

## REDLINE VERSION



BASIC SAFETY PUBLICATION

**Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors**

Preview

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**Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 Methods of identification.....	9
5 Application of identification means.....	10
6 Identification by colours.....	10
6.1 General.....	10
6.2 Use of single colours .....	11
6.2.1 Permitted colours.....	11
6.2.2 Neutral or mid-point conductor.....	11
6.2.3 Line conductor in AC system .....	11
6.2.4 Line conductor in DC system .....	11
6.2.5 Functional earthing conductor.....	11
6.3 Use of bi-colour combinations .....	11
6.3.1 Permitted colours.....	11
6.3.2 Protective conductor.....	11
6.3.3 PEN conductor .....	12
6.3.4 PEL conductor.....	12
6.3.5 PEM conductor.....	13
6.3.6 Protective bonding conductor.....	13
7 Identification by alphanumeric notation.....	13
7.1 General.....	13
7.2 Equipment terminal identification – Marking principles .....	14
7.3 Identification of certain designated conductors.....	16
7.3.1 General .....	16
7.3.2 Neutral conductor .....	16
7.3.3 Protective conductor.....	16
7.3.4 PEN conductor .....	17
7.3.5 PEL conductor.....	17
7.3.6 PEM conductor.....	17
7.3.7 Protective bonding conductor.....	17
7.3.8 Protective bonding conductor earthed.....	17
7.3.9 Protective bonding conductor unearthed.....	17
7.3.10 Functional earthing conductor.....	17
7.3.11 Functional bonding conductor.....	17
7.3.12 Mid-point conductor .....	17
7.3.13 Line conductor.....	17
Annex A (informative) Colours, alphanumeric notations and graphical symbols used for identification of conductors and terminals .....	18
Annex B (informative) List of notes concerning certain countries.....	20
Bibliography.....	26
Figure 1 – Single element with two terminals .....	14

Figure 2 – Single element with four terminals: Two endpoints and two intermediate points.....	14
Figure 3 – Three-phase equipment with six terminals.....	15
Figure 4 – Three-element equipment with twelve terminals: Six endpoints and six intermediate points .....	15
Figure 5 – Equipment with groups of elements.....	16
Figure 6 – Interconnection of equipment terminals and certain designated conductors.....	16
Table A.1 – Colours, alphanumeric notations and graphical symbols used for identification of conductors and terminals .....	18

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Preview

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE  
INTERFACE, MARKING AND IDENTIFICATION –  
IDENTIFICATION OF EQUIPMENT TERMINALS,  
CONDUCTOR TERMINATIONS AND CONDUCTORS**

## FOREWORD

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**This Redline version provides you with a quick and easy way to compare all the changes between this standard and its 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.**

This document has been prepared by IEC technical committee 3: Information structures and elements, identification and marking principles, documentation and graphical symbols.

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

This sixth edition cancels and replaces the fifth edition of IEC 60445, published in 2010.

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

- a) the text of the Introduction has been moved into the scope in accordance with IEC Guide 104;
- b) colour codes for the identification of line conductors of DC systems;
- c) colour code for the identification of functional earthing conductor;
- d) update of Table A.1 with colour codes for DC line conductors;
- e) conversion of notes containing non-mandatory requirements to normative text;
- f) the terminology is aligned with IEC 60050-195.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
3/1313/FDIS	3/1326/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.

The reader's attention is drawn to the fact that Annex B lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this standard.

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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# BASIC AND SAFETY PRINCIPLES FOR MAN-MACHINE INTERFACE, MARKING AND IDENTIFICATION – IDENTIFICATION OF EQUIPMENT TERMINALS, CONDUCTOR TERMINATIONS AND CONDUCTORS

## 1 Scope

This document applies to the identification and marking of terminals of electrical equipment such as resistors, fuses, relays, contactors, transformers, rotating machines and, wherever applicable, to combinations of such equipment (e.g. assemblies), and also applies to the identification of terminations of certain designated conductors. It also provides general rules for the use of certain colours or alphanumeric notations to identify conductors with the aim of avoiding ambiguity and ensuring safe operation. These conductor colours or alphanumeric notations are intended to be applied in cables or cores, busbars, electrical equipment and installations.

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

It is not intended for use by manufacturers or certification bodies. One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications. The requirements of this basic safety publication will not apply unless specifically referred to or included in the relevant publications.

~~In this fifth edition of IEC 60445, the terminology has been aligned with IEC 60050-195.~~

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60417, *Graphical symbols for use on equipment*

IEC 60617, *Graphical symbols for diagrams*

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.

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

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



NOTE The terms are sorted in alphabetical order in the English language.

