IEC 61010-2-033

Edition 2.0 2019-06
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Safety requirements for electrical equipment for measurement, control and laboratory use –
Part 2-033: Particular requirements for hand-held multimeters ~~and other METERS,~~ for domestic and professional use, capable of measuring MAINS voltage

IEC 61010-2-033:2019-06 RLV(en)

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Part 2-033: Particular requirements for hand-held multimeters ~~and other METERS,~~ for domestic and professional use, capable of measuring MAINS voltage

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2-033: Particular requirements for hand-held multimeters ~~and other METERS,~~ for domestic and professional use, capable of measuring MAINS voltage

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 61010-2-033 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

a) The scope has been reduced to hand-held multimeters. Voltmeters and clamp multimeters have been removed. They are addressed respectively by IEC 61010-2-030 and IEC 61010-2-032. The relevant definitions have been removed.

b) Subclause 4.4.2.101 has been relocated into Clause 102.

c) CLEARANCES and CREEPAGE DISTANCES for WET LOCATIONS and for measuring circuit TERMINALS exceeding 1 000 V a.c. or 1 414 V d.c. have been specified.

d) Subclause 14.101 related to "Circuits or components used as TRANSIENT OVERVOLTAGE limiting devices in measuring circuits used to measure MAINS" has been removed.

e) References to IEC 61010-031 for probe assemblies and IEC 61010-2-032 for current sensors have been added.

f) Requirements for protection against MAINS overvoltage measuring circuits have been added.

g) Clause 102 has been rewritten.

h) Requirements for measuring circuits from 1 000 V to 3 000 V have been added.

i) An informative Annex CC about dimensions of 4-mm banana TERMINALS has been added.

j) A flowchart for insulation according to the type of circuit has been added in a new Annex DD.

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

FDIS	Report on voting
66/692/FDIS	66/694/RVD

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

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

A list of all the parts in the IEC 61010 series, published under the general title *Safety requirements for electrical equipment for measurement, control, and laboratory use*, can be found on the IEC website.

This Part 2-033 is to be used in conjunction with the latest edition of IEC 61010-1. It was established on the basis of the third edition (2010) of IEC 61010-1 and its Amendment 1 (2016), hereinafter referred to as Part 1.

This Part 2-033 supplements or modifies the corresponding clauses in IEC 61010-1 so as to convert that publication into the IEC standard: *Particular requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS voltage.*

Where a particular subclause of Part 1 is not mentioned in this Part 2-033, that subclause applies as far as is reasonable. Where this Part 2-033 states "addition", "modification", "replacement", or "deletion", the relevant requirement, test specification or note in Part 1 should be adapted accordingly.

In this standard:

a) the following print types are used:
   - requirements: in roman type;
   - NOTES: in small roman type;
   - *conformity and tests: in italic type;*
   - terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS;

b) subclauses, figures, tables and notes which are additional to those in Part 1 are numbered starting from 101. Additional annexes are lettered starting from AA and additional list items are lettered from aa).

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

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

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INTRODUCTION

~~IEC 61010-1 specifies the safety requirements that are generally applicable to all equipment within its scope. For certain types of equipment, the requirements of IEC 61010-1 will be supplemented or modified by the special requirements of one, or more than one, particular part 2's of the standard which must be read in conjunction with the Part 1 requirements.~~

~~This Part 2-033 specifies the safety requirements for HAND HELD METERS that have a primary purpose of measuring voltage on a live MAINS CIRCUIT.~~

~~Part 2-032 specifies the safety requirements that are generally applicable to HAND HELD and hand-manipulated current sensors.~~

~~Part 2-030 specifies the safety requirements for testing and measuring circuits which are connected for test or measurement purposes to devices or circuits outside the measurement equipment itself.~~

~~VOLTMETER and similar equipment that are not within the scope of Part 2-033 are considered to be covered by the requirements of Part 2-030 or Part 2-032. But for equipment within the scopes of both Part 2-032 and Part 2-033, the two standards must be read in conjunction.~~

Part 2-030 specifies the safety requirements for equipment with testing and measuring circuits which are connected for test or measurement purposes to devices or circuits outside the measurement equipment itself. Requirements of Part 2-030 have been included in this Part 2-033. Equipment within the scopes of both Part 2-030 and Part 2-033 are considered to be covered by the requirements of this Part 2-033.

Part 2-032 specifies the safety requirements for hand-held and hand-manipulated current sensors. For equipment within the scope of Part 2-032 and Part 2-033, only Part 2-032 is applicable.

Part 2-034 specifies the safety requirements for measurement equipment for insulation resistance and test equipment for electric strength which are connected to units, lines or circuits for test or measurement purposes. For equipment within the scope of Part 2-033 and Part 2-034, only Part 2-034 is applicable.

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

Part 2-033: Particular requirements for hand-held multimeters ~~and other METERS,~~ for domestic and professional use, capable of measuring MAINS voltage

1 Scope and object

This clause of Part 1 is applicable except as follows:

1.1.1 Equipment included in scope

Replace the existing text with the following:

~~This part of IEC 61010 specifies safety requirements for METERS.~~

~~The METERS that have a primary purpose of measuring voltage on a live MAINS CIRCUIT are within the scope of this standard. They have various names, but all of them have capability for measurements of voltages on a live MAINS CIRCUIT. Some of the names given to this equipment are as follows:~~

- ~~MULTIMETER;~~
- ~~digital MULTIMETER;~~
- ~~VOLTMETER;~~
- ~~clamp METER (see also Part 2-032).~~

~~For the purpose of this standard, the term METER is used for these HAND-HELD measuring instruments.~~

~~NOTE Parts of the equipment that are not within the scope of this Part 2-033 are considered to be covered by the requirements of Part 1 or other part 2's of IEC 61010 and then will also need to meet the requirements of these other parts.~~

This part of IEC 61010 specifies safety requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS.

Hand-held multimeters are multi-range multifunction measuring instruments intended to measure voltage and other electrical quantities such as resistance or current. Their primary purpose is to measure voltage on a live MAINS. They are suitable to be supported by one hand during NORMAL USE.

1.1.2 Equipment excluded from scope

Add the following new item to the list and the following paragraph:

aa) IEC 61557-1 to IEC 61557-12, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures*

~~*Addition:*~~

~~*Add the two following paragraphs at the end of the subclause:*~~

~~Equipment that is not capable of measuring MAINS voltages is not within the scope of this Part 2-033. See IEC 61010-2-030 for requirements pertaining to such equipment.~~

~~Such equipment, including other~~ HAND-HELD EQUIPMENT such as oscilloscopes, wattmeters, process control multimeters not RATED for measuring voltage on a live MAINS, clamp multimeters and communications test sets ~~is~~ are not within the scope of this document.

1.2.1 Aspects included in scope

Add the following two new paragraphs at the end of the subclause:

Requirements for protection against HAZARDS resulting from NORMAL USE and REASONABLY FORESEEABLE MISUSE of measuring circuits are given in Clause 101.

Requirements for reliance on the displayed value are given in Clause 102.

2 Normative references

This clause of Part 1 is applicable except as follows:

Replace "IEC 61010-031" with the following new reference:

IEC 61010-031:2015, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated probe assemblies for electrical test and measurement*
IEC 61010-031:2015/AMD1:2018

Replace "IEC 61180-1 (all parts)", "IEC 61180-1" and "IEC 61180-2", with the following new reference:

IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

Add the following new normative reference:

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

~~**3.1 Equipment and states of equipment**~~

~~*Addition:*~~

~~*Add the following new definitions:*~~

~~**3.1.101**~~
~~**MULTIMETER**~~
~~multirange multifunction measuring instrument intended to measure voltage and sometimes other electrical quantities such as current and resistance~~

~~[SOURCE: IEC 60050-300:2001, 312-02-24, modified]~~

~~**3.1.102**~~
~~**VOLTMETER**~~
~~instrument intended to measure the value of a voltage~~

~~[SOURCE: IEC 60050-300:2001, 313-01-03]~~

~~**3.1.103**~~
~~**METER**~~
~~voltage measuring instrument which is either a HAND-HELD VOLTMETER or a HAND-HELD MULTIMETER~~

~~**3.1.104**~~
~~**HAND-HELD (equipment)**~~
~~intended to be supported by one hand during NORMAL USE~~

3.5 Safety terms

Replace the definition~~s~~ of 3.5.4 ~~and 3.5.5~~ with the following new definition~~s~~:

3.5.4
MAINS
~~low-voltage electricity supply system to which the current sensor concerned is designed to be connected for the purpose of powering the current sensor or for measurements~~
electricity supply system

~~**3.5.5**~~
~~**MAINS CIRCUIT**~~
~~circuit which is intended to be directly connected to the MAINS for the purpose of powering the current sensor or for measurements~~

Add the following new term and definition:

3.5.101
MEASUREMENT CATEGORY
classification of testing and measuring circuits according to the type of MAINS ~~CIRCUITS~~ to which they are intended to be connected

Note 1 to entry: MEASUREMENT CATEGORIES take into account OVERVOLTAGE CATEGORIES, short-circuit current levels, the location in the building installation ~~at which~~ where the test or measurement is to be made, and some forms of energy limitation or transient protection included in the building installation. See Annex AA for more information.

4 Tests

This clause of Part 1 is applicable, except as follows:

~~**4.4.2 Application of fault conditions**~~

~~**4.4.2.1 General**~~

~~*Replacement:*~~

~~*Replace the first sentence with the following text:*~~

~~Fault conditions shall include those specified in 4.4.2.2 to 4.4.2.14 and in 4.4.2.101.~~

~~*Addition:*~~

~~*Add the following new subclause:*~~

~~**4.4.2.101 Input voltages**~~

~~For measuring circuit TERMINALS RATED for MAINS CIRCUITS voltage measurements:~~

~~a) up to 600 V a.c. r.m.s., the voltage applied to the TERMINALS is the RATED voltage multiplied by 1,90 but not to exceed 920 V a.c. r.m.s.;~~

~~b) above 600 V a.c. r.m.s. and up to 1 000 V a.c. r.m.s., the voltage applied to the TERMINALS is 1 100 V a.c. r.m.s.;~~

~~c) above 1 000 V a.c. r.m.s., the voltage applied to the TERMINALS is the RATED voltage multiplied by 1,1;~~

~~d) of d.c. voltage, the d.c. voltage applied to the TERMINALS is the RATED voltage multiplied by 1,1.~~

~~These voltages are applied with the METER set to each voltage measurement range capable of MAINS voltage measurements.~~

~~NOTE The 1,9 multiplication factor is derived from phase-to-phase voltage measurements with a 10 % overvoltage condition.~~

4.3.2.5 MAINS supply

Replace the existing title and the text with:

4.3.2.5 Power supply

The following requirements apply.

a) The MAINS supply voltage shall be between 90 % and 110 % of any RATED supply voltage for which the equipment can be set or, if the equipment is RATED for a greater fluctuation, at any supply voltage within the fluctuation range.

b) The MAINS frequency shall be any RATED frequency.

c) Equipment for both a.c. and d.c. shall be connected to an a.c. or d.c. supply.

d) Equipment powered by single-phase a.c. MAINS supply shall be connected both with normal and reverse polarity.

e) If the means of connection permits reversal, battery-operated and d.c. equipment shall be connected with both reverse and normal polarity.

4.3.2.6 Input and output voltages

Replace the first paragraph with the following:

Input and output voltages, including floating voltages but excluding the MAINS supply voltage, shall be set to any voltage within the RATED voltage range, in normal and reverse polarity if possible.

5 Marking and documentation

This clause of Part 1 is applicable except as follows:

5.1.2 Identification

Add the following note after the existing note:

NOTE 101 Some national regulations might require a marking to indicate the name and edition of the standard used for compliance evaluation.

5.1.5 TERMINALS, connections, and operating devices

5.1.5.1 General

Replace the first paragraph with the following:

If necessary for safety, an indication shall be given of the purpose of TERMINALS, connectors, controls, and indicators. Where there is insufficient space, symbol 14 from Table 1 may be used.

5.1.5.2 TERMINALS

Replace the existing item d) with the following item d):

d) TERMINALS supplied from the interior of the ~~equipment or from other TERMINALS~~ hand-held multimeter and which could be HAZARDOUS LIVE, with the voltage, current, charge or energy value or range, or with symbol 12 of Table 1;

Add the following new item to the list:

aa) TERMINALS supplied from other TERMINALS which could be HAZARDOUS LIVE, with symbol 12 or 14 of Table 1.

Add the following new subclause:

5.1.5.101 Measuring circuit TERMINALS

Measuring circuit TERMINALS shall be marked with the value of the RATED voltage to earth.

Each pair or set of measuring circuit TERMINALS that are intended to be used together shall be marked with the value of the RATED voltage or the RATED current as applicable to the pair or set of TERMINALS.

~~NOTE~~ Measuring circuit TERMINALS are usually arranged in pairs or sets. Each pair or set of TERMINALS may have a RATED voltage or a RATED current, or both, within that set, and each individual TERMINAL will have a RATED voltage to earth. For some ~~equipment~~ hand-held multimeters, the ~~measurement~~ RATED voltage ~~(~~between TERMINALS~~) is~~ may be different from the RATED voltage to earth. Markings shall be clear to avoid misunderstanding.

~~Measuring circuit~~ TERMINALS of measuring circuits RATED for MAINS ~~CIRCUITS~~ voltage measurements shall be additionally marked "CAT III" and/or "CAT IV" as applicable. Marking those TERMINALS with these two types, and only these two types, of MEASUREMENT CATEGORY and its RATED voltage to earth, is permissible. Marking MEASUREMENT CATEGORY II is not allowed.

Measuring circuit TERMINALS that do not have a RATING for connection to voltages above the levels of 6.3.1, may be marked with alternative markings.

Measuring circuit TERMINALS which are dedicated only for connection to specific TERMINALS of other equipment need not be marked provided that there is a means of identifying these TERMINALS.

TERMINAL~~S~~ markings shall be visible when the ~~equipment~~ hand-held multimeter is ready for NORMAL USE with connectors and TERMINALS mated and shall reference the applicable TERMINALS.

Conformity is checked by inspection.

5.2 Warning markings

Replace the existing text with the following text:

Warning markings specified in ~~5.1.5.2 d), 6.1.2 b), 6.6.2, 7.3.2 b) 3), 7.4, 10.1, and 13.2.2~~ in this document shall meet the following requirements.

Warning markings shall be visible when the ~~equipment~~ hand-held multimeter is ready for NORMAL USE. If a warning applies to a particular part of the ~~equipment~~ hand-held multimeter, the marking shall be placed on or near that part.

The size of warning markings shall be as follows.

a) Symbols shall be at least 2,75 mm high. Text shall be at least 1,5 mm high and contrast in colour with the background.

b) Symbols or text moulded, stamped or engraved in a material shall be at least 2,0 mm high. If not contrasting in colour, they shall have a depth or raised height of at least 0,5 mm.

If it is necessary for the RESPONSIBLE BODY or OPERATOR to refer to the instruction manual to preserve the protection afforded by the ~~equipment~~ hand-held multimeter, the ~~equipment~~ hand-held multimeter shall be marked with symbol 14 of Table 1. Symbol 14 is not required to be used together with symbols which are explained in the manual.

If the instructions for use state that an OPERATOR is permitted to gain access, using a TOOL, to a part which in NORMAL USE may be HAZARDOUS LIVE, there shall be a warning marking which states that the ~~equipment must~~ hand-held multimeter shall be isolated or disconnected from the HAZARDOUS LIVE voltage before access.

NOTE National regulations ~~may~~ can require safety markings in a nationally accepted language.

Conformity is checked by inspection.

5.4.1 General

Replace the first paragraph with the following paragraph:

The following documentation necessary for safety purposes, as needed by the OPERATOR or the RESPONSIBLE BODY, shall be provided with the ~~equipment~~ hand-held multimeter, in an accepted language of the country where the product is intended to be placed on the market. Safety documentation for service personnel authorized by the manufacturer shall be made available to those personnel, in a language selected by the manufacturer.

Add the following two new items to the list:

aa) the documentation shall indicate that probe assemblies to be used for MAINS measurements shall be RATED as appropriate for MEASUREMENT CATEGORY III or IV according to IEC 61010-031 and shall have a voltage RATING of at least the voltage of the circuit to be measured;

bb) information about each relevant MEASUREMENT CATEGORY (see 5.1.5.101). If the ~~METER~~ hand-held multimeter has multiple MEASUREMENT CATEGORY RATINGS for the same measuring circuit, the documentation shall clearly identify the MEASUREMENT CATEGORIES where the ~~equipment~~ hand-held multimeter may be used and where it ~~must~~ shall not be used.

6 Protection against electric shock

This clause of Part 1 is applicable except as follows:

6.5.1 General

Replace the text, the conformity statement, and Figure 4 with the following text, conformity statement and Figure 4:

ACCESSIBLE parts shall be prevented from becoming HAZARDOUS LIVE in SINGLE FAULT CONDITION. The primary means of protection (see 6.4) shall be supplemented by one of a) or b). Alternatively, one of the single means of protection c) or d) shall be used. See Figure 4 and Annex ~~D~~ DD.

a) SUPPLEMENTARY INSULATION (see 6.5.3).

b) Current or voltage limiting device (see 6.5.6).

c) REINFORCED INSULATION (see 6.5.3).

D) PROTECTIVE IMPEDANCE (see 6.5.4).

Conformity is checked by inspection and as specified in 6.5.3, 6.5.4, or 6.5.6, as applicable.

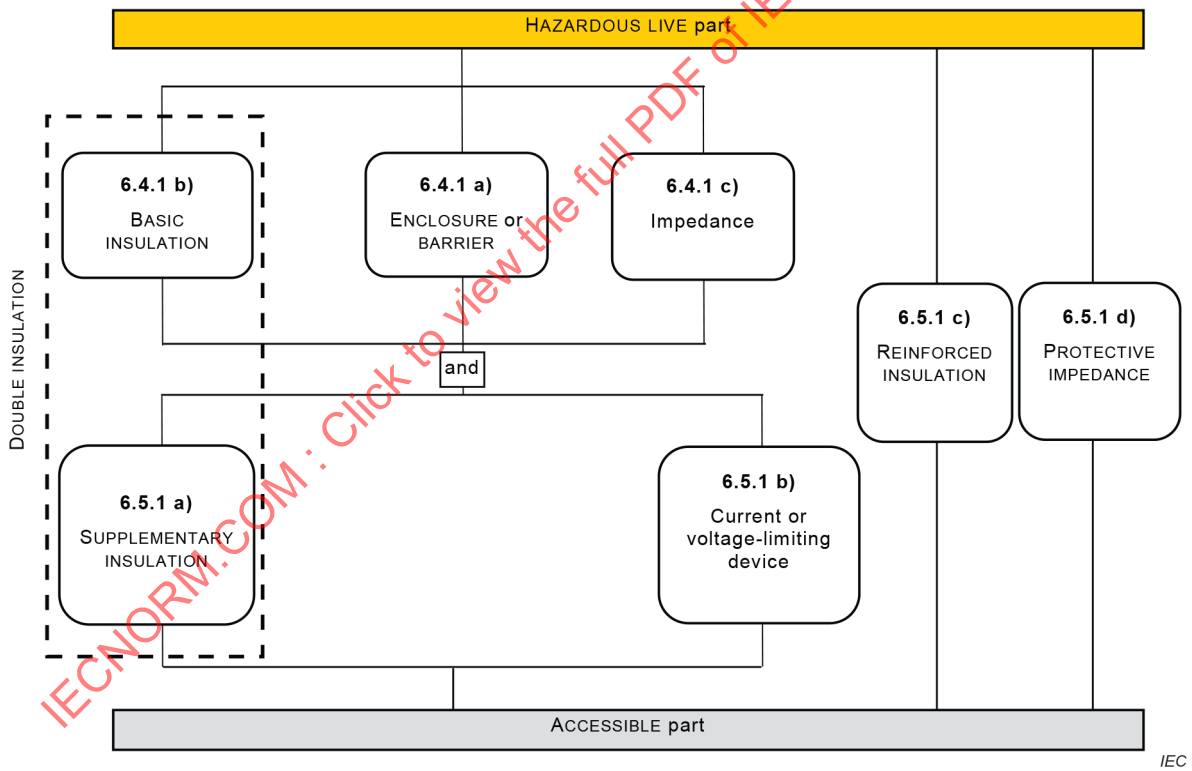


Figure 4 – Acceptable ~~combinations~~ arrangement of protective means against electric shock

6.5.2 PROTECTIVE BONDING

Replace the existing title ~~and text~~ of 6.5.2 with the following and delete the text:

6.5.2 Not used

6.5.5 Automatic disconnection of the supply

Replace the existing title ~~and text~~ of 6.5.5 with the following and delete the text:

6.5.5 Not used

6.6 Connections to external circuits

Add the following two new subclauses:

6.6.101 Measuring circuit TERMINALS

The conductive parts of each unmated measuring circuit TERMINAL which could become HAZARDOUS LIVE when the highest RATED voltage is applied to other measuring circuit TERMINALS on the ~~equipment~~ hand-held multimeter shall be separated by at least:

a) for TERMINALS with voltage RATING up to 1 000 V a.c. or 1 500 V d.c., the applicable CLEARANCE and CREEPAGE DISTANCE of Table 101 from the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position (see Figure 1 ~~of Part 1~~).

b) for TERMINALS with voltage RATING exceeding 1 000 V a.c. or 1 500 V d.c., 2,8 mm for the CLEARANCE and CREEPAGE DISTANCE from the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position. These TERMINALS shall also withstand the voltage test of 6.8 with a test voltage equal to the RATED voltage of the TERMINAL multiplied by 1,25 applied between the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position and the other measuring circuit TERMINALS.

EXAMPLE For a 4 000 V a.c. r.m.s. RATED voltage, the test voltage is 5 000 V a.c. r.m.s. (7 070 V peak). The calculated CLEARANCE is 13,1 mm according to D_2 in Table K.15. For homogeneous fields, a lower CLEARANCE value can be achieved by testing (see IEC 60664-1 for more information about homogeneous fields).

Table 101 – CLEARANCES **and CREEPAGE DISTANCES for measuring circuit** TERMINALS **with** HAZARDOUS LIVE **conductive parts up to 1 000 V a.c. or 1 500 V d.c**

~~Voltage on conductive parts of TERMINAL~~		~~CLEARANCE and CREEPAGE DISTANCE~~
~~V a.c. r.m.s.~~	~~V d.c.~~	~~mm~~
~~300~~	~~300~~	~~0,8~~
~~> 300 ≤ 600~~	~~> 300 ≤ 848~~	~~1,0~~
~~> 600 ≤ 1 000~~	~~> 848 ≤ 1 414~~	~~2,6~~

Voltage on conductive parts of TERMINAL V a.c. r.m.s. and V d.c.	CLEARANCE and CREEPAGE DISTANCE mm
≥ 30 ≤ 300	0,8
> 300 ≤ 600	1,0
> 600 ≤ 1 000	2,6
> 1 000 ≤ 1 500 [a]	2,8
[a] Only for d.c. voltage.	

Annex CC provides information regarding the recommended dimensions of 4-mm "banana" TERMINALS.

Conformity is checked by inspection, by the determination of ACCESSIBLE parts, and by measurement of the applicable CLEARANCES and CREEPAGE DISTANCES and, if applicable, by the voltage test of 6.8.

6.6.102 Specialized measuring circuit TERMINALS

Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS shall not be both ACCESSIBLE and HAZARDOUS LIVE, in either NORMAL CONDITION or SINGLE-FAULT CONDITION, even when the highest RATED voltage is applied to any other measuring circuit TERMINAL.

NOTE These specialized TERMINALS include, but are not limited to, TERMINALS for semiconductor measuring functions, capacitance measurements, and thermocouple sockets.

Conformity is checked by inspection and measurement. Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS are connected. The measurements of 6.3 are made to establish that the levels of 6.3.1 and 6.3.2 are not exceeded when each of the following voltages is applied to each other measuring circuit TERMINAL, if applicable:

a) highest RATED a.c. voltage at any RATED MAINS frequency;

b) highest RATED d.c. voltage;

c) highest RATED a.c. voltage at the maximum related RATED measurement frequency.

