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GUIDE FOR UNIFORM SYSTEM OF MARKING AND IDENTIFICATION OF CONDUCTORS AND APPARATUS TERMINALS

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Indian Standard

GUIDE FOR UNIFORM SYSTEM OF MARKING AND IDENTIFICATION OF CONDUCTORS AND APPARATUS TERMINALS

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Indian Standard

GUIDE FOR UNIFORM SYSTEM OF MARKING AND IDENTIFICATION OF CONDUCTORS AND APPARATUS TERMINALS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 18 October 1985, after the draft finalized by the Basic Electrotechnical Standards Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 In India, identification of insulated and bare conductors by colours is a predominant feature. A uniform system of colour identification is required to be evolved together with standard alphanumeric notations for marking of apparatus terminals so that installation and interconnection work is done with increasing safety.

0.3 A standardized system of terminal marking is essential to apparatus standardization keeping in view the advantages that would be derived in the design, manufacture and operation of equipment. Such identifications are also frequently referred to in a variety of documents, such as diagrams, schedules and notices, and an uniformity in approach is highly desirable.

0.4 The rules for marking of conductors by colours given in this standard basically follows the recommendations of the International Electrotechnical Commission, except in respect of colours for neutral and midwire, the 'black' colour is preferred in the Indian context in place of 'light blue'. This is keeping in view the fact that 'light blue' would hardly be distinguishable in practice from 'blue' chosen for one of the pahses conductors (in ac circuits) and the negative conductor in the dc system; and is likely to cause confusion.

0.5 In current day technology, the increasing tendency for wiring diagrams to be replaced by computer printed lists and for schedules and descriptions to be transmitted by teletype systems indicates that such a standard system of terminal marking should also be compatible with these methods of communications. It is recommended that where terminal markings are considered necessary, the methods specified in this standard should be employed and in particular, that where letters/figures are used for identification, the uniform systems detailed in **5** should be employed.

0.6 Colours and letter codes for main connections and bus-bars are originally covered in IS : 375-1963*. This Indian Standard recommended then the British Standard practice of marking conductors by letter symbols and colours, which was also adopted in India. This standard is intended to supersede the corresponding requirements in IS : 375-1963*.

0.7 The correlation between alphanumeric notations, graphical symbols and colours is given in Appendix A.

0.8 In the preparation of the standard, considerable assistance has been derived from the following publications, issued by the International Electrotechnical Commission:

IEC Pub 445 (1973)	Identification of apparatus terminals and general rules for a uniform system of terminal marking, using an alphanumeric notation
IEE Pub 446 (1973)	Identification of insulated and bare conductors by colours

1. SCOPE

1.1 This standard gives rules for the general application of marking conductors by colours in installations, assemblies, equipment and apparatus.

1.2 This standard also applies to the terminal markings for basic electrical unit (for example, resistors, fuses, relays, transformers, rotating machines) and for combinations of such units (for example, motor control equipment). It also applies to the identification of the terminations of conductors performing certain functions (for example, power supply; earthing, earthing to frame, etc).

1.3 This standard serves as a guide when dealing with identification systems in particular type of equipment.

NOTE — In the context of this standard, the expression 'terminal marking' refers to the markings applied to the conducting parts of a circuit or apparatus which are provided for electrical connection to external circuits.

2. GENERAL RULES

2.0 Whenever colour coding is used, the rules given in **2.1** to **2.4** shall apply.

*Marking and arrangement for switchgear bus-bars, main connections and auxiliary wiring (*revised*).

2.1 Use of Bi-colour Combination Green-and-Yellow

2.1.1 The bi-colour combination green-and-yellow (green/yellow) shall be used for identifying the protective conductor and for no other purpose. This is the only colour code recognized for identifying the protective conductor.

2.1.2 Bare conductors or bus-bars, used as protective conductors, shall be coloured by equally broad green-and-yellow stripes, each 15 mm up to 100 mm wide, close together, either throughout the 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.

2.1.3 For insulated conductors, the combination of the colours green-and-yellow shall be such that, on any 15 mm length of insulated conductor, one of these colours covers at least 30 percent and not more than 70 percent of the surface of the conductor, the other colour covering the remainder of that surface.

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

2.2 Use of the Colour Black

2.2.1 Black is intended for the neutral or mid-wire conductor.

2.2.2 Where a circuit includes a neutral or mid-wire conductor identified by colour, the colour used for this purpose shall be Black. Black colour shall not be used for identifiying any other conductor where confusion might arise.

