimmers, and universal phase control dimmers without default mode set to trailing edge, is lower than the lower bound for trailing edge dimmers because the higher order harmonic emissions of leading edge dimmers are significantly higher when loaded with lamps other than incandescent lamps.

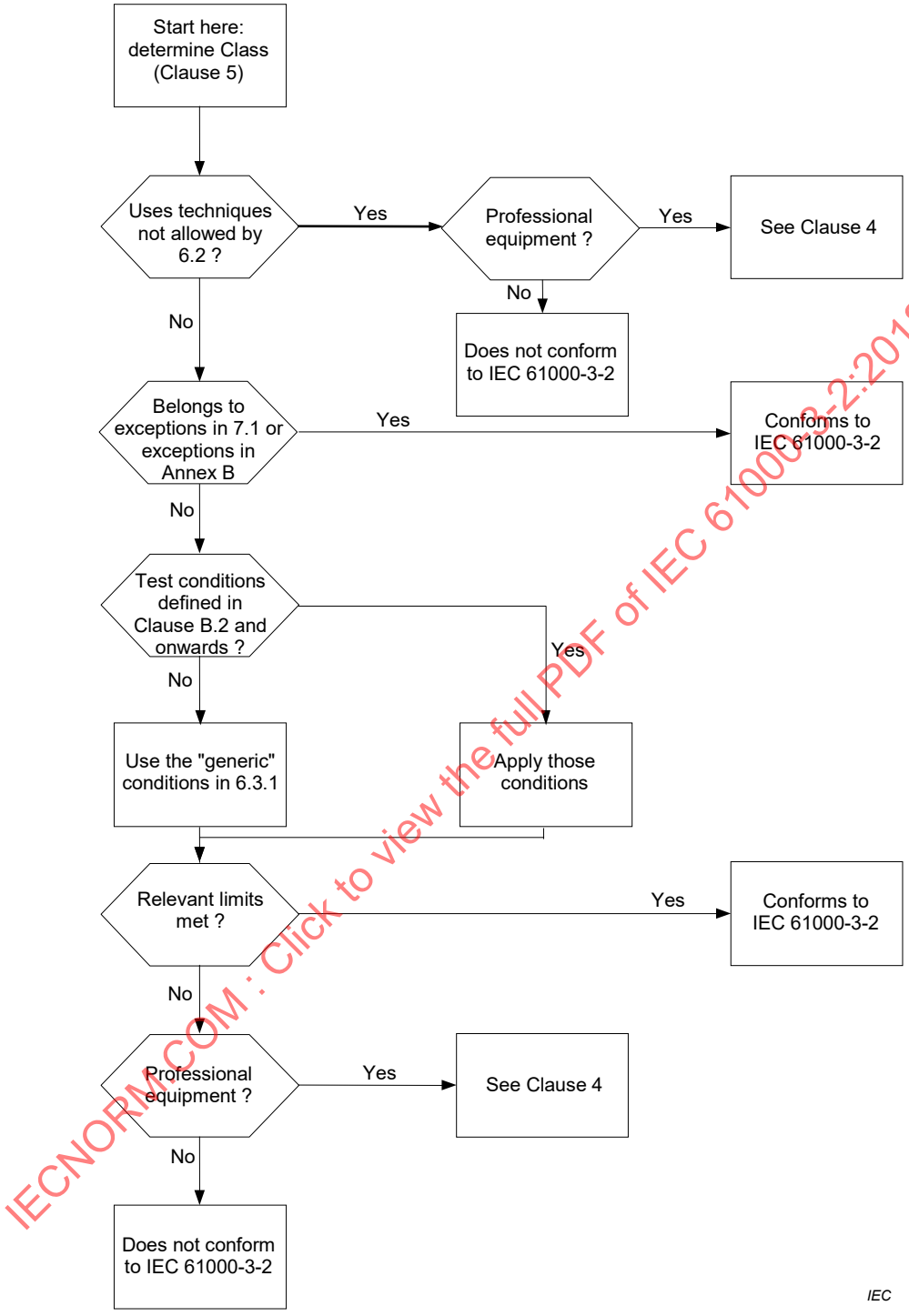


Figure 1 – Flowchart for determining conformity

7.2 Limits for Class A equipment

For Class A equipment, the harmonics of the input current shall not exceed the values given in Table 1.

Audio amplifiers shall be tested according to Clause B.3. Independent phase control dimmers for lighting equipment shall be tested according to Clause B.6.

7.3 Limits for Class B equipment

For Class B equipment, the harmonics of the input current shall not exceed the values given in Table 1 multiplied by a factor of 1,5.

7.4 Limits for Class C equipment

7.4.1 General

Lighting equipment shall be tested according to Clause B.5.

If the lighting equipment does not comply with the requirements of 7.4.2 or 7.4.3 due to the harmonic contribution of one control module with an active input power ≤ 2 W, the contribution of that control module may be disregarded provided that it is possible to measure the supply currents of the control module and the rest of the equipment separately, and the rest of the equipment draws the same current during emission tests as under normal operating conditions.

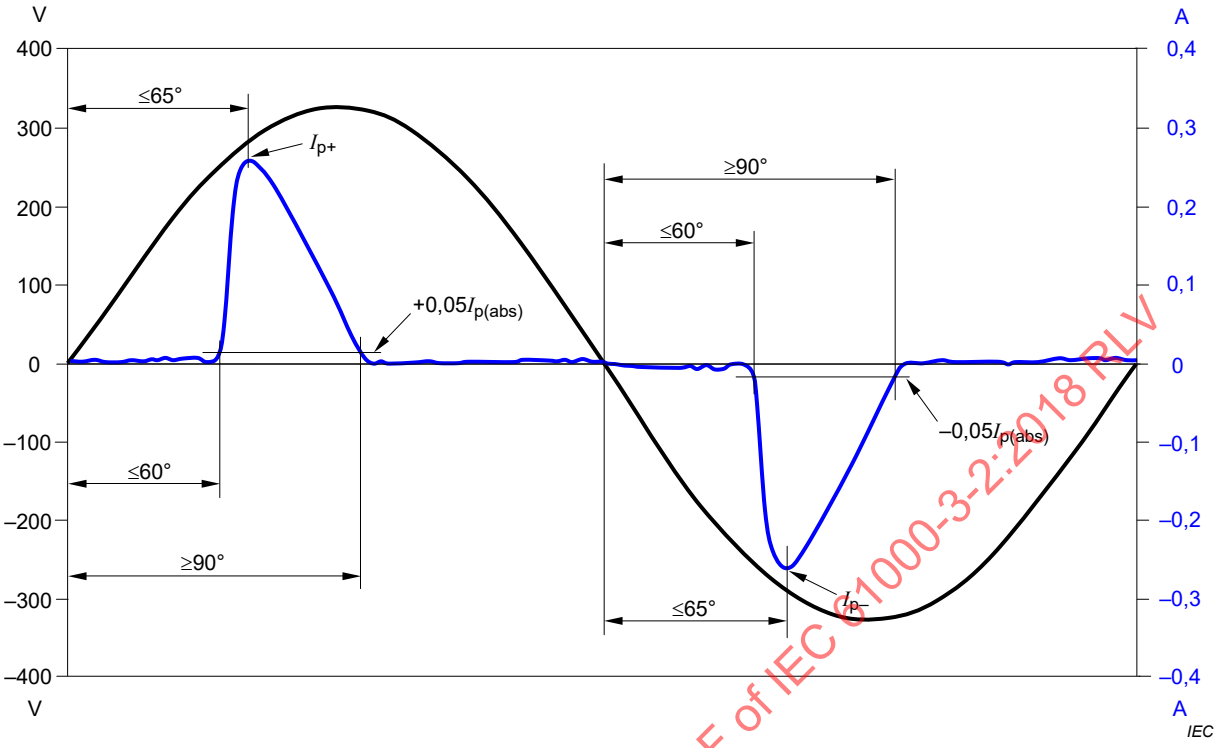
7.4.2 Rated power > 25 W

For luminaires with incandescent lamps and built-in phase control dimming having a rated power greater than 25 W, the harmonics of the input current shall not exceed the limits given in Table 1.

For any other lighting equipment having a rated power greater than 25 W, the harmonics of the input current shall not exceed the relative limits given in Table 2. For those types that include means for control (e.g. dimming, colour), the harmonics of the input current shall not exceed the harmonic current values derived from the percentage limits given in Table 2 for the maximum active input power (P_{max}) condition when tested in both following conditions:

– with the means for control set to obtain P_{max};
– with the means for control set to the position expected to produce the maximum total harmonic current (THC) within the active input power range [P_{min}, P_{max}], where
  - P_{min} = 5 W, if P_{max} ≤ 50 W;
  - P_{min} = 10 % of P_{max}, if 50 W < P_{max} ≤ 250 W;
  - P_{min} = 25 W, if P_{max} > 250 W.

7.4.3 Rated power ≥ 5 W and ≤ 25 W



NOTE $I_{p(abs)}$ is the higher absolute value of I_{p+} and I_{p-}.

