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Fourth edition
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BASIC SAFETY PUBLICATION

Basic and safety principles for man-machine interface, marking and identification –

Identification of conductors by colours or alphanumerics



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Identification of conductors by colours or alphanumerics

Commission Electrotechnique Internationale
International Electrotechnical Commission
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE INTERFACE, MARKING AND IDENTIFICATION –

IDENTIFICATION OF CONDUCTORS BY COLOURS OR ALPHANUMERICS

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International Standard IEC 60446 has been prepared by IEC technical committee 16: Basic and safety principles for man-machine interface, marking and identification.

This fourth edition cancels and replaces the third edition, published in 1999 and constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

a) addition of Clause 3 – Terms and definitions
b) addition of Clause 4 – Identification of conductors
c) addition of subclauses 5.3.4 to 5.3.6 – Use of bi-colour combinations
d) addition of subclause 6.2 – Identification of certain designated conductors
e) addition of a new Annex A (informative) "Identification of certain designated conductors by means of colour code and alphanumeric"
f) deletion of the old Annex A (informative) "Methods of marking PEN conductors in different countries".

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It has the status of a basic safety publication in accordance with IEC Guide 104.

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

FDIS	Report on voting
16/461/FDIS	16/462/RVD

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

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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- withdrawn;
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INTRODUCTION

This International Standard is a basic safety publication is intended for use by technical committees in the preparation of standards in accordance and with the principles laid down in IEC Guide 104 and in ISO/IEC Guide 51.

It should be noted that one of the responsibilities of a technical committee is, wherever possible, to include or refer to requirements of basic safety publications in standards for equipment within its scope. Consequently, the requirements of this basic safety publication apply only if they are included, or are referred to in those standards.

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BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE INTERFACE, MARKING AND IDENTIFICATION –

IDENTIFICATION OF CONDUCTORS BY COLOURS OR ALPHANUMERICS

1 Scope

This International Standard provides general rules for the use of certain colours or alphanumerics to identify conductors with the aim of avoiding ambiguity and ensuring safe operation. These conductor colours or alphanumerics are intended to be applied in cables or cores, busbars, electrical equipment and installations.

2 Normative references

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

IEC 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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE The terms are sorted in alphabetical order.

3.1
functional bonding conductor
conductor provided for functional-equipotential-bonding

[IEV 195-02-16]

3.2
functional earthing conductor
functional grounding conductor (in US)
earthing conductor provided for functional earthing

[IEV 195-02-15]

3.3
line conductor
phase conductor (in AC systems) (deprecated)
pole conductor (in DC systems) (deprecated)
conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a neutral or mid-point conductor

[IEV 195-02-08]

3.4
mid-point conductor
conductor electrically connected to the mid-point and capable of contributing to the distribution of electric energy

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[IEV 195-02-07]

3.5
neutral conductor
conductor electrically connected to the neutral point and capable of contributing to the distribution of electric energy

[IEV 195-02-06]

3.6
PEL conductor
conductor combining the functions of both a protective earthing conductor and a line conductor

[IEV 195-02-14]

3.7
PEM conductor
conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[IEV 195-02-13]

3.8
PEN conductor
conductor combining the functions of both a protective earthing conductor and a neutral conductor

[IEV 195-02-12]

3.9
protective bonding conductor
equipotential bonding conductor (deprecated)
protective conductor provided for protective-equipotential-bonding

[IEV 195-02-10]

3.10
protective bonding conductor, earthed
protective bonding conductor with a conductive path to earth

3.11
protective bonding conductor, unearthed
protective bonding conductor without a conductive path to earth

3.12
protective conductor
(identification: PE)
conductor provided for purposes of safety, for example protection against electric shock

[IEV 195-02-09]

4 Identification of conductors

Conductors shall be identified either by colours or by an alphanumeric designation or both. Identification of conductors by colours shall be in accordance with the requirements provided in Clause 5. Identification of conductors by alphanumerics shall be in accordance with the requirements provided in Clause 6.

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5 Identification by colours

5.1 General

For identification of conductors, the following colours are permitted:

– black, brown, red, orange, yellow, green, blue, violet, grey, white, pink, turquoise.

NOTE This list of colours is derived from IEC 60757.

The identification by colour shall be used at terminations and preferably throughout the length of the conductor either by the colour of the insulation or by colour markers, except for bare conductors where the colour identification shall be at termination and connection points.

Identification by colour or marking is not required for

– concentric conductors of cables,
– metal sheath or armour of cables when used as a protective conductor,
– bare conductors where permanent identification is not practicable,
– extraneous-conductive-parts used as a protective conductor,
– exposed-conductive-parts used as a protective conductor.

Additional markings, for example alphanumerical, are allowed, provided that the colour identification remains unambiguous.