2.2.3 In the absence of a neutral or mid-wire conductor, the black conductor in a multicore cable can also be used for other purposes, except as protective conductor.

2.2.4 If identification by colour is used, bare conductors or bus-bars, used as neutral or mid-wire conductors, shall be either coloured by a black stripe, 15 mm to 100 mm wide in each compartment or unit or at each accessible position or coloured black throughout their length.

2.3 Use of Colours for Internal Wiring with Single-core Insulated Conductors — For the internal wiring of apparatus and equipment, it is recommended that only one colour be used. This colour shall be so chosen that it is not one of the colours listed in col 2 of Table 1 for designation of other conductors. The use of light blue colour for internal wiring is also not permitted.

2.4 Busbars

2.4.1 It is recommended that individual busbars and similar conductors, whether insulated or not, should be identified where appropriate, by a graphical symbol or alphanumeric notation rather than by colours.

2.4.2 If, however, colours are used, the colours selected shall be in accordance with **2.1** and **2.2**. When busbars or similar conductors are insulated, the preferred colour for the insulation is black. Identification of the phases shall be done using stripes or bands or other suitable means of colours given in col 2 of Table 1.

2.5 Table 1 gives the recommended colours for various conductors.

TABLE 1 RECOMMENDED COLOURS FOR IDENTIFICATION OF CONDUCTORS

(*Clauses* 2.3.1, 2.4.2 *and* 2.5)

DESIGNATION OF CONDUCTORS		IDENTIFICATION BY COLOUR
(1)		(2)
Supply ac system (three phase)	Phase 1	Red
	Phase 2	Yellow
	Phase 3	Blue
	Neutral	Black
Apparatus ac system	Phase 1	Red
	Phase 2	Yellow
	Phase 3	Blue
dc system	Positive	Red
	Negative	Blue
	Mid wire	Black
Supply ac* system (single phase)	Phase	Red
	Neutral	Black
Protective conductor		Green and yellow
Earth		No colour other than the colour of the bare conductor. If insulated, the colour for insulation so chosen to avoid those listed above for designation of other conductors.
Noiseless (clean) earth		Under consideration

*For single phase ac systems, the colour of red and black are recommended if the circuit is in isolation. In cases where the single phase conductors are associated with the 3-phase system from which they are derived, the phase conductor shall use the same colour as that phase from which it is derived.

3. METHODS OF IDENTIFYING TERMINALS

3.0 The purpose of identifying apparatus terminals is to provide information regarding the function of the terminal or its location with respect to other terminals or for other purposes.

3.1 Where the identification of apparatus terminals is considered necessary, it is recommended that this be effected by the use of one or more of the following methods:

a) The physical location of the terminals in accordance with a recognized system,

b) A colour code in accordance with a recognized system,

c) Graphical symbols in accordance with IS : 2032 (Series)* in general, and with standard, graphical symbols for use on equipment, and

d) An alphanumeric notation in accordance with the uniform system laid down in **5.**

The various methods have equal status when applied to apparatus terminals.

3.2 Graphical symbols as recommended in relevant standards (*see also* Appendix A) may be used as alternatives to the alphanumeric markings, where appropriate.

3.3 The choice of method will depend upon the type of apparatus, the physical arrangement of the terminals and the complexity of the particular apparatus or installation.

For example, the physical or relative location and shape of pins can be acceptable for a plug. Colour coding alone may be sufficient for the simplest application such as small units without fixed terminals where a colour code is applied to the insulated wiring and graphical symbols may be most suitable for equipment such as domestic appliances.

3.4 The alphanumeric system of marking will be necessary for the more complex apparatus or installations and its use is essential when the terminals are referred to in communication systems employing typescript.

The adoption of the uniform system, referred to in **5,** is strongly recommended to the relevant Technical Committee.

*Graphical symbols used in electrotechnology.

4. APPLICATION OF IDENTIFICATION MEANS

4.1 The identifying colour, graphical symbols or alphanumeric notation shall normally be applied to the corresponding apparatus terminal.

4.2 Where an identifying colour, in accordance with a recognized system, is applied to an apparatus terminal, the correlation between this colour and the equivalent graphical symbol or the alphanumeric notation shall, where necessary, be recorded on an associated drawing or document.

4.3 In those cases where the construction of an item of equipment does not permit the physical application of any terminal identification marking, the location of the terminal and its corresponding identification shall, where necessary, be recorded on an associated drawing or document. This drawing or document must be executed in such a way that the relative positions of terminals can be determined easily and without risk of error.