Figure 2 – Illustration of the relative phase angle and current parameters described in 7.4.3

Lighting equipment having a rated power greater than or equal to 5 W and less than or equal to 25 W shall comply with one of the following three sets of requirements:

– the harmonic currents shall not exceed the power-related limits of Table 3, column 2;

– the third harmonic current, expressed as a percentage of the fundamental current, shall not exceed 86 % and the fifth harmonic current shall not exceed 61 %. In addition, the waveform of the input current shall be such that it reaches the 5 % current threshold before or at 60°, has its peak value before or at 65° and does not fall below the 5 % current threshold before 90°, referenced to any zero crossing of the fundamental supply voltage. The current threshold is 5 % of the highest absolute peak value that occurs in the measurement window, and the phase angle measurements are made on the cycle that includes this absolute peak value (see Figure 2). Components of current with frequencies above 9 kHz shall not influence this evaluation (a filter similar to the one described in 5.3 of IEC 61000-4-7:2002 and IEC 61000-4-7:2002/AMD1:2008 may be used);

– the *THD* shall not exceed 70 %. The third order harmonic current, expressed as a percentage of the fundamental current, shall not exceed 35 %, the fifth order current shall not exceed 25 %, the seventh order current shall not exceed 30 %, the ninth and eleventh order currents shall not exceed 20 % and the second order current shall not exceed 5 %.

If the lighting equipment includes means for control (e.g. dimming, colour), or is specified to drive multiple loads, then the measurement is made only at the control setting and the load of lamps that gives the maximum active input power.

NOTE The preceding requirement is based on the assumption that, for lighting equipment using control other than phase control, the *THC* decreases when the input power is reduced.

7.5 Limits for Class D equipment

For Class D equipment, the harmonic currents and the power shall be measured as defined in 6.3.2. The input currents at harmonic frequencies shall not exceed the values that can be derived from Table 3 according to the requirements specified in 6.3.3 and 6.3.4.

Table 1 – Limits for Class A equipment

Harmonic order h	Maximum permissible harmonic current A
Odd harmonics	
3	2,30
5	1,14
7	0,77
9	0,40
11	0,33
13	0,21
$15 \leq h \leq 39$	$0{,}15\frac{15}{h}$
Even harmonics	
2	1,08
4	0,43
6	0,30
$8 \leq h \leq 40$	$0{,}23\frac{8}{h}$

Table 2 – Limits for Class C equipment [a]

Harmonic order h	Maximum permissible harmonic current expressed as a percentage of the input current at the fundamental frequency %
2	2
3	$30 \cdot \lambda$ [b]
5	10
7	7
9	5
$11 \leq h \leq 39$ (odd harmonics only)	3

[a] For some Class C products, other emission limits apply (see 7.4).

[b] λ is the circuit power factor.

Table 3 – Limits for Class D equipment

Harmonic order h	Maximum permissible harmonic current per watt mA/W	Maximum permissible harmonic current A
3	3,4	2,30
5	1,9	1,14
7	1,0	0,77
9	0,5	0,40
11	0,35	0,33
$13 \leq h \leq 39$ (odd harmonics only)	$\frac{3,85}{h}$	See Table 1

Table 4 – Test observation period

Type of equipment behaviour	Observation period
Quasi-stationary	T_{obs} of sufficient duration to meet the requirements for repeatability in 6.3.3.1
Short cyclic ($T_{cycle} \leq 2,5$ min)	$T_{obs} \geq 10$ cycles (reference method) or T_{obs} of sufficient duration or synchronization to meet the requirements for repeatability in 6.3.3.1 [a]
Random	T_{obs} of sufficient duration to meet the requirements for repeatability in 6.3.3.1
Long cyclic ($T_{cycle} > 2,5$ min)	Full equipment program cycle (reference method) or a representative 2,5 min period considered by the manufacturer as the operating period with the highest THC
[a] 'Synchronization' means that the total observation period is sufficiently close to including an exact integral number of equipment cycles such that the requirements for repeatability in 6.3.3.1 are met.	

Annex A
(normative)

Measurement circuit and supply source

A.1 Test circuit

The measured harmonic values shall be compared with the limits given in Clause 7. The harmonic currents of the equipment under test (EUT) shall be measured in accordance with the circuits given in the following figures:

– Figure A.1 for single-phase equipment;
– Figure A.2 for three-phase equipment.

Measurement equipment complying with IEC 61000-4-7 shall be used. Specific test conditions for some types of equipment are given in Annex B.

A.2 Supply source

While the measurements are being made, the test voltage (U) at the terminals of the equipment under test shall meet the following requirements:

a) The test voltage (U) shall be the rated voltage of the equipment. In the case of a voltage range, the test voltage shall be 230 V or 400 V for single-phase or three-phase supplies respectively. The test voltage shall be maintained within ±2,0 % and the frequency within ±0,5 % of the nominal value.
b) In the case of a three-phase supply, the angle between the fundamental voltage on each pair of phases of a three-phase source shall be 120° ± 1,5°.
c) The harmonic ratios of the test voltage (U) shall not exceed the following values with the EUT connected as in normal operation:

   0,9 % for harmonic of order 3;

   0,4 % for harmonic of order 5;

   0,3 % for harmonic of order 7;

   0,2 % for harmonic of order 9;

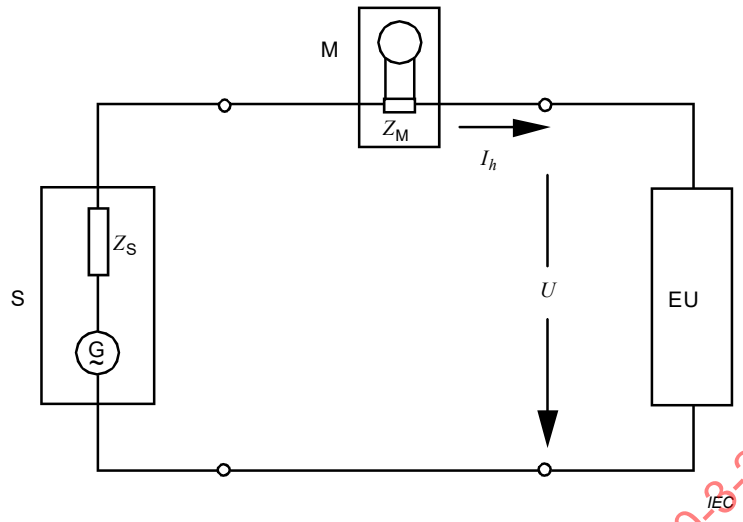
   0,2 % for even harmonics of order from 2 to 10;

   0,1 % for harmonics of order from 11 to 40.
d) The peak value of the test voltage shall be within 1,40 times and 1,42 times its RMS value and shall be reached within 87° to 93° after the zero crossing. This requirement does not apply when Class A or B equipment is tested.

The values of impedances Z_S and Z_M in Figures A.1 and A.2 are not specified, but shall be sufficiently low for the requirements of Clause A.2 to be met. This is checked by measuring the properties of the supply voltage at the point of connection of the EUT to the measurement equipment. More information can be found in IEC 61000-4-7.

In some special cases, particular care can be necessary to avoid resonance between the internal inductance of the source and the capacitances of the equipment under test.

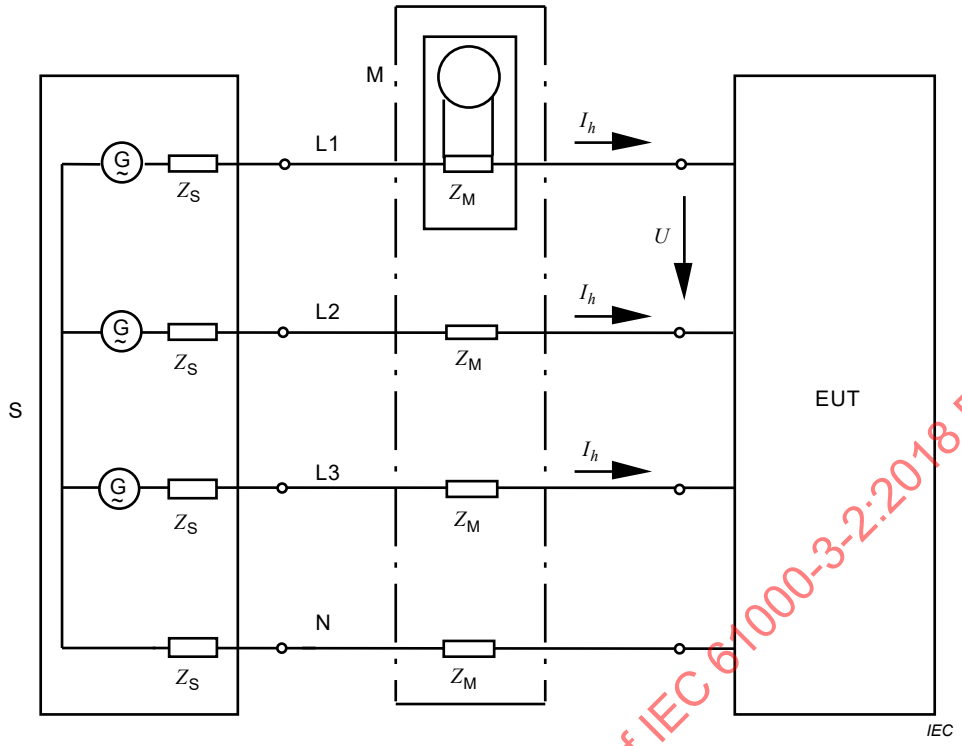
For some types of equipment, such as single-phase uncontrolled rectifiers, some harmonic amplitudes vary greatly with the supply voltage. To minimize variability, it is recommended to maintain the voltage at the point of connection of the EUT to the measurement equipment to 230 V or 400 V within ±1,0 V, evaluated over the same 200 ms observation window, used for harmonic assessment.