5.2 Use of single colours

5.2.1 Permitted colours

The single colours green and yellow are only permitted where confusion with the colouring of the conductors in accordance with 5.3.2 to 5.3.6 is not likely to occur.

5.2.2 Neutral or mid-point conductors

Where a circuit includes a neutral or mid-point conductor identified by colour, the colour used for this purpose shall be blue. In order to avoid confusion with other colours it is recommended to use an unsaturated colour blue, often called "light blue". Blue shall not be used for identifying any other conductor where confusion is possible.

In the absence of a neutral or mid-point conductor, a conductor identified by blue within the whole wiring system may also be used for any other purposes, except as a protective conductor.

If identification by colour is used, bare conductors used as neutral or mid-point conductors shall be either coloured by a blue stripe, 15 mm to 100 mm wide in each unit or enclosure and each accessible position, or coloured blue throughout their length.

NOTE 1 IEC 60079-11 prescribes blue when a colour is used for the marking of terminal, terminal boxes, plugs and sockets of intrinsically-safe circuits.

NOTE 2 In the United States, Canada and Japan, the colour identification white or natural grey for the mid-point or neutral conductor is used as a replacement for the colour identification blue.

5.2.3 AC-phase conductors

For AC-phase conductors the preferred colours are BLACK, BROWN and GREY.

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NOTE 1 In the United States, Canada and Japan, where the colour GREY is used as a replacement for the colour identification BLUE for neutral or mid-point conductor, the colour GREY shall not be used for identification of phase conductors if confusion is likely.

NOTE 2 In the United States, Canada and Japan, the colour GREY can be applied as identification of neutral or mid-point conductor, the colour GREY shall not be used for any other purpose than specified in this standard.

NOTE 3 Neither a phasing nor a direction of rotation is implied by the colours given.

5.3 Use of bi-colour combinations

5.3.1 Permitted colours

Combinations of any two of the colours listed in 5.1 are permitted provided there is no risk of confusion.

To avoid such confusion the colour green and the colour yellow shall not be used in colour combinations other than the combination green-and-yellow. The use of the combination of the colours green-and-yellow is restricted to the purposes of 5.3.2 to 5.3.6.

5.3.2 Protective conductors

Protective conductors shall be identified by the bi-colour combination green-and-yellow.

NOTE 1 It may be necessary to provide additional marking to unambiguously identify a certain designated conductor.

NOTE 2 An additional colour marking is required for PEN, PEL and PEM conductors.

Green-and-yellow is the only colour combination recognized for identifying the protective conductor.

The colour combination green-and-yellow shall be such that, on any 15 mm length of the conductor where colour coding is applied, one of these colours covers at least 30 % and not more than 70 % of the surface of the conductor, the other colour covering the remainder of that surface.

If bare conductors, used as protective conductors, are provided with colouring they shall be coloured green-and-yellow, either throughout the whole length of each conductor or in each compartment or unit or at each accessible position. If adhesive tape is used, only bi-coloured tape shall be applied.

NOTE 3 Where the protective conductor can be easily identified by its shape, construction or position, for example a concentric conductor, colour coding throughout its length is not necessary but the ends or accessible positions should be clearly identified by the graphical symbol  or the bi-colour combination green-and-yellow or the alphanumeric notation PE.

NOTE 4 In the United States, Canada and Japan the colour identification green for the protective conductor is used as a replacement for the colour combination green-and-yellow.

NOTE 5 If extraneous conductive parts are used as a PE conductor identification by colours is not necessary.

5.3.3 PEN conductors

PEN conductors, when insulated, shall be marked by one of the following methods:

– green-and-yellow throughout their length with, in addition, blue markings at the terminations; or

– blue throughout their length with, in addition, green-and-yellow markings at the terminations.

NOTE 1 The choice of method or methods to be applied within a country should be made by the relevant committees.

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NOTE 2 The additional blue markings at the termination may be omitted once either of the following two indents is met:

– in electrical equipment, if relevant requirements are included in specific product standards or within a country;

– in case of wiring systems, for example those used in industry, if decided by the relevant committee.

5.3.4 PEL conductors

PEL conductors, when insulated, shall be marked green-and-yellow throughout their length with, in addition blue markings at their terminations.

NOTE The additional blue markings at the termination may be omitted once either of the following two indents is met:

– in electrical equipment, if relevant requirements are included in specific product standards or within a country;

– in case of wiring systems, for example those used in industry, if decided by the relevant committee.

If confusion with a PEN or PEM conductor is likely, the alphanumeric designation as given in 6.2.4 shall be indicated at their terminations.

5.3.5 PEM conductors

PEM conductors, when insulated, shall be marked green-and-yellow throughout their length with, in addition, blue markings at their terminations.

