



IEC 61010-031

Edition 2.1 2018-05  
CONSOLIDATED VERSION

# INTERNATIONAL STANDARD



GROUP SAFETY PUBLICATION

**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 measurement and test and measurement**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 19.080

ISBN 978-2-8322-5773-9

**Warning! Make sure that you obtained this publication from an authorized distributor.**

# REDLINE VERSION



GROUP SAFETY PUBLICATION

**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 **measurement and** test and measurement**

## CONTENTS

FOREWORD.....	7
1 Scope and object.....	10
1.1 Scope .....	10
1.1.1 Probe assemblies included in scope .....	10
1.1.2 Probe assemblies excluded from scope .....	13
1.2 Object.....	13
1.2.1 Aspects included in scope .....	13
1.2.2 Aspects excluded from scope .....	13
1.3 Verification.....	13
1.4 Environmental conditions .....	13
1.4.1 Normal environmental conditions .....	13
1.4.2 Extended environmental conditions .....	13
2 Normative references .....	14
3 Terms and definitions .....	14
3.1 Parts and accessories.....	14
3.2 Quantities .....	15
3.3 Tests .....	16
3.4 Safety terms .....	16
3.5 Insulation .....	17
4 Tests .....	18
4.1 General.....	18
4.2 Sequence of tests .....	19
4.3 Reference test conditions.....	19
4.3.1 Environmental conditions.....	19
4.3.2 State of probe assemblies.....	19
4.3.3 Position of the probe assembly .....	19
4.3.4 Accessories .....	20
4.3.5 Covers and removable parts .....	20
4.3.6 Input and output voltages .....	20
4.3.7 Controls.....	20
4.3.8 Connections .....	20
4.3.9 <b>Duty cycle</b> Short-term or intermittent operation .....	20
4.4 Testing in SINGLE FAULT CONDITION.....	20
4.4.1 General .....	20
4.4.2 Application of fault conditions .....	20
4.4.3 Duration of tests .....	21
4.4.4 Conformity after application of fault conditions.....	21
4.5 Tests in REASONABLY FORESEEABLE MISUSE .....	22
4.5.1 General .....	22
4.5.2 Fuses .....	22
5 Marking and documentation.....	22
5.1 Marking.....	22
5.1.1 General .....	22
5.1.2 Identification .....	23
5.1.3 Fuses .....	23
5.1.4 CONNECTORS and operating devices.....	24

5.1.5	RATING .....	24
5.2	Warning markings .....	24
5.3	Durability of markings .....	24
5.4	Documentation.....	25
5.4.1	General .....	25
5.4.2	Probe assembly RATING .....	25
5.4.3	Probe assembly operation .....	25
5.4.4	Probe assembly maintenance and service .....	26
6	Protection against electric shock .....	26
6.1	General.....	26
6.2	Determination of ACCESSIBLE parts .....	27
6.2.1	General .....	27
6.2.2	Examination.....	27
6.2.3	Openings for pre-set controls.....	29
6.3	Limit values for ACCESSIBLE parts .....	29
6.3.1	General .....	29
6.3.2	Levels in NORMAL CONDITION.....	29
6.3.3	Levels in SINGLE FAULT CONDITION.....	29
6.3.4	Measurement of voltage and touch current .....	32
6.4	Means of protection against electric shock .....	35
6.4.1	General .....	35
6.4.2	CONNECTORS.....	36
6.4.3	PROBE TIPS.....	37
6.4.4	Impedance.....	39
6.4.5	PROTECTIVE IMPEDANCE .....	39
6.4.6	BASIC INSULATION, SUPPLEMENTARY INSULATION, DOUBLE INSULATION and REINFORCED INSULATION .....	40
6.5	Insulation requirements.....	40
6.5.1	The nature of insulation .....	40
6.5.2	Insulation requirements for probe assemblies .....	46
6.6	Procedure for voltage tests .....	57
6.6.1	General .....	57
6.6.2	Humidity preconditioning .....	57
6.6.3	Conduct of tests .....	58
6.6.4	Test voltages.....	58
6.6.5	Test procedures.....	60
6.7	Constructional requirements for protection against electric shock .....	61
6.7.1	General .....	61
6.7.2	Insulating materials .....	61
6.7.3	ENCLOSURES of probe assemblies with DOUBLE INSULATION or REINFORCED INSULATION .....	61
6.7.4	PROBE WIRE attachment .....	61
7	Protection against mechanical HAZARDS.....	65
8	Resistance to mechanical stresses .....	65
8.1	General.....	65
8.2	Rigidity test.....	66
8.3	Drop test.....	66
8.4	Impact swing test.....	66
9	Temperature limits and protection against the spread of fire .....	67

9.1	General.....	67
9.2	Temperature tests.....	68
10	Resistance to heat.....	68
10.1	Integrity of SPACINGS.....	68
10.2	Resistance to heat.....	68
11	Protection against HAZARDS from fluids.....	68
11.1	General.....	68
11.2	Cleaning.....	69
11.3	Specially protected probe assemblies.....	69
12	Components.....	69
12.1	General.....	69
12.2	Fuses.....	69
12.3	PROBE WIRE.....	70
12.3.1	General.....	70
12.3.2	RATING of PROBE WIRE.....	70
12.3.3	Pressure test at high temperature for insulations.....	70
12.3.4	Tests for resistance of insulation to cracking.....	72
12.3.5	Voltage test.....	73
12.3.6	Tensile test.....	73
13	Prevention of HAZARD from arc flash and short-circuits.....	75
13.1	General.....	75
13.2	Exposed conductive parts.....	75
	Bibliography.....	96
	Annex A (normative) Measuring circuits for touch current (see 6.3).....	77
A.1	Measuring circuits for a.c. with frequencies up to 1 MHz and for d.c. ....	77
A.2	Measuring circuits for a.c. with sinusoidal frequencies up to 100 Hz and for d.c. ....	77
A.3	Current measuring circuit for electrical burns at frequencies above 100 kHz.....	78
A.4	Current measuring circuit for WET LOCATIONS.....	79
	Annex B (normative) Standard test fingers.....	81
	Annex C (normative) Measurement of CLEARANCES and CREEPAGE DISTANCES.....	84
	Annex D (normative) Routine spark tests on PROBE WIRE.....	86
D.1	General.....	86
D.2	Spark test procedure.....	86
D.3	Routine spark test method for PROBE WIRE.....	88
	Annex E (informative) 4 mm CONNECTORS.....	90
E.1	General.....	90
E.2	Dimensions.....	90
	Annex F (normative) MEASUREMENT CATEGORIES.....	93
F.1	General.....	93
F.2	MEASUREMENT CATEGORIES.....	93
F.2.1	MEASUREMENT CATEGORY II.....	93
F.2.2	MEASUREMENT CATEGORY III.....	93
F.2.3	MEASUREMENT CATEGORY IV.....	93
F.2.4	Probe assemblies without a MEASUREMENT CATEGORY RATING.....	94
	Annex G Index of defined terms.....	95