Key

S	power supply source	Z_M	input impedance of measurement equipment
M	measurement equipment	Z_S	internal impedance of the supply source
EUT	equipment under test	I_h	harmonic component of order h of the line current
U	test voltage	G	open-loop voltage of the supply source

Figure A.1 – Measurement circuit for single-phase equipment



Key

S power supply source
M measurement equipment
EUT equipment under test
G open-loop voltage of the supply source
Z_M input impedance of the measurement equipment
Z_S internal impedance of the supply source
I_h harmonic component of order h of the line current
U test voltage (shown as an example between phases L1 and L2)

Figure A.2 – Measurement circuit for three-phase equipment

Annex B
(normative)

Type test conditions

B.1 General

The test conditions for the measurement of harmonic currents associated with some types of equipment are given Clauses B.2 to B.16.

NOTE Product committees are invited to submit proposals for defined test conditions for specific products to IEC SC 77A, for inclusion in Annex B.

B.2 Test conditions for television receivers (TV)

B.2.1 General requirements

Measurements shall include the loading of any auxiliary circuits included in the receiver, but exclude the loading of any peripheral equipment powered from the receiver.

The TV shall be fed by an input signal in accordance with B.2.2.1 and the image level adjustments, sound level adjustments and energy-saving functions shall be set in accordance with B.2.2.2 to B.2.2.4. Settings for which no specific requirements have been defined in B.2.2 shall be set to the default conditions under which the TV is delivered to the customer for home use.

B.2.2 Measurement conditions

B.2.2.1 Input signal

Any input signal (RF or baseband), containing video and audio as specified in B.2.2.1, may be used. The television receiver is set to reproduce the content of the input signal. The signal level shall be high enough, so that the full screen display image has no noise and no bit error.

The video signal is the colour bar signal, as defined in IEC 60107-1:1997, 3.2.1.2.

The audio signal is a 1 kHz sinusoidal signal.

B.2.2.2 Image level adjustments

Contrast, brightness, backlight and other functions (if they exist) of the TV shall be set to the default conditions under which the TV is delivered to the customer for home use.

B.2.2.3 Sound level adjustments

The volume control shall be adjusted between 8 % and 12 % of the maximum of the on-screen audio display. All other audio functions shall be kept in the default conditions under which the TV is delivered to the customer for home use.

B.2.2.4 Energy-saving function

Ambient light control, dynamic backlight control and other similar functions shall be switched off. If they cannot be deactivated, use lighting equipment with illuminance ≥ 300 lx directly irradiating the light sensor while testing, and indicate this in the test report. Any lighting functions that are included in the TV and illuminate the environment of the TV shall be switched on.

B.2.3 Test report

The test report shall indicate the input signal and settings of the television receiver.

B.3 Test conditions for audio amplifiers

B.3.1 Conditions

Audio amplifiers which draw a supply current which varies less than 15 % of the maximum current with input signal voltages between zero and a rated source e.m.f. (as defined in IEC 60268-3) shall be tested with no input signal.

Other audio amplifiers shall be tested under the following conditions:

- rated supply voltage;
- normal position of user controls. In particular, any controls affecting the frequency response set to give the widest flat response achievable;
- input signals and loads as given in B.3.2.

B.3.2 Input signals and loads

The following test procedure applies.

a) Connect suitable resistors, equal to the rated load impedance(s), to each amplifier output for supplying loudspeakers. To monitor the output voltage waveform of the audio amplifier of a powered loudspeaker, the audio analyzer/oscilloscope is connected to internal wiring at a point representing the electrical output of the amplifier.

NOTE 1 In the case of powered loudspeakers with internal audio amplifiers, the load is the loudspeaker and associated crossover network.

b) Apply a sinusoidal signal at 1 kHz (see note 2) to a suitable input. For multi-channel amplifiers in which the surround sound channel amplifiers cannot be alternatively used as a second set of left and right channel amplifiers, set the controls so that the surround sound channel amplifiers are supplied with signal at a level 3 dB lower than the signal applied to the left and right channels.

NOTE 2 For products not intended to reproduce 1 kHz signals, a frequency geometrically centred within the reproducing bandwidth of the amplifier is applied.

c) Adjust the input signal and/or amplifier gain control(s) so as to obtain an output signal for the left and right channels having 1 % total harmonic distortion, simultaneously. If 1 % total harmonic distortion cannot be obtained, adjust the signal voltage and/or gain controls to obtain the highest achievable power output at each output simultaneously. Confirm that the output signals of the surround sound channel amplifiers are 3 dB lower than the output signal at the outputs of the left and right channels.

d) Measure the output voltages of all channels and then readjust the input signal voltage and/or controls to obtain voltages of 0,354 ($1/\sqrt{8}$) times the voltages obtained at the end of step c) above.

e) In the case of products with provision for connection to external loudspeakers, proceed as specified in 6.3.

f) For products with internal loudspeakers and without provision for connection to external loudspeakers, note the RMS output voltage of the sinusoidal signal at the output of each amplifier. Substitute the sinusoidal signal by a pink noise signal, bandwidth-limited as specified in 6.1 of IEC 60268-1:1985. Confirm the RMS value of the pink noise signal as it appears at the output of each amplifier output is equal to the RMS value of the sinusoidal waveform for that channel set as in step d) above. Proceed as specified in 6.3.

B.4 Test conditions for video-cassette recorders

Measurements shall be made in the playback mode with the standard tape speed.

B.5 Test conditions for lighting equipment

B.5.1 General conditions

Measurements shall be made in a draught-free atmosphere and at an ambient temperature within the range from 20 °C to 27 °C. During measurement the temperature shall not vary by more than 1 K.

B.5.2 Lamps

Discharge lamps shall be aged for at least 100 h at rated voltage. Discharge lamps shall be operated for at least 15 min before a series of measurements is made. Some lamp types require a stabilization period exceeding 15 min. Information given in the relevant IEC lamp performance standard shall be observed.

During ageing, stabilization and measurement, lamps shall be installed as in normal use. Self-ballasted lamps shall be operated in cap-up position.

B.5.3 Luminaires

The luminaire is measured as manufactured. It shall be tested with lamps (or artificial loads) having electrical characteristics close to those of the type of lamps specified for use with the luminaire. If the luminaire incorporates more than one lamp, all lamps are connected and operated during the test. If the luminaire is specified for use with more than one type of lamp, measurements shall be made with all the types and the luminaire shall comply each time. In the case where the luminaire is equipped with a glow starter, a starter in accordance with IEC 60155 shall be used.

Incandescent lamp luminaires which incorporate no lighting control gear and no control device, excluding a mechanical switch, are deemed to fulfil the harmonic current requirements and need not be tested.

If separate tests with each type of lamps (or artificial loads) specified for use with the luminaire – the lamps (or artificial loads) having electrical characteristics close to those of the type of lamps considered – have proved that the lighting control gear which is built into the luminaire complies with the requirements, the luminaire is deemed to comply with these requirements and need not be checked. If this is not the case, the luminaire itself shall be tested and shall comply.

B.5.4 Lighting control gear

Lighting control gear shall be tested with lamps (or artificial loads) having electrical characteristics close to the objective lamp values given in the lighting control gear specification and being representative of the type of lamps intended to be used with the lighting control gear.

In the case where the lighting control gear can be used with or without a series capacitor, or where the lighting control gear is designed for several types of lamps, the manufacturer shall specify in its catalogue for which type of circuit and lamps the lighting control gear fulfils the harmonic requirements, and the lighting control gear shall be tested for each corresponding type of circuit and lamps and shall comply each time.

B.5.5 DLT control devices

The DLT control device shall be tested with a resistive load or a lighting load having the maximum power allowed for the DLT control device.

B.6 Test conditions for independent phase control dimmers for lighting equipment

If the phase control dimmer is specified for use with one or more types of lighting equipment, the dimmer shall be tested with one representative sample of each type of lighting equipment and shall comply each time. In each case, the measurements shall be made with a lighting load having the maximum power allowed for the dimmer. The setting of the dimmer is set to the position expected to produce the maximum total harmonic current (THC).

The dimmer is deemed to comply when used with other lighting equipment substantially similar to the representative types up to the declared power.

When a phase control dimmer is tested with an incandescent lamp load, the control is set to a firing-angle of 90° ± 5°, or if controlled by steps, to that step closest to 90°.

B.7 Test conditions for vacuum cleaners

The air inlet of the vacuum cleaner is adjusted according to normal operation as defined in IEC 60335-2-2.

Vacuum cleaners with variable input power shall be tested in three modes of operation, each for an identical time interval that is at least 2 min long, with the control adjusted:

– to maximum input power,

– to 50 % ± 5 % of the maximum active input power, or, if that is not possible (e.g. controlled in steps), to the point closest to 50 % that is supported by the equipment design, and

– to minimum input power.