5. UNIFORM SYSTEM OF TERMINAL MARKING

5.1 General

5.1.1 The uniform system of terminal marking shall be based on alphanumeric notation employing Latin alphabetical characters and Arbic numeral characters.

5.1.2 The alphabetical characters used for the marking of terminals on apparatus and conductors shall be capital (upper case) Latin characters only.

The letters I and O shall not be used.

NOTE 1 — Where reference is made to these terminal markings in correspondence, documents, etc, the use of capital (upper case) letters is preferred, however, in these cases where difficulties would otherwise arise, the use of small (lower case) letters, which have the same significance, is permitted.

NOTE 2 — Care should be taken when confusion might arise between two similar characters, for example, lower case 'l' and the numeral '1'.

5.1.3 The complete notation is based on the use of combinations of alternate alphabetical and numerical character groups, each containing one or more letters or digits.

For some applications, where no confusion is possible, it will not be necessary to apply the complete alphanumeric notation and, in these cases, it is permissible to omit one or more of the character groups.

In those cases where character groups containing figures only or letters only are used and where it is necessary to distinguish between successive groups, a full stop shall be used to separate the groups.

The complete notation 1U1 may be simplified if the letter U is not necessary; the abbreviated notation is normally 1·1 or, if there is no need to distinguish between successive groups, 11.

If the complete notation is 1U11, the abbreviated notation is normally 1·11 or, if there is no need to distinguish between successive groups, 111.

5.1.4 Symbols such as + and −, which can easily be transmitted by teletype systems, may be used.

5.2 Marking Principles

5.2.1 The uniform system is based on the following marking principles:

a) The two end points of a single element are distinguished by successive reference numbers, for example, 1 and 2 (*see* Fig. 1).

b) The intermediate points of a single element are distinguished by reference numbers, preferably in a naturally ascending sequence, for example, 3, 4, 5, etc. The reference numbers of the intermediate points are chosen higher than those at the end points: their numbering commences at the point which lies closest to the end point with the lowest reference number. Thus, for example, the intermediate points of an element with the end points 1 and 2 will be denoted by the reference numbers 3, 4, 5, etc (*see* Fig. 2).

c) If several similar elements are combined in a group, the ends of individual elements can be denoted by:

   i) Reference letters which will precede the reference numbers referred to in (a) and (b), for example, *U*, *V*, *W*, corresponding to the phases of a three-phase ac system (*see* Fig. 3).

   ii) Reference numbers which will precede the reference numbers referred to in (a) and (b) where a phase identification is not necessary or possible (*see* **5.1.3**), for example the ends of one element are marked by 1·1 and 1·2 and those of the other elements by 2.1 and 2·2 or by 11, 12 and 21, 22 respectively where no confusion is possible.

d) Similar groups of elements having the same reference letters are distinguished by a numerical prefix to the reference letters (*see* Fig. 4).

e) The reference letters for dc elements should preferably be chosen from the first part and reference letters for ac elements from the second part of the alphabet.

NOTE — Figure 5, illustrates the interconnection of apparatus and particular conductors, marked in accordance with the alphanumeric notation.

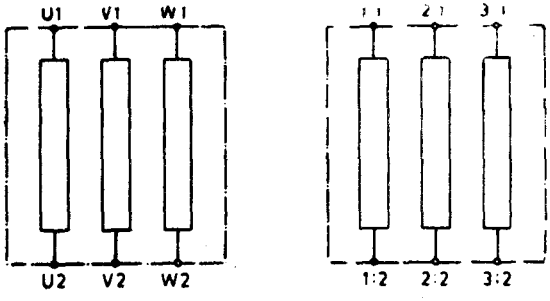
FIG. 1 SINGLE ELEMENT WITH 2 TERMINALS

FIG. 2 SINGLE ELEMENT WITH 4 TERMINALS

5.3 Markings for Terminals of Apparatus Connected to Particular Conductors

5.3.1 Terminals of apparatus which are intended to be connected directly or indirectly to supply conductors of three-phase ac system shall preferably be marked with the reference letters, *U*, *V*, *W*, especially if the phase sequence is of significance.

5.3.2 The terminals for connection to neutral conductor, protective conductor, earth and noiseless earth conductors shall be marked with the letters *N*, *PE*, *E* and *TE* respectively.



a) Three-Phase Apparatus with 6 Terminals

b) Three-Element Apparatus with 6 Terminals

FIG. 3 APPARATUS WITH 6 TERMINALS

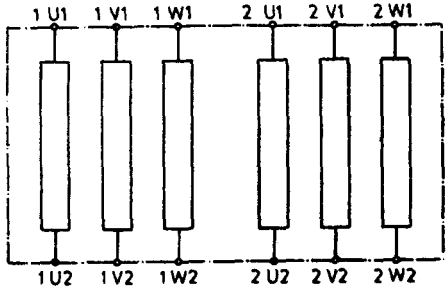


FIG. 4 THREE PHASE APPARATUS CONTAINING 2 GTOUPS OF 3 ELEMENTS WITH 6 TERMINALS EACH

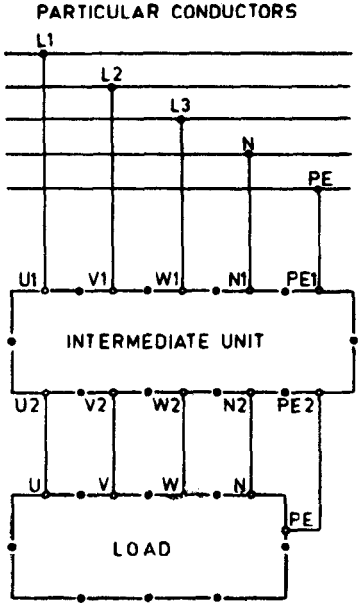


FIG. 5 INTERCONNECTION OF APPARATUS AND PARTICULAR CONDUCTORS

5.3.3 The terminal connected to the frame or chasis shall be marked *MM*. The equipotential terminal shall be marked *CC* (*see also* Table 2). These markings shall apply only when it is not intended that these terminals shall be at the potential of the protective conductor or earth.

TABLE 2 MARKINGS FOR TERMINALS OF APPARATUS

Apparatus Terminal for		Marking by Alphanumeric Notation
ac system	Phase 1	*U*
	Phase 2	*V*
	Phase 3	*W*
	Neutral	*N*
Protective conductor		*PE*
Earth		*E*
Noiseless (clean) earth		*TE*
Frame or chassis		*MM*
Equipotential terminal		*CC*

5.4 Markings for Particular Conductors

5.4.1 Markings for particular conductors shall be as in Table 3.

TABLE 3 MARKINGS FOR PARTICULAR CONDUCTORS

Designation of Conductors		Marking by Alphanumeric Notation
(1)		(2)
Supply dc system	Phase 1	*L1*
	Phase 2	*L2*
	Phase 3	*L3*
	Neutral	*N*
Supply dc system	Positive	*L+*
	Negative	*L−*
	Mid-wire	*M*
Protective conductor		*PE*
Protective conductor unearthed		*PU*
Protective conductor and natural conductor combined		*PEN*
Earth		*E*
Noiseless (clean) earth		*TE*
Frame or chassis		*MM*
Equipotentially		*CC*

APPENDIX A

(*Clauses* 0.7 *and* 3.2)

CORRELATION BETWEEN ALPHANUMERIC NOTATION, GRAPHICAL SYMBOLS AND COLOURS

Designation of Conductors		Identification by		
		Alphanumeric Notation	Graphical Symbol	Colour
(1)		(2)	(3)	(4)
Supply ac system	Phase 1	$L1$		Red
	Phase 2	$L2$		Yellow
	Phase 3	$L3$		Blue
	Neutral	N		Black
Apparatus ac system	Phase 1	U		Red
	Phase 2	V		Yellow
	Phase 3	W		Blue
	Neutral	N		Black
Supply dc system	Positive	$L+$	+	Red
	Negative	$L-$	−	Blue
	Midwire	M		Black
Supply ac system (single phase)	Phase	L		Red
	Neutral			Black
Protective conductor		PE		Green and yellow
Earth		E	⏚	No colour other than the colour of the bare conductor. If insulated, the colour for insulation so chosen to avoid those listed above for designation of other conductors
Noiseless (clean earth)		TE		Under consideration
Frame or chassis		MM		—
Equipotential terminal		CC		—

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	$1\ N = 1\ kg.m/s^2$
Energy	joule	J	$1\ J = 1\ N.m$
Power	watt	W	$1\ W = 1\ J/s$
Flux	weber	Wb	$1\ Wb = 1\ V.s$
Flux density	tesla	T	$1\ T = 1\ Wb/m^2$
Frequency	hertz	Hz	$1\ Hz = 1\ c/s\ (s^{-1})$
Electric conductance	siemens	S	$1\ S = 1\ A/V$
Electromotive force	volt	V	$1\ V = 1\ W/A$
Pressure, stress	pascal	Pa	$1\ Pa = 1\ N/m^2$