NOTE The additional blue markings at the termination may be omitted once either of the following two indents is met:

– in electrical equipment, if relevant requirements are included in specific product standards or within a country;

– in case of wiring systems, for example those used in industry, if decided by the relevant committee.

If confusion with a PEN or PEL conductor is likely, the alphanumeric designation as given in 6.2.5 shall be indicated at their terminations.

5.3.6 Protective bonding conductors

Protective bonding conductors shall be identified by the bi-colour combination green-and-yellow as specified in 5.3.1.

6 Identification by alphanumerics

6.1 General

The alphanumeric system applies to identification of conductors and of conductors in a group of conductors. Conductors with green-and-yellow coloured insulation shall only be identified as a certain designated conductor in accordance with 6.2.2 to 6.2.8.

The identification shall be clearly legible and durable.

NOTE For evaluation of the durability see IEC 60227-2.

All alphanumerics shall be in strong contrast to the colour of the insulation. The identification shall be given in Arabic numerals.

In order to avoid confusion, unattached numerals 6 and 9 shall be underlined.

The alphanumeric identifications specified in 6.2 shall not be used for any other purpose than that specified.

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6.2 Identification of certain designated conductors

6.2.1 Neutral conductor

The alphanumeric identification of a neutral conductor shall be ‘N’.

6.2.2 Protective conductor

The alphanumeric identification of a protective conductor shall be ‘PE’. This identification also applies for a protective earthing conductor.

6.2.3 PEN conductor

The alphanumeric identification of a PEN conductor shall be ‘PEN’.

6.2.4 PEL conductor

The alphanumeric identification of a PEL conductor shall be ‘PEL’.

6.2.5 PEM conductor

The alphanumeric identification of a PEM conductor shall be ‘PEM’.

6.2.6 Protective bonding conductor

The alphanumeric identification of a protective bonding conductor shall be ‘PB’.

6.2.7 Protective bonding conductor earthed

If it is necessary to distinguish between a protective bonding conductor earthed and a protective bonding conductor unearthed, the alphanumeric identification of a protective bonding conductor earthed shall be ‘PBE’.

6.2.8 Protective bonding conductor unearthed

If it is necessary to distinguish between a protective bonding conductor earthed and a protective bonding conductor unearthed, the alphanumeric identification of a protective bonding conductor unearthed shall be ‘PBU’.

6.2.9 Functional earthing conductor

The alphanumeric identification of a functional earthing conductor shall be ‘FE’.

6.2.10 Functional bonding conductor

The alphanumeric identification of a functional bonding conductor shall be ‘FB’.

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Annex A
(informative)

Identification of certain designated conductors by means of colour code and alphanumeric

The following table provides a list of designated conductors identified by means of colour code and alphanumeric.

Table A.1 – Identification of certain designated conductors by means of colour code and alphanumeric

NOTE Footnotes have been grouped together at the end of Table A.1

Designated terminal		Identification of conductors	
		Alphanumeric [a]	**Colour identification** (For black/white copies, the colour code according to IEC 60757 is given)
AC conductor terminal	Line 1	L1	BK [b]  or BN [b]  or GY [b] 
	Line 2	L2	
	Line 3	L3	
	Mid-point conductor	M	BU [c] 
	Neutral	N	BU [c] 

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Table A.1 *(continued)*

Designated terminal	Identification of conductors	
	Alphanumeric[a]	**Colour identification** (For black/white copies, the colour code according to IEC 60757 is given)
DC conductor terminal Positive	L+	no recommendation necessary
Negative	L–	no recommendation necessary
Protective conductor terminal	PE	GNYE 
PEN conductor terminal	PEN	GNYE [d]  BU [d] 
PEL conductor terminal	PEL	
PEM conductor terminal	PEM	

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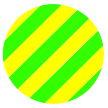
Table A.1 *(continued)*

Designated terminal		Identification of conductors	
		Alphanumeric[a]	**Colour identification** (For black/white copies, the colour code according to IEC 60757 is given)
Protective bonding conductor terminal		PB	GNYE 
	earthed	PBE	
	unearthed	PBU	
Functional earthing conductor terminal		FE	no recommendation necessary
Functional bonding conductor terminal		FB	no recommendation necessary

[a] **See Clause 6.**

[b] **Neither a phasing nor a direction of rotation is implied by the colours given.**

[c] **See 5.2.2.**

[d] **See 5.3.3 to 5.3.5.**

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IEC 60079-11:2006, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "I"*

IEC 60227-2:1997, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750V – Part 2: Test methods*

IEC 60601 (all parts), *Medical electrical equipment*

IEC 60757:1983, *Code for designation of colours*

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