If the active input power at minimum input power is higher than 50 % of the maximum active input power, the above requirements imply that the vacuum cleaner is tested for three identical time intervals: one time interval with the control adjusted to maximum input power and two time intervals with the control adjusted to minimum input power.

These three time intervals need not be consecutive, but the application of limits according to 6.3.3.4 is done as if the intervals were consecutive. In that case, the entire test observation period is made up of the three identical time intervals, without taking into account harmonic current values outside these three intervals.

If the vacuum cleaner includes a control to select a temporary high-power ('booster') mode of operation, which automatically returns to a lower power mode, this high-power mode is not considered for the calculation of the average values. This mode shall be tested only against the limits for single 1,5 s smoothed RMS values (see 6.3.3.4).

B.8 Test conditions for washing machines

The washing machine shall be tested during a complete laundry program incorporating the normal wash-cycle, filled with the rated load of double hemmed, pre-washed cotton cloths, size approximately 70 cm × 70 cm, dry weight from 140 g/m^2 to 175 g/m^2. The cloths shall be loaded into the washing machine in a way to avoid an unrealistic unbalance of the weight.

NOTE Loading the cloths one-by-one is one way to achieve this.

The temperature of the fill water shall be

- 65 °C ± 5 °C for washing machines without heating elements and intended for connection to a hot water supply;
- from 10 °C to 25 °C for other washing machines.

For washing machines with a programmer, the 60 °C cotton programme without pre-wash, if available, shall be used, otherwise the regular wash programme without pre-wash shall be used. If the washing machine contains heating elements which are not controlled by the programmer, the water shall be heated to 65 °C ± 5 °C before starting the first wash period.

If the washing machine contains heating elements and does not incorporate a programmer, the water shall be heated to 90 °C ± 5 °C or lower if steady conditions are established, before starting the first wash period.

B.9 Test conditions for microwave ovens

The microwave oven is tested with 100 % nominal power. It is operated with a potable water load of initially 1 000 g ± 50 g in a cylindrical borosilicate glass vessel, having a maximum material thickness of 3 mm and an outside diameter of approximately 190 mm. The load is placed at the centre of the shelf.

B.10 Test conditions for information technology equipment (ITE)

B.10.1 General conditions

ITE (including personal computers) which is marketed without “factory-fitted options” and without expansion slot capabilities shall be tested as supplied. ITE, other than personal computers, which is marketed with “factory-fitted options” or has expansion slots, shall be tested with additional loads in each expansion slot that result in the maximum power consumption attainable using the “factory-fitted options” specified by the manufacturer.

For the testing of personal computers with up to 3 expansion slots, load cards configured for the maximum permitted power for each expansion slot shall be added to each respective expansion slot. For the testing of personal computers with more than 3 expansion slots, additional load cards shall be installed at the rate of at least one load card for each group of up to 3 additional slots (i.e. for 4, 5 or 6 slots a total of at least 4 load cards shall be added. For 7, 8 or 9 slots a total of at least 5 load cards shall be added, etc.).

In all configurations, the use of additional loads shall not cause the total DC output power available from the ITE power supply to be exceeded.

NOTE Common load cards for expansion slots such as PCI or PCI-2 are configured for 30 W but might be adjusted as industry standards change.

Modular equipment, such as hard drive arrays and network servers, are tested in their maximum configuration. This does not mean that multiple options of the same type, such as more than one hard drive, should be fitted, unless that is representative of the user configuration, or the product is of a type (such as redundant arrays of inexpensive disks (RAID)) for which such a configuration is not abnormal.

Emission tests shall be conducted with the user’s operation controls or automatic programs set to the mode expected to produce the maximum total harmonic current (THC) under normal operating conditions.

Power saving modes which can cause large power level fluctuations shall be disabled, so that all, or part, of the equipment does not automatically switch off during the measurements.

For ITE systems designed for use with a manufacturer-supplied power distribution system, such as one or more transformers, uninterruptible power supply (UPS) or a power conditioner, compliance with the limits of this document shall be met at the input supplied from the public low-voltage distribution network.

B.10.2 Optional conditions for measuring emissions of IT equipment with external power supplies or battery chargers

For IT equipment with external power supplies or battery chargers, manufacturers may choose

- either to test the whole equipment according to B.10.1 (General conditions),
- or to test the equipment by measuring the AC input power and the harmonic emissions of the associated power supply or battery charger according to 6.3.2 with the DC output side loaded by a resistive load, provided that, with the resistive load applied, the peak-to-peak ripple voltage across the load is not greater than 5 % of the DC output voltage.

The resistance value of the load shall be such that the active power dissipated in the load is equal to the DC output power rating, or, if that is not available, to the DC output voltage rating multiplied by the DC output current rating marked on the power supply/battery charger unit.

Power supply/battery charger units whose AC input power measured according to 6.3.2 under the above load conditions is 75 W or less are deemed to conform without further testing, as specified in Clause 7.

B.11 Test conditions for cooking appliances

B.11.1 Induction hobs and hotplates

Induction hobs and hotplates shall be operated with a steel pan which contains approximately half its maximum capacity of water at room temperature and which is positioned at the centre of each cooking zone. Each cooking zone shall be tested separately in a two-step procedure:

1) The different control levels (including boost mode) are tested at first for a few seconds. If there are no discrete power levels, the control range is divided into 10 approximately equidistant steps. The control level with the highest THC is determined.
2) The measurement for comparison with the harmonic emission limits, as defined in 6.3.2, shall be done with the control level producing the highest THC, as determined in step 1), and with a test observation period according to Table 4.

The diameter of the base of the pan shall be at least the diameter of the cooking zone. The smallest standard cooking vessel complying with this requirement is used.

The nominal diameters of the contact surface of standard cooking vessels are 110 mm, 145 mm, 180 mm, 210 mm, 300 mm.

The vessel bottom shall be concave and shall not deviate from flatness by more than 0,6 % of its diameter at the ambient temperature (20 ± 5) °C.

Cooking zones which are intended for use with vessels having a curved bottom (e.g. wok zones) shall be measured with the vessel provided together with the hob, or with the vessel recommended by the manufacturer.

Side by side cooking zones which can be combined and controlled together shall be measured separately.

Cooking zones with many small coils which are automatically configured to an active heating zone shall be tested with a vessel of 300 mm diameter. The vessel shall be placed centrically in the cooking zone.

B.11.2 Hobs and hotplates other than induction cooking appliances

For equipment with several cooking zones, the measurements as defined in 6.3.2 shall be performed separately on each individual cooking zone.

Each cooking zone shall be operated with the control settings expected to produce the maximum THC. A suitable pan or pot filled with approximately half its maximum capacity of water shall be placed at the centre of the cooking zone.

B.12 Test conditions for air conditioners

If the input power of the air conditioner is controlled by an electronic device so that the revolution speed of the fan or compressor motor is changed in order to get the suitable air temperature, the harmonic currents are measured after the operation becomes steady-state under the following conditions:

– The temperature control shall be set to the lowest value in the cooling mode and to the highest value in the heating mode.

– The ambient temperature for testing shall be 30 °C ± 2 °C in the cooling mode, and 15 °C ± 2 °C in the heating mode. If in the heating mode the rated input power is reached at a higher temperature, the air conditioner shall be tested at this ambient temperature but no higher than 18 °C. The ambient temperature is defined as the temperature of the air inhaled from the indoor and from the outdoor unit of the appliance.

If the heat is not exchanged to the ambient air but to another medium for example water, all settings and temperatures shall be chosen so that the appliance is operated with the rated input power.

If the air conditioner does not contain power electronic elements (e.g. diodes, dimmers, thyristors, etc.), it need not be tested against harmonic current limits.

B.13 Test conditions for kitchen machines as defined in IEC 60335-2-14

Kitchen machines as listed in the scope of IEC 60335-2-14 are deemed to conform to the harmonic current limits of this document without further testing.

B.14 Test conditions for arc welding equipment which is not professional equipment

Testing shall be carried out at an ambient temperature between 20 °C and 30 °C. The test shall be started with the arc welding power source at ambient temperature. The arc welding power source shall be connected to a conventional load. It shall be operated at the rated maximum welding current I_{2max} and conventional load voltage given in Table B.1. The observation period shall be 10 thermal cycles (for short cyclic equipment where the first thermal cycle is less than or equal to 2,5 min) or one full thermal cycle (for long cyclic equipment where the first thermal cycle is greater than 2,5 min). Multi-process arc welding power sources shall be tested using the process which gives the highest input current. The definitions for conventional load, I_{2max}, I_2 and U_2 are given in IEC 60974-1.

Table B.1 – Conventional load for arc welding equipment tests

Welding process	Load voltage V
Manual metal arc welding with covered electrodes	$U_2 = (18 + 0{,}04\ I_2)$
Tungsten inert gas	$U_2 = (10 + 0{,}04\ I_2)$
Metal inert/active gas and flux cored arc welding	$U_2 = (14 + 0{,}05\ I_2)$
Plasma cutting	$U_2 = (80 + 0{,}4\ I_2)$

B.15 Test conditions for high pressure cleaners which are not professional equipment

The high pressure cleaner is adjusted according to normal operation as defined in IEC 60335-2-79 except for the electronic power control.