6.7.1.3 CREEPAGE DISTANCES

Add the following two new paragraphs after the third paragraph:

For hand-held multimeters not powered from the MAINS or the measuring circuit, CREEPAGE DISTANCES according to material group I are allowed to be used for other materials.

For TERMINALS of hand-held multimeters intended to be connected only to a hand-held probe assembly complying with Part 031, CREEPAGE DISTANCES according to material group I are allowed to be used for the insulating materials of the TERMINALS.

6.7.1.5 Requirements for insulation according to type of circuit

~~*Addition:*~~

~~*Add the following new item to the list:*~~

~~aa) in K.101 for measuring circuits of MEASUREMENT CATEGORIES III and IV.~~

~~*Replacement:*~~

~~*Replace existing Note 2 with the following note:*~~

~~NOTE 2 Not used.~~

Replace the text with the following:

Requirements for insulation in particular types of circuits are specified as follows:

a) in 6.7.2 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II with a nominal supply voltage up to 300 V;

NOTE 1 See Annex I for nominal voltages of MAINS supplies.

b) in 6.7.3 for secondary circuits separated from the circuits in a) only by means of a transformer;

c) in Clause K.1 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY III or IV or for OVERVOLTAGE CATEGORY II over 300 V;

d) in Clause K.2 for secondary circuits separated from the circuits in c) only by means of a transformer;

e) in Clause K.3 for circuits that have one or more of the following characteristics:

1) the maximum possible TRANSIENT OVERVOLTAGE is above the level assumed for the MAINS CIRCUIT;

2) the WORKING VOLTAGE is the sum of voltages from more than one circuit, or is a mixed voltage;

3) the WORKING VOLTAGE includes a recurring peak voltage that may include a periodic non-sinusoidal waveform or a non-periodic waveform that occurs with some regularity;

4) the WORKING VOLTAGE has a frequency above 30 kHz;

5) the circuit is a measuring circuit where MEASUREMENT CATEGORIES do not apply;

f) in Clause K.101 for measuring circuits RATED for MEASUREMENT CATEGORIES III and IV.

NOTE 2 These requirements are illustrated in the flowchart of Annex DD, Figure DD.1.

The TRANSIENT OVERVOLTAGE level for MAINS corresponds to the "required RATED impulse voltage of equipment" value specified in Table 443.2 of IEC 60364-4-44:2007/AMD1:2015.

6.8.3.1 The a.c. voltage test

Replace the first sentence with the following sentence:

The voltage tester shall be capable of maintaining the test voltage throughout the test within ±5% of the specified value.

6.9 Constructional requirements for protection against electric shock

Add the following new subclause:

6.9.101 ~~METER~~ Hand-held multimeter RATINGS

~~Measuring circuit TERMINALS capable of~~ TERMINALS of measuring circuits intended for MAINS voltage measurements shall be RATED for a minimum of 300 V a.c. r.m.s. to earth, and a minimum of MEASUREMENT CATEGORY III.

The RATED voltage of the TERMINALS of a measuring circuit ~~TERMINALS capable of~~ intended for MAINS voltage measurements shall be equal to or higher than their RATED voltage to earth ~~of the TERMINALS~~.

NOTE These TERMINALS can also have ~~other~~ RATING~~S~~ for other functions.

Conformity is checked by inspection.

7 Protection against mechanical HAZARDS

This clause of Part 1 is applicable.

8 Resistance to mechanical stresses

This clause of Part 1 is applicable.

9 Protection against the spread of fire

This clause of Part 1 is applicable.

10 Equipment temperature limits and resistance to heat

This clause of Part 1 is applicable.

11 Protection against HAZARDS from fluids and solid foreign objects

This clause of Part 1 is applicable.

12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure

This clause of Part 1 is applicable.

13 Protection against liberated gases and substances, explosion and implosion

This clause of Part 1 is applicable.

14 Components and subassemblies

This clause of Part 1 is applicable, except as follows.

~~*Addition:*~~

~~*Add the following new subclauses:*~~

~~**14.101 Circuits or components used as TRANSIENT OVERVOLTAGE limiting devices in measuring circuits used to measure MAINS**~~

~~If control of TRANSIENT OVERVOLTAGE is employed in a measuring circuit used to measure MAINS, any overvoltage limiting component or circuit shall have adequate strength to limit likely TRANSIENT OVERVOLTAGES in NORMAL USE.~~

~~*Conformity is checked by applying 5 positive and 5 negative impulses with the applicable impulse withstand voltage of Table 102, spaced up to 1 min apart, from a hybrid impulse generator (see IEC 61180-1). The generator produces an open-circuit voltage waveform of 1,2/50 µs, a short-circuit current waveform of 8/20 µs, with an output impedance (peak open-circuit voltage divided by peak short-circuit current) of 2 Ω. Resistance may be added in series if needed to raise the impedance. The test impulse is applied in combination with the MAINS voltage. The MAINS voltage is the highest RATED voltage of the measuring circuit TERMINALS, but no more than 400 V a.c. r.m.s.*~~

~~*The test voltage is applied between each pair of TERMINALS, used to measure MAINS, where voltage-limiting devices are present.*~~

~~*NOTE This test can be extremely hazardous. Explosion shields and other provisions can be used to protect personnel performing the test.*~~

~~*No HAZARD shall arise due to the operation of overvoltage limiting component. The component shall not rupture and shall operate as intended during the test. If the component is heated as a result of this test, it shall not heat other materials to their ignition points. Tripping the circuit*~~

~~*breaker of the MAINS installation is an indication of failure. If the results of the test are questionable or inconclusive, the test is to be repeated two more times.*~~

~~**Table 102 – Impulse withstand voltages**~~

~~**Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured**~~ ~~V~~	~~**Impulse withstand voltage**~~ ~~V~~	
	~~**MEASUREMENT CATEGORY III**~~	~~**MEASUREMENT CATEGORY IV**~~
~~300~~	~~4 000~~	~~6 000~~
~~> 300 ≤ 600~~	~~6 000~~	~~8 000~~
~~> 600 ≤ 1 000~~	~~8 000~~	~~12 000~~

~~**14.102 Probe assemblies and accessories**~~

~~Probe assemblies and accessories within the scope of IEC 61010-031 shall meet the requirements thereof.~~

~~*Conformity is checked by inspection.*~~

14.8 Circuits used to limit TRANSIENT OVERVOLTAGES

Replace the existing title of 14.8 with the following and delete the text:

14.8 Not used

Add the following new subclause:

14.101 Probe assemblies and accessories

Probe assemblies and accessories within the scope of IEC 61010-031, and current sensors within the scope of IEC 61010-2-032 shall meet the requirements thereof.

At minimum, one set of the test leads supplied with the hand-held multimeter shall be RATED according to IEC 61010-031 for at least the highest voltage and MEASUREMENT CATEGORIES of the hand-held multimeter.

Conformity is checked by inspection.

15 Protection by interlocks

This clause of Part 1 is applicable.

16 HAZARDS resulting from application

This clause of Part 1 is applicable ~~except as follows:~~

~~*Addition:*~~

~~*Add the following new subclause:*~~

~~**16.101 Over-range indication**~~

~~If a HAZARD could arise from an OPERATOR'S reliance on the value (for example, voltage) displayed by the equipment, the display shall give an unambiguous indication whenever the value is above the maximum positive value or below the minimum negative value of the range to which the equipment is set.~~

~~NOTE Examples of ambiguous indications include the following, unless there is a separate unambiguous indication of an over-range value:~~

~~a) analogue METERS with stops at the exact ends of the range;~~

~~b) digital METERS which show a low value when the true value is above the range maximum (for example 1 001,5 V displayed as 001,5 V).~~

~~*Conformity is checked by inspection and by provoking an over-range condition*~~.

17 RISK assessment

This clause of Part 1 is applicable.

Add the following new Clause 101 and Clause 102:

101 Measuring circuits

101.1 General

The ~~equipment~~ hand-held multimeter shall provide protection against HAZARDS resulting from NORMAL USE and REASONABLY FORESEEABLE MISUSE of measuring circuits, as specified below.

a) If a HAZARD could result, a current measuring circuit shall not interrupt the circuit being measured during range changing, or during the use of current transformers without internal protection (see 101.2).

b) An electrical quantity that is within specification for any TERMINAL shall not cause a HAZARD when it is applied to that TERMINAL or to any other compatible TERMINAL, with the range and function settings set in any possible manner (see 101.3).

c) Any interconnections between the ~~equipment~~ hand-held multimeter and other devices or accessories intended to be used with the ~~equipment~~ hand-held multimeter shall not cause a HAZARD even if the documentation or markings prohibit the interconnection while the ~~equipment~~ hand-held multimeter is used for measurement purposes (see 6.6).

d) Other HAZARDS that could result from REASONABLY FORESEEABLE MISUSE shall be addressed by RISK assessment (see Clause 16 and Clause 17).

e) A TEMPORARY OVERVOLTAGE or a TRANSIENT OVERVOLTAGE applied on the measuring circuit TERMINALS in a voltage measurement function shall not cause a HAZARD (see 101.4).

Conformity is checked as specified in 6.6, Clause 16 and Clause 17, 101.2, 101.3 and 101.4, as applicable.

101.2 Current measuring circuits

Current measuring circuits shall be so designed that, when range changing takes place, there shall be no interruption which could cause a HAZARD.

Conformity is checked by inspection, and, in case of doubt, by causing the device to switch the maximum RATED current 6 000 times.

Current measuring circuits intended for connection to current transformers without internal protection shall be adequately protected to prevent a HAZARD arising from interruption of these circuits during operation.

Conformity is checked ~~by inspection,~~ by an overload test~~s~~ at a value of 10 times the maximum RATED current for 1 s, and, if applicable, by causing the ~~device~~ hand-held multimeter to switch the maximum RATED current 6 000 times. No interruption which could cause a HAZARD shall occur during the tests.

101.3 Protection against mismatches of inputs and ranges

101.3.1 General

In NORMAL CONDITION and in cases of REASONABLY FORESEEABLE MISUSE, no HAZARD shall arise when the highest RATED voltage or current of a measuring circuit TERMINAL is applied to that TERMINAL or any other compatible TERMINAL, with any combination of function and range settings.

NOTE ~~1~~ Mismatches of inputs and ranges are examples of REASONABLY FORESEEABLE MISUSE, even if the documentation or markings prohibit such mismatch. A typical example is inadvertent connection of a high voltage to a measuring input intended for current or resistance. Possible HAZARDS include electric shock, burns, fire, arcing and explosion.

~~NOTE 2~~ TERMINALS that are clearly not of similar types and that will not retain the ~~TERMINALS~~ connectors of the probe or accessory do not need ~~not~~ to be tested and TERMINALS that can only be accessed by use of a TOOL do not need to meet the requirement of 101.3.1.

The ~~equipment~~ hand-held multimeter shall provide protection against these HAZARDS. One of the following techniques shall be used.

a) Use of a certified overcurrent protection device to interrupt short-circuit currents before a HAZARD arises. In this case, the requirements and test of 101.3.2 apply.

b) Use of an uncertified current limitation device, an impedance, or a combination of both to prevent the HAZARD from arising. In this case, the requirements and tests of 101.3.3 apply.

Conformity is checked by inspection, evaluation of the design of the ~~equipment~~ hand-held multimeter, and as specified in 101.3.2 to 101.3.3, as applicable.

~~*These tests shall be performed with any probe assemblies supplied by the manufacturer, and repeated with the test leads of 101.3.4.*~~

101.3.2 Protection by a certified overcurrent protection device

An overcurrent protection device is considered suitable if it is certified by an independent laboratory ~~to meet~~ and if all of the following requirements are met.

a) The a.c. and d.c. RATED voltages of the overcurrent protection device shall be at least as high as, respectively, the highest a.c. and d.c. RATED voltages of any measuring circuit TERMINAL on the ~~equipment~~ hand-held multimeter.

b) The RATED time-current characteristic (speed) of the overcurrent protection device shall be such that no HAZARD will result from any possible combination of RATED input voltages, TERMINALS, and range selection.

NOTE In practice, downstream circuit elements such as components and printed wiring board traces are selected to be able to withstand the energy that the overcurrent protection device will let through.

c) The a.c. and d.c. RATED breaking capacities of the overcurrent protection device shall exceed, respectively, the possible a.c. and d.c. short-circuit currents.

The possible a.c. and d.c. short-circuit currents are calculated as the highest RATED voltage for any TERMINAL divided by the impedance of the overcurrent-protected measuring circuit, taking the impedance of the test leads specified in 101.3.4 into account.

The possible a.c. short-circuit current need not exceed the applicable values of Table AA.1.

Additionally, spacings surrounding the overcurrent protection device in the ~~equipment~~ hand-held multimeter and following the protection device in the measuring circuit shall be sufficiently large to prevent arcing after the protection device opens.

Conformity is checked by inspection of the RATING~~S~~ of the overcurrent protection device and by the following test.

If the protection device is a fuse, it is replaced with an open-circuited fuse. If the protection device is a circuit breaker, it is set to its open position. A voltage of two times the highest RATED voltage for any TERMINAL is applied to the TERMINALS of the overcurrent-protected measuring circuit for 1 min. ~~The source of the test voltage shall be capable of delivering 500 VA.~~ During and after the test, no damage to the ~~equipment~~ hand-held multimeter shall occur.

101.3.3 Protection by uncertified current limitation devices or by impedances

Devices used for current limitation shall be capable of safely withstanding, dissipating, or interrupting the energy that will ~~be applied as a result of short-circuit current~~ result from the application of the maximum RATED voltage of any compatible TERMINAL in NORMAL CONDITION and in the case of REASONABLY FORESEEABLE MISUSE.

An impedance used for limitation of current shall be one or more of the following.

a) An appropriate single component which is constructed, selected, and tested so that safety and reliability for protection against relevant HAZARDS is assured. In particular, the component shall
   1) be RATED for the maximum voltage that may be present in NORMAL CONDITION or during the REASONABLY FORESEEABLE MISUSE event;
   2) if a resistor, be RATED for twice the power or energy dissipation that may result in NORMAL CONDITION or from the REASONABLY FORESEEABLE MISUSE event;
   3) meet the applicable CLEARANCE and CREEPAGE DISTANCE requirements of Annex K for ~~REINFORCED~~ BASIC INSULATION between its terminations.
b) A combination of components which shall:
   1) withstand the maximum voltage that may be present in NORMAL CONDITION or during the REASONABLY FORESEEABLE MISUSE event;
   2) be able to dissipate the power or energy that may result in NORMAL CONDITION or from the REASONABLY FORESEEABLE MISUSE event;
   3) meet the applicable CLEARANCE and CREEPAGE DISTANCE requirements of Annex K for ~~REINFORCED~~ BASIC INSULATION between the terminations of the combination of components.

      NOTE 1 The CLEARANCES and CREEPAGE DISTANCES take into account the WORKING VOLTAGE across each insulation.

Conformity is checked by inspection and the following test, performed three times on the same unit of hand-held multimeter. If the test results in heating of any component, the hand-held multimeter is allowed to cool before the test is repeated. If a device used for current limitation is damaged, it is replaced before the test is repeated.

The possible a.c. and d.c. short-circuit currents are calculated as the highest RATED voltage for any TERMINAL divided by the impedance of the current-limited measuring circuit, taking the impedance of the test leads specified in 101.3.4 into account. The possible a.c. short-circuit current ~~need~~ should not exceed the ~~applicable~~ values in Table AA.1.

~~*Conformity is checked by inspection and the following test, repeated three times on the same unit of equipment. If the test results in heating of any component, the equipment is allowed to cool before the test is repeated. If a device used for current limitation is damaged, it is replaced before the test is repeated.*~~

A voltage equal to the highest RATED voltage for any TERMINAL is applied between the TERMINALS of the measuring circuit for 1 min. The source of the test voltage shall be able to deliver a current of at least the possible a.c. or d.c. short-circuit current as applicable. If the function or range controls have any effect on the electrical characteristics of the input circuit, the test is repeated with the function or range controls in every combination of positions, including during the change of function or range. During the test, the voltage output of the source is measured. If the source voltage decreases by more than 20 % for more than 10 ms, the test is considered inconclusive and is repeated with a lower impedance source.

During and after the test, no HAZARD shall arise, nor shall there be any evidence of fire, arcing, explosion, or damage to ~~impedance~~ current limitation devices, impedances or any component intended to provide protection against electric shock, heat, arc or fire, including the ENCLOSURE and traces on the printed wiring board. ~~Any damage to a device used for current limitation shall be ignored if other parts of the equipment were not affected during the test.~~

~~*During the test, the voltage output of the source is measured. If the source voltage decreases by more than 20 % for more than 10 ms, the test is considered inconclusive and is repeated with a lower impedance source.*~~

NOTE 2 This test can be extremely hazardous. Explosion shields and other provisions can be used to protect personnel performing the test.

101.3.4 Test leads for the tests of 101.3.2 and 101.3.3

The tests of 101.3.2 and 101.3.3 shall be performed with ~~any~~ all test leads that are ~~included~~ specified or supplied by the manufacturer for use with the ~~equipment~~ hand-held multimeter and if the manufacturer has not specified the test leads, the tests shall be ~~repeated~~ performed with test leads that meet the following specifications:

a) length = 1,0 m;

b) cross section of the conductor = 1,5 mm^2, stranded copper wire;

NOTE ~~1~~ A conductor with a 16 AWG (American Wire Gauge) cross section is acceptable.

c) ~~equipment~~ connector compatible with the measuring circuit TERMINAL;

d) connection to the test voltage source via a bare wire into suitable screw TERMINALS or thimble connectors (twist-on wire connectors) or equivalent means of providing a low-impedance connection;

e) arranged as straight as possible.

~~NOTE 2~~ Test leads built to these specifications will have a d.c. resistance of about 15 mΩ each, or 30 mΩ per pair. For the purposes of calculation of possible fault current in 101.3.2 and 101.3.3, the value of 30 mΩ can be used for these test leads.

If the manufacturer-supplied test leads are permanently connected to the ~~equipment~~ hand-held multimeter, then the attached test leads supplied by the manufacturer shall be used without modification.

~~**101.4 Functional integrity**~~

~~After the voltage of 4.4.2.101 has been applied to the METER, the METER shall continue to be able to indicate the presence of HAZARDOUS LIVE voltages up to the maximum RATED voltage.~~

~~NOTE The METER is not required to maintain its normal accuracy. A maximum deviation of 10 % is acceptable.~~

~~*Conformity is checked by inspection while applying the maximum RATED voltage of each voltage measurement range capable of MAINS voltage measurements.*~~

101.4 Protection against MAINS overvoltages

To ensure protection against arc flash or fire, measuring circuits RATED for measuring MAINS voltages shall have minimum CLEARANCES and CREEPAGE DISTANCES equivalent to BASIC INSULATION between MAINS-connected conductive parts of opposite polarity.

Conformity is checked by inspection and measurement.

In addition, the measuring circuit TERMINALS of a voltage measuring circuit shall withstand the applicable TRANSIENT OVERVOLTAGE with the voltage measurement function selectors set for the proper function and range, without damage which could cause a HAZARD.

Conformity is checked by the following impulse voltage test using the applicable impulse voltage of Table 102.

The impulse voltage is applied between each pair of TERMINALS. The impulse voltage test shall be conducted for five impulses of each polarity spaced up to 1 min apart, from a hybrid impulse generator (see IEC 61180). The generator produces an open-circuit voltage waveform of 1,2/50 μs, a short-circuit current waveform of 8/20 μs, with an output impedance (peak open-circuit voltage divided by peak short-circuit current) of 2 Ω. Resistance may be added in series if needed to raise the impedance.

The impulse voltage is applied while the circuit is working under conditions of NORMAL USE, in combination with the MAINS voltage.

The MAINS voltage used for the test is the maximum RATED line-to-neutral voltage of the MAINS being measured. For measuring circuits RATED for MAINS line-to-neutral voltages above 400 V a.c. r.m.s. or d.c., the test may be performed with an available MAINS voltage source that has a line-to-neutral voltage of at least 400 V a.c. r.m.s. or d.c. The MAINS voltage source does not, in this case, need to match the measuring circuit RATING, but circuits RATED for a.c. or a.c. plus d.c. shall be tested with an a.c. source, and circuits RATED for d.c. only shall be tested with a d.c. source.

NOTE 1 The impulses are synchronized with the MAINS voltage phase, timed to occur at the peak of the MAINS voltage, and to be of the same polarity, with a phase tolerance of ±10° (see IEC 61180).

NOTE 2 This test can be extremely hazardous. Explosion shields and other provisions can be used to protect personnel performing the test.

When verifying CLEARANCES within the hand-held multimeter by an impulse voltage test, it is necessary to ensure that the specified impulse voltage appears at the CLEARANCE.

The wave shape of each impulse shall be observed (see Note 3). Distortions of the impulse voltage which do not change from impulse to impulse may be caused by operation of an overvoltage limiting device and do not indicate a (partial) breakdown of solid insulation.

No HAZARD shall arise. No flashover of CLEARANCES or breakdown of solid insulation shall occur during the test, but partial discharges are allowed. Partial discharge will be indicated by a step in the resulting wave shape which will occur earlier in successive impulses. Breakdown on the first impulse may either indicate a complete failure of the insulation system or the operation of overvoltage limiting devices in the hand-held multimeter. If overvoltage limiting devices are present, they shall not rupture or overheat during the test. Tripping the circuit breaker of the MAINS installation is an indication of failure. If the results of the test are questionable or inconclusive, the test is to be repeated two more times.

NOTE 3 Partial discharges in voids can lead to partial notches of extremely short durations in the wave shape which can be repeated in the course of an impulse.

Table 102 – Impulse voltages

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	Impulse voltage V peak	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	4 000	6 000
> 300 ≤ 600	6 000	8 000
> 600 ≤ 1 000	8 000	12 000
> 1 000 ≤ 1 500	10 000	15 000
> 1 500 ≤ 2 000	15 000	18 000
> 2 000 ≤ 3 000	18 000	20 000
Values over 1 000 V are from IEC TS 62993:2017, Table 1.		

102 Indicating devices

102.1 General

No HAZARD shall occur from reading a voltage value when the hand-held multimeter is operated for measuring voltages as RATED and in case of REASONABLE FORESEEABLE MISUSE.

A displayed voltage value is considered to be unambiguous when the value is less than 10 % inaccurate, or if there is an indication that the value is out of range when it should be, or if there is a clear indication that the value is not correct. A display off is also considered to be unambiguous.

The tests of 102.2, 102.3 and 102.4 shall be performed when relevant.

The a.c. r.m.s. voltages applied to the TERMINALS during the tests have a frequency of 50 Hz or 60 Hz. The hand-held multimeter is not required to maintain its normal accuracy during and after the tests.

102.2 Battery level

A voltage value displayed by the hand-held multimeter shall not be affected by the expected variation of its battery voltage.

Conformity is checked by the following test:

For each measuring circuit TERMINAL RATED for MAINS voltage measurements, the voltage below is applied to these TERMINALS.

– *a.c. measurement TERMINALS are connected to 60 V a.c. r.m.s.*

– *d.c. measurement TERMINALS are connected to 120 V d.c.*

The supply voltage of the d.c. source connected to the battery connectors decreases by no more than 20 mV/s from the maximum battery voltage to zero. The d.c. source used for this test shall be the batteries or similar source while the impedance of the batteries and ripple free conditions are taken into account. The test terminates when the display turns off.

The displayed voltage values during the test shall be unambiguous.

NOTE See 102.1 for the meaning of the term "unambiguous".

102.3 Over-range

The hand-held multimeter shall be able to display unambiguously over-range voltage values whenever the value is above the maximum absolute value of the range to which the hand-held multimeter is set.

NOTE Examples of ambiguous indications include the following, unless there is a separate unambiguous indication of an over-range value:

a) analogue hand-held multimeter which stops at the exact ends of the range;

b) digital hand-held multimeter which shows a low value when the true value is above the range maximum (for example 1 001,5 V displayed as 001,5 V).

Conformity is checked by the following test:

An over-range voltage is applied to the measuring circuit TERMINALS RATED for MAINS voltage measurements of the hand-held multimeter set to each voltage measurement range.