### 3.1

#### **electrical equipment**

item used for such purposes as generation, conversion, **transmission**, distribution or utilization of electric energy, such as electrical machines, transformers, switchgear and controlgear, measuring instruments, **protective devices**, wiring systems, current-using equipment, ~~etc.~~

[SOURCE: IEC 60050-826:2004, 826-16-01, ~~modified~~]

### 3.2

#### **functional bonding conductor**

conductor provided for functional-equipotential-bonding

[SOURCE: IEC 60050-195:1998, 195-02-16]

### 3.3

#### **functional earthing**

#### **functional grounding (US)**

earthing a point or points in a system or in an installation or in equipment, for purposes other than electrical safety

[SOURCE: IEC 60050-195/AMD1:2001, 195-01-13]

### 3.4

#### **functional earthing conductor**

#### **functional grounding conductor, US**

earthing conductor provided for functional earthing

[SOURCE: IEC 60050-195:1998, 195-02-15]

### 3.5

#### **functional-equipotential-bonding**

equipotential bonding for operational reasons other than safety

[SOURCE: IEC 60050-195:1998, 195-01-16]

### 3.6

#### **line conductor**

DEPRECATED: phase conductor (in AC systems)

DEPRECATED: pole conductor (in DC systems)

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

[SOURCE: IEC 60050-195:1998, 195-02-08]

### 3.7

#### **mid-point conductor**

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

[SOURCE: IEC 60050-195:1998, 195-02-07]

### 3.8

#### **neutral conductor**

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

[SOURCE: IEC 60050-195:1998, 195-02-06]

**3.9  
PEL conductor**

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

[SOURCE: IEC 60050-195:1998, 195-02-14]

**3.10  
PEM conductor**

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

[SOURCE: IEC 60050-195:1998, 195-02-13]

**3.11  
PEN conductor**

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

[SOURCE: IEC 60050-195:1998, 195-02-12]

**3.12  
protective bonding conductor**

DEPRECATED: equipotential bonding conductor  
protective conductor provided for protective equipotential-bonding

[SOURCE: IEC 60050-195:1998, 195-02-10]

**3.13  
protective bonding conductor earthed**

protective bonding conductor with a conductive path to local earth

**3.14  
protective bonding conductor unearthed**

protective bonding conductor without a conductive path to local earth

**3.15  
protective conductor**  
(identification: PE)

equipment grounding conductor, US  
grounding electrode conductor, US

conductor provided for purposes of safety, for example protection against electric shock

Note 1 to entry: The terms equipment grounding conductor and grounding electrode conductor are used in the US depending on their application.

[SOURCE: IEC 60050-195:1998, 195-02-09, modified – two synonyms and a note to entry have been added.]

**3.16  
protective earthing  
protective grounding, US**

earthing a point or points in a system or in an installation or in equipment, for purposes of electrical safety

[SOURCE: IEC 60050-195:Amendment 1:2001, 195-01-11]

**3.17****protective earthing conductor**  
**protective grounding conductor, US**

protective conductor provided for protective earthing

[SOURCE: IEC 60050-195:1998, 195-02-11]

**3.18****protective equipotential-bonding**

equipotential bonding for the purposes of safety

[SOURCE: IEC 60050-195:1998, 195-01-15]

**3.19**

**earth, verb**

**ground, verb, US**

make an electric connection between a given point in a system or in an installation or in equipment and a local earth

Note 1 to entry: The connection to local earth may be  
– intentional, or  
– unintentional or accidental  
and may be permanent or temporary.

[SOURCE: IEC 60050-195:1998, 195-01-08]

**3.20****equipotential bonding**

provision of electric connections between conductive parts, intended to achieve equipotentiality

[SOURCE: IEC 60050-195:1998, 195-01-10]

**3.21****equipotentiality**

state when conductive parts are at a substantially equal electric potential

[SOURCE: IEC 60050-195:1998, 195-01-09]

**4 Methods of identification**

Where the identification of equipment terminals and of terminations of certain designated conductors is considered necessary, it shall be effected by the use of one or more of the following methods:

- the physical or relative location of the equipment terminals or of terminations of certain designated conductors;
- a colour code for equipment terminals and terminations of certain designated conductors in accordance with Clause 6;
- graphical symbols in accordance with IEC 60417. If additional symbols are required, these shall be consistent with IEC 60617;
- an alphanumeric notation in accordance with the system laid down in Clause 7.

To keep consistency with the documentation, conductor and equipment terminal designation, the alphanumeric notation is recommended.

Identification of conductors by colours shall be in accordance with the requirements provided in Clause 6. Identification of conductors by alphanumeric notation shall be in accordance with the requirements provided in Clause 7.

NOTE It is recognised that for complex systems and installations additional marking and labelling ~~may be needed~~ are used for reasons other than safety, see for example IEC 62491.

## 5 Application of identification means

The identifying colour, graphical symbol or alphanumeric notation shall be located on, or adjacent to, the corresponding terminal.

When more than one identification method is used and confusion is possible, the correlation between the methods shall be clarified in the associated documentation.

When no confusion is possible, the juxtaposition of numerical and alphanumeric notation may be applied.

Terminals and conductors used for earthing are divided concerning their purpose of earthing into the two basic concepts of protective earthing and functional earthing.

- If a terminal or conductor fulfils the requirements for both protective earthing and functional earthing, it shall be designated as a protective earthing terminal or protective earthing conductor, respectively.
- If the requirements for protective earthing are not met by a functional earthing terminal or functional earthing conductor, it shall not be marked with an identification of a protective earthing terminal or protective earthing conductor, respectively.
- The requirements for functional earthing are to be defined by the manufacturer or the relevant product committee and should be specified within the documentation of the equipment.

NOTE For example, requirements for handling EMC issues.

## 6 Identification by colours

### 6.1 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 alphanumeric, are allowed, provided that the colour identification remains unambiguous.

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