High pressure cleaners with variable input power shall be tested in three modes of operation, each for an identical time interval that is at least 2 min long, with the control adjusted:

– to maximum input power,

– to 50 % ± 5 % of the maximum active input power, or, if that is not possible (e.g. controlled in steps), to the point closest to 50 % that is supported by the equipment design, and

– to minimum input power.

NOTE If the active input power at minimum input power is higher than 50 % of the maximum active input power, the above requirements imply that the high pressure cleaner is tested for three identical time intervals: one time interval with the control adjusted to maximum input power and two time intervals with the control adjusted to minimum input power.

These three time intervals need not be consecutive, but the application of limits according to 6.3.3.4 is done as if the intervals were consecutive. In that case, the entire test observation period is made up of the three identical time intervals, without taking into account harmonic current values outside these three intervals.

B.16 Test conditions for refrigerators and freezers

B.16.1 General

Refrigerators and freezers shall be tested with an empty cabinet. The temperature shall be set to its lowest value intended for constant use (quick cool down functions are not considered). The measurement shall be started after the internal temperature has been stabilized.

NOTE Stabilization of the temperature can be deduced, for example, from the input power going into a low power mode.

When the measurement is started, the ambient temperature shall be between 20 °C and 30 °C. During the test the ambient temperature shall be maintained within ±2 °C.

B.16.2 Refrigerators and freezers with VSD

The observation period shall be 1 h. A few seconds after starting the measurement, all doors and further internal compartments shall be fully opened for 60 s and then closed again and kept closed for the rest of the observation period.

NOTE 1 A timing accuracy of ±6 s is assumed to be sufficient for the targeted measurement repeatability, see note 3 below.

Deviating from 6.3.2, the value of the input power to be used for the calculation of limits shall be determined according to the following formula:

$$P_i = 0{,}78 \times I_m \times U_r$$

where

P_i is the active input power in watts, to be used for the calculation of Class D limits (see Table 3);

I_m is the current in amperes of the appliance measured according to IEC 60335-2-24:2010, 10.2;

U_r is the rated voltage in volts of the appliance. If the appliance has a rated voltage range, U_r has the value that has been used for measuring I_m.

NOTE 2 P_i is used for the calculation of limits instead of the measured active input power to eliminate the influence of other loads than the VSD, for example lighting devices or heating elements for defrosting, on the limit calculation. This also increases the repeatability of the measurement.

NOTE 3 The 5 % repeatability, mentioned in 6.3.3.1, can be achieved only if the climatic conditions are strongly controlled and, for each test, the measurement is started at the same point in the control cycle of the EUT. If these conditions are not fulfilled, the repeatability of the average value of the individual harmonic currents over the entire test observation period can be as much as 10 % of the applicable limit.

B.16.3 Refrigerators and freezers without VSD

Refrigerators and freezers without any variable speed drive to control compressor motor(s) are tested according to Class A limits in a representative 2,5 min observation period according to Table 4 for long cyclic equipment.

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IEC 60335-2-2, *Household and similar electrical appliances – Safety – Part 2-2: Particular requirements for vacuum cleaners and water-suction cleaning appliances*

IEC 60335-2-14, *Household and similar electrical appliances – Safety – Part 2-14: Particular requirements for kitchen machines*

IEC 60335-2-79, *Household and similar electrical appliances – Safety – Part 2-79: Particular requirements for high pressure cleaners and steam cleaners*

IEC 60598-2-17, *Luminaires – Part 2-17: Particular requirements – Luminaires for stage lighting, television and film studios (outdoor and indoor)*

IEC TR 60755, *General requirements for residual current operated protective devices*

IEC 60974-1, *Arc welding equipment – Part 1: Welding power sources*

IEC 60974-6, *Arc welding equipment – Part 6: Limited duty equipment*

IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-3-12, *Electromagnetic compatibility (EMC) – Part 3-12: Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC 62756-1, *Digital load side transmission lighting control (DLT) – Part 1: Basic requirements*

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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COMPATIBILITÉ ÉLECTROMAGNÉTIQUE (CEM) –

Partie 3-2: Limites – Limites pour les émissions de courant harmonique (courant appelé par les appareils ≤ 16 A par phase)

AVANT-PROPOS

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La Norme internationale IEC 61000-3-2 a été établie par le sous-comité 77A: CEM – Phénomènes basse fréquence, du comité d'études 77 de l'IEC: Compatibilité électromagnétique.

Elle constitue la partie 3-2 de la série IEC 61000. Elle a le statut d'une norme de famille de produit.

Cette cinquième édition annule et remplace la quatrième édition parue en 2014. Cette édition constitute une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) une mise à jour des limites d'émission pour les appareils d'éclairage ayant une puissance assignée ≤ 25 W afin de tenir compte des nouveaux types d'appareils d'éclairage;

b) l'ajout d'un seuil de 5 W en dessous duquel aucune limite d'émission ne s'applique à l'ensemble des appareils d'éclairage;

c) la modification des exigences qui s'appliquent aux variateurs de lumière lorsqu'ils font fonctionner des lampes qui ne sont pas à incandescence;

d) l'ajout de conditions d'essai applicables aux dispositifs de commande d'éclairage par transmission numérique côté charge;

e) la suppression de l'emploi de lampes de référence et de ballasts de référence pour les essais des appareils d'éclairage;

f) la simplification et la clarification de la terminologie employée pour les appareils d'éclairage;

g) la classification en classe A des luminaires professionnels pour l'éclairage des scènes de théâtre et pour les studios;

h) une clarification de la classification des appareils d'éclairage de secours;

i) une clarification pour les appareils d'éclairage comportant un module de commande ayant une puissance active d'entrée ≤ 2 W;

j) une mise à jour des conditions d'essai des récepteurs de télévision;

k) une mise à jour des conditions d'essai des tables de cuisson à induction, tenant compte également des autres types d'appareils de cuisson;

l) en cohérence avec l'IEC 61000-3-12, une modification du domaine d'application de l'IEC 61000-3-2, qui couvrait les appareils ayant un courant d'entrée ≤ 16 A, et qui couvre maintenant les appareils ayant un courant d'entrée assigné ≤ 16 A.

Le texte de cette norme est issu des documents suivants.

FDIS	Rapport de vote
77A/986/FDIS	77A/990/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2

Une liste de toutes les parties de la série IEC 61000, publiées sous le titre général *Compatibilité électromagnétique (CEM)*, peut être consultée sur le site web de l'IEC.

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- remplacée par une édition révisée, ou
- amendée.

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INTRODUCTION

L'IEC 61000 est publiée sous forme de plusieurs parties séparées, conformément à la structure suivante:

Partie 1: Généralités

Considérations générales (introduction, principes fondamentaux)

Définitions, terminologie

Partie 2: Environnement

Description de l'environnement

Classification de l'environnement

Niveaux de compatibilité

Partie 3: Limites

Limites d'émission

Limites d'immunité (dans la mesure où elles ne relèvent pas des comités de produits)

Partie 4: Techniques d'essai et de mesure

Techniques de mesure

Techniques d'essais

Partie 5: Guides d'installation et d'atténuation

Guides d'installation

Méthodes et dispositifs d'atténuation

Partie 6: Normes génériques

Partie 9: Divers

Chaque partie est à son tour subdivisée en plusieurs parties, publiées soit comme Normes internationales, soit comme spécifications techniques ou rapports techniques, dont certaines ont déjà été publiées en tant que sections. D'autres seront publiées avec le numéro de partie, suivi d'un tiret et d'un second numéro identifiant la subdivision (exemple: IEC 61000-6-1).

COMPATIBILITÉ ÉLECTROMAGNÉTIQUE (CEM) –

Partie 3-2: Limites – Limites pour les émissions de courant harmonique (courant appelé par les appareils ≤ 16 A par phase)

1 Domaine d'application

La présente partie de l'IEC 61000 traite de la limitation des courants harmoniques injectés dans le réseau public d'alimentation.

Elle définit les limites des harmoniques du courant d'entrée qui peuvent être produits par les matériels soumis à l'essai dans des conditions spécifiées.

La présente partie de l'IEC 61000 est applicable aux appareils électriques et électroniques ayant un courant d'entrée assigné dont la valeur est inférieure ou égale à 16 A par phase et qui sont destinés à être raccordés à des réseaux publics de distribution à basse tension.

Le matériel de soudage à l'arc qui n'est pas du matériel professionnel, dont le courant d'entrée assigné est inférieur ou égal à 16 A par phase, relève du présent document. Le matériel de soudage à l'arc destiné à un usage professionnel, tel que spécifié dans l'IEC 60974-1, est exclu du domaine d'application du présent document et peut être sujet à des restrictions d'installation comme indiqué dans l'IEC 61000-3-12.

Les essais effectués conformément au présent document sont des essais de type.

Les limites applicables aux réseaux dont la tension nominale est strictement inférieure à 220 V (entre phase et neutre) n'ont pas encore été envisagées.

