

Basic and safety principles for man-machine interface, marking and identification — Identification of conductors by colours or alphanumerics

The European Standard EN 60446:2007 has the status of a British Standard

ICS 01.070; 29.020

National foreword

This British Standard is the UK implementation of EN 60446:2007. It is identical to IEC 60446:2007. It supersedes BS EN 60446:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/16, Terminal marking and other identifications.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2007

© BSI 2007

ISBN 978 0 580 53780 6

Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
| | | |
| | | |
| | | |
| | | |

English version

**Basic and safety principles for man-machine interface,
marking and identification -
Identification of conductors by colours or alphanumerics
(IEC 60446:2007)**

Principes fondamentaux et de sécurité
pour les interfaces homme-machines,
le marquage et l'identification -
Identification des conducteurs par des
couleurs ou par des repères numériques
(CEI 60446:2007)

Grund- und Sicherheitsregeln
für die Mensch-Maschine-Schnittstelle -
Kennzeichnung von Leitern durch Farben
oder alphanumerische Zeichen
(IEC 60446:2007)

This European Standard was approved by CENELEC on 2007-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in two official versions (English and German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 16/461/FDIS, future edition 4 of IEC 60446, prepared by IEC TC 16, Basic and safety principles for man-machine interface, marking and identification, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60446 on 2007-06-01.

This European Standard supersedes EN 60446:1999.

EN 60446:2007 includes the following significant technical changes with respect to EN 60446:1999:

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

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2008-03-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2010-03-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60446:2007 was approved by CENELEC as a European Standard without any modification.

CONTENTS

| | |
|---|----|
| INTRODUCTION..... | 4 |
| 1 Scope..... | 5 |
| 2 Normative references | 5 |
| 3 Terms and definitions | 5 |
| 4 Identification of conductors..... | 6 |
| 5 Identification by colours..... | 7 |
| 5.1 General..... | 7 |
| 5.2 Use of single colours..... | 7 |
| 5.3 Use of bi-colour combinations | 8 |
| 6 Identification by alphanumerics | 9 |
| 6.1 General..... | 9 |
| 6.2 Identification of certain designated conductors | 10 |
| Annex A (informative) Identification of certain designated conductors by means of colour code and alphanumeric | 11 |
| Annex ZA (normative) Normative references to international publications with their corresponding European publications | 15 |
| Bibliography..... | 14 |
| Table A.1 – Identification of certain designated conductors by means of colour code and alphanumeric | 11 |

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.

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

[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.

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.

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.

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.

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'.

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  |
| | Line 2 | L2 | or BN ^b  |
| | Line 3 | L3 | or GY ^b  |
| | Mid-point conductor | M | BU ^c  |
| | Neutral | N | BU ^c  |

Table A.1 (continued)

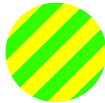
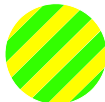



| Designated terminal | Identification of conductors | | |
|-------------------------------|------------------------------|--|-----------------------------|
| | Alphanumeric ^a | Colour identification (For black/white copies, the colour code according to IEC 60757 is given) | |
| DC conductor terminal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

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. | | |

Bibliography

IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

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

NOTE Harmonized as EN 60079-11:2007 (not modified).

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*

NOTE Harmonized in EN 60601 series (not modified).

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

NOTE Harmonized as HD 457 S1:1985 (not modified).

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

| <u>Publication</u> | <u>Year</u> | <u>Title</u> | <u>EN/HD</u> | <u>Year</u> |
|--------------------|-----------------|---|--------------|-------------|
| IEC Guide 104 | - ¹⁾ | The preparation of safety publications and the - use of basic safety publications and group safety publications | - | - |
| ISO/IEC Guide 51 | - ¹⁾ | Safety aspects - Guidelines for their inclusion - in standards | - | - |

¹⁾ Undated reference.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.
Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001.
Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at <http://www.bsi-global.com>.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre.
Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.
Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001.
Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at <http://www.bsi-global.com/bsonline>.

Further information about BSI is available on the BSI website at <http://www.bsi-global.com>.

Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

Details and advice can be obtained from the Copyright & Licensing Manager.
Tel: +44 (0)20 8996 7070. Fax: +44 (0)20 8996 7553.
Email: copyright@bsi-global.com.