The value of the over-range voltage applied to the TERMINALS is equal at 110 % of the RATED voltage measurement range. For measurement RATED for d.c., the over-range voltage is applied with positive and negative polarities.

The displayed voltage values during the test shall be unambiguous.

102.4 Permanent overvoltages

The hand-held multimeter shall be able to withstand permanent overvoltages and continue to give an unambiguous indication of any HAZARDOUS LIVE voltages up to the maximum RATED voltage.

NOTE 1 Subclause 101.4 provides protection against HAZARDS from TRANSIENT OVERVOLTAGES.

Conformity is checked by the following test:

An overvoltage is applied for 5 min to the measuring circuit TERMINALS' RATED for MAINS voltage measurements of the hand-held multimeter set to each voltage measurement range.

The value of the overvoltage applied to the TERMINALS is based on the TERMINALS' RATED voltage:

a) *when the TERMINALS' RATED voltage value is up to 1 000 V a.c. r.m.s., the overvoltage value is the TERMINALS' RATED voltage value multiplied by 1,9 but without exceeding 1 100 V a.c. r.m.s.;*

b) *when the TERMINALS' RATED voltage value is above 1 000 V a.c. r.m.s. the overvoltage value is the RATED voltage value multiplied by 1,1;*

c) *when the TERMINALS' RATED voltage is d.c., the overvoltage value is the RATED voltage value multiplied by 1,1.*

NOTE 2 The 1,9 multiplication factor is derived from phase-to-phase voltage measurements with a 10 % overvoltage condition.

After each overvoltage has been applied, each measuring circuit TERMINAL RATED for MAINS voltage measurements shall in turn:

1) measure a voltage of 60 V a.c. r.m.s. or 120 V d.c. based on the measurement TERMINAL input type;

2) measure a voltage equal to the maximum RATED voltage for the measurement TERMINAL under test.

The above test may need to be repeated at any combination of settings, TERMINALS and voltage RATING. The displayed voltage values shall be unambiguous.

Annexes

All annexes of Part 1 are applicable except as follows:

Annex K
(normative)

Insulation requirements not covered by 6.7

K.3 Insulation in circuits not addressed in 6.7, Clause K.1 or Clause K.2

Replace the existing title of Clause K.3 with the following:

K.3 Insulation for circuits not addressed in 6.7, Clauses K.1, K.2 or K.101

K.3.1 General

~~*Deletion.*~~

~~*Delete the note.*~~

Replace the note with the following:

NOTE These requirements are illustrated in the flowchart of Annex DD, Figure DD.1.

Add the following new clause and tables:

K.101 Insulation requirements for measuring circuits ~~of~~ RATED for MEASUREMENT CATEGORIES III and IV

K.101.1 General

Measuring circuits are subjected to WORKING VOLTAGES and transient stresses from the circuit to which they are connected during measurement or test. When the measuring circuit is used to measure MAINS, the transient stresses can be estimated by the location within the installation at which the measurement is performed. When the measuring circuit is used to measure any other electrical signal, the transient stresses ~~must~~ shall be considered by the OPERATOR to ensure that they do not exceed the capabilities of the measuring ~~equipment~~ hand-held multimeter.

When the measuring circuit is used to connect to MAINS, there is a RISK of arc ~~flash explosion~~ blast. MEASUREMENT CATEGORIES define the amount of energy available, which may contribute to arc flash. In conditions where arc flash may occur, additional precautions identified by the manufacturer to reduce the HAZARD related to shock and burn from arc flash should be described in the user documentation (see also Annex AA and Annex BB).

K.101.2 CLEARANCES

For ~~equipment~~ a hand-held multimeter intended to be powered from the circuit being measured, CLEARANCES for the MAINS CIRCUIT shall be designed according to the requirements of the RATED MEASUREMENT CATEGORY. Additional marking requirements are in 5.1.5.2 and 5.1.5.101.

CLEARANCES ~~for~~ of measuring circuits ~~of~~ RATED for MEASUREMENT CATEGORIES III and IV are specified in Table K.101.

NOTE See Annex I for nominal voltages of MAINS supplies.

If the ~~equipment~~ hand-held multimeter is RATED to operate at an altitude greater than 2 000 m, the values for CLEARANCES shall be multiplied by the applicable factor of Table K.1.

Minimum CLEARANCE for BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION is 0,2 mm for POLLUTION DEGREE 2 and 0,8 mm for POLLUTION DEGREE 3.

Table K.101 – CLEARANCES ~~for~~ **of measuring circuits** ~~of~~ **RATED for** MEASUREMENT CATEGORIES **III and IV**

~~Nominal a.c. r.m.s line-to-neutral or d.c. voltage of MAINS being measured~~ ~~V~~	~~CLEARANCE~~ ~~mm~~			
	~~BASIC INSULATION and SUPPLEMENTARY INSULATION~~		~~REINFORCED INSULATION~~	
	~~MEASUREMENT CATEGORY III~~	~~MEASUREMENT CATEGORY IV~~	~~MEASUREMENT CATEGORY III~~	~~MEASUREMENT CATEGORY IV~~
~~300~~	~~3,0~~	~~5,5~~	~~5,9~~	~~10,5~~
~~> 300 ≤ 600~~	~~5,5~~	~~8~~	~~10,5~~	~~14,3~~
~~> 600 ≤ 1 000~~	~~8~~	~~14~~	~~14,3~~	~~24,3~~

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	CLEARANCE mm			
	BASIC INSULATION and SUPPLEMENTARY INSULATION		REINFORCED INSULATION	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	3,0	5,5	6	10,4
> 300 ≤ 600	5,5	8	10,4	15
> 600 ≤ 1 000	8	14	15	23,9
> 1 000 ≤ 1 500	11	18	22	36
> 1 500 ≤ 2 000	18	22	36	44
> 2 000 ≤ 3 000	22	25	44	50

Conformity is checked by inspection and measurement or by the a.c. voltage test of 6.8.3.1 with a duration of at least 5 s, or the impulse voltage test of 6.8.3.3, or, for measuring circuits stressed only by d.c., the d.c. voltage test of 6.8.3.2 with a duration of at least 5 s, using the applicable test voltage of Table K.16 for the required CLEARANCE. The value of the d.c. test voltage is √2 times the a.c. r.m.s. test voltage.

K.101.3 CREEPAGE DISTANCES

The requirements of K.2.3 apply.

Conformity is checked as specified in K.2.3.

K.101.4 Solid insulation

K.101.4.1 General

K.101.4.1.1 Solid insulation shall withstand the electrical and mechanical stresses that may occur in NORMAL USE, in all RATED environmental conditions (see 1.4), during the intended life of the ~~equipment~~ hand-held multimeter.

The manufacturer should take the expected life of the hand-held multimeter into account when selecting insulating materials.

Conformity is checked by both of the following tests:

a) the a.c. voltage test of 6.8.3.1 with a duration of at least 5 s using the applicable test voltage of Table K.102 or the impulse voltage test of 6.8.3.3 using the applicable test voltage of ~~Table K.102 or~~ Table K.103, including for measuring circuits stressed only by d.c.;

b) the a.c. voltage test of 6.8.3.1 with a duration of at least 1 min or, for ~~MAINS~~ measuring circuits stressed only by d.c., the ~~1 min~~ d.c. voltage test of 6.8.3.2 with a duration of at least 1 min using the ~~applicable~~ test voltage ~~of Table K.104~~ determined by K.101.4.1.2.

NOTE ~~1~~ Test a) checks the effects of TRANSIENT OVERVOLTAGES, while test b) checks the effects of long-term stress of solid insulation.

Table K.102 – a.c. test voltages for testing electric strength of solid insulation in measuring circuits ~~of~~ RATED for MEASUREMENT ~~CATEGORY~~ CATEGORIES III and IV

~~Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured~~ ~~V~~	~~Test voltage~~			
	~~5 seconds a.c. test~~ ~~V r.m.s.~~		~~Impulse test~~ ~~V peak~~	
	~~BASIC INSULATION and SUPPLEMENTARY INSULATION~~	~~REINFORCED INSULATION~~	~~BASIC INSULATION and SUPPLEMENTARY INSULATION~~	~~REINFORCED INSULATION~~
~~300~~	~~2 210~~	~~3 510~~	~~4 000~~	~~6 400~~
~~> 300 ≤ 600~~	~~3 310~~	~~5 400~~	~~6 000~~	~~9 600~~
~~> 600 ≤ 1 000~~	~~4 260~~	~~7 400~~	~~8 000~~	~~12 800~~

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	a.c. test voltage V r.m.s.			
	BASIC INSULATION and SUPPLEMENTARY INSULATION		REINFORCED INSULATION	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	2 200	3 300	3 500	5 100
> 300 ≤ 600	3 300	4 300	5 100	7 000
> 600 ≤ 1 000	4 300	6 600	7 000	10 000
> 1 000 ≤ 1 500	5 400	8 200	9 700	15 000
> 1 500 ≤ 2 000	8 200	9 700	15 000	18 000
> 2 000 ≤ 3 000	9 700	11 000	18 000	20 000

Table K.103 – Impulse test voltages for testing electric strength of solid insulation in measuring circuits of RATED for MEASUREMENT CATEGORY CATEGORIES III and IV

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	Test voltage			
	5 s a.c. test V r.m.s.		Impulse test V peak	
	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION
300	3 310	5 400	6 000	9 600
> 300 ≤ 600	4 260	7 400	8 000	12 800
> 600 ≤ 1 000	6 600	11 940	12 000	19 200

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	Impulse test voltage V peak			
	BASIC INSULATION and SUPPLEMENTARY INSULATION		REINFORCED INSULATION	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	4 000	6 000	6 400	9 600
> 300 ≤ 600	6 000	8 000	9 600	12 800
> 600 ≤ 1 000	8 000	12 000	12 800	19 200
> 1 000 ≤ 1 500	10 000	15 000	17 900	27 100
> 1 500 ≤ 2 000	15 000	18 000	27 100	32 000
> 2 000 ≤ 3 000	18 000	20 000	32 000	36 000

K.101.4.1.2 Test voltage values for testing the long-term stress of solid insulation are determined as follows:

The test voltage for BASIC INSULATION and SUPPLEMENTARY INSULATION is calculated with the following formula:

$$U_T = A \times U_N + B$$

where U_T is the test voltage, U_N is the nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured and A and B are parameters determined as follows:

when $U_N \leq$ 1 000 V, $A = 1$ and B = 1 200 V

when $U_N >$ 1 000 V, $A = 1{,}5$ and B = 750 V

The a.c. test voltage is equal to U_T and the d.c. test voltage is equal to 1,414 × U_T.

For REINFORCED INSULATION, the test voltage value is twice the value for BASIC INSULATION.

The rounded values of Table K.104 can also be used:

Table K.104 – Test voltages for testing long-term stress of solid insulation in measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	Test voltage			
	1-min a.c. test V r.m.s.		1-min d.c. test V d.c.	
	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION
≤ 300	1 500	3 000	2 100	4 200
> 300 ≤ 600	1 800	3 600	2 550	5 100
> 600 ≤ 1 000	2 200	4 400	3 100	6 200
> 1 000 ≤ 1 500	3 000	6 000	4 250	8 500
> 1 500 ≤ 2 000	3 750	7 500	5 300	10 600
> 2 000 ≤ 3 000	5 250	10 500	7 400	14 800

K.101.4.1.3 Solid insulation shall also meet the following requirements, as applicable:

a) for solid insulation used as an ENCLOSURE or PROTECTIVE BARRIER, the requirements of Clause 8;

b) for moulded and potted parts, the requirements of K.101.4.2;

c) for ~~inner~~ insulating layers of printed wiring boards, the requirements of K.101.4.3;

d) for thin-film insulation, the requirements of K.101.4.4.

Conformity is checked as specified in K.101.4.2 to K.101.4.4, and Clause 8, as applicable.

K.101.4.2 Moulded and potted parts

For BASIC INSULATION, SUPPLEMENTARY INSULATION, and REINFORCED INSULATION, conductors located between the same two layers moulded together (see Figure K.1, item L) shall be separated by at least the applicable minimum distance of Table K.~~9~~105 after the moulding is completed.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

K.101.4.3 ~~Inner~~ Insulating layers of printed wiring boards

For BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION, conductors located between the same two layers (see Figure K.2, item L) shall be separated by at least the applicable minimum distance of Table K.~~9~~105.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

Table K.105 – Minimum values for distance or thickness of solid insulation in measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Line-to-neutral voltage V r.m.s. or d.c.	Minimum thickness [a] mm	Minimum distance L (see Figure K.2) [a, b] mm
≤ 300	0,4	0,4
> 300 ≤ 600	0,6	0,6
> 600	1,0	1,0

[a] These values are independent of the MEASUREMENT CATEGORY.

[b] These values apply for BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION.

REINFORCED INSULATION of inner insulating layers of printed wiring boards shall also have adequate electric strength through the respective layers. One of the following methods shall be used.

a) The thickness through the insulation is at least the applicable value of Table K.~~9~~105.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

b) The insulation is assembled from at least two separate layers of printed wiring board materials, each of which is RATED by the manufacturer of the material for an electric strength at least the value of the applicable test voltage of Table K.102 or Table K.103 for BASIC INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.

c) The insulation is assembled from at least two separate layers of printed wiring board materials, and the combination of layers is RATED by the manufacturer of the material for an electric strength at least the value of the applicable test voltage of Table K.102 or Table K.103 for REINFORCED INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.

K.101.4.4 Thin-film insulation

For BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION, conductors located between the same two layers (see Figure K.3, item L) shall be separated by at least the applicable CLEARANCE and CREEPAGE DISTANCE of K.101.2 and K.101.3.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

REINFORCED INSULATION through the layers of thin-film insulation shall also have adequate electric strength. One of the following methods shall be used.

a) The thickness through the insulation is at least the applicable value of Table K.~~9~~105.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

b) The insulation consists of at least two separate layers of thin-film materials, each of which is RATED by the manufacturer of the material for an electric strength of at least the value of the applicable test voltage of Table K.102 or Table K.103 for BASIC INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.

c) The insulation consists of at least three separate layers of thin-film materials, any two of which have been tested to exhibit adequate electric strength.

~~*Conformity is checked by the a.c. voltage test of 6.8.3.1 with a duration of at least 1 min applied to two of the three layers using the applicable test voltage of Table K.102 or Table K.103 for REINFORCED INSULATION.*~~

Conformity is checked by the voltage tests of K.101.4.1.1 applied to two of the three layers for REINFORCED INSULATION.

~~*NOTE*~~ *For the purposes of this test, a special sample ~~can~~ may be assembled with only two layers of the material.*

Annex L
(informative)

Index of defined terms

~~*Addition:*~~

Add the following defined term~~s~~ to the list:

~~**HAND-HELD EQUIPMENT** ..... 3.1.104~~

MEASUREMENT CATEGORY 3.5.101

~~**METER** ..... 3.1.103~~

~~**MULTIMETER** ..... 3.1.101~~

~~**VOLTMETER** ..... 3.1.102~~

Add the following new annexes ~~AA and BB~~:

Annex AA
(normative)

Measurement categories

AA.1 General

For the purposes of this document, only MEASUREMENT CATEGORIES III and IV are used. These MEASUREMENT CATEGORIES are not the same as the OVERVOLTAGE CATEGORIES in accordance with K.1.1 and with IEC 60664-1, or the classification of rated impulse ~~withstand categories~~ voltages (overvoltage categories) in accordance with IEC 60364-4-44.

MEASUREMENT CATEGORIES are based on locations on the MAINS where measurements may be made.

NOTE 1 IEC 60664-1 and IEC 60364-4-44 categories are created to achieve an insulation coordination of the components and equipment used within the ~~low voltage MAINS supply system~~ MAINS.

~~NOTE 2 MEASUREMENT CATEGORIES are based on locations on the MAINS supply system where measurements may be made.~~

NOTE ~~3~~2 It is expected that these ~~METERS~~ hand-held multimeters will also be used in MEASUREMENT CATEGORY II and some other measuring environments also (see 6.9.101 for minimum required RATINGS for ~~METERS~~ hand-held multimeters).

AA.2 MEASUREMENT CATEGORIES

AA.2.1 MEASUREMENT CATEGORY II

MEASUREMENT CATEGORY II is applicable to test and measuring circuits connected directly to utilization points (socket outlets and similar points) of the low-voltage MAINS installation (see Table AA.1 and Figure AA.1). ~~This part of the installation is expected to have a minimum of two levels of overcurrent protective devices between the transformer and the connecting points of the measuring circuit (see Table AA.1 and Figure AA.1).~~

EXAMPLE Measurements on MAINS CIRCUITS of household appliances, portable TOOLS and similar equipment and on the consumer side only of socket-outlets in the fixed installation.

AA.2.2 MEASUREMENT CATEGORY III

MEASUREMENT CATEGORY III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation (see Table AA.1 and Figure AA.1). ~~This part of the installation is expected to have a minimum of one level of over-current protective devices between the transformer and possible connecting points (see Table AA.1 and Figure AA.1).~~

To avoid RISKS caused by the HAZARDS arising from these higher short-circuit currents, additional insulation and other provisions are required.

~~NOTE~~ For equipment that is part of a fixed installation, the fuse or circuit breaker of the installation ~~may be~~ is considered to provide adequate protection against short-circuit currents.

EXAMPLE Measurements on distribution boards (including secondary electricity meters), photovoltaic panels, circuit-breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment such as stationary motors with permanent connection to the fixed installation.

AA.2.3 MEASUREMENT CATEGORY IV

MEASUREMENT CATEGORY IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation (see Table AA.1 and Figure AA.1). ~~This part of the installation could have no over-current protective devices between the transformer and connecting points of the measuring circuit (see Table AA.1 and Figure AA.1).~~

~~Due to these high short-circuit currents which can be followed by a high energy level, measurements made within these locations are extremely dangerous. Great precautions shall be made to avoid any chance of a shortcircuit.~~

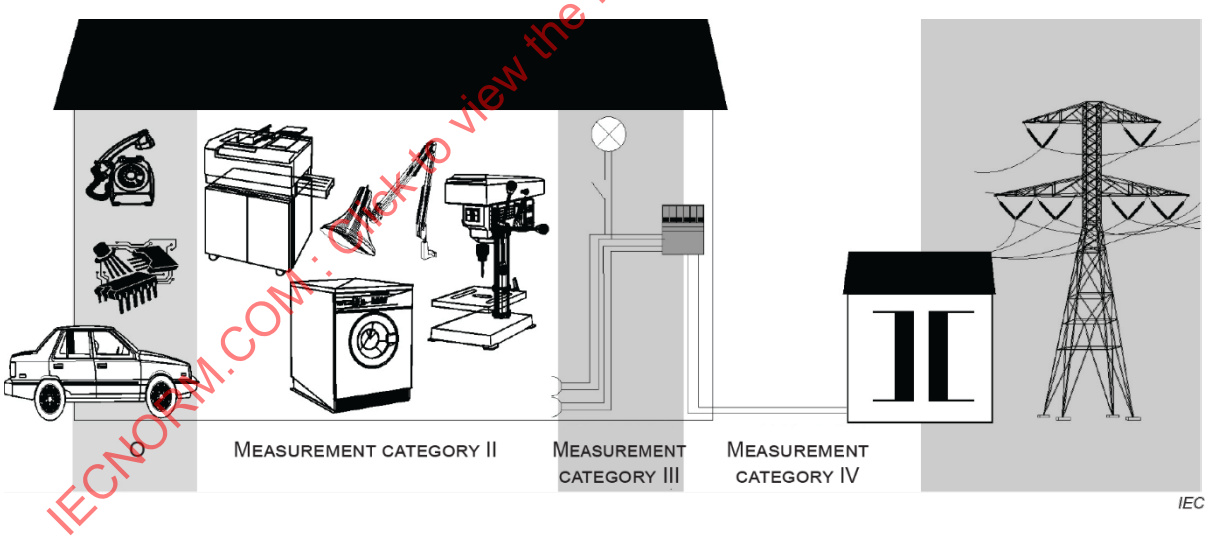
Owing to the high potential short-circuit currents existing in these circuits, any accidental short-circuit caused whilst making measurements can create a high energy level arc flash which is extremely dangerous to bystanders in the immediate vicinity. Great precautions shall be taken to avoid any chance of a short-circuit.

EXAMPLE Measurements on devices installed before the main fuse or circuit breaker in the building installation.

AA.2.4 Measuring circuits without a ~~RATED~~ MEASUREMENT CATEGORY RATING

Many types of test and measuring circuits are not intended to be directly connected to the MAINS supply. Some of these measuring circuits are intended for very low energy applications, but others of these measuring circuits may experience very high amounts of available energy because of high short-circuit currents or high open-circuit voltages. There are no standard transient levels defined for these circuits. An analysis of the WORKING VOLTAGES, loop impedances, TEMPORARY OVERVOLTAGES, and TRANSIENT OVERVOLTAGES in these circuits is necessary to determine the insulation requirements and short-circuit current requirements.

EXAMPLE Thermocouple measuring circuits, high-frequency measuring circuits, automotive testers, and testers used to characterize the MAINS installation before the installation is connected to the MAINS supply.



Key

O: ~~Other circuits that are not directly connected to MAINS~~ Measuring circuits without a MEASUREMENT CATEGORY

CAT II: MEASUREMENT CATEGORY II

CAT III: MEASUREMENT CATEGORY III

CAT IV: MEASUREMENT CATEGORY IV

Figure AA.1 – Example to identify the locations of measuring circuits

Table AA.1 – Characteristics of MEASUREMENT CATEGORIES

MEASUREMENT CATEGORY	**Short-circuit current** [a] (typical) kA	**Location in the building installation**
II	< 10	Circuits connected to MAINS socket outlets, and similar points in the MAINS installation
III	< 50	MAINS distribution parts of the building
IV	~~>>~~ > 50	Source of the MAINS installation in the building

[a] ~~The short-circuit current is calculated for a 1 000 V line-to-neutral voltage and the minimum loop impedance.~~

The values of loop impedances (installation impedances) do not take into account the resistance of the ~~probe assemblies~~ test leads and impedances internal to the measuring equipment. These short-circuit currents vary, depending on the characteristics of the installation.

Annex BB
(informative)

HAZARDS pertaining to measurements performed in certain environments

BB.1 General

Annex BB provides guidance to the equipment manufacturer on HAZARDS that should be considered for equipment intended to measure electrical quantities in certain environments. This list of HAZARDS is not to be considered comprehensive: other HAZARDS certainly exist in these and other environments.

BB.2 ~~MAINS CIRCUITS~~ HAZARDS

BB.2.1 General

Testing and measuring circuits are subjected to WORKING VOLTAGES and transient stresses from the circuit to which they are connected during measurement or test. When the measuring circuit is used to measure MAINS, the transient stresses can be estimated by the location within the installation at which the measurement is performed.

BB.2.2 Electric shock

MAINS CIRCUITS present a HAZARD of electric shock. The voltages and currents are above the permissible levels (see 6.3), and access to the circuit is usually required to perform the measurement. The manufacturer should provide adequate information to permit the OPERATOR to be aware of the HAZARD of electric shock, and should ensure that the design requirements of this document and those of other related documents (for example, IEC 61010-031 for voltage probe assemblies) are met.

BB.2.3 Arc ~~flash~~ blast

Arc flash occurs when a conductor (such as a probe tip or a low-impedance measuring circuit) temporarily bridges two high-energy conductors and then opens or is withdrawn. This can result in arcing, which ionizes the air. Ionized air is conductive, and can result in continued current flow in the vicinity of the conductors.

The arc flash will release significant amounts of very hot air and molten or vaporised metal particles (from the active conductors) which are the primary RISK to the OPERATOR and other persons in the immediate vicinity.

If there is sufficient available energy, then the ionization of the air will continue to spread and the flow of current through the air continues to increase. The result is similar to an explosion, and can cause significant injury or death to an OPERATOR or a bystander. See the descriptions of the MEASUREMENT CATEGORIES in Annex AA for the voltage and energy levels likely to cause arc flash.

BB.~~3~~2.4 Thermal burns

Any conductor (such as jewellery) that connects two high-energy conductors may become hot from current flow through the item. This can cause burns to the skin adjacent to the item.

BB.3 MAINS

When the measuring circuit is used to measure live MAINS, there is a RISK of arc ~~flash explosion~~ blast. MEASUREMENT CATEGORIES (see Annex AA) define the amount of energy available, which may contribute to arc flash. In conditions where arc flash can exist, the instructions for use need to specify additional precautions to reduce the HAZARD related to shock and burn from arc flash.

BB.4 Telecommunications networks

The voltages and currents continually present in telecommunications networks are below the levels that could be considered HAZARDOUS LIVE. However, the "ring" voltages (the voltage imposed on the telecommunications line to indicate that the telephone receiver should signal an incoming call) are typically around 90 V a.c., which is considered HAZARDOUS LIVE. If a technician were to come into contact with the ~~proper~~ relevant conductor while the ring event occurred, then the technician could suffer an electric shock.

EN 41003~~:1999~~ addresses safety requirements for equipment to be connected to telecommunications networks. It addresses the possibility of electric shock from contact with telecommunications conductors, and concludes that, with the access limitations imposed by the connectors, the RISK is reduced to a negligible level. However, if in the process of test or measurement, the conductor is made fully ACCESSIBLE, then there is a possibility of electric shock.

The manufacturer of equipment that may be used for testing and ~~measurement~~ measuring of telecommunications networks should be aware of the HAZARD from the ring voltage and should take suitable steps to reduce the HAZARD (where possible by limiting access to the conductors; in other cases, by providing adequate instructions and warnings to the OPERATOR). Also see IEC 61010-031, which specifies barriers for voltage probes that may be used on HAZARDOUS LIVE voltages.

BB.5 Current measurements in inductive circuits

When a current-measuring device is inserted in series with an inductive circuit, a HAZARD may occur if the circuit is suddenly opened (a probe falls off or a fuse opens, for example). Such sudden events can produce an inductive voltage spike across the unintentional opening of the circuit. These spikes can be many times the magnitude of the WORKING VOLTAGE of the circuit, and can cause breakdown of insulation or electric shock to an OPERATOR.

The manufacturer should provide adequate instructions to an OPERATOR to ensure that current-measuring devices are not used in series with inductive circuits, or if it is necessary to do so, then precautions are taken to mitigate the HAZARD of electric shock from the voltage spike.

BB.6 Battery-driven circuits

Batteries can present electrical, explosion and fire HAZARDS to the person conducting tests on them or their associated circuits. Examples include batteries used for stand-by sources or to operate motors.

HAZARDS may arise from electric shock, explosions from short-circuiting the TERMINALS of the battery, or explosions from arc ignition of gases evolved from the battery during charging cycles.

BB.7 Measurements at higher frequencies

Some measuring equipment depends on inductive connection to the circuit being measured. See IEC 61010-2-032 for examples of some current probes that use inductive connections. The behaviour of the measuring circuit will, in these cases, depend on the frequency of the signal being measured. If the measuring device is used to measure a frequency higher than it was designed for, then circulating currents could cause significant heating of some of the conductive parts of the measuring device.

The manufacturer should provide adequate instructions for the use of such devices.

Annex CC
(informative)

4-mm "banana" TERMINALS

CC.1 General

A HAZARD may arise from an OPERATOR's reliance on values displayed by the hand-held multimeter when connectors and TERMINALS appear to be in mated position but conductive parts are not in contact.

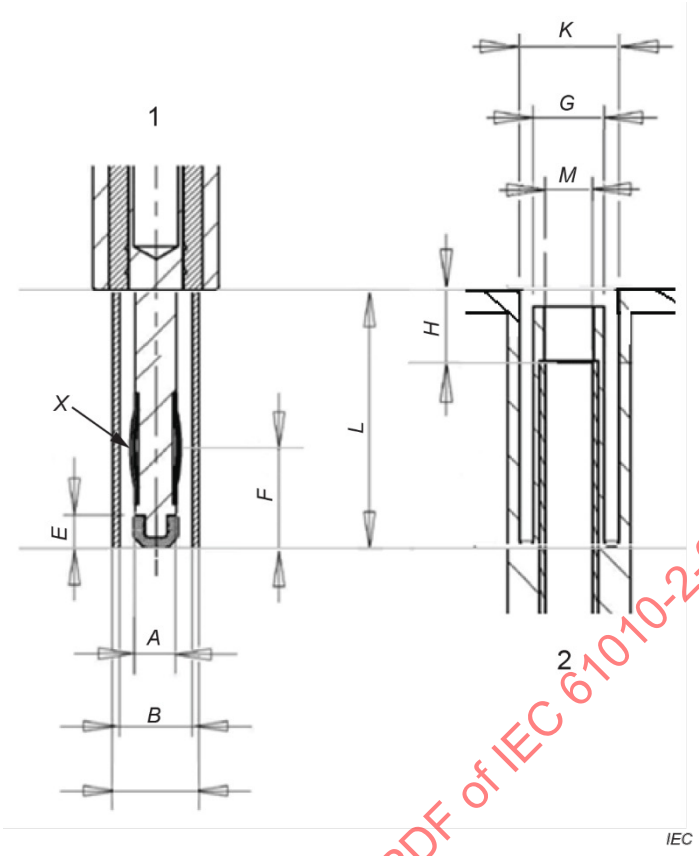
Annex CC gives the recommended dimensions for safety purposes of 4-mm TERMINALS when probe assemblies complying with IEC 61010-031:2015/AMD1:2018, Annex E, can be connected. These 4-mm TERMINALS are often called "banana connectors".

CC.2 Dimensions

The dimensions of Figure CC.1 are compatible with the requirements of TERMINALS RATED for MEASUREMENT CATEGORIES II, III or IV up to 1 000 V.

These dimensions ensure that the CLEARANCES of 6.6.101 are met when the connectors and TERMINALS are mated, unmated or partially mated, and that conductive parts of mated connectors and TERMINALS are in contact.

NOTE Extraction or insertion forces and contact resistance values have not been considered.



Key:

A = 3,90 mm ± 0,05 mm (compressed)	*M* = 4,00 mm + 0,05 mm
B ≥ 6,6 mm	G ≤ 6,4 mm
C ≤ 7,9 mm	*K* ≥ 8,1 mm
2,6 mm ≤ *E* ≤ 6 mm	4 mm ≤ *H* ≤ 6 mm
F ≤ 12 mm	*L* ≥ 20 mm

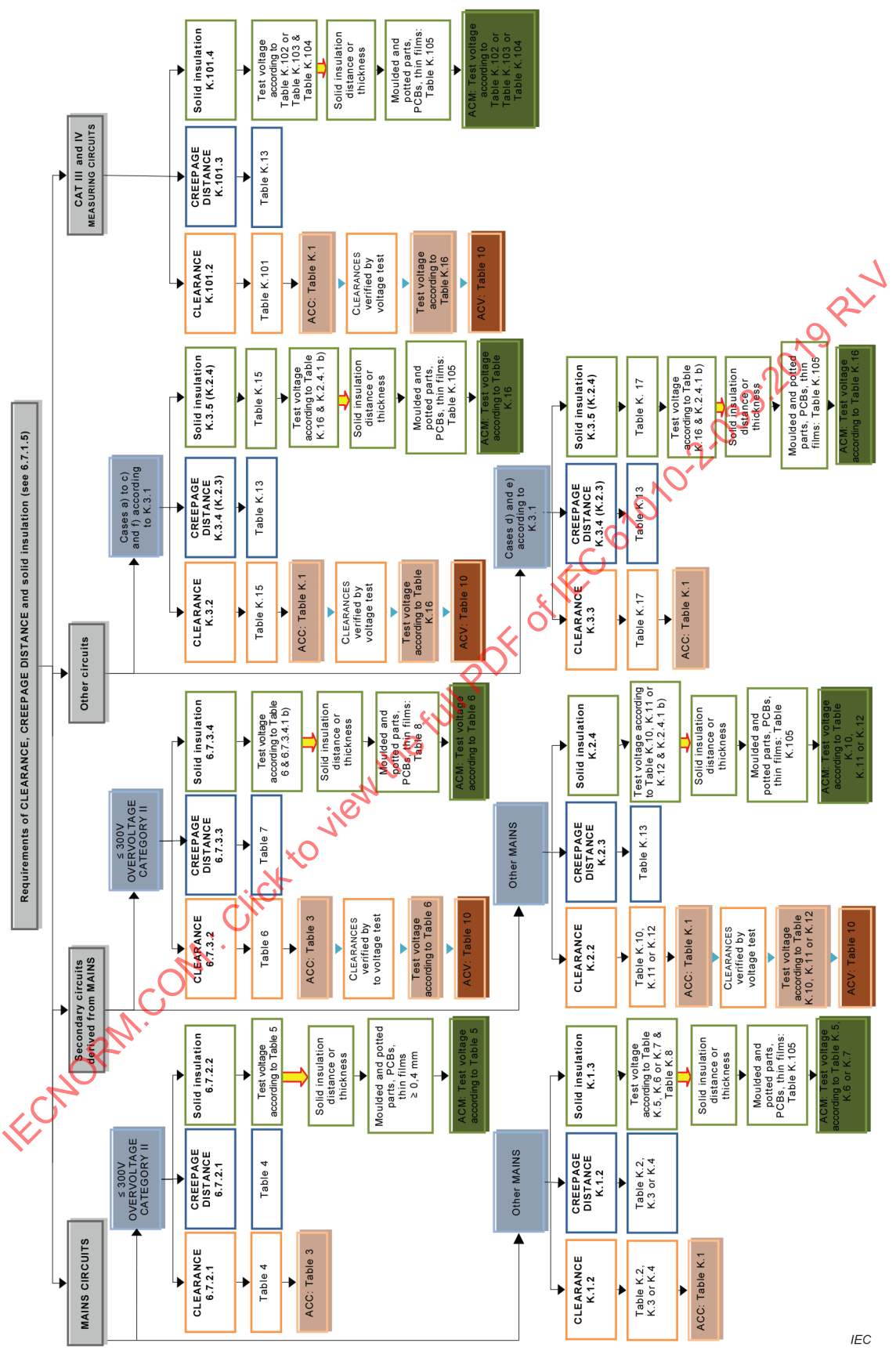
– 1 is a male TERMINAL
– 2 is a female TERMINAL
– X is the point where the best contact occurs
– the minimum value of *E* and *H* depends on whether or not plastic parts are present. CLEARANCES shall be at least 2,6 mm.

Figure CC.1 – Recommended dimensions of 4-mm TERMINALS

Annex DD
(informative)

Flowchart for insulation according to the type of circuit

A circuit can fall under more than one category. It is then necessary to follow two or more branches of the flowchart of Figure DD.1 and compare the results. For example, a measuring circuit can be RATED for MEASUREMENT CATEGORY III and can also be RATED for measuring signals at 1 MHz. This measuring circuit has to be evaluated under both K.3.3 and Clause K.101.



Key

ACC	RATED altitude correction of CLEARANCE
ACV	Site altitude correction of test voltage
&	Both required
ACM	Alternative conformity means
	As applicable
	Optional test path

Figure DD.1 – Requirements for CLEARANCE, CREEPAGE DISTANCE and solid insulation

Bibliography

The Bibliography of Part 1 is applicable except as follows.

Addition:

Add the following references:

~~IEC 61010-2-030, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits*~~

~~IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*~~

IEC 61010-2-034, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-034: Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength*

IEC 61557-1, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance*

IEC 61557-3, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 3: Loop impedance*

IEC 61557-4, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 4: Resistance of earth connection and equipotential bonding*

IEC 61557-5, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 5: Resistance to earth*

IEC 61557-6, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 6: Effectiveness of residual current devices (RCD) in TT, TN and IT systems*

IEC 61557-7, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 7: Phase sequence*

IEC 61557-8, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

IEC 61557-9, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 9: Equipment for insulation fault location in IT systems*

IEC 61557-10, *Electrical safety in low voltage distribution systems up to 1 000 v a.c. and 1 500 v d.c. – Equipment for testing, measuring or monitoring of protective measures –*

Part 10: Combined measuring equipment for testing, measuring and monitoring of protective measures

IEC 61557-11, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 11: Effectiveness of residual current monitors (RCMs) type A and type B in TT, TN and IT systems*

IEC 61557-12, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 12: Power metering and monitoring devices (PMD)*

IEC TS 62993:2017, *Guidance for determination of clearances, creepage distances and requirements for solid insulation for equipment with a rated voltage above 1 000 V AC and 1 500 V DC, and up to 2 000 V AC and 3 000 V DC*

EN 41003:1999, *Particular safety requirements for equipment to be connected to telecommunication networks and/or a cable distribution system*

IEC 61010-2-033

Edition 2.0 2019-06

INTERNATIONAL STANDARD

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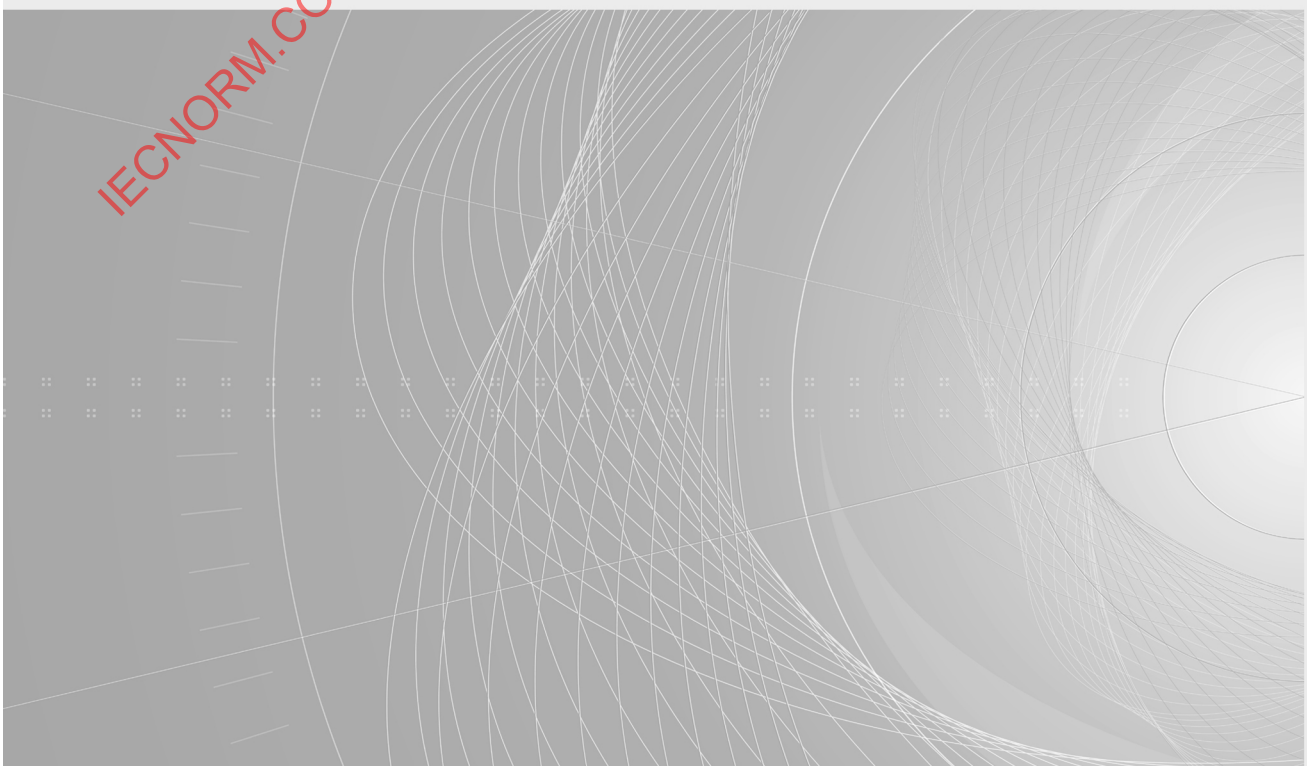
Safety requirements for electrical equipment for measurement, control and laboratory use –
Part 2-033: Particular requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS voltage

Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –
Partie 2-033: Exigences particulières pour les multimètres portatifs pour usage domestique et professionnel, capables de mesurer la tension RESEAU



IEC 61010-2-033:2019-06(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2-033: Particular requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS voltage

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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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61010-2-033 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

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

a) The scope has been reduced to hand-held multimeters. Voltmeters and clamp multimeters have been removed. They are addressed respectively by IEC 61010-2-030 and IEC 61010-2-032. The relevant definitions have been removed.
b) Subclause 4.4.2.101 has been relocated into Clause 102.

c) CLEARANCES and CREEPAGE DISTANCES for WET LOCATIONS and for measuring circuit TERMINALS exceeding 1 000 V a.c. or 1 414 V d.c. have been specified.

d) Subclause 14.101 related to "Circuits or components used as TRANSIENT OVERVOLTAGE limiting devices in measuring circuits used to measure MAINS" has been removed.

e) References to IEC 61010-031 for probe assemblies and IEC 61010-2-032 for current sensors have been added.

f) Requirements for protection against MAINS overvoltage measuring circuits have been added.

g) Clause 102 has been rewritten.

h) Requirements for measuring circuits from 1 000 V to 3 000 V have been added.

i) An informative Annex CC about dimensions of 4-mm banana TERMINALS has been added.

j) A flowchart for insulation according to the type of circuit has been added in a new Annex DD.

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

FDIS	Report on voting
66/692/FDIS	66/694/RVD

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

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

A list of all the parts in the IEC 61010 series, published under the general title *Safety requirements for electrical equipment for measurement, control, and laboratory use*, can be found on the IEC website.

This Part 2-033 is to be used in conjunction with the latest edition of IEC 61010-1. It was established on the basis of the third edition (2010) of IEC 61010-1 and its Amendment 1 (2016), hereinafter referred to as Part 1.

This Part 2-033 supplements or modifies the corresponding clauses in IEC 61010-1 so as to convert that publication into the IEC standard: *Particular requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS voltage.*

Where a particular subclause of Part 1 is not mentioned in this Part 2-033, that subclause applies as far as is reasonable. Where this Part 2-033 states "addition", "modification", "replacement", or "deletion", the relevant requirement, test specification or note in Part 1 should be adapted accordingly.

In this standard:

a) the following print types are used:
   - requirements: in roman type;
   - NOTES: in small roman type;
   - *conformity and tests: in italic type;*
   - terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS;

b) subclauses, figures, tables and notes which are additional to those in Part 1 are numbered starting from 101. Additional annexes are lettered starting from AA and additional list items are lettered from aa).

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

Part 2-030 specifies the safety requirements for equipment with testing and measuring circuits which are connected for test or measurement purposes to devices or circuits outside the measurement equipment itself. Requirements of Part 2-030 have been included in this Part 2-033. Equipment within the scopes of both Part 2-030 and Part 2-033 are considered to be covered by the requirements of this Part 2-033.

Part 2-032 specifies the safety requirements for hand-held and hand-manipulated current sensors. For equipment within the scope of Part 2-032 and Part 2-033, only Part 2-032 is applicable.

Part 2-034 specifies the safety requirements for measurement equipment for insulation resistance and test equipment for electric strength which are connected to units, lines or circuits for test or measurement purposes. For equipment within the scope of Part 2-033 and Part 2-034, only Part 2-034 is applicable.

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

Part 2-033: Particular requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS voltage

1 Scope and object

This clause of Part 1 is applicable except as follows:

1.1.1 Equipment included in scope

Replace the existing text with the following:

This part of IEC 61010 specifies safety requirements for hand-held multimeters for domestic and professional use, capable of measuring MAINS.

Hand-held multimeters are multi-range multifunction measuring instruments intended to measure voltage and other electrical quantities such as resistance or current. Their primary purpose is to measure voltage on a live MAINS. They are suitable to be supported by one hand during NORMAL USE.

1.1.2 Equipment excluded from scope

Add the following new item to the list and the following paragraph:

aa) IEC 61557-1 to IEC 61557-12, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures*

HAND-HELD EQUIPMENT such as oscilloscopes, wattmeters, process control multimeters not RATED for measuring voltage on a live MAINS, clamp multimeters and communications test sets are not within the scope of this document.

1.2.1 Aspects included in scope

Add the following two new paragraphs at the end of the subclause:

Requirements for protection against HAZARDS resulting from NORMAL USE and REASONABLY FORESEEABLE MISUSE of measuring circuits are given in Clause 101.

Requirements for reliance on the displayed value are given in Clause 102.

2 Normative references

This clause of Part 1 is applicable except as follows:

Replace "IEC 61010-031" with the following new reference:

IEC 61010-031:2015, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated probe assemblies for electrical test and measurement*
IEC 61010-031:2015/AMD1:2018

Replace "IEC 61180-1 (all parts)", "IEC 61180-1" and "IEC 61180-2", with the following new reference:

IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

Add the following new normative reference:

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

3.5 Safety terms

Replace the definition of 3.5.4 with the following new definition:

3.5.4
MAINS
electricity supply system

Add the following new term and definition:

3.5.101
MEASUREMENT CATEGORY
classification of testing and measuring circuits according to the type of MAINS to which they are intended to be connected

Note 1 to entry: MEASUREMENT CATEGORIES take into account OVERVOLTAGE CATEGORIES, short-circuit current levels, the location in the building installation where the test or measurement is to be made, and some forms of energy limitation or transient protection included in the building installation. See Annex AA for more information.

4 Tests

This clause of Part 1 is applicable, except as follows:

4.3.2.5 MAINS supply

Replace the existing title and the text with:

4.3.2.5 Power supply

The following requirements apply.

a) The MAINS supply voltage shall be between 90 % and 110 % of any RATED supply voltage for which the equipment can be set or, if the equipment is RATED for a greater fluctuation, at any supply voltage within the fluctuation range.

b) The MAINS frequency shall be any RATED frequency.

c) Equipment for both a.c. and d.c. shall be connected to an a.c. or d.c. supply.

d) Equipment powered by single-phase a.c. MAINS supply shall be connected both with normal and reverse polarity.

e) If the means of connection permits reversal, battery-operated and d.c. equipment shall be connected with both reverse and normal polarity.

4.3.2.6 Input and output voltages

Replace the first paragraph with the following:

Input and output voltages, including floating voltages but excluding the MAINS supply voltage, shall be set to any voltage within the RATED voltage range, in normal and reverse polarity if possible.

5 Marking and documentation

This clause of Part 1 is applicable except as follows:

5.1.2 Identification

Add the following note after the existing note:

NOTE 101 Some national regulations might require a marking to indicate the name and edition of the standard used for compliance evaluation.

5.1.5 TERMINALS, connections, and operating devices

5.1.5.1 General

Replace the first paragraph with the following:

If necessary for safety, an indication shall be given of the purpose of TERMINALS, connectors, controls, and indicators. Where there is insufficient space, symbol 14 from Table 1 may be used.

5.1.5.2 TERMINALS

Replace the existing item d) with the following item d):

d) TERMINALS supplied from the interior of the hand-held multimeter and which could be HAZARDOUS LIVE, with the voltage, current, charge or energy value or range, or with symbol 12 of Table 1;

Add the following new item to the list:

aa) TERMINALS supplied from other TERMINALS which could be HAZARDOUS LIVE, with symbol 12 or 14 of Table 1.

Add the following new subclause:

5.1.5.101 Measuring circuit TERMINALS

Measuring circuit TERMINALS shall be marked with the value of the RATED voltage to earth.

Each pair or set of measuring circuit TERMINALS that are intended to be used together shall be marked with the value of the RATED voltage or the RATED current as applicable to the pair or set of TERMINALS.

Measuring circuit TERMINALS are usually arranged in pairs or sets. Each pair or set of TERMINALS may have a RATED voltage or a RATED current, or both, within that set, and each individual TERMINAL will have a RATED voltage to earth. For some hand-held multimeters, the RATED voltage between TERMINALS may be different from the RATED voltage to earth. Markings shall be clear to avoid misunderstanding.

TERMINALS of measuring circuits RATED for MAINS voltage measurements shall be additionally marked "CAT III" and/or "CAT IV" as applicable. Marking those TERMINALS with these two types, and only these two types, of MEASUREMENT CATEGORY and its RATED voltage to earth, is permissible. Marking MEASUREMENT CATEGORY II is not allowed.

Measuring circuit TERMINALS that do not have a RATING for connection to voltages above the levels of 6.3.1, may be marked with alternative markings.

Measuring circuit TERMINALS which are dedicated only for connection to specific TERMINALS of other equipment need not be marked provided that there is a means of identifying these TERMINALS.

TERMINAL markings shall be visible when the hand-held multimeter is ready for NORMAL USE with connectors and TERMINALS mated and shall reference the applicable TERMINALS.

Conformity is checked by inspection.

5.2 Warning markings

Replace the existing text with the following text:

Warning markings specified in in this document shall meet the following requirements.

Warning markings shall be visible when the hand-held multimeter is ready for NORMAL USE. If a warning applies to a particular part of the hand-held multimeter, the marking shall be placed on or near that part.

The size of warning markings shall be as follows.

a) Symbols shall be at least 2,75 mm high. Text shall be at least 1,5 mm high and contrast in colour with the background.

b) Symbols or text moulded, stamped or engraved in a material shall be at least 2,0 mm high. If not contrasting in colour, they shall have a depth or raised height of at least 0,5 mm.

If it is necessary for the RESPONSIBLE BODY or OPERATOR to refer to the instruction manual to preserve the protection afforded by the hand-held multimeter, the hand-held multimeter shall be marked with symbol 14 of Table 1. Symbol 14 is not required to be used together with symbols which are explained in the manual.

If the instructions for use state that an OPERATOR is permitted to gain access, using a TOOL, to a part which in NORMAL USE may be HAZARDOUS LIVE, there shall be a warning marking which states that the hand-held multimeter shall be isolated or disconnected from the HAZARDOUS LIVE voltage before access.

NOTE National regulations can require safety markings in a nationally accepted language.

Conformity is checked by inspection.

5.4.1 General

Replace the first paragraph with the following paragraph:

The following documentation necessary for safety purposes, as needed by the OPERATOR or the RESPONSIBLE BODY, shall be provided with the hand-held multimeter, in an accepted language of the country where the product is intended to be placed on the market. Safety documentation for service personnel authorized by the manufacturer shall be made available to those personnel, in a language selected by the manufacturer.

Add the following two new items to the list:

aa) the documentation shall indicate that probe assemblies to be used for MAINS measurements shall be RATED as appropriate for MEASUREMENT CATEGORY III or IV according to IEC 61010-031 and shall have a voltage RATING of at least the voltage of the circuit to be measured;

bb) information about each relevant MEASUREMENT CATEGORY (see 5.1.5.101). If the hand-held multimeter has multiple MEASUREMENT CATEGORY RATINGS for the same measuring circuit, the documentation shall clearly identify the MEASUREMENT CATEGORIES where the hand-held multimeter may be used and where it shall not be used.

6 Protection against electric shock

This clause of Part 1 is applicable except as follows:

6.5.1 General

Replace the text, the conformity statement, and Figure 4 with the following text, conformity statement and Figure 4:

ACCESSIBLE parts shall be prevented from becoming HAZARDOUS LIVE in SINGLE FAULT CONDITION. The primary means of protection (see 6.4) shall be supplemented by one of a) or b). Alternatively, one of the single means of protection c) or d) shall be used. See Figure 4 and Annex DD.

a) SUPPLEMENTARY INSULATION (see 6.5.3).

b) Current or voltage limiting device (see 6.5.6).

c) REINFORCED INSULATION (see 6.5.3).

d) PROTECTIVE IMPEDANCE (see 6.5.4).

Conformity is checked by inspection and as specified in 6.5.3, 6.5.4, or 6.5.6, as applicable.

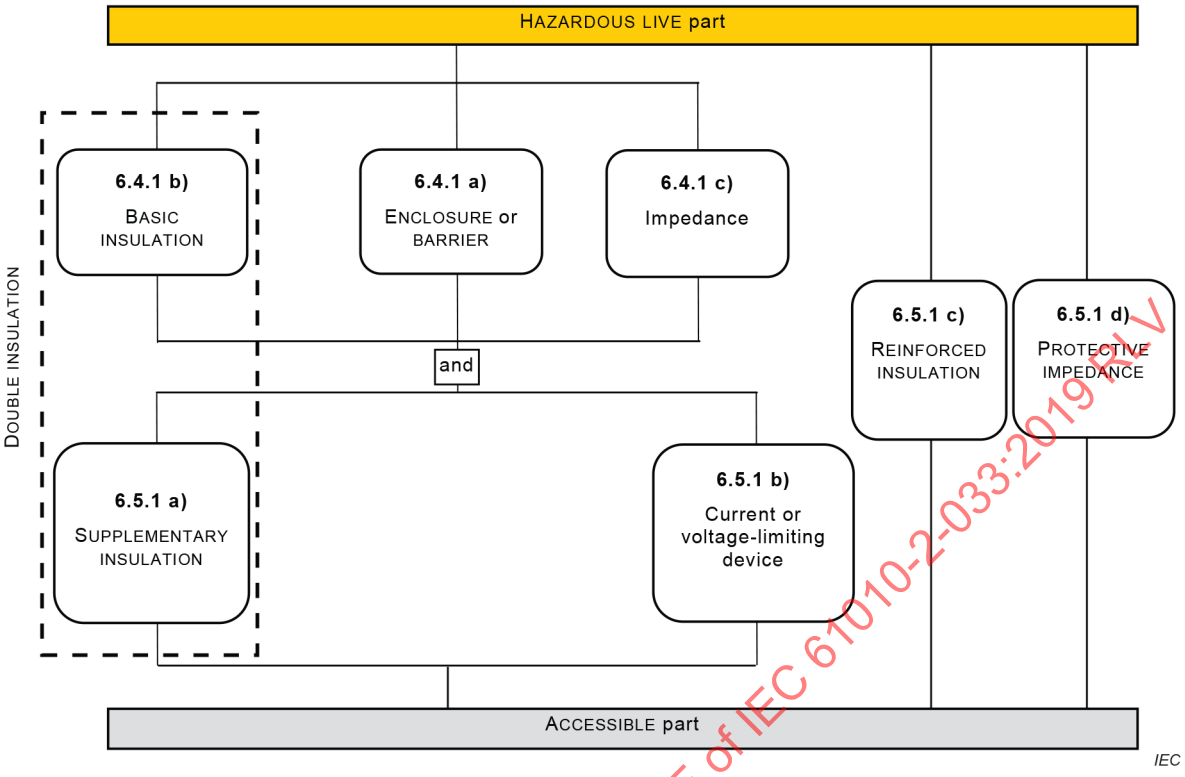


Figure 4 – Acceptable arrangement of protective means against electric shock

6.5.2 PROTECTIVE BONDING

Replace the existing title of 6.5.2 with the following and delete the text:

6.5.2 Not used

6.5.5 Automatic disconnection of the supply

Replace the existing title of 6.5.5 with the following and delete the text:

6.5.5 Not used

6.6 Connections to external circuits

Add the following two new subclauses:

6.6.101 Measuring circuit TERMINALS

The conductive parts of each unmated measuring circuit TERMINAL which could become HAZARDOUS LIVE when the highest RATED voltage is applied to other measuring circuit TERMINALS on the hand-held multimeter shall be separated by at least:

a) for TERMINALS with voltage RATING up to 1 000 V a.c. or 1 500 V d.c., the applicable CLEARANCE and CREEPAGE DISTANCE of Table 101 from the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position (see Figure 1);

b) for TERMINALS with voltage RATING exceeding 1 000 V a.c. or 1 500 V d.c., 2,8 mm for the CLEARANCE and CREEPAGE DISTANCE from the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position. These TERMINALS shall also withstand the voltage test of 6.8 with a test voltage equal to the RATED voltage of the TERMINAL multiplied by 1,25 applied between the closest approach of the test finger

touching the external parts of the TERMINAL in the least favourable position and the other measuring circuit TERMINALS.

EXAMPLE For a 4 000 V a.c. r.m.s. RATED voltage, the test voltage is 5 000 V a.c. r.m.s. (7 070 V peak). The calculated CLEARANCE is 13,1 mm according to D_2 in Table K.15. For homogeneous fields, a lower CLEARANCE value can be achieved by testing (see IEC 60664-1 for more information about homogeneous fields).

Table 101 – CLEARANCES and CREEPAGE DISTANCES for measuring circuit TERMINALS with HAZARDOUS LIVE conductive parts up to 1 000 V a.c. or 1 500 V d.c

Voltage on conductive parts of TERMINAL V a.c. r.m.s. and V d.c.	CLEARANCE and CREEPAGE DISTANCE mm
≥ 30 ≤ 300	0,8
> 300 ≤ 600	1,0
> 600 ≤ 1 000	2,6
> 1 000 ≤ 1 500 [a]	2,8
[a] Only for d.c. voltage.	

Annex CC provides information regarding the recommended dimensions of 4-mm "banana" TERMINALS.

Conformity is checked by inspection, by the determination of ACCESSIBLE parts, and by measurement of the applicable CLEARANCES and CREEPAGE DISTANCES and, if applicable, by the voltage test of 6.8.

6.6.102 Specialized measuring circuit TERMINALS

Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS shall not be both ACCESSIBLE and HAZARDOUS LIVE, in either NORMAL CONDITION or SINGLE-FAULT CONDITION, even when the highest RATED voltage is applied to any other measuring circuit TERMINAL.

NOTE These specialized TERMINALS include, but are not limited to, TERMINALS for semiconductor measuring functions, capacitance measurements, and thermocouple sockets.

Conformity is checked by inspection and measurement. Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS are connected. The measurements of 6.3 are made to establish that the levels of 6.3.1 and 6.3.2 are not exceeded when each of the following voltages is applied to each other measuring circuit TERMINAL, if applicable:

a) highest RATED a.c. voltage at any RATED MAINS frequency;

b) highest RATED d.c. voltage;

c) highest RATED a.c. voltage at the maximum related RATED measurement frequency.

6.7.1.3 CREEPAGE DISTANCES

Add the following two new paragraphs after the third paragraph:

For hand-held multimeters not powered from the MAINS or the measuring circuit, CREEPAGE DISTANCES according to material group I are allowed to be used for other materials.

For TERMINALS of hand-held multimeters intended to be connected only to a hand-held probe assembly complying with Part 031, CREEPAGE DISTANCES according to material group I are allowed to be used for the insulating materials of the TERMINALS.

6.7.1.5 Requirements for insulation according to type of circuit

Replace the text with the following:

Requirements for insulation in particular types of circuits are specified as follows:

a) in 6.7.2 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II with a nominal supply voltage up to 300 V;

NOTE 1 See Annex I for nominal voltages of MAINS supplies.

b) in 6.7.3 for secondary circuits separated from the circuits in a) only by means of a transformer;

c) in Clause K.1 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY III or IV or for OVERVOLTAGE CATEGORY II over 300 V;

d) in Clause K.2 for secondary circuits separated from the circuits in c) only by means of a transformer;

e) in Clause K.3 for circuits that have one or more of the following characteristics:

1) the maximum possible TRANSIENT OVERVOLTAGE is above the level assumed for the MAINS CIRCUIT;
2) the WORKING VOLTAGE is the sum of voltages from more than one circuit, or is a mixed voltage;
3) the WORKING VOLTAGE includes a recurring peak voltage that may include a periodic non-sinusoidal waveform or a non-periodic waveform that occurs with some regularity;
4) the WORKING VOLTAGE has a frequency above 30 kHz;
5) the circuit is a measuring circuit where MEASUREMENT CATEGORIES do not apply;

f) in Clause K.101 for measuring circuits RATED for MEASUREMENT CATEGORIES III and IV.

NOTE 2 These requirements are illustrated in the flowchart of Annex DD, Figure DD.1.

The TRANSIENT OVERVOLTAGE level for MAINS corresponds to the "required RATED impulse voltage of equipment" value specified in Table 443.2 of IEC 60364-4-44:2007/AMD1:2015.

6.8.3.1 The a.c. voltage test

Replace the first sentence with the following sentence:

The voltage tester shall be capable of maintaining the test voltage throughout the test within ±5% of the specified value.

6.9 Constructional requirements for protection against electric shock

Add the following new subclause:

6.9.101 Hand-held multimeter RATINGS

TERMINALS of measuring circuits intended for MAINS voltage measurements shall be RATED for a minimum of 300 V a.c. r.m.s. to earth, and a minimum of MEASUREMENT CATEGORY III.

The RATED voltage of the TERMINALS of a measuring circuit intended for MAINS voltage measurements shall be equal to or higher than their RATED voltage to earth.

NOTE These TERMINALS can also have RATING for other functions.

Conformity is checked by inspection.

7 Protection against mechanical HAZARDS

This clause of Part 1 is applicable.

8 Resistance to mechanical stresses

This clause of Part 1 is applicable.

9 Protection against the spread of fire

This clause of Part 1 is applicable.

10 Equipment temperature limits and resistance to heat

This clause of Part 1 is applicable.

11 Protection against HAZARDS from fluids and solid foreign objects

This clause of Part 1 is applicable.

12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure

This clause of Part 1 is applicable.

13 Protection against liberated gases and substances, explosion and implosion

This clause of Part 1 is applicable.

14 Components and subassemblies

This clause of Part 1 is applicable, except as follows.

14.8 Circuits used to limit TRANSIENT OVERVOLTAGES

Replace the existing title of 14.8 with the following and delete the text:

14.8 Not used

Add the following new subclause:

14.101 Probe assemblies and accessories

Probe assemblies and accessories within the scope of IEC 61010-031, and current sensors within the scope of IEC 61010-2-032 shall meet the requirements thereof.

At minimum, one set of the test leads supplied with the hand-held multimeter shall be RATED according to IEC 61010-031 for at least the highest voltage and MEASUREMENT CATEGORIES of the hand-held multimeter.

Conformity is checked by inspection.

15 Protection by interlocks

This clause of Part 1 is applicable.

16 HAZARDS resulting from application

This clause of Part 1 is applicable.

17 RISK assessment

This clause of Part 1 is applicable.

Add the following new Clause 101 and Clause 102:

101 Measuring circuits

101.1 General

The hand-held multimeter shall provide protection against HAZARDS resulting from NORMAL USE and REASONABLY FORESEEABLE MISUSE of measuring circuits, as specified below.

a) If a HAZARD could result, a current measuring circuit shall not interrupt the circuit being measured during range changing, or during the use of current transformers without internal protection (see 101.2).

b) An electrical quantity that is within specification for any TERMINAL shall not cause a HAZARD when it is applied to that TERMINAL or to any other compatible TERMINAL, with the range and function settings set in any possible manner (see 101.3).

c) Any interconnections between the hand-held multimeter and other devices or accessories intended to be used with the hand-held multimeter shall not cause a HAZARD even if the documentation or markings prohibit the interconnection while the hand-held multimeter is used for measurement purposes (see 6.6).

d) Other HAZARDS that could result from REASONABLY FORESEEABLE MISUSE shall be addressed by RISK assessment (see Clause 16 and Clause 17).

e) A TEMPORARY OVERVOLTAGE or a TRANSIENT OVERVOLTAGE applied on the measuring circuit TERMINALS in a voltage measurement function shall not cause a HAZARD (see 101.4).

Conformity is checked as specified in 6.6, Clause 16 and Clause 17, 101.2, 101.3 and 101.4, as applicable.

101.2 Current measuring circuits

Current measuring circuits shall be so designed that, when range changing takes place, there shall be no interruption which could cause a HAZARD.

Conformity is checked by inspection, and, in case of doubt, by causing the device to switch the maximum RATED current 6 000 times.

Current measuring circuits intended for connection to current transformers without internal protection shall be adequately protected to prevent a HAZARD arising from interruption of these circuits during operation.

Conformity is checked by an overload test at a value of 10 times the maximum RATED current for 1 s, and, if applicable, by causing the hand-held multimeter to switch the maximum RATED current 6 000 times. No interruption which could cause a HAZARD shall occur during the tests.

101.3 Protection against mismatches of inputs and ranges

101.3.1 General

In NORMAL CONDITION and in cases of REASONABLY FORESEEABLE MISUSE, no HAZARD shall arise when the highest RATED voltage or current of a measuring circuit TERMINAL is applied to that TERMINAL or any other compatible TERMINAL, with any combination of function and range settings.

NOTE Mismatches of inputs and ranges are examples of REASONABLY FORESEEABLE MISUSE, even if the documentation or markings prohibit such mismatch. A typical example is inadvertent connection of a high voltage to a measuring input intended for current or resistance. Possible HAZARDS include electric shock, burns, fire, arcing and explosion.

TERMINALS that are clearly not of similar types and that will not retain the connectors of the probe or accessory do not need to be tested and TERMINALS that can only be accessed by use of a TOOL do not need to meet the requirement of 101.3.1.

The hand-held multimeter shall provide protection against these HAZARDS. One of the following techniques shall be used.

a) Use of a certified overcurrent protection device to interrupt short-circuit currents before a HAZARD arises. In this case, the requirements and test of 101.3.2 apply.

b) Use of an uncertified current limitation device, an impedance, or a combination of both to prevent the HAZARD from arising. In this case, the requirements and tests of 101.3.3 apply.

Conformity is checked by inspection, evaluation of the design of the hand-held multimeter, and as specified in 101.3.2 to 101.3.3, as applicable.

101.3.2 Protection by a certified overcurrent protection device

An overcurrent protection device is considered suitable if it is certified by an independent laboratory and if all of the following requirements are met.

a) The a.c. and d.c. RATED voltages of the overcurrent protection device shall be at least as high as, respectively, the highest a.c. and d.c. RATED voltages of any measuring circuit TERMINAL on the hand-held multimeter.

b) The RATED time-current characteristic (speed) of the overcurrent protection device shall be such that no HAZARD will result from any possible combination of RATED input voltages, TERMINALS, and range selection.

   NOTE In practice, downstream circuit elements such as components and printed wiring board traces are selected to be able to withstand the energy that the overcurrent protection device will let through.

c) The a.c. and d.c. RATED breaking capacities of the overcurrent protection device shall exceed, respectively, the possible a.c. and d.c. short-circuit currents.

   The possible a.c. and d.c. short-circuit currents are calculated as the highest RATED voltage for any TERMINAL divided by the impedance of the overcurrent-protected measuring circuit, taking the impedance of the test leads specified in 101.3.4 into account.

   The possible a.c. short-circuit current need not exceed the applicable values of Table AA.1.

Additionally, spacings surrounding the overcurrent protection device in the hand-held multimeter and following the protection device in the measuring circuit shall be sufficiently large to prevent arcing after the protection device opens.

Conformity is checked by inspection of the RATING of the overcurrent protection device and by the following test.

If the protection device is a fuse, it is replaced with an open-circuited fuse. If the protection device is a circuit breaker, it is set to its open position. A voltage of two times the highest RATED voltage for any TERMINAL is applied to the TERMINALS of the overcurrent-protected measuring circuit for 1 min. During and after the test, no damage to the hand-held multimeter shall occur.

101.3.3 Protection by uncertified current limitation devices or by impedances

Devices used for current limitation shall be capable of safely withstanding, dissipating, or interrupting the energy that will result from the application of the maximum RATED voltage of any compatible TERMINAL in NORMAL CONDITION and in the case of REASONABLY FORESEEABLE MISUSE.

An impedance used for limitation of current shall be one or more of the following.

a) An appropriate single component which is constructed, selected, and tested so that safety and reliability for protection against relevant HAZARDS are assured. In particular, the component shall:
   1) be RATED for the maximum voltage that may be present in NORMAL CONDITION or during the REASONABLY FORESEEABLE MISUSE event;
   2) if a resistor, be RATED for twice the power or energy dissipation that may result in NORMAL CONDITION or from the REASONABLY FORESEEABLE MISUSE event;
   3) meet the applicable CLEARANCE and CREEPAGE DISTANCE requirements of Annex K for BASIC INSULATION between its terminations.
b) A combination of components which shall:
   1) withstand the maximum voltage that may be present in NORMAL CONDITION or during the REASONABLY FORESEEABLE MISUSE event;
   2) be able to dissipate the power or energy that may result in NORMAL CONDITION or from the REASONABLY FORESEEABLE MISUSE event;
   3) meet the applicable CLEARANCE and CREEPAGE DISTANCE requirements of Annex K for BASIC INSULATION between the terminations of the combination of components.

   NOTE 1 The CLEARANCES and CREEPAGE DISTANCES take into account the WORKING VOLTAGE across each insulation.

Conformity is checked by inspection and the following test, performed three times on the same unit of hand-held multimeter. If the test results in heating of any component, the hand-held multimeter is allowed to cool before the test is repeated. If a device used for current limitation is damaged, it is replaced before the test is repeated.

The possible a.c. and d.c. short-circuit currents are calculated as the highest RATED voltage for any TERMINAL divided by the impedance of the current-limited measuring circuit, taking the impedance of the test leads specified in 101.3.4 into account. The possible a.c. short-circuit current should not exceed the values in Table AA.1.

A voltage equal to the highest RATED voltage for any TERMINAL is applied between the TERMINALS of the measuring circuit for 1 min. The source of the test voltage shall be able to deliver a current of at least the possible a.c. or d.c. short-circuit current as applicable. If the function or range controls have any effect on the electrical characteristics of the input circuit, the test is repeated with the function or range controls in every combination of positions, including during the change of function or range. During the test, the voltage output of the source is measured. If the source voltage decreases by more than 20 % for more than 10 ms, the test is considered inconclusive and is repeated with a lower impedance source.

During and after the test, no HAZARD shall arise, nor shall there be any evidence of fire, arcing, explosion, or damage to current limitation devices, impedances or any component intended to provide protection against electric shock, heat, arc or fire, including the ENCLOSURE and traces on the printed wiring board.

NOTE 2 This test can be extremely hazardous. Explosion shields and other provisions can be used to protect personnel performing the test.

101.3.4 Test leads for the tests of 101.3.2 and 101.3.3

The tests of 101.3.2 and 101.3.3 shall be performed with all test leads that are specified or supplied by the manufacturer for use with the hand-held multimeter and if the manufacturer has not specified the test leads, the tests shall be performed with test leads that meet the following specifications:

a) length = 1,0 m;

b) cross section of the conductor = 1,5 mm^2, stranded copper wire;

NOTE A conductor with a 16 AWG (American Wire Gauge) cross section is acceptable.

c) connector compatible with the measuring circuit TERMINAL;

d) connection to the test voltage source via a bare wire into suitable screw TERMINALS or thimble connectors (twist-on wire connectors) or equivalent means of providing a low-impedance connection;

e) arranged as straight as possible.

Test leads built to these specifications will have a d.c. resistance of about 15 mΩ each, or 30 mΩ per pair. For the purposes of calculation of possible fault current in 101.3.2 and 101.3.3, the value of 30 mΩ can be used for these test leads.

If the manufacturer-supplied test leads are permanently connected to the hand-held multimeter, then the attached test leads supplied by the manufacturer shall be used without modification.

101.4 Protection against MAINS overvoltages

To ensure protection against arc flash or fire, measuring circuits RATED for measuring MAINS voltages shall have minimum CLEARANCES and CREEPAGE DISTANCES equivalent to BASIC INSULATION between MAINS-connected conductive parts of opposite polarity.

Conformity is checked by inspection and measurement.

In addition, the measuring circuit TERMINALS of a voltage measuring circuit shall withstand the applicable TRANSIENT OVERVOLTAGE with the voltage measurement function selectors set for the proper function and range, without damage which could cause a HAZARD.

Conformity is checked by the following impulse voltage test using the applicable impulse voltage of Table 102.

The impulse voltage is applied between each pair of TERMINALS. The impulse voltage test shall be conducted for five impulses of each polarity spaced up to 1 min apart, from a hybrid impulse generator (see IEC 61180). The generator produces an open-circuit voltage waveform of 1,2/50 μs, a short-circuit current waveform of 8/20 μs, with an output impedance (peak open-circuit voltage divided by peak short-circuit current) of 2 Ω. Resistance may be added in series if needed to raise the impedance.

The impulse voltage is applied while the circuit is working under conditions of NORMAL USE, in combination with the MAINS voltage.

The MAINS voltage used for the test is the maximum RATED line-to-neutral voltage of the MAINS being measured. For measuring circuits RATED for MAINS line-to-neutral voltages above 400 V a.c. r.m.s. or d.c., the test may be performed with an available MAINS voltage source that has a line-to-neutral voltage of at least 400 V a.c. r.m.s. or d.c. The MAINS voltage source does not, in this case, need to match the measuring circuit RATING, but circuits RATED for a.c. or

a.c. plus d.c. shall be tested with an a.c. source, and circuits RATED for d.c. only shall be tested with a d.c. source.

NOTE 1 The impulses are synchronized with the MAINS voltage phase, timed to occur at the peak of the MAINS voltage, and to be of the same polarity, with a phase tolerance of ±10° (see IEC 61180).

NOTE 2 This test can be extremely hazardous. Explosion shields and other provisions can be used to protect personnel performing the test.

When verifying CLEARANCES within the hand-held multimeter by an impulse voltage test, it is necessary to ensure that the specified impulse voltage appears at the CLEARANCE.

The wave shape of each impulse shall be observed (see Note 3). Distortions of the impulse voltage which do not change from impulse to impulse may be caused by operation of an overvoltage limiting device and do not indicate a (partial) breakdown of solid insulation.

No HAZARD shall arise. No flashover of CLEARANCES or breakdown of solid insulation shall occur during the test, but partial discharges are allowed. Partial discharge will be indicated by a step in the resulting wave shape which will occur earlier in successive impulses. Breakdown on the first impulse may either indicate a complete failure of the insulation system or the operation of overvoltage limiting devices in the hand-held multimeter. If overvoltage limiting devices are present, they shall not rupture or overheat during the test. Tripping the circuit breaker of the MAINS installation is an indication of failure. If the results of the test are questionable or inconclusive, the test is to be repeated two more times.

NOTE 3 Partial discharges in voids can lead to partial notches of extremely short durations in the wave shape which can be repeated in the course of an impulse.

Table 102 – Impulse voltages

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	**Impulse voltage** V peak	
	MEASUREMENT CATEGORY III	**MEASUREMENT CATEGORY IV**
≤ 300	4 000	6 000
> 300 ≤ 600	6 000	8 000
> 600 ≤ 1 000	8 000	12 000
> 1 000 ≤ 1 500	10 000	15 000
> 1 500 ≤ 2 000	15 000	18 000
> 2 000 ≤ 3 000	18 000	20 000
Values over 1 000 V are from IEC TS 62993:2017, Table 1.		

102 Indicating devices

102.1 General

No HAZARD shall occur from reading a voltage value when the hand-held multimeter is operated for measuring voltages as RATED and in case of REASONABLE FORESEEABLE MISUSE.

A displayed voltage value is considered to be unambiguous when the value is less than 10 % inaccurate, or if there is an indication that the value is out of range when it should be, or if there is a clear indication that the value is not correct. A display off is also considered to be unambiguous.

The tests of 102.2, 102.3 and 102.4 shall be performed when relevant.

The a.c. r.m.s. voltages applied to the TERMINALS during the tests have a frequency of 50 Hz or 60 Hz. The hand-held multimeter is not required to maintain its normal accuracy during and after the tests.

102.2 Battery level

A voltage value displayed by the hand-held multimeter shall not be affected by the expected variation of its battery voltage.

Conformity is checked by the following test:

For each measuring circuit TERMINAL RATED for MAINS voltage measurements, the voltage below is applied to these TERMINALS.

– *a.c. measurement TERMINALS are connected to 60 V a.c. r.m.s.*

– *d.c. measurement TERMINALS are connected to 120 V d.c.*

The supply voltage of the d.c. source connected to the battery connectors decreases by no more than 20 mV/s from the maximum battery voltage to zero. The d.c. source used for this test shall be the batteries or similar source while the impedance of the batteries and ripple free conditions are taken into account. The test terminates when the display turns off.

The displayed voltage values during the test shall be unambiguous.

NOTE See 102.1 for the meaning of the term "unambiguous".

102.3 Over-range

The hand-held multimeter shall be able to display unambiguously over-range voltage values whenever the value is above the maximum absolute value of the range to which the hand-held multimeter is set.

NOTE Examples of ambiguous indications include the following, unless there is a separate unambiguous indication of an over-range value:

a) analogue hand-held multimeter which stops at the exact ends of the range;

b) digital hand-held multimeter which shows a low value when the true value is above the range maximum (for example 1 001,5 V displayed as 001,5 V).

Conformity is checked by the following test:

An over-range voltage is applied to the measuring circuit TERMINALS RATED for MAINS voltage measurements of the hand-held multimeter set to each voltage measurement range.

The value of the over-range voltage applied to the TERMINALS is equal at 110 % of the RATED voltage measurement range. For measurement RATED for d.c., the over-range voltage is applied with positive and negative polarities.

The displayed voltage values during the test shall be unambiguous.

102.4 Permanent overvoltages

The hand-held multimeter shall be able to withstand permanent overvoltages and continue to give an unambiguous indication of any HAZARDOUS LIVE voltages up to the maximum RATED voltage.

NOTE 1 Subclause 101.4 provides protection against HAZARDS from TRANSIENT OVERVOLTAGES.

Conformity is checked by the following test:

An overvoltage is applied for 5 min to the measuring circuit TERMINALS' RATED for MAINS voltage measurements of the hand-held multimeter set to each voltage measurement range.

The value of the overvoltage applied to the TERMINALS is based on the TERMINALS' RATED voltage:

a) *when the TERMINALS' RATED voltage value is up to 1 000 V a.c. r.m.s., the overvoltage value is the TERMINALS' RATED voltage value multiplied by 1,9 but without exceeding 1 100 V a.c. r.m.s.;*

b) *when the TERMINALS' RATED voltage value is above 1 000 V a.c. r.m.s. the overvoltage value is the RATED voltage value multiplied by 1,1;*

c) *when the TERMINALS' RATED voltage is d.c., the overvoltage value is the RATED voltage value multiplied by 1,1.*

NOTE 2 The 1,9 multiplication factor is derived from phase-to-phase voltage measurements with a 10 % overvoltage condition.

After each overvoltage has been applied, each measuring circuit TERMINAL RATED for MAINS voltage measurements shall in turn:

1) measure a voltage of 60 V a.c. r.m.s. or 120 V d.c. based on the measurement TERMINAL input type;

2) measure a voltage equal to the maximum RATED voltage for the measurement TERMINAL under test.

The above test may need to be repeated at any combination of settings, TERMINALS and voltage RATING. The displayed voltage values shall be unambiguous.

Annexes

All annexes of Part 1 are applicable except as follows:

Annex K
(normative)

Insulation requirements not covered by 6.7

K.3 Insulation in circuits not addressed in 6.7, Clause K.1 or Clause K.2

Replace the existing title of Clause K.3 with the following:

K.3 Insulation for circuits not addressed in 6.7, Clauses K.1, K.2 or K.101

K.3.1 General

Replace the note with the following:

NOTE These requirements are illustrated in the flowchart of Annex DD, Figure DD.1.

Add the following new clause and tables:

K.101 Insulation requirements for measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

K.101.1 General

Measuring circuits are subjected to WORKING VOLTAGES and transient stresses from the circuit to which they are connected during measurement or test. When the measuring circuit is used to measure MAINS, the transient stresses can be estimated by the location within the installation at which the measurement is performed. When the measuring circuit is used to measure any other electrical signal, the transient stresses shall be considered by the OPERATOR to ensure that they do not exceed the capabilities of the measuring hand-held multimeter.

When the measuring circuit is used to connect to MAINS, there is a RISK of arc blast. MEASUREMENT CATEGORIES define the amount of energy available, which may contribute to arc flash. In conditions where arc flash may occur, additional precautions identified by the manufacturer to reduce the HAZARD related to shock and burn from arc flash should be described in the user documentation (see also Annex AA and Annex BB).

K.101.2 CLEARANCES

For a hand-held multimeter intended to be powered from the circuit being measured, CLEARANCES for the MAINS CIRCUIT shall be designed according to the requirements of the RATED MEASUREMENT CATEGORY. Additional marking requirements are in 5.1.5.2 and 5.1.5.101.

CLEARANCES of measuring circuits RATED for MEASUREMENT CATEGORIES III and IV are specified in Table K.101.

NOTE See Annex I for nominal voltages of MAINS supplies.

If the hand-held multimeter is RATED to operate at an altitude greater than 2 000 m, the values for CLEARANCES shall be multiplied by the applicable factor of Table K.1.

Minimum CLEARANCE for BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION is 0,2 mm for POLLUTION DEGREE 2 and 0,8 mm for POLLUTION DEGREE 3.

Table K.101 – CLEARANCES of measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	CLEARANCE mm			
	BASIC INSULATION and SUPPLEMENTARY INSULATION		REINFORCED INSULATION	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	3,0	5,5	6	10,4
> 300 ≤ 600	5,5	8	10,4	15
> 600 ≤ 1 000	8	14	15	23,9
> 1 000 ≤ 1 500	11	18	22	36
> 1 500 ≤ 2 000	18	22	36	44
> 2 000 ≤ 3 000	22	25	44	50

Conformity is checked by inspection and measurement or by the a.c. voltage test of 6.8.3.1 with a duration of at least 5 s, or the impulse voltage test of 6.8.3.3, or, for measuring circuits stressed only by d.c., the d.c. voltage test of 6.8.3.2 with a duration of at least 5 s, using the applicable test voltage of Table K.16 for the required CLEARANCE. The value of the d.c. test voltage is √2 times the a.c. r.m.s. test voltage.

K.101.3 CREEPAGE DISTANCES

The requirements of K.2.3 apply.

Conformity is checked as specified in K.2.3.

K.101.4 Solid insulation

K.101.4.1 General

K.101.4.1.1 Solid insulation shall withstand the electrical and mechanical stresses that may occur in NORMAL USE, in all RATED environmental conditions (see 1.4), during the intended life of the hand-held multimeter.

The manufacturer should take the expected life of the hand-held multimeter into account when selecting insulating materials.

Conformity is checked by both of the following tests:

a) the a.c. voltage test of 6.8.3.1 with a duration of at least 5 s using the applicable test voltage of Table K.102 or the impulse voltage test of 6.8.3.3 using the applicable test voltage of Table K.103, including for measuring circuits stressed only by d.c.;

b) the a.c. voltage test of 6.8.3.1 with a duration of at least 1 min or, for measuring circuits stressed only by d.c., the d.c. voltage test of 6.8.3.2 with a duration of at least 1 min using the test voltage determined by K.101.4.1.2.

NOTE Test a) checks the effects of TRANSIENT OVERVOLTAGES, while test b) checks the effects of long-term stress of solid insulation.

Table K.102 – a.c. test voltages for testing electric strength of solid insulation in measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	a.c. test voltage V r.m.s.			
	BASIC INSULATION and SUPPLEMENTARY INSULATION		REINFORCED INSULATION	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	2 200	3 300	3 500	5 100
> 300 ≤ 600	3 300	4 300	5 100	7 000
> 600 ≤ 1 000	4 300	6 600	7 000	10 000
> 1 000 ≤ 1 500	5 400	8 200	9 700	15 000
> 1 500 ≤ 2 000	8 200	9 700	15 000	18 000
> 2 000 ≤ 3 000	9 700	11 000	18 000	20 000

Table K.103 – Impulse test voltages for testing electric strength of solid insulation in measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	Impulse test voltage V peak			
	BASIC INSULATION and SUPPLEMENTARY INSULATION		REINFORCED INSULATION	
	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 300	4 000	6 000	6 400	9 600
> 300 ≤ 600	6 000	8 000	9 600	12 800
> 600 ≤ 1 000	8 000	12 000	12 800	19 200
> 1 000 ≤ 1 500	10 000	15 000	17 900	27 100
> 1 500 ≤ 2 000	15 000	18 000	27 100	32 000
> 2 000 ≤ 3 000	18 000	20 000	32 000	36 000

K.101.4.1.2 Test voltage values for testing the long-term stress of solid insulation are determined as follows:

The test voltage for BASIC INSULATION and SUPPLEMENTARY INSULATION is calculated with the following formula:

$$U_T = A \times U_N + B$$

where U_T is the test voltage, U_N is the nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured and A and B are parameters determined as follows:

when $U_N \leq$ 1 000 V, $A = 1$ and B = 1 200 V

when $U_N >$ 1 000 V, $A = 1{,}5$ and B = 750 V

The a.c. test voltage is equal to U_T and the d.c. test voltage is equal to 1,414 × U_T.

For REINFORCED INSULATION, the test voltage value is twice the value for BASIC INSULATION.

The rounded values of Table K.104 can also be used:

Table K.104 – Test voltages for testing long-term stress of solid insulation in measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Nominal a.c. r.m.s. line-to-neutral or d.c. voltage of MAINS being measured V	Test voltage			
	1-min a.c. test V r.m.s.		1-min d.c. test V d.c.	
	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION	BASIC INSULATION and SUPPLEMENTARY INSULATION	REINFORCED INSULATION
≤ 300	1 500	3 000	2 100	4 200
> 300 ≤ 600	1 800	3 600	2 550	5 100
> 600 ≤ 1 000	2 200	4 400	3 100	6 200
> 1 000 ≤ 1 500	3 000	6 000	4 250	8 500
> 1 500 ≤ 2 000	3 750	7 500	5 300	10 600
> 2 000 ≤ 3 000	5 250	10 500	7 400	14 800

K.101.4.1.3 Solid insulation shall also meet the following requirements, as applicable:

a) for solid insulation used as an ENCLOSURE or PROTECTIVE BARRIER, the requirements of Clause 8;

b) for moulded and potted parts, the requirements of K.101.4.2;

c) for insulating layers of printed wiring boards, the requirements of K.101.4.3;

d) for thin-film insulation, the requirements of K.101.4.4.

Conformity is checked as specified in K.101.4.2 to K.101.4.4, and Clause 8, as applicable.

K.101.4.2 Moulded and potted parts

For BASIC INSULATION, SUPPLEMENTARY INSULATION, and REINFORCED INSULATION, conductors located between the same two layers moulded together (see Figure K.1, item L) shall be separated by at least the applicable minimum distance of Table K.105 after the moulding is completed.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

K.101.4.3 Insulating layers of printed wiring boards

For BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION, conductors located between the same two layers (see Figure K.2, item L) shall be separated by at least the applicable minimum distance of Table K.105.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

Table K.105 – Minimum values for distance or thickness of solid insulation in measuring circuits RATED for MEASUREMENT CATEGORIES III and IV

Line-to-neutral voltage V r.m.s. or d.c.	Minimum thickness [a] mm	Minimum distance L (see Figure K.2) [a, b] mm
≤ 300	0,4	0,4
> 300 ≤ 600	0,6	0,6
> 600	1,0	1,0

[a] These values are independent of the MEASUREMENT CATEGORY.

[b] These values apply for BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION.

REINFORCED INSULATION of inner insulating layers of printed wiring boards shall also have adequate electric strength through the respective layers. One of the following methods shall be used.

a) The thickness through the insulation is at least the applicable value of Table K.105.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

b) The insulation is assembled from at least two separate layers of printed wiring board materials, each of which is RATED by the manufacturer of the material for an electric strength at least the value of the applicable test voltage of Table K.102 or Table K.103 for BASIC INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.

c) The insulation is assembled from at least two separate layers of printed wiring board materials, and the combination of layers is RATED by the manufacturer of the material for an electric strength at least the value of the applicable test voltage of Table K.102 or Table K.103 for REINFORCED INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.

K.101.4.4 Thin-film insulation

For BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION, conductors located between the same two layers (see Figure K.3, item L) shall be separated by at least the applicable CLEARANCE and CREEPAGE DISTANCE of K.101.2 and K.101.3.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

REINFORCED INSULATION through the layers of thin-film insulation shall also have adequate electric strength. One of the following methods shall be used.

a) The thickness through the insulation is at least the applicable value of Table K.105.

Conformity is checked by inspection and either by measurement of the separation or by inspection of the manufacturer's specifications.

b) The insulation consists of at least two separate layers of thin-film materials, each of which is RATED by the manufacturer of the material for an electric strength of at least the value of the applicable test voltage of Table K.102 or Table K.103 for BASIC INSULATION.

Conformity is checked by inspection of the manufacturer's specifications.

c) The insulation consists of at least three separate layers of thin-film materials, any two of which have been tested to exhibit adequate electric strength.

Conformity is checked by the voltage tests of K.101.4.1.1 applied to two of the three layers for REINFORCED INSULATION.

For the purposes of this test, a special sample may be assembled with only two layers of the material.

Annex L
(informative)

Index of defined terms

Add the following defined term to the list:

MEASUREMENT CATEGORY **3.5.101**

Addition:

Add the following new annexes:

Annex AA
(normative)

Measurement categories

AA.1 General

For the purposes of this document, only MEASUREMENT CATEGORIES III and IV are used. These MEASUREMENT CATEGORIES are not the same as the OVERVOLTAGE CATEGORIES in accordance with K.1.1 and with IEC 60664-1, or the classification of rated impulse voltages (overvoltage categories) in accordance with IEC 60364-4-44.

MEASUREMENT CATEGORIES are based on locations on the MAINS where measurements may be made.

NOTE 1 IEC 60664-1 and IEC 60364-4-44 categories are created to achieve an insulation coordination of the components and equipment used within the MAINS.

NOTE 2 It is expected that these hand-held multimeters will also be used in MEASUREMENT CATEGORY II and some other measuring environments also (see 6.9.101 for minimum required RATINGS for hand-held multimeters).

AA.2 MEASUREMENT CATEGORIES

AA.2.1 MEASUREMENT CATEGORY II

MEASUREMENT CATEGORY II is applicable to test and measuring circuits connected directly to utilization points (socket outlets and similar points) of the low-voltage MAINS installation (see Table AA.1 and Figure AA.1).

EXAMPLE Measurements on MAINS CIRCUITS of household appliances, portable TOOLS and similar equipment and on the consumer side only of socket-outlets in the fixed installation.

AA.2.2 MEASUREMENT CATEGORY III

MEASUREMENT CATEGORY III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation (see Table AA.1 and Figure AA.1).

To avoid RISKS caused by the HAZARDS arising from these higher short-circuit currents, additional insulation and other provisions are required.

For equipment that is part of a fixed installation, the fuse or circuit breaker of the installation is considered to provide adequate protection against short-circuit currents.

EXAMPLE Measurements on distribution boards (including secondary electricity meters), photovoltaic panels, circuit-breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment such as stationary motors with permanent connection to the fixed installation.

AA.2.3 MEASUREMENT CATEGORY IV

MEASUREMENT CATEGORY IV is applicable to test and measuring circuits connected at the source of the building's low-voltage MAINS installation (see Table AA.1 and Figure AA.1).

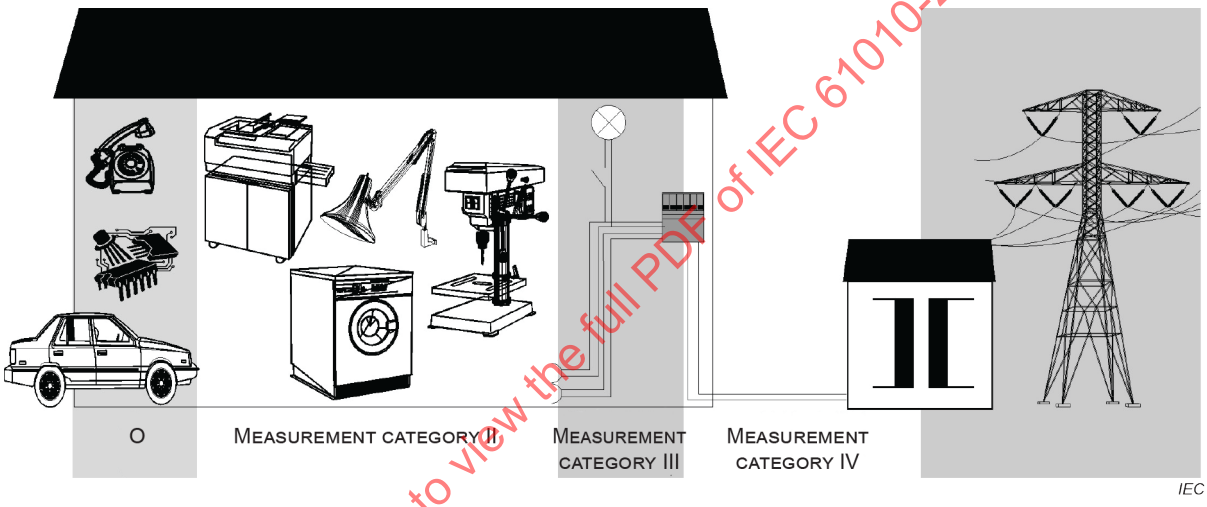
Owing to the high potential short-circuit currents existing in these circuits, any accidental short-circuit caused whilst making measurements can create a high energy level arc flash which is extremely dangerous to bystanders in the immediate vicinity. Great precautions shall be taken to avoid any chance of a short-circuit.

EXAMPLE Measurements on devices installed before the main fuse or circuit breaker in the building installation.

AA.2.4 Measuring circuits without a MEASUREMENT CATEGORY RATING

Many types of test and measuring circuits are not intended to be directly connected to the MAINS supply. Some of these measuring circuits are intended for very low energy applications, but others of these measuring circuits may experience very high amounts of available energy because of high short-circuit currents or high open-circuit voltages. There are no standard transient levels defined for these circuits. An analysis of the WORKING VOLTAGES, loop impedances, TEMPORARY OVERVOLTAGES, and TRANSIENT OVERVOLTAGES in these circuits is necessary to determine the insulation requirements and short-circuit current requirements.

EXAMPLE Thermocouple measuring circuits, high-frequency measuring circuits, automotive testers, and testers used to characterize the MAINS installation before the installation is connected to the MAINS supply.



Key

O: Measuring circuits without a MEASUREMENT CATEGORY

CAT II: MEASUREMENT CATEGORY II

CAT III: MEASUREMENT CATEGORY III

CAT IV: MEASUREMENT CATEGORY IV

Figure AA.1 – Example to identify the locations of measuring circuits

Table AA.1 – Characteristics of MEASUREMENT CATEGORIES

MEASUREMENT CATEGORY	Short-circuit current [a] (typical) kA	Location in the building installation
II	< 10	Circuits connected to MAINS socket outlets, and similar points in the MAINS installation
III	< 50	MAINS distribution parts of the building
IV	> 50	Source of the MAINS installation in the building

[a] The values of loop impedances (installation impedances) do not take into account the resistance of the test leads and impedances internal to the measuring equipment. These short-circuit currents vary, depending on the characteristics of the installation.

Annex BB
(informative)

HAZARDS pertaining to measurements performed in certain environments

BB.1 General

Annex BB provides guidance to the equipment manufacturer on HAZARDS that should be considered for equipment intended to measure electrical quantities in certain environments. This list of HAZARDS is not to be considered comprehensive: other HAZARDS certainly exist in these and other environments.

BB.2 HAZARDS

BB.2.1 General

Testing and measuring circuits are subjected to WORKING VOLTAGES and transient stresses from the circuit to which they are connected during measurement or test. When the measuring circuit is used to measure MAINS, the transient stresses can be estimated by the location within the installation at which the measurement is performed.

BB.2.2 Electric shock

MAINS CIRCUITS present a HAZARD of electric shock. The voltages and currents are above the permissible levels (see 6.3), and access to the circuit is usually required to perform the measurement. The manufacturer should provide adequate information to permit the OPERATOR to be aware of the HAZARD of electric shock, and should ensure that the design requirements of this document and those of other related documents (for example, IEC 61010-031 for voltage probe assemblies) are met.

BB.2.3 Arc blast

Arc flash occurs when a conductor (such as a probe tip or a low-impedance measuring circuit) temporarily bridges two high-energy conductors and then opens or is withdrawn. This can result in arcing, which ionizes the air. Ionized air is conductive, and can result in continued current flow in the vicinity of the conductors.

The arc flash will release significant amounts of very hot air and molten or vaporised metal particles (from the active conductors) which are the primary RISK to the OPERATOR and other persons in the immediate vicinity.

If there is sufficient available energy, then the ionization of the air will continue to spread and the flow of current through the air continues to increase. The result is similar to an explosion, and can cause significant injury or death to an OPERATOR or a bystander. See the descriptions of the MEASUREMENT CATEGORIES in Annex AA for the voltage and energy levels likely to cause arc flash.

BB.2.4 Thermal burns

Any conductor (such as jewellery) that connects two high-energy conductors may become hot from current flow through the item. This can cause burns to the skin adjacent to the item.

BB.3 MAINS

When the measuring circuit is used to measure live MAINS, there is a RISK of arc blast. MEASUREMENT CATEGORIES (see Annex AA) define the amount of energy available, which may contribute to arc flash. In conditions where arc flash can exist, the instructions for use need to specify additional precautions to reduce the HAZARD related to shock and burn from arc flash.

BB.4 Telecommunications networks

The voltages and currents continually present in telecommunications networks are below the levels that could be considered HAZARDOUS LIVE. However, the "ring" voltages (the voltage imposed on the telecommunications line to indicate that the telephone receiver should signal an incoming call) are typically around 90 V a.c., which is considered HAZARDOUS LIVE. If a technician were to come into contact with the relevant conductor while the ring event occurred, then the technician could suffer an electric shock.

EN 41003 addresses safety requirements for equipment to be connected to telecommunications networks. It addresses the possibility of electric shock from contact with telecommunications conductors, and concludes that, with the access limitations imposed by the connectors, the RISK is reduced to a negligible level. However, if in the process of test or measurement, the conductor is made fully ACCESSIBLE, then there is a possibility of electric shock.

The manufacturer of equipment that may be used for testing and measuring of telecommunications networks should be aware of the HAZARD from the ring voltage and should take suitable steps to reduce the HAZARD (where possible by limiting access to the conductors; in other cases, by providing adequate instructions and warnings to the OPERATOR). Also see IEC 61010-031, which specifies barriers for voltage probes that may be used on HAZARDOUS LIVE voltages.

BB.5 Current measurements in inductive circuits

When a current-measuring device is inserted in series with an inductive circuit, a HAZARD may occur if the circuit is suddenly opened (a probe falls off or a fuse opens, for example). Such sudden events can produce an inductive voltage spike across the unintentional opening of the circuit. These spikes can be many times the magnitude of the WORKING VOLTAGE of the circuit, and can cause breakdown of insulation or electric shock to an OPERATOR.

The manufacturer should provide adequate instructions to an OPERATOR to ensure that current-measuring devices are not used in series with inductive circuits, or if it is necessary to do so, then precautions are taken to mitigate the HAZARD of electric shock from the voltage spike.

BB.6 Battery-driven circuits

Batteries can present electrical, explosion and fire HAZARDS to the person conducting tests on them or their associated circuits. Examples include batteries used for stand-by sources or to operate motors.

HAZARDS may arise from electric shock, explosions from short-circuiting the TERMINALS of the battery, or explosions from arc ignition of gases evolved from the battery during charging cycles.

BB.7 Measurements at higher frequencies

Some measuring equipment depends on inductive connection to the circuit being measured. See IEC 61010-2-032 for examples of some current probes that use inductive connections. The behaviour of the measuring circuit will, in these cases, depend on the frequency of the signal being measured. If the measuring device is used to measure a frequency higher than it was designed for, then circulating currents could cause significant heating of some of the conductive parts of the measuring device.

The manufacturer should provide adequate instructions for the use of such devices.

Annex CC
(informative)

4-mm "banana" TERMINALS

CC.1 General

A HAZARD may arise from an OPERATOR's reliance on values displayed by the hand-held multimeter when connectors and TERMINALS appear to be in mated position but conductive parts are not in contact.

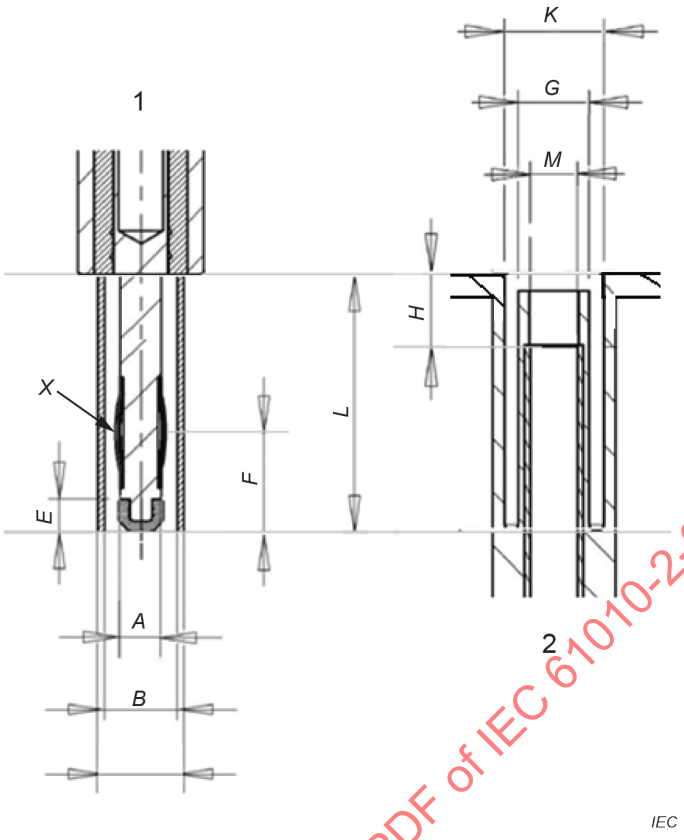
Annex CC gives the recommended dimensions for safety purposes of 4-mm TERMINALS when probe assemblies complying with IEC 61010-031:2015/AMD1:2018, Annex E, can be connected. These 4-mm TERMINALS are often called "banana connectors".

CC.2 Dimensions

The dimensions of Figure CC.1 are compatible with the requirements of TERMINALS RATED for MEASUREMENT CATEGORIES II, III or IV up to 1 000 V.

These dimensions ensure that the CLEARANCES of 6.6.101 are met when the connectors and TERMINALS are mated, unmated or partially mated, and that conductive parts of mated connectors and TERMINALS are in contact.

NOTE Extraction or insertion forces and contact resistance values have not been considered.



Key:

A = 3,90 mm ± 0,05 mm (compressed)	*M* = 4,00 mm + 0,05 mm
B ≥ 6,6 mm	G ≤ 6,4 mm
C ≤ 7,9 mm	*K* ≥ 8,1 mm
2,6 mm ≤ *E* ≤ 6 mm	4 mm ≤ *H* ≤ 6 mm
F ≤ 12 mm	*L* ≥ 20 mm

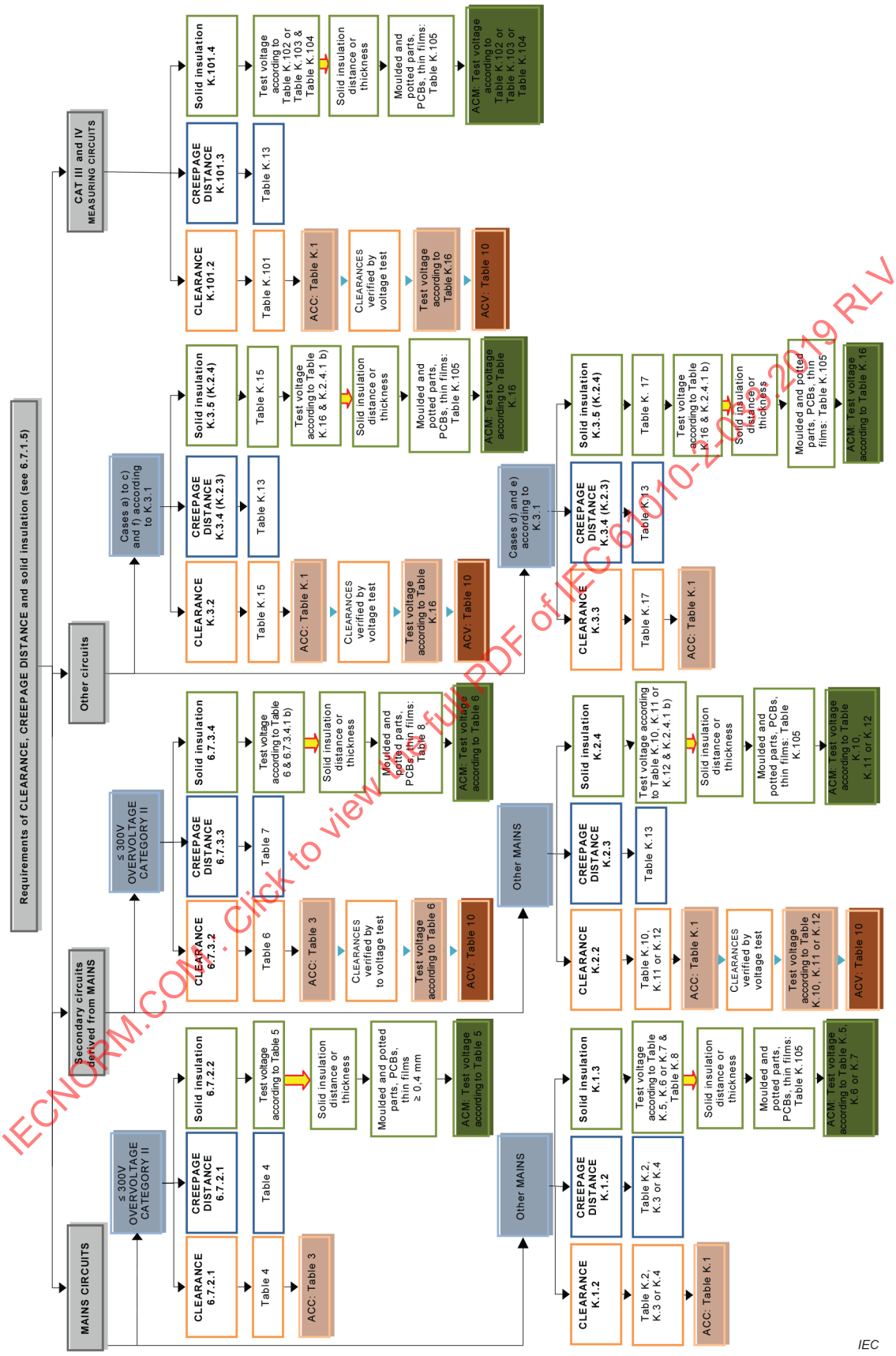
– 1 is a male TERMINAL
– 2 is a female TERMINAL
– X is the point where the best contact occurs
– the minimum value of *E* and *H* depends on whether or not plastic parts are present. CLEARANCES shall be at least 2,6 mm.

Figure CC.1 – Recommended dimensions of 4-mm TERMINALS

Annex DD
(informative)

Flowchart for insulation according to the type of circuit

A circuit can fall under more than one category. It is then necessary to follow two or more branches of the flowchart of Figure DD.1 and compare the results. For example, a measuring circuit can be RATED for MEASUREMENT CATEGORY III and can also be RATED for measuring signals at 1 MHz. This measuring circuit has to be evaluated under both K.3.3 and Clause K.101.



Key

ACC	RATED altitude correction of CLEARANCE
ACV	Site altitude correction of test voltage
&	Both required
ACM	Alternative conformity means
	As applicable
	Optional test path

Figure DD.1 – Requirements for CLEARANCE, CREEPAGE DISTANCE and solid insulation

Bibliography

The Bibliography of Part 1 is applicable except as follows.

Addition:

Add the following references:

IEC 61010-2-034, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-034: Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength*

IEC 61557-1, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance*

IEC 61557-3, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 3: Loop impedance*

IEC 61557-4, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 4: Resistance of earth connection and equipotential bonding*

IEC 61557-5, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 5: Resistance to earth*

IEC 61557-6, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 6: Effectiveness of residual current devices (RCD) in TT, TN and IT systems*

IEC 61557-7, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 7: Phase sequence*

IEC 61557-8, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

IEC 61557-9, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 9: Equipment for insulation fault location in IT systems*

IEC 61557-10, *Electrical safety in low voltage distribution systems up to 1 000 v a.c. and 1 500 v d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 10: Combined measuring equipment for testing, measuring and monitoring of protective measures*

IEC 61557-11, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 11: Effectiveness of residual current monitors (RCMs) type A and type B in TT, TN and IT systems*

IEC 61557-12, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 12: Power metering and monitoring devices (PMD)*

IEC TS 62993:2017, *Guidance for determination of clearances, creepage distances and requirements for solid insulation for equipment with a rated voltage above 1 000 V AC and 1 500 V DC, and up to 2 000 V AC and 3 000 V DC*

EN 41003:1999, *Particular safety requirements for equipment to be connected to telecommunication networks and/or a cable distribution system*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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EXIGENCES DE SÉCURITÉ POUR APPAREILS ÉLECTRIQUES DE MESURAGE, DE RÉGULATION, ET DE LABORATOIRE –

Partie 2-033: Exigences particulières pour les multimètres portatifs pour usage domestique et professionnel, capables de mesurer la tension RESEAU

AVANT-PROPOS

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La Norme internationale IEC 61010-2-033 a été établie par le comité d'études 66 de l'IEC: Sécurité des appareils de mesure, de commande et de laboratoire.

Cette deuxième édition annule et remplace la première édition parue en 2012. Cette édition constitue une révision technique.

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

a) Le domaine d'application a été réduit aux multimètres portatifs. Les voltmètres et les pinces multimétriques ont été supprimés. Ils sont traités respectivement par

l'IEC 61010-2-030 et l'IEC 61010-2-032. Les définitions correspondantes ont été supprimées.

b) Le 4.4.2.101 a été intégré à l'Article 102.

c) Les DISTANCES D'ISOLEMENT et les LIGNES DE FUITE applicables aux EMPLACEMENTS HUMIDES et aux BORNES des circuits de mesure dont la tension alternative est supérieure à 1 000 V ou la tension continue est supérieure à 1 414 V ont été spécifiées.

d) Les exigences pour "Circuits ou composants utilisés comme limiteurs de surtensions dans les circuits de mesure utilisés sur un RESEAU" ont été supprimées. Le paragraphe 14.102 a été renuméroté 14.101.

e) Des références à l'IEC 61010-031 pour les sondes équipées et à l'IEC 61010-2-032 pour les capteurs de courant ont été ajoutées.

f) Des exigences relatives à la protection des circuits de mesure contre les surtensions du RESEAU ont été ajoutées.

g) L'Article 102 a été reformulé.

h) Des exigences concernant les circuits de mesure entre 1 000 V et 3 000 V ont été ajoutées.

i) Une Annexe CC informative relative aux dimensions des BORNES "banane" de 4 mm a été ajoutée.

j) Un organigramme de l'isolation selon le type de circuit a été ajouté dans une nouvelle Annexe DD.

Le texte de cette Norme internationale est basé sur les documents suivants:

FDIS	Rapport de vote
66/692/FDIS	66/694/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 internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61010, publiées sous le titre général *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire*, peut être consultée sur le site web de l'IEC.

La présente Partie 2-033 doit être utilisée conjointement avec la dernière édition de l'IEC 61010-1. Elle a été établie sur la base de la troisième édition (2010) de l'IEC 61010-1 et son Amendement 1 (2016), ci-après dénommé la Partie 1.

La présente Partie 2-033 complète ou modifie les articles correspondants de l'IEC 61010-1 de façon à transformer cette publication en norme IEC: *Exigences particulières pour les multimètres portatifs pour usage domestique et professionnel, capables de mesurer la tension RESEAU.*

Lorsqu'un paragraphe particulier de la Partie 1 n'est pas mentionné dans cette Partie 2-033, ce paragraphe s'applique pour autant que cela soit raisonnable. Lorsque cette Partie 2-033 indique "addition", "modification", "remplacement" ou "suppression", il convient d'adapter en conséquence l'exigence, la modalité d'essai ou la note correspondante de la Partie 1.

Dans la présente norme:

a) les caractères d'imprimerie suivants sont utilisés:

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- NOTES: petits caractères romains;
- *conformité et essais: caractères italiques;*
- termes définis à l'Article 3 et utilisés dans toute cette norme: PETITES CAPITALES EN CARACTERES ROMAINS;

b) les paragraphes, figures, tableaux et notes qui viennent en supplément de ceux de la Partie 1 sont numérotés à partir de 101. Les annexes complémentaires sont numérotées à partir de AA et les listes de termes additionnels à partir de aa).

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INTRODUCTION

La Partie 2-030 spécifie les exigences de sécurité applicables aux appareils équipés de circuits d'essai et de mesure qui sont connectés à des fins d'essai ou de mesurage à des dispositifs ou à des circuits externes à l'appareil de mesure lui-même. Les exigences de la Partie 2-030 ont été incluses dans cette Partie 2-033. Les appareils dans les domaines d'application de la Partie 2-030 et de la Partie 2-033 sont considérés comme étant couverts par les exigences de cette Partie 2-033.

La Partie 2-032 spécifie les exigences de sécurité applicables aux capteurs de courant portatifs et manipulés manuellement. Pour les appareils qui relèvent du domaine d'application de la Partie 2-032 et de la Partie 2-033, seule la Partie 2-032 s'applique.

La Partie 2-034 spécifie les exigences de sécurité applicables aux appareils de mesure de la résistance d'isolement et aux appareils d'essai de rigidité diélectrique qui sont connectés aux unités, aux lignes ou aux circuits à des fins d'essai ou de mesurage. Pour les appareils qui relèvent du domaine d'application de la Partie 2-033 et de la Partie 2-034, seule la Partie 2-034 s'applique.

EXIGENCES DE SÉCURITÉ POUR APPAREILS ÉLECTRIQUES DE MESURAGE, DE RÉGULATION, ET DE LABORATOIRE –

Partie 2-033: Exigences particulières pour les multimètres portatifs pour usage domestique et professionnel, capables de mesurer la tension RESEAU

1 Domaine d'application et objet

L'article de la Partie 1 est applicable avec les exceptions suivantes:

1.1.1 Appareils inclus dans le domaine d'application

Remplacer le texte existant par le suivant:

La présente partie de l'IEC 61010 spécifie les exigences de sécurité applicables aux multimètres portatifs pour usage domestique et professionnel, capables de mesurer la tension RESEAU.

Les multimètres portatifs sont des instruments de mesure multifonctions et avec plusieurs plages, destinés à mesurer la tension et d'autres grandeurs électriques telles que la résistance ou le courant. Ils ont pour objectif principal de mesurer la tension sur un RESEAU sous tension. Ils peuvent être tenus à la main en UTILISATION NORMALE.

1.1.2 Appareils exclus du domaine d'application

Ajouter le nouveau point suivant à la liste ainsi que l'alinéa suivant:

aa) IEC 61557-1 à IEC 61557-12, *Sécurité électrique dans les réseaux de distribution basse tension de 1 000 V c.a. et 1 500 V c.c – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection*

Les APPAREILS PORTATIFS tels que les oscilloscopes, les wattmètres, les multimètres utilisés pour la commande de processus non ASSIGNES pour mesurer la tension sur un RESEAU sous tension, les pinces multimétriques et les équipements d'essais de transmission ne relèvent pas du domaine d'application du présent document.

1.2.1 Aspects inclus dans le domaine d'application

Ajouter les deux nouveaux alinéas suivants à la fin du paragraphe:

Les exigences pour la protection contre les DANGERS résultant d'une UTILISATION NORMALE et d'un MAUVAIS USAGE RAISONNABLEMENT PREVISIBLE de circuits de mesure sont données à l'Article 101.

Les exigences relatives à la confiance dans la valeur affichée sont données à l'Article 102.

2 Références normatives

L'article de la Partie 1 est applicable à l'exception de ce qui suit.

Remplacer "IEC 61010-031" par la nouvelle référence suivante:

IEC 61010-031:2015, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 031: Exigences de sécurité pour sondes équipées tenues à la main pour mesurage et essais électriques*

Remplacer "IEC 61180-1 (toutes les parties)", "IEC 61180-1" et "IEC 61180-2", par la nouvelle référence suivante:

IEC 61180, *Techniques des essais à haute tension pour matériel à basse tension – Définitions, exigences relatives aux essais, matériel d'essai*

Ajouter la nouvelle référence normative suivante:

IEC 61010-2-032, *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-032: Exigences particulières pour les capteurs de courant, portatifs et manipulés manuellement, pour essai électrique et mesurage*

3 Termes et définitions

L'article de la Partie 1 est applicable à l'exception de ce qui suit.

3.5 Termes de sécurité

Remplacer la définition de 3.5.4 par la nouvelle définition suivante:

3.5.4
RESEAU
alimentation électrique

Ajouter la nouvelle définition suivante:

3.5.101
CATEGORIE DE MESURE
classification des circuits d'essai et de mesure selon le type de RESEAU auquel ils sont destinés à être connectés

Note 1 à l'article: Les CATEGORIES DE MESURE tiennent compte des CATEGORIES DE SURTENSION, des niveaux des courants de court-circuit, de l'emplacement de l'installation du bâtiment auquel l'essai ou le mesurage doit être réalisé et de certaines dispositions de limitation de l'énergie ou de protection contre les transitoires de l'installation du bâtiment. Voir l'Annexe AA pour de plus amples informations.

4 Essais

L'article de la Partie 1 est applicable à l'exception de ce qui suit.

4.3.2.5 Alimentation RESEAU

Remplacer le titre et le texte existants par:

4.3.2.5 Alimentation

Les exigences suivantes s'appliquent.

a) La tension d'alimentation RESEAU doit être comprise entre 90 % et 110 % de toute tension d'alimentation ASSIGNEE pour laquelle l'appareil peut être réglé ou, si l'appareil est ASSIGNE pour une fluctuation supérieure, toute tension d'alimentation comprise dans la plage de fluctuation.

b) La fréquence RESEAU doit être toute fréquence ASSIGNEE.

c) Les appareils prévus pour être alimentés en courant alternatif aussi bien qu'en courant continu doivent être connectés à une alimentation en courant alternatif et en courant continu.

d) La polarité de connexion des appareils prévus pour être alimentés par RESEAU en courant alternatif monophasé doit être à tour de rôle normale et inverse.

e) Si les moyens de connexion permettent une inversion, la polarité de connexion des appareils fonctionnant sur accumulateurs ou piles, et en courant continu doit être à tour de rôle inverse et normale.

4.3.2.6 Tensions d'entrée et de sortie

Remplacer le premier alinéa par ce qui suit:

Les tensions d'entrée et de sortie, y compris les potentiels flottants, mais à l'exclusion de la tension d'alimentation RESEAU, doivent être réglées sur toute tension dans la plage ASSIGNEE, dans les polarités normale et inverse, si possible.

5 Marquage et documentation

L'article de la Partie 1 est applicable à l'exception de ce qui suit.

5.1.2 Identification

Ajouter la note suivante après la note existante:

NOTE 101 Certaines réglementations nationales peuvent exiger un marquage pour indiquer le nom et l'édition de la norme utilisée pour l'évaluation de la conformité.

5.1.5 BORNES, connexions et dispositifs de manœuvre

5.1.5.1 Généralités

Remplacer le premier alinéa par ce qui suit:

Si cela est nécessaire pour la sécurité, l'objectif des BORNES, connecteurs, dispositifs de commande et indicateurs doit être indiqué. Lorsqu'il n'y a pas suffisamment d'espace, le symbole 14 du Tableau 1 peut être utilisé.

5.1.5.2 BORNES

Remplacer le point d) existant par le point d) suivant:

d) les BORNES alimentées de l'intérieur du multimètre portatif et qui peuvent être SOUS TENSION DANGEREUSE doivent porter la valeur ou la plage de tension, courant, charge ou énergie, ou le symbole 12 du Tableau 1.

Ajouter le nouvel élément suivant à la liste:

aa) Les BORNES alimentées par d'autres BORNES qui peuvent être SOUS TENSION DANGEREUSE doivent porter le symbole 12 ou 14 du Tableau 1.

Ajouter le nouveau paragraphe suivant:

5.1.5.101 BORNES des circuits de mesure

Le marquage de la valeur de la tension ASSIGNEE par rapport à la terre doit être apposé sur les BORNES des circuits de mesure.

Chaque paire ou jeu de BORNES des circuits de mesure destiné à être utilisé ensemble doit porter le marquage de la valeur de la tension ASSIGNEE ou du courant ASSIGNE applicable à chaque paire ou jeu de BORNES.

Les BORNES des circuits de mesure sont habituellement disposées par paires ou jeux. Chaque paire ou jeu de BORNES peut avoir une tension ASSIGNEE ou un courant ASSIGNE, ou les deux, au sein de ce jeu, et chaque BORNE a individuellement une tension ASSIGNEE par rapport à la terre. Pour certains multimètres portatifs, la tension ASSIGNEE entre les BORNES peut être différente de la tension ASSIGNEE par rapport à la terre. Les marquages doivent être clairs pour éviter toute confusion.

Les BORNES des circuits de mesure assignés pour les mesurages de la tension RESEAU doivent de plus être marquées "CAT III" et/ou "CAT IV" selon le cas. Seuls les marquages sur les BORNES de ces deux types de CATÉGORIES DE MESURE et des tensions ASSIGNÉES par rapport à la terre associées sont admis. Le marquage de la CATÉGORIE DE MESURE II n'est pas autorisé.

Les BORNES des circuits de mesure qui ne sont pas ASSIGNEES pour une connexion à des tensions supérieures aux niveaux définis en 6.3.1 peuvent être marquées au moyen d'autres marquages.

Il n'est pas nécessaire de marquer les BORNES des circuits de mesure destinées uniquement à être connectées à des BORNES spécifiques d'autres appareils, sous réserve qu'il existe un moyen d'identification de ces BORNES.

Les marquages des BORNES doivent être visibles lorsque le multimètre portatif est prêt pour une UTILISATION NORMALE avec couplage des connecteurs et des BORNES, et doivent concerner les BORNES applicables.

La conformité est vérifiée par examen.

5.2 Marquage des avertissements

Remplacer le texte existant par le texte suivant:

Le marquage des avertissements spécifiés dans ce document doit satisfaire aux exigences suivantes.

Le marquage des avertissements doit être visible lorsque le multimètre portatif est prêt pour une UTILISATION NORMALE. Si un avertissement s'applique à une partie particulière du multimètre portatif, il doit être marqué sur celle-ci ou à proximité.

Le marquage des avertissements doit avoir les dimensions suivantes.

a) Les symboles doivent avoir au moins une hauteur de 2,75 mm. Le texte doit avoir au moins une hauteur de 1,5 mm et une couleur contrastée par rapport à la couleur du fond.

b) Les symboles ou les textes moulés, estampés ou gravés dans un matériau doivent avoir au moins une hauteur de 2,0 mm. S'ils ne sont pas contrastés en couleur, ils doivent avoir une profondeur ou une élévation de 0,5 mm au moins.

S'il est nécessaire que l'AUTORITE RESPONSABLE ou l'OPERATEUR se reporte au manuel d'instructions pour disposer de la protection offerte par le multimètre portatif, celui-ci doit porter le marquage du symbole 14 du Tableau 1. L'utilisation du symbole 14 avec d'autres symboles expliqués dans le manuel n'est pas exigée.

Si les instructions d'utilisation indiquent qu'un OPERATEUR est autorisé à avoir accès, en utilisant un OUTIL, à une partie qui peut être SOUS TENSION DANGEREUSE en UTILISATION

NORMALE, un avertissement doit être marqué indiquant que le multimètre portatif doit être isolé ou déconnecté de la TENSION DANGEREUSE avant l'accès.

NOTE Les réglementations nationales peuvent exiger que le marquage de sécurité soit rédigé dans une langue acceptée à l'échelle nationale.

La conformité est vérifiée par examen.

5.4.1 Généralités

Remplacer le premier alinéa par l'alinéa suivant:

La documentation suivante nécessaire à des fins de sécurité selon les besoins de l'OPERATEUR ou de l'AUTORITE RESPONSABLE doit être fournie avec le multimètre portatif dans une langue acceptée par le pays dans lequel le produit est destiné à être mis sur le marché. La documentation de sécurité à l'intention du personnel d'entretien autorisé par le fabricant doit être mise à disposition de celui-ci, dans une langue choisie par le fabricant.

Ajouter les deux nouveaux points suivants à la liste:

aa) la documentation doit indiquer que les sondes équipées à utiliser pour des mesurages de tension RESEAU doivent avoir, selon le cas, une CATEGORIE DE MESURE III ou IV ASSIGNEE conformément à l'IEC 61010-031 et une tension ASSIGNEE au moins égale à la tension du circuit à mesurer;

bb) les informations sur chaque CATEGORIE DE MESURE applicable (voir 5.1.5.101). Si le multimètre portatif comporte plusieurs CATEGORIES DE MESURE ASSIGNEES pour le même circuit de mesure, la documentation doit clairement identifier les CATEGORIES DE MESURE dans lesquelles le multimètre portatif est destiné à être utilisé et celles dans lesquelles il ne doit pas l'être.

6 Protection contre les chocs électriques

L'article de la Partie 1 est applicable à l'exception de ce qui suit.

6.5.1 Généralités

Remplacer le texte, la déclaration de conformité et la Figure 4 par le texte, la déclaration de conformité et la Figure 4 suivants:

Les parties ACCESSIBLES ne doivent pas pouvoir être SOUS TENSION DANGEREUSE en CONDITION DE PREMIER DEFAUT. Les moyens principaux de protection (voir 6.4) doivent être complétés par un des moyens de a) ou b). En variante, l'un des moyens uniques de protection de c) ou d) doit être utilisé. Voir la Figure 4 et l'Annexe DD.

a) ISOLATION SUPPLÉMENTAIRE (voir 6.5.3).

b) Dispositif de limitation du courant ou de la tension (voir 6.5.6)

c) ISOLATION RENFORCÉE (voir 6.5.3).

d) IMPÉDANCE DE PROTECTION (voir 6.5.4).

La conformité est vérifiée par examen et comme cela est spécifié en 6.5.3, 6.5.4, ou 6.5.6 selon le cas.

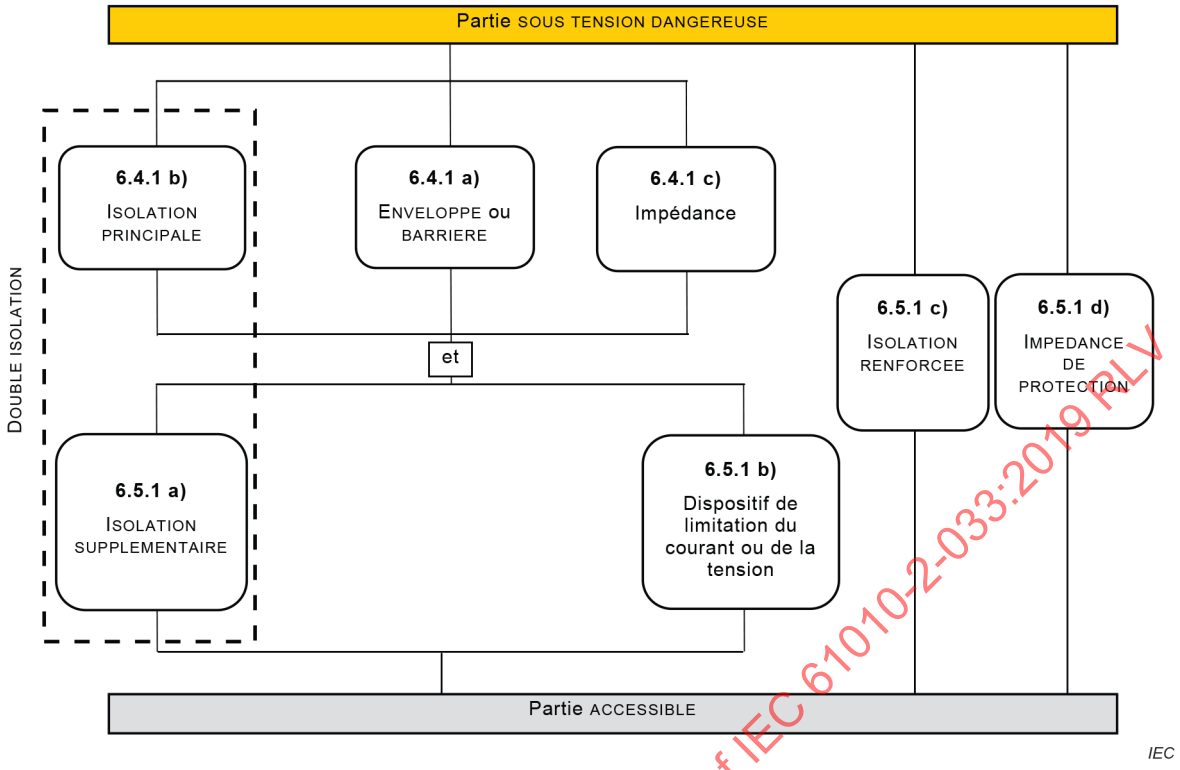

Figure 4 – Agencements acceptables des moyens de protection contre les chocs électriques

6.5.2 LIAISON DE PROTECTION

Remplacer le titre existant de 6.5.2 par le suivant et supprimer le texte:

6.5.2 Non utilisé

6.5.5 Déconnexion automatique de l'alimentation

Remplacer le titre existant de 6.5.5 par le suivant et supprimer le texte:

6.5.5 Non utilisé

6.6 Connexion aux circuits externes

Ajouter les deux nouveaux paragraphes suivants:

6.6.101 BORNES des circuits de mesure

Les parties conductrices de chaque BORNE non couplée d'un circuit de mesure qui peuvent devenir SOUS TENSION DANGEREUSE lorsque la tension ASSIGNEE la plus élevée est appliquée aux autres BORNES du circuit de mesure du multimètre portatif doivent être séparées:

a) de la partie la plus proche du doigt d'épreuve touchant les parties extérieures de la BORNE dans la position la plus défavorable, par au moins la DISTANCE D'ISOLEMENT et la LIGNE DE FUITE applicables du Tableau 101 pour les BORNES ayant une tension ASSIGNEE qui peut atteindre 1 000 V en courant alternatif ou 1 500 V en courant continu (voir Figure 1);

b) de la partie la plus proche du doigt d'épreuve touchant les parties extérieures de la BORNE dans la position la plus défavorable, par au moins 2,8 mm pour la DISTANCE D'ISOLEMENT et la LIGNE DE FUITE pour les BORNES ayant une tension ASSIGNEE supérieure à 1 000 V en courant alternatif ou 1 500 V en courant continu. Ces BORNES doivent également résister à l'essai en tension de 6.8 avec une tension d'essai égale à la tension ASSIGNEE de la BORNE

multipliée par 1,25 et appliquée entre la partie la plus proche du doigt d'épreuve touchant les parties extérieures de la BORNE dans la position la plus défavorable et les BORNES du circuit de mesure.

EXEMPLE Pour une tension alternative assignée de 4 000 V (valeur efficace), la tension d'essai alternative est de 5 000 V (valeur efficace) (valeur crête de 7 070 V). La DISTANCE D'ISOLEMENT calculée est de 13,1 mm selon D_2 du Tableau K.15. Pour les champs homogènes, une DISTANCE D'ISOLEMENT moins élevée peut être obtenue au moyen d'essais (voir l'IEC 60664-1 pour de plus amples informations sur les champs homogènes).

Tableau 101 – DISTANCES D'ISOLEMENT et LIGNES DE FUITE des BORNES d'un circuit de mesure ayant des parties conductrices SOUS TENSION DANGEREUSE qui peuvent atteindre 1 000 V en courant alternatif ou 1 500 V en courant continu

Tension des parties conductrices de la BORNE V en courant alternatif (valeur efficace) et V en courant continu	**DISTANCE D'ISOLEMENT et LIGNE DE FUITE** mm
≥ 30 ≤ 300	0,8
> 300 ≤ 600	1,0
> 600 ≤ 1 000	2,6
> 1 000 ≤ 1 500 [a]	2,8
[a] Pour la tension continue uniquement.	

L'Annexe CC fournit des informations concernant les dimensions recommandées des BORNES "banane" de 4 mm.

La conformité est vérifiée par examen, par la détermination des parties ACCESSIBLES, et par mesurage des DISTANCES D'ISOLEMENT et LIGNES DE FUITE applicables, et le cas échéant, par l'essai en tension de 6.8.

6.6.102 BORNES spécialisées des circuits de mesure

Les composants, les capteurs et les dispositifs prévus pour être connectés à des BORNES spécialisées des circuits de mesure ne doivent pas être à la fois ACCESSIBLES et SOUS TENSION DANGEREUSE, que ce soit en CONDITION NORMALE ou en CONDITION DE PREMIER DEFAUT, même lorsque la tension ASSIGNEE la plus élevée est appliquée à toute autre BORNE du circuit de mesure.

NOTE Ces BORNES spécialisées incluent entre autres les BORNES de mesure de semiconducteurs, de condensateurs et les connecteurs de thermocouple.

La conformité est vérifiée par examen et mesurage. Les composants, capteurs et dispositifs prévus pour être connectés aux BORNES spécialisées d'un circuit de mesure sont connectés. Les mesurages de 6.3 sont effectués afin de garantir que les niveaux de 6.3.1 et de 6.3.2 ne sont pas dépassés lorsque chacune des tensions suivantes est appliquée à chaque BORNE du circuit de mesure, le cas échéant:

a) la tension alternative ASSIGNEE la plus élevée à toute fréquence RESEAU ASSIGNEE;

b) la tension continue ASSIGNEE la plus élevée;

c) la tension alternative ASSIGNEE la plus élevée à la fréquence de mesure maximale ASSIGNEE associée.

6.7.1.3 LIGNES DE FUITE

Ajouter les deux nouveaux alinéas suivants après le troisième alinéa:

Pour les multimètres portatifs non alimentés par le RESEAU ou le circuit de mesure, il est admis d'utiliser les LIGNES DE FUITE conformes au groupe de matériaux I pour les autres matériaux.

Pour les BORNES des multimètres portatifs prévus pour être connectés uniquement à une sonde équipée manuelle conforme à la Partie 031, il est admis d'utiliser les LIGNES DE FUITE conformes au groupe de matériaux I pour l'isolation des BORNES.

6.7.1.5 Exigences pour l'isolation suivant le type de circuit

Remplacer le texte existant par le suivant:

Les exigences pour l'isolation de types particuliers de circuits sont spécifiées comme suit:

a) en 6.7.2 pour les CIRCUITS RESEAU en CATEGORIE DE SURTENSION II avec une tension d'alimentation nominale jusqu'à 300 V;

NOTE 1 Voir l'Annexe I pour les tensions nominales des RESEAUX de distribution.

b) En 6.7.3 pour les circuits secondaires séparés des circuits du a) au moyen seulement d'un transformateur;

c) à l'Article K.1 pour les CIRCUITS RESEAU en CATEGORIE DE SURTENSION III ou IV ou en CATEGORIE DE SURTENSION II au-delà de 300 V;

d) à l'Article K.2 pour les circuits secondaires séparés des circuits du c) au moyen seulement d'un transformateur;

e) à l'Article K.3 pour les circuits ayant une ou plusieurs des caractéristiques suivantes:

1) la SURTENSION TRANSITOIRE maximale possible est supérieure aux valeurs prises par hypothèse pour le CIRCUIT RESEAU;
2) la TENSION DE SERVICE est la somme des tensions de plusieurs circuits, ou est une tension mixte;
3) la TENSION DE SERVICE comporte une tension de crête répétitive qui peut comprendre une forme d'onde périodique non sinusoïdale ou une forme d'onde non périodique survenant régulièrement;
4) la TENSION DE SERVICE a une fréquence supérieure à 30 KHz;
5) le circuit est un circuit de mesure pour lequel les CATEGORIES DE MESURE ne s'appliquent pas;

f) à l'Article K.101 pour les circuits de mesure dont les CATEGORIES DE MESURE III et IV sont des CARACTERISTIQUES ASSIGNEES.

NOTE 2 Ces exigences sont représentées dans l'organigramme de l'Annexe DD, Figure DD.1.

Le niveau de SURTENSION TRANSITOIRE pour le RESEAU correspond à la valeur spécifiée de "tension ASSIGNEE de tenue aux chocs exigée des équipements" du Tableau 443.2 de l'IEC 60364-4-44:2007/AMD1:2015.

6.8.3.1 Essai en tension alternative

Remplacer la première phrase par la phrase suivante:

Le générateur de tension doit pouvoir maintenir la tension d'essai à ±5 % de la valeur spécifiée tout au long de l'essai.

6.9 Exigences relatives à la construction pour la protection contre les chocs électriques

Ajouter le nouveau paragraphe suivant:

6.9.101 Caractéristiques assignées des multimètres portatifs

Les BORNES des circuits de mesure destinés aux mesurages de la tension RESEAU doivent être ASSIGNEES pour une tension alternative (valeur efficace) minimale de 300 V par rapport à la terre et une CATEGORIE DE MESURE minimale de III.

La tension ASSIGNEE des BORNES d'un circuit de mesure destiné aux mesurages de la tension RESEAU doit être supérieure ou égale à leur tension ASSIGNEE par rapport à la terre.

NOTE Ces BORNES peuvent également avoir d'autres CARACTERISTIQUES ASSIGNEES pour d'autres fonctions.

La conformité est vérifiée par examen.

7 Protection contre les DANGERS mécaniques

L'article de la Partie 1 est applicable.

8 Résistance aux contraintes mécaniques

L'article de la Partie 1 est applicable.

9 Protection contre la propagation du feu

L'article de la Partie 1 est applicable.

10 Limites de température de l'appareil et résistance à la chaleur

L'article de la Partie 1 est applicable.

11 Protection contre les DANGERS des fluides et des corps solides étrangers

L'article de la Partie 1 est applicable.

12 Protection contre les radiations, y compris les sources laser, et contre la pression acoustique et ultrasonique

L'article de la Partie 1 est applicable.

13 Protection contre les émissions de gaz et substances, les explosions et les implosions

L'article de la Partie 1 est applicable.

14 Composants et sous-ensembles

L'article de la Partie 1 est applicable à l'exception de ce qui suit.

14.8 Circuits utilisés pour limiter les SURTENSIONS TRANSITOIRES

Remplacer le titre existant de 14.8 par le suivant et supprimer le texte:

14.8 Non utilisé

Ajouter le nouveau paragraphe suivant:

14.101 Sondes équipées et accessoires

Les sondes équipées et les accessoires relevant du domaine d'application de l'IEC 61010-031 et les capteurs de courant relevant du domaine d'application de l'IEC 61010-2-032, doivent satisfaire aux exigences applicables de ces normes.

Au moins un ensemble de cordons d'essai fourni avec le multimètre portatif doit être ASSIGNE conformément à l'IEC 61010-031 pour au moins la tension et la CATEGORIE DE MESURE les plus élevées du multimètre portatif.

La conformité est vérifiée par examen.

15 Protection par systèmes de verrouillage

L'article de la Partie 1 est applicable.

16 DANGERS résultant de l'application

L'article de la Partie 1 est applicable.

17 Appréciation du RISQUE

L'article de la Partie 1 est applicable.

Ajouter les nouveaux Articles 101 et 102 suivants:

101 Circuits de mesure

101.1 Généralités

Le multimètre portatif doit assurer une protection contre les DANGERS résultant de l'UTILISATION NORMALE et du MAUVAIS USAGE RAISONNABLEMENT PREVISIBLE des circuits de mesure, comme indiqué ci-dessous.

a) Un circuit de mesure de courant ne doit pas interrompre le circuit mesuré en cas de modification de calibre ou lors de l'utilisation de transformateurs de courant sans protection interne, si cela peut provoquer un DANGER (voir 101.2).

b) Une grandeur électrique conforme aux spécifications de toute BORNE ne doit pas provoquer de DANGER quand elle est appliquée à cette BORNE ou à toute autre BORNE compatible, pour tous les réglages possibles des fonctions et calibres (voir 101.3).

c) Tout raccordement entre le multimètre portatif et d'autres dispositifs ou accessoires prévus pour être utilisés avec le multimètre portatif ne doit pas provoquer de DANGER même si le marquage ou la documentation interdit le raccordement alors que le multimètre est utilisé à des fins de mesurage (voir 6.6).

d) Les autres DANGERS susceptibles de résulter d'un MAUVAIS USAGE RAISONNABLEMENT PREVISIBLE doivent être traités par une appréciation du RISQUE (voir les Articles 16 et 17).

e) Une SURTENSION TEMPORAIRE ou une SURTENSION TRANSITOIRE appliquée sur les BORNES des circuits de mesure dans la fonction de mesure de tension ne doit pas provoquer de DANGER (voir 101.4).

La conformité est vérifiée comme cela est spécifié en 6.6, à l'Article 16 et à l'Article 17, 101.2, 101.3 et 101.4 selon le cas.

101.2 Circuits de mesure de courant

Les circuits de mesure de courant doivent être conçus de telle façon que, lors de la modification du calibre, il n'y ait pas d'ouverture qui puisse provoquer un DANGER.

La conformité est vérifiée par examen et, en cas de doute, par un essai de 6 000 commutations du dispositif pour le courant maximal ASSIGNE.

Les circuits de mesure de courant destinés à être connectés à des transformateurs de courant sans protection interne doivent être protégés de façon satisfaisante pour éviter tout DANGER provoqué par l'ouverture de ces circuits pendant le fonctionnement.

La conformité est vérifiée par un essai de surcharge basé sur 10 fois le courant maximal ASSIGNE pendant 1 s et, le cas échéant, par un essai de 6 000 commutations du multimètre portatif pour le courant maximal ASSIGNE. Aucune ouverture susceptible de provoquer un DANGER ne doit se produire pendant les essais.

101.3 Protection contre l'inadéquation des entrées et des calibres

101.3.1 Généralités

En CONDITION NORMALE et en cas de MAUVAIS USAGE RAISONNABLEMENT PREVISIBLE, aucun DANGER ne doit survenir lorsque la tension ASSIGNEE la plus élevée ou le courant assigné le plus élevé d'une BORNE de circuit de mesure est appliqué(e) à cette BORNE ou à toute autre BORNE compatible, pour tous les réglages possibles des fonctions et calibres.

NOTE L'inadéquation des entrées et des calibres constitue un exemple de MAUVAIS USAGE RAISONNABLEMENT PREVISIBLE, même si la documentation ou les marquages interdisent une telle inadéquation. Un exemple typique est la connexion par inadvertance d'une tension élevée à une entrée prévue pour des mesures du courant ou de la résistance. Les DANGERS possibles comprennent les chocs électriques, les brûlures, le feu, l'apparition d'un arc et les explosions.

Il n'est pas nécessaire de soumettre à l'essai les BORNES qui sont manifestement de types différents et qui ne correspondent pas aux connecteurs de la sonde ou de l'accessoire et il n'est pas nécessaire que les BORNES ACCESSIBLES uniquement à l'aide d'un OUTIL satisfassent à l'exigence de 101.3.1.

Le multimètre portatif doit assurer une protection contre ces DANGERS. Une des méthodes suivantes doit être utilisée.

a) Utilisation d'un dispositif certifié de protection contre les surintensités afin de couper les courants de court-circuit avant qu'un DANGER ne survienne. Dans ce cas, les exigences et les essais de 101.3.2 s'appliquent.

b) Utilisation d'un dispositif de limitation du courant non certifié, d'une impédance, ou d'une combinaison de ces deux dispositifs pour empêcher la survenue d'un DANGER. Dans ce cas, les exigences et les essais de 101.3.3 s'appliquent.

La conformité est vérifiée par examen, par évaluation de la conception du multimètre portatif et comme cela est spécifié en 101.3.2 et 101.3.3, selon le cas.

101.3.2 Protection par un dispositif certifié de protection contre les surintensités

Un dispositif de protection contre les surintensités est considéré comme approprié s'il est certifié par un laboratoire indépendant et si toutes les exigences suivantes sont satisfaites.

a) Les tensions alternatives et continues ASSIGNEES du dispositif de protection contre les surintensités doivent être au moins aussi élevées que, respectivement, les tensions