NOTE Les mots «appareil», «matériel» et «dispositif» sont utilisés dans le présent document. Ils ont la même signification pour les besoins du présent document.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-161, *Vocabulaire Electrotechnique International (VEI) – Partie 161*: *Compatibilité électromagnétique* (disponible sous www.electropedia.org)

IEC 60155, *Interrupteurs d'amorçage à lueur pour lampes à fluorescence (starters)*

IEC 60268-3, *Équipements pour systèmes électroacoustiques – Partie 3: Amplificateurs*

IEC 60335-2-24:2010, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-24: Règles particulières pour les appareils de réfrigération, les sorbetières et les fabriques de glace*

IEC 61000-4-7:2002, *Compatibilité électromagnétique (CEM) – Partie 4-7: Techniques d'essai et de mesure – Guide général relatif aux mesures d'harmoniques et d'interharmoniques, ainsi qu'à l'appareillage de mesure, applicable aux réseaux d'alimentation et aux appareils qui y sont raccordés*
IEC 61000-4-7:2002/AMD1:2008

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 60050-161, ainsi que les suivants, s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
outil portatif
outil électrique tenu à la main pendant son fonctionnement normal et utilisé pendant une courte période uniquement (quelques minutes)

Note 1 à l'article: Le qualificatif «tenu à la main» signifie qu'aucune partie de l'outil, à l'exception du câble d'alimentation, ne repose sur le sol au cours du fonctionnement normal.

3.2
lampe
source destinée à produire un rayonnement optique, en général visible

Note 1 à l'article: Pour les besoins du présent document, une lampe peut également être un module d'éclairage à semiconducteurs, qui peut contenir d'autres composants, par exemple des composants optiques, électriques, mécaniques et/ou électroniques.

3.3
lampe à ballast incorporé
élément qui ne peut être démonté sans être endommagé définitivement, muni d'un culot et contenant une source lumineuse et l'appareillage destiné à l'éclairage, nécessaire au fonctionnement de la source lumineuse

3.4
luminaire
appareil servant à répartir, filtrer ou transformer la lumière d'une ou de plusieurs lampes et comprenant, à l'exclusion des lampes elles-mêmes, toutes les pièces nécessaires pour fixer et protéger les lampes et, éventuellement, les circuits auxiliaires ainsi que les dispositifs de connexion au circuit d'alimentation

[SOURCE: IEC 60050-845:1987, 845-10-01 modifiée – les notes existantes ont été supprimées]

3.5
courant d'entrée
courant directement fourni à un appareil ou à une partie d'appareil par le réseau alternatif de distribution

3.6
facteur de puissance du circuit
rapport de la puissance active d'entrée mesurée au produit de la tension efficace d'alimentation et de l'intensité efficace du courant d'alimentation

3.7
puissance active
valeur moyenne de la puissance instantanée, prise sur 10 (réseaux à 50 Hz) ou 12 (réseaux à 60 Hz) périodes du fondamental et mesurée conformément à l'IEC 61000-4-7

Note 1 à l'article: La puissance active d'entrée est la puissance active mesurée aux bornes d'entrée d'alimentation de l'équipement en essai.

3.8
appareil triphasé équilibré
appareil dont les modules des courants assignés par phase ne diffèrent pas de plus de 20 % les uns par rapport aux autres

3.9
matériel professionnel
matériel utilisé dans les échanges commerciaux, dans les professions libérales ou dans l'industrie, et qui n'est pas destiné à être vendu au grand public, tel que désigné par le fabricant

[SOURCE: IEC 60050-161:1990, 161-05-05 modifiée – la Note existante a été remplacée par le texte ajouté à la fin de la définition]

3.10
courant harmonique total
THC
valeur efficace totale des composantes harmoniques du courant dont les rangs vont de 2 à 40, exprimé comme suit:

$$THC = \sqrt{\sum_{h=2}^{40} I_h^2}$$

Note 1 à l'article: L'abréviation «*THC*» est dérivée du terme anglais développé correspondant «total harmonic current».

3.11
distorsion harmonique totale
THD
rapport de la valeur efficace de la somme des composantes harmoniques (dans ce contexte, composantes harmoniques de courant I_h de rangs 2 à 40) sur la valeur efficace de la composante fondamentale, exprimé comme suit:

$$THD = \sqrt{\sum_{h=2}^{40} \left(\frac{I_h}{I_1} \right)^2}$$

Note 1 à l'article: L'abréviation «*THD*» est dérivée du terme anglais développé correspondant «total harmonic distortion».

3.12
courant harmonique impair partiel
POHC
valeur efficace totale des composantes harmoniques impaires du courant dont les rangs vont de 21 à 39, exprimé comme suit:

$$POHC = \sqrt{\sum_{h=21,23}^{39} I_h^2}$$

Note 1 à l'article: L'abréviation «*POHC*» est dérivée du terme anglais développé correspondant «partial odd harmonic current».

3.13
appareils d'éclairage
appareils dont une fonction principale est de produire et/ou de réguler et/ou de distribuer du rayonnement optique

Note 1 à l'article: Voir aussi 5.2.

3.14
mode veille
mode (habituellement indiqué d'une façon ou d'une autre sur l'équipement) où l'appareil n'est pas en fonctionnement et où sa consommation de puissance est faible, et qui peut se prolonger pendant une durée indéterminée

3.15
répétabilité
<résultats de mesures> étroitesse de l'accord entre les résultats des mesures de courants harmoniques obtenues sur le même appareil en essai, et effectuées avec le même système d'essai, au même emplacement et dans des conditions d'essai identiques

3.16
reproductibilité
<résultats de mesures> étroitesse de l'accord entre les résultats des mesures de courants harmoniques obtenues sur le même appareil en essai, et effectuées avec des systèmes d'essai différents dans des conditions de mesure voulues identiques à chaque fois

Note 1 à l'article: Le système d'essai et les conditions d'essai sont réputés satisfaire à toutes les exigences normatives des normes applicables.

3.17
variabilité
<résultats de mesures> étroitesse de l'accord entre les résultats des mesures de courants harmoniques obtenues sur des exemplaires différents du même type d'appareil en essai, n'ayant pas de différences intentionnelles, et effectuées avec des systèmes d'essai différents dans des conditions de mesure voulues identiques à chaque fois

Note 1 à l'article: Le système d'essai et les conditions d'essai sont réputés satisfaire à toutes les exigences normatives des normes applicables.

Note 2 à l'article: Dans le contexte du présent document, la signification des termes peut être résumée comme suit:

Terme	Signification
Répétabilité	Même appareil en essai (EUT[1]), même système d'essai, mêmes conditions d'essai, essais successifs
Reproductibilité	Même appareil en essai (EUT), systèmes d'essai différents mais normalisés, conditions d'essai différentes mais normalisées
Variabilité	Différents appareils en essai (EUT) du même type, n'ayant pas de différences intentionnelles, systèmes d'essai différents mais normalisés, conditions d'essai différentes mais normalisées

[1] EUT = *equipment under test*.

3.18
entraînement à vitesse variable
EVV
matériel, basé sur de l'électronique de puissance, permettant à la vitesse et/ou au couple d'un moteur d'être contrôlé en continu

3.19
appareillage destiné à l'éclairage
dispositif raccordé entre l'alimentation et une ou plusieurs lampes, permettant à la ou aux lampes de fonctionner comme prévu

Note 1 à l'article: L'appareillage destiné à l'éclairage peut comprendre un ou plusieurs composants distincts. Il peut comprendre des moyens permettant de faire varier l'intensité de la lumière, de corriger le facteur de puissance et de supprimer le brouillage radioélectrique, et d'autres fonctions de commande.

Note 2 à l'article: L'appareillage destiné à l'éclairage peut être intégré partiellement ou totalement dans certaines lampes, comme dans le cas des lampes à ballast incorporé. Toutes les références à l'appareillage destiné à l'éclairage comprennent toutes les lampes intégrées de ce type.

Note 3 à l'article: Des exemples d'appareillage destiné à l'éclairage sont les ballasts ou l'appareillage électronique pour les lampes à décharge, les convertisseurs abaisseurs pour les lampes à incandescence, les circuits de commande pour les modules d'éclairage à semiconducteurs.

Note 4 à l'article: Pour les besoins du présent document, les variateurs de lumière indépendants à commande de phase tels que définis en 3.23 et 3.24 ne sont pas considérés comme étant de l'appareillage destiné à l'éclairage.

Note 5 à l'article: Les interrupteurs mécaniques et les relais, et autres dispositifs simples qui assurent uniquement une commande marche/arrêt, ne produisent pas de courants déformés et ne sont pas considérés comme étant de l'appareillage destiné à l'éclairage.

3.20
dispositif de commande d'éclairage par transmission numérique côté charge
dispositif de commande DLT
dispositif destiné à commander les paramètres d'éclairage d'appareils d'éclairage électroniques, comme le niveau de lumière et la couleur de la lumière, en utilisant une transmission de données sur le câblage secteur côté charge, conformément à l'IEC 62756-1

Note 1 à l'article: Un dispositif de commande DLT est câblé comme un variateur de lumière à commande de phase, mais il ne fait pas varier directement la puissance d'alimentation fournie aux appareils d'éclairage raccordés concernés. Il transmet des signaux numériques sur le câble d'alimentation côté charge à destination des appareils d'éclairage concernés, qui comprennent des moyens pour recevoir et interpréter les signaux de commande, ainsi que des moyens incorporés permettant de faire varier l'intensité de la lumière et la couleur, etc.