Figure 1 – Examples of type A probe assemblies .....	11
Figure 2 – Examples of type B probe assemblies .....	11
Figure 3 – Examples of type C probe assemblies .....	12
Figure 4 – Examples of type D probe assemblies .....	12
Figure 5 – Example of a STACKABLE CONNECTOR with a male CONNECTOR and a female TERMINAL .....	15
Figure 6 – Methods for determination of ACCESSIBLE parts (see 6.2) and for voltage tests of (see 6.4.2) .....	28
Figure 7 – Capacitance level versus voltage in NORMAL CONDITION and SINGLE-FAULT CONDITION (see 6.3.2 c) and 6.3.3 c)) .....	31
Figure 8 – Voltage and touch current measurement .....	32
Figure 9 – Voltage and touch current measurement for the reference CONNECTOR .....	33
Figure 10 – Voltage and touch current measurement with shielded test probe .....	34
Figure 11 – Maximum test probe input voltage for 70 mA touch current .....	35
Figure 12 – Protection by a PROTECTIVE FINGERGUARD .....	38
Figure 13 – Protection by distance .....	38
Figure 14 – Protection by tactile indicator .....	39
Figure 15 – Distance between conductors on an interface between two layers .....	54
Figure 16 – Distance between adjacent conductors along an interface of two layers .....	54
Figure 17 – Distance between adjacent conductors located between the same two layers .....	56
Figure 18 – Example of recurring peak voltage .....	49
Figure 19 – Flexing test .....	63
Figure 20 – Rotational flexing test .....	65
Figure 21 – Impact swing test .....	67
Figure 22 – Indentation device .....	71
Figure A.1 – Measuring circuit for a.c. with frequencies up to 1 MHz and for d.c. ....	77
Figure A.2 – Measuring circuits for a.c. with sinusoidal frequencies up to 100 Hz and for d.c. ....	78
Figure A.3 – Current measuring circuit for electrical burns .....	79
Figure A.4 – Current measuring circuit for high frequency test probes .....	79
Figure A.5 – Current measuring circuit for WET LOCATIONS .....	80
Figure B.1 – Rigid test finger .....	81
Figure B.2 – Jointed test finger .....	82
Figure D.1 – Bead Chain Configuration (if applicable) .....	87
Figure E.1 – Recommended dimensions of 4 mm CONNECTORS .....	91
Figure F.1 – Example to identify the locations of MEASUREMENT CATEGORIES .....	94
Table 1 – Symbols .....	23
Table 2 – SPACINGS for unmated CONNECTORS RATED up to 1 000 V a.c. or 1 500 V d.c. with HAZARDOUS LIVE conductive parts .....	37
Table 3 – Multiplication factors for CLEARANCES of probe assembly RATED for operation at altitudes up to 5 000 m .....	41
<del>Table 4 – Test voltages for testing solid insulation .....</del>	<del>.....</del>
Table 4 – a.c. test voltages for testing electric strength of solid insulation in probe assemblies RATED for MEASUREMENT CATEGORIES .....	52

Table 5 – Minimum values for distance or thickness.....	55
Table 6 – CLEARANCES <del>for</del> of probe assemblies <del>RATED-of</del> for MEASUREMENT CATEGORIES <del>II, III and IV</del> .....	46
Table 7 – CLEARANCE values for the calculation of 6.5.2.3.2.....	48
Table 8 – CLEARANCES for BASIC INSULATION in probe assemblies subjected to recurring peak voltages or WORKING VOLTAGES with frequencies above 30 kHz.....	50
Table 9 – CREEPAGE DISTANCES for BASIC INSULATION or SUPPLEMENTARY INSULATION.....	51
Table 10 – Test voltages based on CLEARANCES.....	59
Table 11 – Correction factors according to test site altitude for test voltages for CLEARANCES.....	60
Table 12 – Pull forces for PROBE WIRE attachment tests.....	64
Table 13 – Diameter of mandrel and numbers of turns.....	72
Table 14 – Impulse test voltages for testing electric strength of solid insulation in probe assemblies RATED for MEASUREMENT CATEGORIES.....	53
Table C.1 – Dimension of X.....	84
Table D.1 – Maximum centre-to-centre spacings of bead chains.....	86
Table D.2 – Formula for maximum speed of wire in terms of electrode length $L$ of link- or bead-chain electrode.....	88
Table F.1 – Characteristics of MEASUREMENT CATEGORIES.....	94

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **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 ~~measurement and~~ test and measurement**

### 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 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.

**This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.**

**IEC 61010-031 edition 2.1 contains the second edition (2015-05) [documents 66/569/FDIS and 66/571/RVD] and its amendment 1 (2018-05) [documents 66/664/FDIS and 66/670/RVD].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.**

International Standard IEC 61010-031 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

It has the status of a group safety publication in accordance with IEC GUIDE 104.

IEC 61010-031 is a stand-alone standard. This edition constitutes a technical revision.

This edition includes the following significant changes from the first edition, as well as numerous other changes:

- a) Voltages above the levels of 30 V r.m.s., 42,4 V peak, or 60 V d.c. are deemed to be HAZARDOUS LIVE instead of 33 V r.m.s., 46,7 V peak, or 70 V d.c.
- b) Servicing is now included within the scope.
- c) Extended environmental conditions are included within the scope.
- d) New terms have been defined.
- e) Tests for REASONABLY FORESEEABLE MISUSE have been added, in particular for fuses.
- f) Additional instruction requirements for probe assembly operation have been specified.
- g) Limit values for ACCESSIBLE parts and for measurement of voltage and touch current have been modified.
- h) SPACINGS requirements for mating of CONNECTORS have been modified.
- i) PROBE TIPS and SPRING-LOADED CLIPS requirements have been modified. The PROTECTIVE FINGERGUARD replace the BARRIER with new requirements.
- j) Insulation requirements (6.5) and test procedures (6.6.5) have been rewritten and aligned when relevant with Part 1. Specific requirements have been added for solid insulation and thin-film insulation.
- k) The terminology for MEASUREMENT CATEGORY I has been replaced with the designation “not RATED for measurements within MEASUREMENT CATEGORIES II, III, or IV”.
- l) The flexing/pull test (6.7.4.3) has been partially rewritten.
- m) Surface temperature limits (Clause 10) have been modified to conform to the limits of IEC Guide 117.
- n) Requirements for resistance of PROBE WIRES to mechanical stresses have been added in Clause 12 and a new Annex D.
- o) Requirements have been added regarding the prevention of HAZARD from arc flash and short-circuits for SPRING-LOADED CLIPS.
- p) A new informative Annex E defines the dimension of the 4 mm banana CONNECTORS.

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

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

In this standard, the following print types are used:

- requirements and definitions: in roman type;
- NOTES and EXAMPLES: in smaller roman type;
- *conformity and tests: in italic type;*

- terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS.

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

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

The contents of the corrigendum of August 2018 have been included in this copy.

**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.**

## 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 ~~measurement and~~ test and measurement

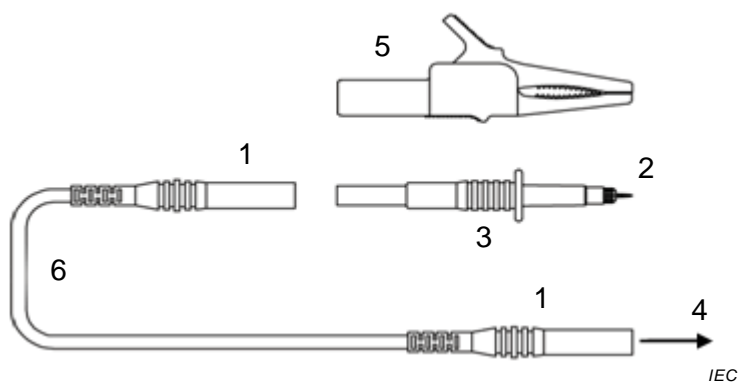
#### 1 Scope and object

##### 1.1 Scope

##### 1.1.1 Probe assemblies included in scope

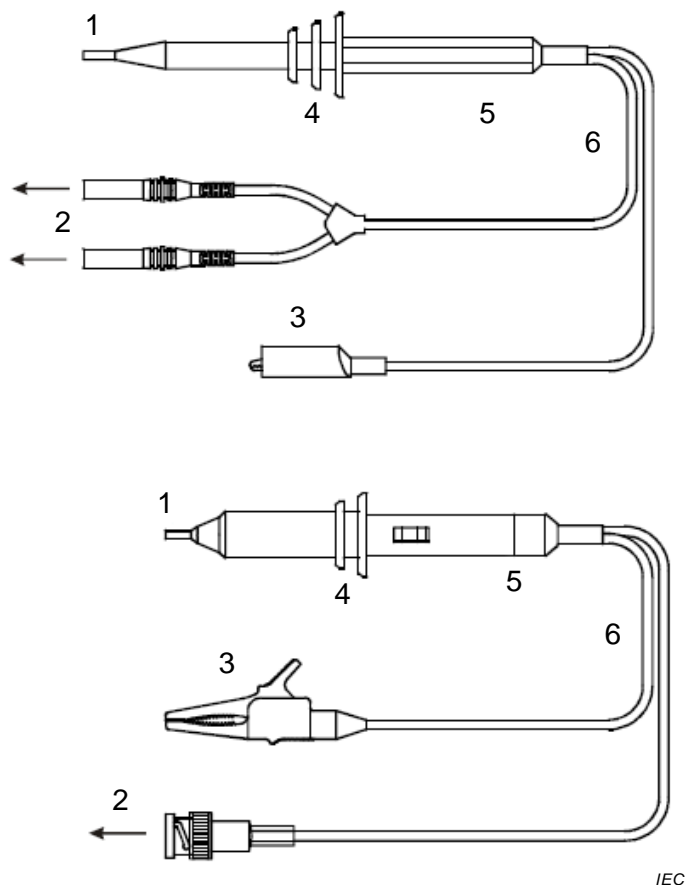
This part of IEC 61010 specifies safety requirements for hand-held and hand-manipulated probe assemblies of the types described below, and their related accessories. These probe assemblies are for direct electrical connection between a part and electrical test and measurement equipment. They may be fixed to the equipment or be detachable accessories for the equipment.

- a) Type A: low-voltage and high-voltage, non-attenuating probe assemblies. Non-attenuating probe assemblies that are RATED for direct connection to voltages exceeding 30 V r.m.s., 42,4 V peak, or 60 V d.c., but not exceeding 63 kV. They do not incorporate components which are intended to provide a voltage divider function or a signal conditioning function, but they may contain non-attenuating components such as fuses (see Figure 1.)
- b) Type B: high-voltage attenuating or divider probe assemblies. Attenuating or divider probe assemblies that are RATED for direct connection to secondary voltages exceeding 1 kV r.m.s. or 1,5 kV d.c. but not exceeding 63 kV r.m.s. or d.c. The divider function may be carried out wholly within the probe assembly, or partly within the test or measurement equipment to be used with the probe assembly (see Figure 2).
- c) Type C: low-voltage attenuating or divider probe assemblies. Attenuating or divider probe assemblies for direct connection to voltages not exceeding 1 kV r.m.s. or 1,5 kV d.c. The signal conditioning function may be carried out wholly within the probe assembly, or partly within the test or measurement equipment intended to be used with the probe assembly (see Figure 3).
- d) Type D: low-voltage attenuating, non-attenuating or other signal conditioning probe assemblies, that are RATED for direct connection only to voltages not exceeding 30 V r.m.s., or 42,4 V peak, or 60 V d.c., and are suitable for currents exceeding 8 A (see Figure 4).



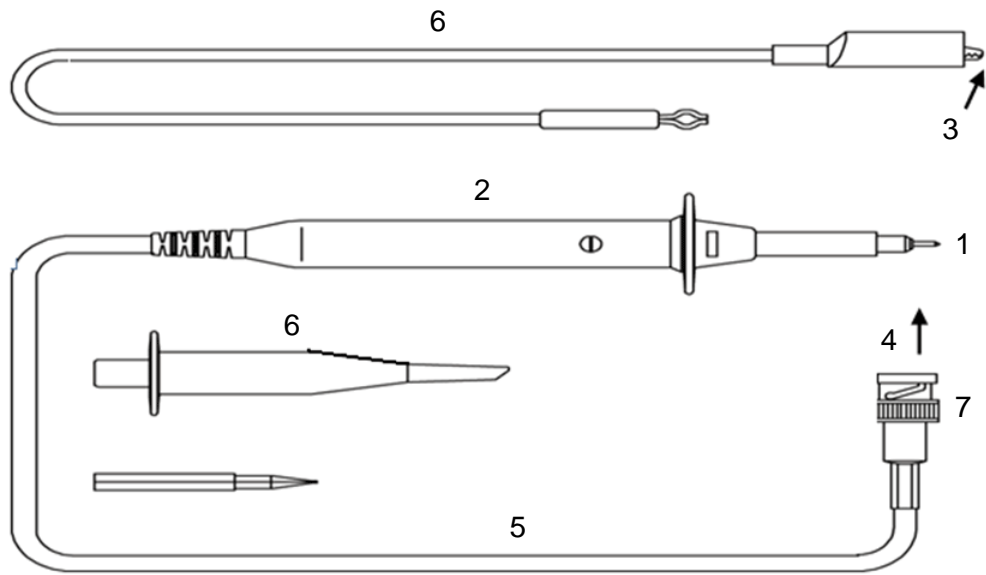
- Key**
- |                      |                      |
|----------------------|----------------------|
| 1 typical CONNECTORS | 4 to equipment       |
| 2 PROBE TIP          | 5 SPRING-LOADED CLIP |
| 3 probe body         | 6 PROBE WIRE         |

**Figure 1 – Examples of type A probe assemblies**



- Key**
- |                       |                                |
|-----------------------|--------------------------------|
| 1 PROBE TIP           | 4 PROTECTIVE FINGERGARD        |
| 2 to equipment        | 5 hand-held area of probe body |
| 3 reference CONNECTOR | 6 PROBE WIRE                   |

**Figure 2 – Examples of type B probe assemblies**

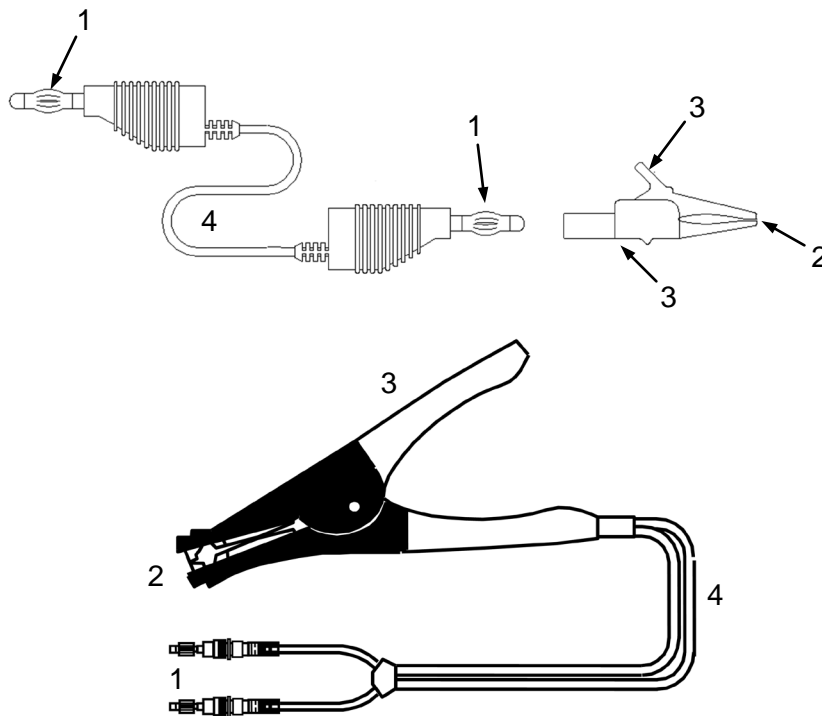


IEC

**Key**

- |                       |                           |
|-----------------------|---------------------------|
| 1 PROBE TIP           | 5 PROBE WIRE              |
| 2 probe body          | 6 examples of accessories |
| 3 reference CONNECTOR | 7 BNC CONNECTOR           |
| 4 to equipment        |                           |

**Figure 3 – Examples of type C probe assemblies**



IEC

**Key**

- |             |                                                 |
|-------------|-------------------------------------------------|
| 1 CONNECTOR | 3 hand-held area of SPRING-LOADED CLIP-or-clamp |
| 2 PROBE TIP | 4 PROBE WIRE                                    |

**Figure 4 – Examples of type D probe assemblies**

### **1.1.2 Probe assemblies excluded from scope**

This standard does not apply to current sensors within the scope of IEC 61010-2-032 (Hand-held and hand-manipulated current sensors), but may apply to their input measuring circuit leads and accessories.

## **1.2 Object**

### **1.2.1 Aspects included in scope**

The purpose of the requirements of this standard is to ensure that HAZARDS to the OPERATOR and the surrounding area are reduced to a tolerable level.

Requirements for protection against particular types of HAZARDS are given in Clauses 6 to 13, as follows:

- a) electric shock or burn (see Clauses 6, 10 and 11);
- b) mechanical HAZARDS (see Clauses 7, 8 and 11);
- c) excessive temperature (see Clause 9);
- d) spread of fire from the probe assembly (see Clause 9);
- e) arc flash (see Clause 13).

Additional requirements for probe assemblies which are designed to be powered from a low-voltage mains supply, or include other features not specifically addressed in this standard are in other parts of IEC 61010.

NOTE Attention is drawn to the possible existence of additional requirements regarding the health and safety of labour forces.

### **1.2.2 Aspects excluded from scope**

This standard does not cover:

- a) reliable function, performance, or other properties of the probe assembly;
- b) effectiveness of transport packaging.

## **1.3 Verification**

This standard also specifies methods of verifying that the probe assembly meets the requirements of this standard, through inspection, TYPE TESTS, and ROUTINE TESTS.

## **1.4 Environmental conditions**

### **1.4.1 Normal environmental conditions**

This standard applies to probe assemblies designed to be safe at least under the following conditions:

- a) altitude up to 2 000 m;
- b) ambient temperature of 5 °C to 40 °C;
- c) maximum relative humidity of 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
- d) applicable POLLUTION DEGREE of the intended environment.

### **1.4.2 Extended environmental conditions**

This standard applies to probe assemblies designed to be safe not only in the environmental conditions specified in 1.4.1, but also in any of the following conditions as RATED by the manufacturer of the probe assemblies:

- a) outdoor use;
- b) altitudes above 2 000 m;
- c) ambient temperatures below 5 °C or above 40 °C;
- d) relative humidities above the levels specified in 1.4.1;
- e) WET LOCATIONS.

## **2 Normative references**

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

IEC 60027 (all parts), *Letters symbols to be used in electrical technology*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61180-1:1992, *High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61180-2, *High-voltage test techniques for low-voltage equipment – Part 2: Test equipment*

IEC GUIDE 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC GUIDE 51, *Safety aspects – Guidelines for their inclusion in standards*

# FINAL VERSION

GROUP SAFETY PUBLICATION

---

**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**



## CONTENTS

FOREWORD.....	7
1 Scope and object.....	10
1.1 Scope .....	10
1.1.1 Probe assemblies included in scope .....	10
1.1.2 Probe assemblies excluded from scope .....	13
1.2 Object.....	13
1.2.1 Aspects included in scope .....	13
1.2.2 Aspects excluded from scope .....	13
1.3 Verification.....	13
1.4 Environmental conditions .....	13
1.4.1 Normal environmental conditions .....	13
1.4.2 Extended environmental conditions .....	13
2 Normative references .....	14
3 Terms and definitions .....	14
3.1 Parts and accessories.....	14
3.2 Quantities .....	15
3.3 Tests .....	16
3.4 Safety terms .....	16
3.5 Insulation .....	17
4 Tests .....	18
4.1 General.....	18
4.2 Sequence of tests .....	19
4.3 Reference test conditions.....	19
4.3.1 Environmental conditions.....	19
4.3.2 State of probe assemblies.....	19
4.3.3 Position of the probe assembly .....	19
4.3.4 Accessories .....	20
4.3.5 Covers and removable parts .....	20
4.3.6 Input and output voltages .....	20
4.3.7 Controls.....	20
4.3.8 Connections .....	20
4.3.9 Short-term or intermittent operation .....	20
4.4 Testing in SINGLE FAULT CONDITION.....	20
4.4.1 General .....	20
4.4.2 Application of fault conditions .....	20
4.4.3 Duration of tests .....	21
4.4.4 Conformity after application of fault conditions.....	21
4.5 Tests in REASONABLY FORESEEABLE MISUSE .....	22
4.5.1 General .....	22
4.5.2 Fuses .....	22
5 Marking and documentation.....	22
5.1 Marking.....	22
5.1.1 General .....	22
5.1.2 Identification .....	23
5.1.3 Fuses .....	23
5.1.4 CONNECTORS and operating devices.....	24

5.1.5	RATING .....	24
5.2	Warning markings .....	24
5.3	Durability of markings .....	24
5.4	Documentation .....	25
5.4.1	General .....	25
5.4.2	Probe assembly RATING .....	25
5.4.3	Probe assembly operation .....	25
5.4.4	Probe assembly maintenance and service .....	26
6	Protection against electric shock .....	26
6.1	General.....	26
6.2	Determination of ACCESSIBLE parts .....	27
6.2.1	General .....	27
6.2.2	Examination.....	27
6.2.3	Openings for pre-set controls.....	28
6.3	Limit values for ACCESSIBLE parts .....	28
6.3.1	General .....	28
6.3.2	Levels in NORMAL CONDITION.....	29
6.3.3	Levels in SINGLE FAULT CONDITION.....	29
6.3.4	Measurement of voltage and touch current .....	31
6.4	Means of protection against electric shock .....	34
6.4.1	General .....	34
6.4.2	CONNECTORS.....	35
6.4.3	PROBE TIPS.....	36
6.4.4	Impedance.....	38
6.4.5	PROTECTIVE IMPEDANCE .....	38
6.4.6	BASIC INSULATION, SUPPLEMENTARY INSULATION, DOUBLE INSULATION and REINFORCED INSULATION .....	39
6.5	Insulation requirements.....	39
6.5.1	The nature of insulation .....	39
6.5.2	Insulation requirements for probe assemblies .....	41
6.6	Procedure for voltage tests .....	52
6.6.1	General .....	52
6.6.2	Humidity preconditioning .....	52
6.6.3	Conduct of tests .....	53
6.6.4	Test voltages.....	53
6.6.5	Test procedures.....	55
6.7	Constructional requirements for protection against electric shock .....	56
6.7.1	General .....	56
6.7.2	Insulating materials .....	56
6.7.3	ENCLOSURES of probe assemblies with DOUBLE INSULATION or REINFORCED INSULATION .....	56
6.7.4	PROBE WIRE attachment .....	56
7	Protection against mechanical HAZARDS.....	60
8	Resistance to mechanical stresses .....	60
8.1	General.....	60
8.2	Rigidity test.....	61
8.3	Drop test.....	61
8.4	Impact swing test.....	61
9	Temperature limits and protection against the spread of fire .....	62

9.1	General.....	62
9.2	Temperature tests.....	63
10	Resistance to heat.....	63
10.1	Integrity of SPACINGS.....	63
10.2	Resistance to heat.....	63
11	Protection against HAZARDS from fluids.....	63
11.1	General.....	63
11.2	Cleaning.....	63
11.3	Specially protected probe assemblies.....	64
12	Components.....	64
12.1	General.....	64
12.2	Fuses.....	64
12.3	PROBE WIRE.....	65
12.3.1	General.....	65
12.3.2	RATING of PROBE WIRE.....	65
12.3.3	Pressure test at high temperature for insulations.....	65
12.3.4	Tests for resistance of insulation to cracking.....	66
12.3.5	Voltage test.....	67
12.3.6	Tensile test.....	68
13	Prevention of HAZARD from arc flash and short-circuits.....	69
13.1	General.....	69
13.2	Exposed conductive parts.....	70
	Bibliography.....	89
	Annex A (normative) Measuring circuits for touch current (see 6.3).....	71
A.1	Measuring circuits for a.c. with frequencies up to 1 MHz and for d.c. ....	71
A.2	Measuring circuits for a.c. with sinusoidal frequencies up to 100 Hz and for d.c. ....	71
A.3	Current measuring circuit for electrical burns at frequencies above 100 kHz.....	72
A.4	Current measuring circuit for WET LOCATIONS.....	73
	Annex B (normative) Standard test fingers.....	75
	Annex C (normative) Measurement of CLEARANCES and CREEPAGE DISTANCES.....	78
	Annex D (normative) Routine spark tests on PROBE WIRE.....	80
D.1	General.....	80
D.2	Spark test procedure.....	80
D.3	Routine spark test method for PROBE WIRE.....	82
	Annex E (informative) 4 mm CONNECTORS.....	84
E.1	General.....	84
E.2	Dimensions.....	84
	Annex F (normative) MEASUREMENT CATEGORIES.....	86
F.1	General.....	86
F.2	MEASUREMENT CATEGORIES.....	86
F.2.1	MEASUREMENT CATEGORY II.....	86
F.2.2	MEASUREMENT CATEGORY III.....	86
F.2.3	MEASUREMENT CATEGORY IV.....	86
F.2.4	Probe assemblies without a MEASUREMENT CATEGORY RATING.....	87
	Annex G Index of defined terms.....	88

Figure 1 – Examples of type A probe assemblies .....	11
Figure 2 – Examples of type B probe assemblies .....	11
Figure 3 – Examples of type C probe assemblies .....	12
Figure 4 – Examples of type D probe assemblies .....	12
Figure 5 – Example of a STACKABLE CONNECTOR with a male CONNECTOR and a female TERMINAL .....	15
Figure 6 – Methods for determination of ACCESSIBLE parts (see 6.2) and for voltage tests of (see 6.4.2) .....	28
Figure 7 – Capacitance level versus voltage in NORMAL CONDITION and SINGLE-FAULT CONDITION (see 6.3.2 c) and 6.3.3 c) .....	30
Figure 8 – Voltage and touch current measurement .....	31
Figure 9 – Voltage and touch current measurement for the reference CONNECTOR .....	32
Figure 10 – Voltage and touch current measurement with shielded test probe .....	33
Figure 11 – Maximum test probe input voltage for 70 mA touch current .....	34
Figure 12 – Protection by a PROTECTIVE FINGERGUARD .....	37
Figure 13 – Protection by distance .....	37
Figure 14 – Protection by tactile indicator .....	38
Figure 15 – Distance between conductors on an interface between two layers .....	49
Figure 16 – Distance between adjacent conductors along an interface of two layers .....	49
Figure 17 – Distance between adjacent conductors located between the same two layers .....	51
Figure 18 – Example of recurring peak voltage .....	44
Figure 19 – Flexing test .....	58
Figure 20 – Rotational flexing test .....	60
Figure 21 – Impact swing test .....	62
Figure 22 – Indentation device .....	66
Figure A.1 – Measuring circuit for a.c. with frequencies up to 1 MHz and for d.c. ....	71
Figure A.2 – Measuring circuits for a.c. with sinusoidal frequencies up to 100 Hz and for d.c. ....	72
Figure A.3 – Current measuring circuit for electrical burns .....	73
Figure A.4 – Current measuring circuit for high frequency test probes .....	73
Figure A.5 – Current measuring circuit for WET LOCATIONS .....	74
Figure B.1 – Rigid test finger .....	75
Figure B.2 – Jointed test finger .....	76
Figure D.1 – Bead Chain Configuration (if applicable) .....	81
Figure E.1 – Recommended dimensions of 4 mm CONNECTORS .....	85
Figure F.1 – Example to identify the locations of MEASUREMENT CATEGORIES .....	87
Table 1 – Symbols .....	23
Table 2 – SPACINGS for unmated CONNECTORS RATED up to 1 000 V a.c. or 1 500 V d.c. with HAZARDOUS LIVE conductive parts .....	36
Table 3 – Multiplication factors for CLEARANCES of probe assembly RATED for operation at altitudes up to 5 000 m .....	40
Table 4 – a.c. test voltages for testing electric strength of solid insulation in probe assemblies RATED for MEASUREMENT CATEGORIES .....	47
Table 5 – Minimum values for distance or thickness .....	50

Table 6 – CLEARANCES of probe assemblies RATED for MEASUREMENT CATEGORIES.....	42
Table 7 – CLEARANCE values for the calculation of 6.5.2.3.2.....	43
Table 8 – CLEARANCES for BASIC INSULATION in probe assemblies subjected to recurring peak voltages or WORKING VOLTAGES with frequencies above 30 kHz.....	45
Table 9 – CREEPAGE DISTANCES for BASIC INSULATION or SUPPLEMENTARY INSULATION .....	46
Table 10 – Test voltages based on CLEARANCES.....	54
Table 11 – Correction factors according to test site altitude for test voltages for CLEARANCES .....	55
Table 12 – Pull forces for PROBE WIRE attachment tests.....	59
Table 13 – Diameter of mandrel and numbers of turns .....	67
Table 14 – Impulse test voltages for testing electric strength of solid insulation in probe assemblies RATED for MEASUREMENT CATEGORIES.....	48
Table C.1 – Dimension of X .....	78
Table D.1 – Maximum centre-to-centre spacings of bead chains .....	80
Table D.2 – Formula for maximum speed of wire in terms of electrode length $L$ of link- or bead-chain electrode .....	82
Table F.1 – Characteristics of MEASUREMENT CATEGORIES.....	87

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **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**

#### 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 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.

**This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.**

**IEC 61010-031 edition 2.1 contains the second edition (2015-05) [documents 66/569/FDIS and 66/571/RVD] and its amendment 1 (2018-05) [documents 66/664/FDIS and 66/670/RVD].**

**This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.**

International Standard IEC 61010-031 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

It has the status of a group safety publication in accordance with IEC GUIDE 104.

IEC 61010-031 is a stand-alone standard. This edition constitutes a technical revision.

This edition includes the following significant changes from the first edition, as well as numerous other changes:

- a) Voltages above the levels of 30 V r.m.s., 42,4 V peak, or 60 V d.c. are deemed to be HAZARDOUS LIVE instead of 33 V r.m.s., 46,7 V peak, or 70 V d.c.
- b) Servicing is now included within the scope.
- c) Extended environmental conditions are included within the scope.
- d) New terms have been defined.
- e) Tests for REASONABLY FORESEEABLE MISUSE have been added, in particular for fuses.
- f) Additional instruction requirements for probe assembly operation have been specified.
- g) Limit values for ACCESSIBLE parts and for measurement of voltage and touch current have been modified.
- h) SPACINGS requirements for mating of CONNECTORS have been modified.
- i) PROBE TIPS and SPRING-LOADED CLIPS requirements have been modified. The PROTECTIVE FINGERGUARD replace the BARRIER with new requirements.
- j) Insulation requirements (6.5) and test procedures (6.6.5) have been rewritten and aligned when relevant with Part 1. Specific requirements have been added for solid insulation and thin-film insulation.
- k) The terminology for MEASUREMENT CATEGORY I has been replaced with the designation “not RATED for measurements within MEASUREMENT CATEGORIES II, III, or IV”.
- l) The flexing/pull test (6.7.4.3) has been partially rewritten.
- m) Surface temperature limits (Clause 10) have been modified to conform to the limits of IEC Guide 117.
- n) Requirements for resistance of PROBE WIRES to mechanical stresses have been added in Clause 12 and a new Annex D.
- o) Requirements have been added regarding the prevention of HAZARD from arc flash and short-circuits for SPRING-LOADED CLIPS.
- p) A new informative Annex E defines the dimension of the 4 mm banana CONNECTORS.

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

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

In this standard, the following print types are used:

- requirements and definitions: in roman type;
- NOTES and EXAMPLES: in smaller roman type;
- *conformity and tests: in italic type;*
- terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under

"<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

The contents of the corrigendum of August 2018 have been included in this copy.

## **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**

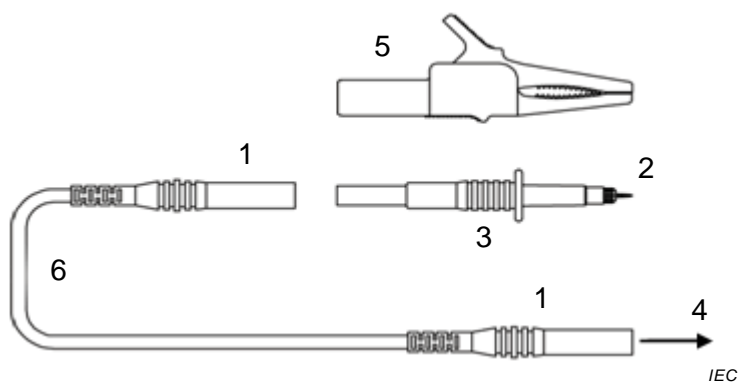
#### **1 Scope and object**

##### **1.1 Scope**

###### **1.1.1 Probe assemblies included in scope**

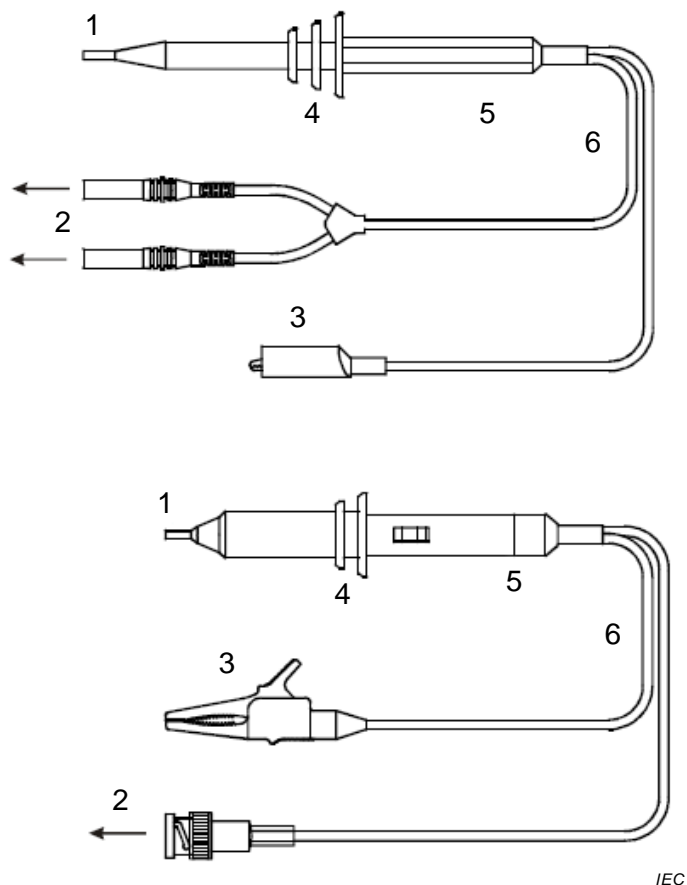
This part of IEC 61010 specifies safety requirements for hand-held and hand-manipulated probe assemblies of the types described below, and their related accessories. These probe assemblies are for direct electrical connection between a part and electrical test and measurement equipment. They may be fixed to the equipment or be detachable accessories for the equipment.

- a) Type A: low-voltage and high-voltage, non-attenuating probe assemblies. Non-attenuating probe assemblies that are RATED for direct connection to voltages exceeding 30 V r.m.s., 42,4 V peak, or 60 V d.c., but not exceeding 63 kV. They do not incorporate components which are intended to provide a voltage divider function or a signal conditioning function, but they may contain non-attenuating components such as fuses (see Figure 1.)
- b) Type B: high-voltage attenuating or divider probe assemblies. Attenuating or divider probe assemblies that are RATED for direct connection to secondary voltages exceeding 1 kV r.m.s. or 1,5 kV d.c. but not exceeding 63 kV r.m.s. or d.c. The divider function may be carried out wholly within the probe assembly, or partly within the test or measurement equipment to be used with the probe assembly (see Figure 2).
- c) Type C: low-voltage attenuating or divider probe assemblies. Attenuating or divider probe assemblies for direct connection to voltages not exceeding 1 kV r.m.s. or 1,5 kV d.c. The signal conditioning function may be carried out wholly within the probe assembly, or partly within the test or measurement equipment intended to be used with the probe assembly (see Figure 3).
- d) Type D: low-voltage attenuating, non-attenuating or other signal conditioning probe assemblies, that are RATED for direct connection only to voltages not exceeding 30 V r.m.s., or 42,4 V peak, or 60 V d.c., and are suitable for currents exceeding 8 A (see Figure 4).



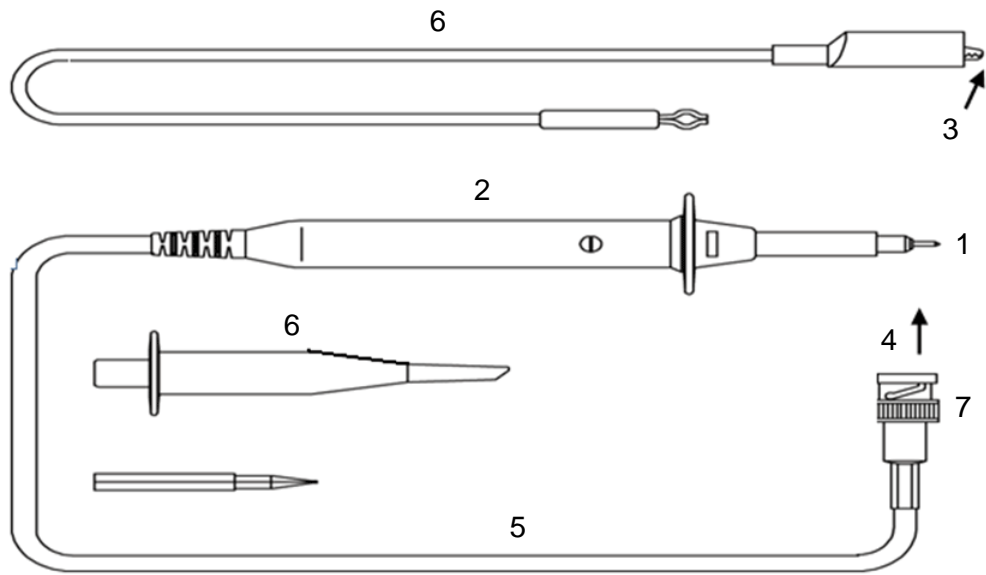
- Key**
- |                      |                      |
|----------------------|----------------------|
| 1 typical CONNECTORS | 4 to equipment       |
| 2 PROBE TIP          | 5 SPRING-LOADED CLIP |
| 3 probe body         | 6 PROBE WIRE         |

**Figure 1 – Examples of type A probe assemblies**



- Key**
- |                       |                                |
|-----------------------|--------------------------------|
| 1 PROBE TIP           | 4 PROTECTIVE FINGERGUARD       |
| 2 to equipment        | 5 hand-held area of probe body |
| 3 reference CONNECTOR | 6 PROBE WIRE                   |

**Figure 2 – Examples of type B probe assemblies**

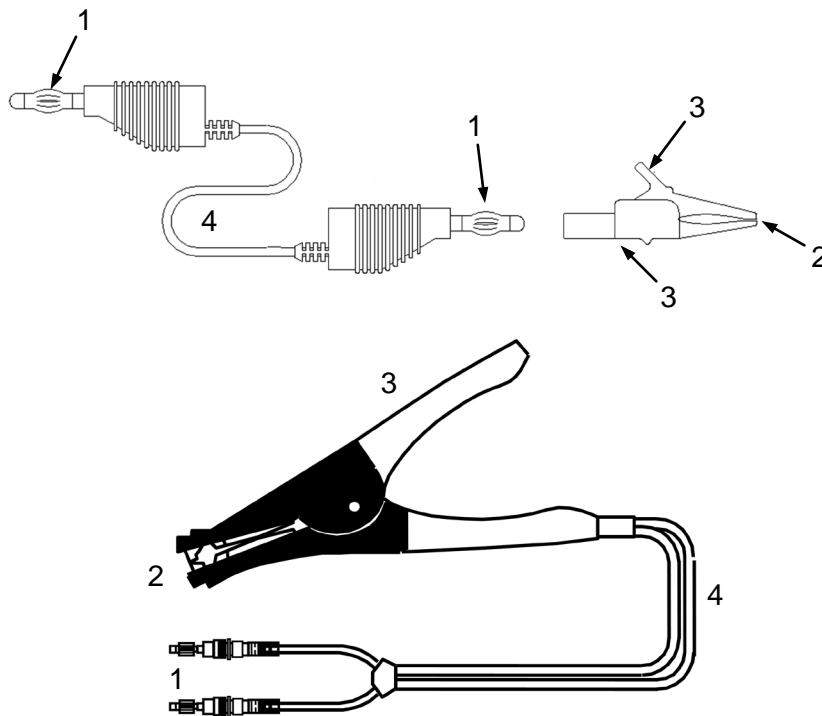


IEC

**Key**

- |                       |                           |
|-----------------------|---------------------------|
| 1 PROBE TIP           | 5 PROBE WIRE              |
| 2 probe body          | 6 examples of accessories |
| 3 reference CONNECTOR | 7 BNC CONNECTOR           |
| 4 to equipment        |                           |

**Figure 3 – Examples of type C probe assemblies**



IEC

**Key**

- |             |                                        |
|-------------|----------------------------------------|
| 1 CONNECTOR | 3 hand-held area of SPRING-LOADED CLIP |
| 2 PROBE TIP | 4 PROBE WIRE                           |

**Figure 4 – Examples of type D probe assemblies**

### **1.1.2 Probe assemblies excluded from scope**

This standard does not apply to current sensors within the scope of IEC 61010-2-032 (Hand-held and hand-manipulated current sensors), but may apply to their input measuring circuit leads and accessories.

## **1.2 Object**

### **1.2.1 Aspects included in scope**

The purpose of the requirements of this standard is to ensure that HAZARDS to the OPERATOR and the surrounding area are reduced to a tolerable level.

Requirements for protection against particular types of HAZARDS are given in Clauses 6 to 13, as follows:

- a) electric shock or burn (see Clauses 6, 10 and 11);
- b) mechanical HAZARDS (see Clauses 7, 8 and 11);
- c) excessive temperature (see Clause 9);
- d) spread of fire from the probe assembly (see Clause 9);
- e) arc flash (see Clause 13).

Additional requirements for probe assemblies which are designed to be powered from a low-voltage mains supply, or include other features not specifically addressed in this standard are in other parts of IEC 61010.

NOTE Attention is drawn to the possible existence of additional requirements regarding the health and safety of labour forces.

### **1.2.2 Aspects excluded from scope**

This standard does not cover:

- a) reliable function, performance, or other properties of the probe assembly;
- b) effectiveness of transport packaging.

## **1.3 Verification**

This standard also specifies methods of verifying that the probe assembly meets the requirements of this standard, through inspection, TYPE TESTS, and ROUTINE TESTS.

## **1.4 Environmental conditions**

### **1.4.1 Normal environmental conditions**

This standard applies to probe assemblies designed to be safe at least under the following conditions:

- a) altitude up to 2 000 m;
- b) ambient temperature of 5 °C to 40 °C;
- c) maximum relative humidity of 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
- d) applicable POLLUTION DEGREE of the intended environment.

### **1.4.2 Extended environmental conditions**

This standard applies to probe assemblies designed to be safe not only in the environmental conditions specified in 1.4.1, but also in any of the following conditions as RATED by the manufacturer of the probe assemblies:

- a) outdoor use;
- b) altitudes above 2 000 m;
- c) ambient temperatures below 5 °C or above 40 °C;
- d) relative humidities above the levels specified in 1.4.1;
- e) WET LOCATIONS.

## **2 Normative references**

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

IEC 60027 (all parts), *Letters symbols to be used in electrical technology*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61180-1:1992, *High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61180-2, *High-voltage test techniques for low-voltage equipment – Part 2: Test equipment*

IEC GUIDE 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC GUIDE 51, *Safety aspects – Guidelines for their inclusion in standards*