Note 2 à l'article: L'abréviation «DLT» est dérivée du terme anglais développé correspondant «digital load side transmission lighting».

3.21
variateur de lumière
dispositif destiné à commander le niveau de lumière en sortie de l'appareil d'éclairage

3.22
variateur de lumière incorporé
variateur de lumière qui est soit contenu à l'intérieur de l'enveloppe d'un luminaire, soit monté sur son câble d'alimentation

3.23
variateur de lumière indépendant
variateur de lumière autre qu'un variateur de lumière incorporé

3.24
variateur de lumière à commande de phase
interrupteur électronique produisant une forme d'onde alternative à front montant (polarité de phase directe) ou à front descendant (polarité de phase inverse)

Note 1 à l'article: Cette forme d'onde alternative est fournie à une ou plusieurs charges et son angle de conduction est ajustable.

3.25
variateur de lumière à commande de phase universel
variateur de lumière à commande de phase capable de changer, automatiquement ou manuellement, entre la production d'une forme d'onde alternative à front montant ou d'une forme d'onde alternative à front descendant

3.26
luminaire professionnel pour l'éclairage des scènes de théâtre et pour les studios
luminaire (à l'extérieur ou à l'intérieur) pour l'éclairage des scènes de théâtre ou pour les studios de télévision, de cinéma ou de photographie, relevant du domaine d'application de l'IEC 60598-2-17, et qui est du matériel professionnel

4 Généralités

L'objectif du présent document est de fixer des limites pour les émissions d'harmoniques des appareils relevant de son domaine d'application, de manière que, compte tenu de la contribution des émissions d'autres appareils, le respect de ces limites garantit que les niveaux de perturbations harmoniques ne dépassent pas les niveaux de compatibilité définis dans l'IEC 61000-2-2.

Les matériels professionnels qui ne satisfont pas aux exigences du présent document peuvent être autorisés à être raccordés à certains types d'alimentations basse tension, si le manuel d'instructions précise qu'il faut demander au distributeur d'électricité l'autorisation de se raccorder. Des recommandations concernant cet aspect figurent dans l'IEC 61000-3-12.

5 Classification des appareils

5.1 Généralités

Pour ce qui concerne la limitation des courants harmoniques, les appareils sont classés de la manière suivante:

Classe A:

Les appareils non spécifiés comme appartenant à la Classe B, C ou D doivent être considérés comme des appareils de classe A.

Exemples d'appareils de classe A:

– appareils triphasés équilibrés;
– appareils électrodomestiques à l'exclusion de ceux spécifiés comme appartenant à la classe B, C ou D;
– aspirateurs;
– appareils de nettoyage à haute pression;
– outils à l'exclusion des outils portatifs;
– variateurs de lumière indépendants à commande de phase;
– matériels audio;
– luminaires professionnels pour l'éclairage des scènes de théâtre et pour les studios.

NOTE 1 Les appareils dont on peut montrer qu'ils ont un effet significatif sur le réseau d'alimentation pourront être changés de classe dans une future édition du présent document, compte tenu des facteurs suivants:

– le nombre d'appareils utilisés;

– la durée d'utilisation;
– la simultanéité d'emploi;
– la puissance consommée;
– le spectre harmonique, y compris les phases.

Classe B:

– outils portatifs;
– matériel de soudage à l'arc qui n'est pas du matériel professionnel.

Classe C:

– appareils d'éclairage.

Classe D:

Appareils ayant une puissance spécifiée, telle que définie en 6.3.2, inférieure ou égale à 600 W, et qui sont des types suivants:

– ordinateurs individuels et écrans pour ordinateurs individuels;
– récepteurs de télévision;
– réfrigérateurs et congélateurs comportant un ou plusieurs entraînements à vitesse variable afin de commander un ou des moteurs de compresseur.

NOTE 2 Les limites pour la classe D sont réservées aux appareils dont on peut montrer, en vertu des facteurs énumérés dans la note 1, qu'ils ont un effet marqué sur le réseau public d'alimentation électrique.

5.2 Description des appareils d'éclairage

Dans le présent document, les appareils d'éclairage tels que définis en 3.13 comprennent:

– les lampes et les luminaires;
– la partie destinée à l'éclairage des appareils à fonctions multiples, lorsqu'une des principales fonctions de ces appareils est l'éclairement lumineux;
– l'appareillage indépendant destiné à l'éclairage;
– les appareils à rayonnement ultraviolet (UV) et infrarouge (IR);
– les enseignes publicitaires lumineuses;
– les variateurs de lumière indépendants, autres que ceux à commande de phase, pour les appareils d'éclairage;
– les dispositifs de commande DLT.

Dans le présent document, les appareils d'éclairage tels que définis en 3.13 ne comprennent pas:

– les dispositifs d'éclairage incorporés dans des appareils ayant une fonction principale différente, tels que les photocopieurs, les rétroprojecteurs et les projecteurs de diapositives, ou employés à des fins d'indicateur ou d'éclairage de graduations;
– les appareils électrodomestiques dont la fonction principale n'est pas de produire et/ou de réguler et/ou de distribuer du rayonnement optique, mais qui contiennent une ou plusieurs lampes avec ou sans interrupteur séparé (par exemple, une hotte de cuisine comportant une lampe incorporée);
– les variateurs de lumière indépendants à commande de phase;
– les luminaires professionnels pour l'éclairage des scènes de théâtre et pour les studios;
– les luminaires pour éclairage de secours qui émettent de la lumière uniquement lorsqu'ils sont en état de fonctionnement de secours.

6 Exigences générales

6.1 Généralités

Les restrictions spécifiées en 6.2 s'appliquent également aux catégories d'appareils énumérées en 7.1 pour lesquelles aucune limite de courants harmoniques ne s'applique.

Les exigences et limites spécifiées dans le présent document sont applicables aux bornes d'entrée de puissance des appareils destinés à être raccordés à des réseaux 220/380 V, 230/400 V et 240/415 V fonctionnant à 50 Hz ou 60 Hz. Les exigences et limites pour les autres cas ne sont pas encore spécifiées.

Une méthode d'essai simplifiée est autorisée pour les appareils qui subissent de petites modifications ou mises à jour, à condition que, lors de précédents essais de conformité complets, on ait montré que les émissions en courant de l'appareil étaient inférieures à 60 % des limites applicables et que le *THD* du courant d'alimentation était inférieur à 15 %. La méthode d'essai simplifiée consiste à vérifier que la puissance active d'entrée de l'appareil modifié est située dans l'intervalle de ± 20 % autour de celle du produit soumis à l'essai initialement, et que le *THD* du courant d'alimentation est inférieur à 15 %. Les produits qui satisfont à ces exigences sont censés respecter les limites applicables, mais en cas de doute, le résultat d'un essai de conformité complet, selon les Articles 6 et 7, prévaut sur celui de cette méthode simplifiée.

6.2 Principes de commande

Les commandes asymétriques, selon la définition de l'IEC 60050-161:1990,161-07-12, et le redressement simple alternance directement sur l'alimentation réseau ne peuvent être utilisés que dans les circonstances suivantes:

a) lorsqu'ils constituent la seule solution pratique permettant de détecter des conditions de non-sécurité, ou

b) lorsque la puissance active d'entrée qui est contrôlée est inférieure ou égale à 100 W, ou

c) lorsque l'appareil contrôlé est un appareil portatif, connecté par un cordon souple à deux conducteurs, et destiné à être utilisé pendant une courte durée, c'est-à-dire pendant quelques minutes seulement.

Si l'une de ces trois conditions est remplie, le redressement simple alternance peut être utilisé en toutes circonstances tandis que les commandes asymétriques ne peuvent être utilisées que pour la commande des moteurs.

NOTE 1 Ce type d'appareils comprend, entre autres, les sèche-cheveux, les machines de cuisine électriques et les outils portatifs.

Les principes de commande symétrique qui peuvent produire des harmoniques jusqu'à et y compris le rang 40 dans le courant d'entrée peuvent être utilisés pour contrôler la puissance fournie à des éléments chauffants à condition que la pleine puissance d'entrée sinusoïdale soit inférieure ou égale à 200 W, ou que les limites données dans le Tableau 3 ne soient pas dépassées.

De tels principes de commande symétrique sont aussi autorisés pour le matériel professionnel à condition que

a) l'une des conditions précédentes soit remplie, ou que

b) les limites d'émission concernées conformément à l'Article 7 ne soient pas dépassées lorsque les essais sont réalisés aux bornes d'entrée d'alimentation, et que, de plus, les deux conditions suivantes soient remplies:

   1) il est nécessaire de contrôler de façon précise la température d'un élément chauffant dont la constante de temps thermique est inférieure à 2 s, et

2) il n'existe aucune autre technique économiquement disponible.

Les matériels professionnels dont la fonction principale, considérée dans son ensemble, n'est pas de chauffer doivent être soumis à l'essai par rapport aux limites d'émission concernées conformément à l'Article 7.

NOTE 2 Un exemple de produit dont la fonction principale n'est pas de chauffer est un photocopieur, tandis que le chauffage est considéré comme la fonction principale d'une cuisinière.

Les appareils domestiques à commande symétrique utilisés pendant une courte durée (sèche-cheveux par exemple) doivent être soumis à l'essai selon les conditions de la classe A.

Les appareils à commande asymétrique ou à redressement simple alternance qui sont autorisés suivant les conditions données ci-dessus, doivent de toute façon être conformes aux exigences du présent document en matière de courants harmoniques.

NOTE 3 Lors de l'utilisation de commandes asymétriques ou d'un redressement simple alternance dans les circonstances susmentionnées, le courant d'entrée a une composante continue qui peut perturber certains types de dispositifs de protection en cas de défaut à la terre. Voir l'IEC TR 60755.

6.3 Mesure des courants harmoniques

6.3.1 Configuration d'essai

Les composantes harmoniques doivent être mesurées conformément aux exigences indiquées à l'Annexe A pour le circuit d'essai et la source d'alimentation.

Les conditions d'essai spécifiques pour la mesure des courants harmoniques concernant certains types d'appareils sont indiquées à l'Annexe B.

Pour les appareils non mentionnés en Annexe B, les essais d'émission doivent être effectués avec les commandes de fonctionnement ou les programmes automatiques de l'utilisateur réglés sur le mode censé produire le courant harmonique total (THC) maximal dans des conditions normales de fonctionnement. Ceci définit la configuration de l'appareil pendant les essais d'émission et non une exigence pour mesurer le THC ou pour effectuer des recherches afin de déterminer les émissions dans le cas le plus défavorable.

Les limites de courant harmonique spécifiées à l'Article 7 sont applicables aux courants de phase, mais pas aux courants dans le conducteur de neutre. Néanmoins, pour les appareils monophasés, il est permis de mesurer les courants dans le conducteur de neutre à la place des courants dans le conducteur de phase.

L'appareil est soumis à l'essai tel qu'il est présenté par le fabricant, et conformément aux informations fournies par ce dernier. Un rodage du moteur par le fabricant peut s'avérer nécessaire avant les essais afin d'assurer que les résultats obtenus correspondent à une utilisation normale.

6.3.2 Procédure de mesure

L'essai doit être effectué selon les exigences générales données en 6.3.3. La durée de l'essai doit être telle que définie en 6.3.4.

La mesure des courants harmoniques doit être effectuée comme suit:

– pour chaque rang harmonique, mesurer le courant harmonique efficace lissé sur 1,5 s, dans chaque fenêtre temporelle de la transformée de Fourier discrète (TFD), comme défini dans l'IEC 61000-4-7;

– calculer la moyenne arithmétique des valeurs mesurées dans les fenêtres temporelles de la TFD, sur la période d'observation complète telle que définie en 6.3.4.

La valeur de la puissance d'entrée à utiliser pour le calcul des limites doit être déterminée comme suit:

– mesurer la puissance active d'entrée lissée sur 1,5s, dans chaque fenêtre temporelle de la TFD;
– déterminer la valeur maximale des valeurs mesurées de la puissance dans les fenêtres temporelles de la TFD, sur la durée complète de l'essai.

NOTE La puissance active d'entrée fournie à l'élément de lissage de l'instrument de mesure tel que défini dans l'IEC 61000-4-7 est la puissance active d'entrée dans chaque fenêtre temporelle de la TFD.

Les courants harmoniques et la puissance active d'entrée doivent être mesurés dans les mêmes conditions d'essai, mais peuvent ne pas être mesurés simultanément.

Le fabricant peut spécifier toute valeur de la puissance qui est située dans l'intervalle de ± 10 % autour de la valeur réelle mesurée et l'utiliser pour déterminer les limites applicables lors de l'essai initial du fabricant pour évaluer la conformité du produit. Les valeurs mesurées et spécifiées de la puissance, telles que définies en 6.3.2, doivent être documentées dans le rapport d'essai.

Si la valeur de la puissance trouvée par mesure pendant des essais d'émission autres que l'essai initial du fabricant pour évaluer la conformité du produit, et mesurée selon les termes de 6.3.2, n'est pas inférieure à 90 % ni supérieure à 110 % de la valeur de la puissance spécifiée par le fabricant dans le rapport d'essai (voir 6.3.3.5), la valeur spécifiée doit être utilisée pour établir les limites. Si la valeur mesurée est située en dehors de cet intervalle de tolérance autour de la valeur spécifiée, la puissance mesurée doit être utilisée pour établir les limites.

Pour les appareils de classe C, le courant fondamental et le facteur de puissance, spécifiés par le fabricant, doivent être utilisés pour le calcul des limites (voir 3.6). La composante fondamentale du courant et le facteur de puissance sont mesurés et spécifiés par le fabricant de la même façon que la puissance est mesurée et spécifiée pour le calcul des limites applicables à la classe D. La valeur utilisée pour le facteur de puissance doit être obtenue avec la même fenêtre de mesure TFD que la valeur employée pour la composante fondamentale du courant.

6.3.3 Exigences générales

6.3.3.1 Répétabilité

La répétabilité (voir 3.15) de la valeur moyenne pour les courants harmoniques individuels sur la période d'observation complète pour les essais doit être meilleure que ± 5 % de la limite applicable, lorsque les conditions suivantes sont remplies:

– le même appareil en essai (EUT) (pas un autre appareil du même type, aussi semblable soit-il);
– le même système d'essai;
– le même emplacement;
– des conditions d'essai identiques;
– des conditions climatiques identiques, si applicable.

Cette exigence de répétabilité a pour but de définir la période d'observation nécessaire, voir 6.3.4. Elle n'est pas destinée à servir de critère d'acceptation ou de rejet pour l'évaluation de la conformité aux exigences du présent document.

6.3.3.2 Reproductibilité

La reproductibilité (voir 3.16) des mesures sur le même EUT avec des systèmes d'essai différents ne peut pas être calculée de façon définitive de manière à s'appliquer à toutes les

combinaisons possibles d'EUT, d'appareil de mesure des harmoniques et d'alimentation d'essai, mais elle peut être estimée meilleure que ± (1 % + 10 mA), où le 1 % signifie 1 % de la valeur moyenne du courant d'entrée total prise sur la période d'observation complète pour les essais. Par conséquent, des différences dans les résultats inférieures à cette valeur de courant sont considérées comme négligeables, mais dans certains cas une valeur plus élevée est possible.

Pour éviter tout doute dans de tels cas, les résultats d'essai, obtenus en différents emplacements ou en différentes occasions, qui montrent que toutes les limites appropriées sont respectées doivent être acceptés comme preuve de conformité, même si les résultats peuvent s'écarter au-delà des valeurs de répétabilité et de reproductibilité données ci-dessus.

NOTE La variabilité (voir 3.17) des mesures sur différents EUT du même type, n'ayant pas de différences intentionnelles, peut être accrue par les tolérances pratiques sur les composants et d'autres effets, tels que les interactions possibles entre les caractéristiques de l'EUT et celles de l'instrument de mesure ou de l'alimentation du réseau. Les résultats de ces effets ne peuvent être quantifiés dans le présent document, pour les mêmes raisons que dans le cas de la reproductibilité. Le second alinéa de 6.3.3.2 s'applique aussi dans le cas de la variabilité.

Une concession pour ce qui concerne les valeurs des limites, en vue d'autoriser une éventuelle variabilité, ne relève pas du domaine d'application du présent document.

6.3.3.3 Démarrage et arrêt

Lors de la mise en marche d'un appareil ou lors de son arrêt, manuel ou automatique, les courants harmoniques et la puissance ne sont pas pris en compte pendant les premières 10 s qui suivent cette commutation.

L'équipement en essai ne doit pas être dans le mode veille (voir 3.14) pendant plus de 10 % de toute période d'observation.

6.3.3.4 Application des limites

Les valeurs moyennes des courants harmoniques individuels, prises sur la période d'observation complète pour les essais, doivent être inférieures ou égales aux limites applicables.

Pour chaque rang harmonique, toutes les valeurs du courant harmonique efficace lissé sur 1,5 s, tel que défini en 6.3.2, doivent être:

a) soit inférieures ou égales à 150 % des limites applicables,

b) soit inférieures ou égales à 200 % des limites applicables si les trois conditions suivantes sont simultanément remplies:

   1) l'EUT est un appareil de classe A pour les harmoniques,

   2) l'excursion au-delà de 150 % des limites applicables dure moins de 10 % de la période d'observation pour les essais ou moins de 10 min au total (à l'intérieur de la période d'observation pour les essais), selon la valeur qui est la plus petite, et

   3) la valeur moyenne du courant harmonique, prise sur la période d'observation complète pour les essais, est inférieure à 90 % des limites applicables.

Les courants harmoniques inférieurs à 0,6% du courant d'entrée mesuré dans les conditions d'essai, ou inférieurs à 5 mA, selon la valeur qui est la plus grande, ne sont pas pris en compte.

Pour les harmoniques de rang impair égal ou supérieur à 21, la valeur moyenne obtenue pour chaque harmonique impair individuel sur la période d'observation complète, calculée à partir des valeurs efficaces lissées sur 1,5 s conformément à 6.3.2, peut dépasser de 50 % les limites applicables, sous réserve que les conditions suivantes soient remplies: