

# INTERNATIONAL STANDARD

**Multicore and symmetrical pair/quad cables for digital communications –  
Part 3: Work area cable – Sectional specification**

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IEC 61156-3

Edition 3.0 2008-11

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE

N

ICS 33.120.20

ISBN 978-2-88910-420-8

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

### Part 3: Work area cable – Sectional specification

#### FOREWORD

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International Standard IEC 61156-6 has been prepared by subcommittee 46C: Wires and symmetric cables, of IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

This third edition cancels and replaces the second edition published in 2003. This edition constitutes a technical revision.

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

- a) new requirements for new cables Cat3, and Cat5 applications;
- b) a better numbering in order to take into account the generic specification.

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

| FDIS         | Report on voting |
|--------------|------------------|
| 46C/864/FDIS | 46C/869/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.

This standard shall be read in conjunction with IEC 61156-1:2002.

The list of all the parts of the IEC 61156 series, under the general title *Multicore and symmetrical pair/quad cables for digital communications*, can be found on the IEC website.

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

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- withdrawn;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

A bilingual version of this publication may be issued at a later date.

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# MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

## Part 3: Work area cable – Sectional specification

### 1 General

#### 1.1 Scope

This sectional specification relates to IEC 61156-1:2002. The cables are specifically intended for work area wiring as defined in ISO/IEC 11801.

This specification defines individually screened, common overall core screen and unscreened pairs or quads in cables for work area wiring. These cables are suitable for the various communication systems for which the reference is given in the relevant detail specification.

The cables covered by this sectional specification are intended to operate with voltages and currents normally adopted for communication systems. These cables should not be connected to low impedance sources, for example, the public mains electricity supply.

The recommended temperature range during installation is 0 °C to +50 °C. The actual temperature range during installation shall be indicated in the relevant detail specification. The normal operating temperature range shall be –40 °C to +60 °C.

#### 1.2 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 61156-1:2002<sup>1</sup>, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC 60304, *Standard colours for insulation for low-frequency cables and wires*

IEC 60344, *Calculation of d.c. resistance of plain and coated copper conductors of low-frequency cables and wires - Application guide*

ISO/IEC 11801, *Information technology – Generic cabling for customer premises*

#### 1.3 Installation considerations

See 1.3 of IEC 61156-1:2002 and ISO/IEC 11801.

### 2 Definitions, materials and cable construction

#### 2.1 Definitions

See 2.1 of IEC 61156-1:2002.

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<sup>1</sup> A more recent version of this standard exists (2007), but as not all of the tests cited herein are addressed by the newer edition, it has been decided that the 2002 edition is to be used.

## **2.2 Materials and cable construction**

### **2.2.1 General remarks**

The choice of materials and cable construction shall be suitable for the intended application and installation of the cable. Particular care shall be taken to meet any special requirements for fire performance (such as burning properties, smoke generation, evolution of halogen gas, etc.).

### **2.2.2 Cable construction**

The cable construction shall be in accordance with the details and dimensions given in the relevant detail cable specification.

### **2.2.3 Conductor**

The conductor shall consist of annealed copper.

The conductor may be solid or stranded. The solid conductor nominal diameter shall be between 0,3 mm and 0,6 mm. Preferably, the stranded conductor should consist of seven strands.

The conductor shall be plain or tinned copper. Joints in the complete element shall not be permitted.

### **2.2.4 Insulation**

The conductor shall be insulated with a suitable thermoplastic material. Examples of suitable materials are:

- polyolefin;
- PVC;
- fluoropolymer;
- low-smoke zero halogen thermoplastic material.

The insulation may be solid or cellular with or without a solid dielectric skin. The insulation shall be continuous and shall have a thickness such that the completed cable meets the specified requirements. The nominal thickness of insulation shall be compatible with the method of conductor connection.

### **2.2.5 Colour code of insulation**

The colour code is not specified but shall be indicated in the relevant detail specification. The colours shall be readily identifiable and shall correspond reasonably with the standard colours shown in IEC 60304.

NOTE It is acceptable to mark or stripe the "a" wire with the colour of the "b" wire to facilitate pair identification.

### **2.2.6 Cable element**

The cable element shall be a pair or quad adequately twisted to aid pair/quad identification.

### **2.2.7 Screening of the cable element**

When required, a screen for the cable element may be provided. The screen shall be in accordance with 2.2.7 of IEC 61156-1:2002.

### **2.2.8 Cable make-up**

The cable elements shall be assembled to form the cable core.

The core of the cable may be wrapped with a protective layer of non-hygroscopic and non-wicking material.

### **2.2.9 Screening of the cable core**

When required by the relevant detail specification, a screen for the cable core may be provided.

The screen shall be in accordance with 2.2.9 of IEC 61156-1:2002.

### **2.2.10 Sheath**

The sheath material shall consist of a suitable thermoplastic material. Examples of suitable materials are:

- polyolefin;
- PVC;
- fluoropolymer;
- low smoke zero halogen thermoplastic material.

The sheath shall be continuous, having a thickness as uniform as possible.

A non-metallic rip cord may be provided. When provided, the rip cord shall be non-hygroscopic and non-wicking.

### **2.2.11 Colour of sheath**

The colour of the sheath shall be agreed between customer and supplier and may be stated in the relevant detail specification.

### **2.2.12 Identification**

Each length of cable shall be identified as to the manufacturer, and when required, the year of manufacture, using one of the following methods:

- a) appropriately coloured threads or tapes;
- b) printed tape;
- c) printing on the core cable wrappings;
- d) marking on the sheath.

Additional markings are permitted and may be indicated in the relevant detail specification.

### **2.2.13 Finished cable**

The finished cable shall be adequately protected for storage and shipment.

## **3 Characteristics and requirements**

### **3.1 General remarks**

This clause lists the characteristics and minimum requirements of a cable complying with this specification. Test methods shall be in accordance with Clause 3 of IEC 61156-1:2002.

## **3.2 Electrical characteristics**

### **3.2.1 Conductor resistance**

The values shall comply with the requirements of IEC 60344.

### **3.2.2 Resistance unbalance**

The value of resistance unbalance shall not exceed 3 %.

### **3.2.3 Dielectric strength**

Unless otherwise specified in the relevant detail specification, the test shall be performed on conductor/conductor and, where screen(s) are present, conductor/screen:

1 kV d.c. 1 min  
or 2,5 kV d.c. 2 s

NOTE An a.c. test voltage may be used at the value of d.c. voltage divided by 1,5.

### **3.2.4 Insulation resistance**

The test shall be performed both on

- conductor/conductor;
- conductor/screen, when present.

The minimum insulation resistance shall not be less than 150 MΩ·km, at or corrected to 20 °C.

### **3.2.5 Mutual capacitance**

Mutual capacitance is not specified but may be indicated in the relevant detail specification.

### **3.2.6 Capacitance unbalance**

The maximum capacitance unbalance pair to ground or pair to screen for screened cables shall not exceed 1 700 pF/500 m at 1 kHz.

### **3.2.7 Transfer impedance**

For screened cables, the value shall not be exceed:

- 100 mΩ/m at 10 MHz.

NOTE Unless otherwise specified, the tests shall be carried out on a cable length of not less than 100 m.

## **3.3 Transmission characteristics**

### **3.3.1 Velocity of propagation (phase velocity)**

A value is not specified but may be indicated in the relevant detail specification.

#### **3.3.1.1 Phase delay**

When measured in accordance with A.4.2.1 and A.4.3 of IEC 61156-1:2002, the phase delay for any pair of a category 5 cable shall not exceed 567 ns/100 m for all frequencies from 2 MHz and the highest referenced frequency.

For non category and for category 3 cables, the value is not specified but may be indicated in the relevant detail specification.

### 3.3.1.2 Differential phase delay (skew)

#### 3.3.1.2.1 General

When phase delay is measured in accordance with A.4.2.1 and A.4.3 of IEC 61156-1:2002, at  $(-40 \pm 1) ^\circ\text{C}$ ,  $(20 \pm 1) ^\circ\text{C}$  and  $(60 \pm 1) ^\circ\text{C}$ , the maximum differential phase delay (skew) for category 5 cables shall not be greater than 45 ns/100 m for frequencies from 1 MHz to the highest referenced frequency.

For non category and for category 3 cables, the value is not specified but may be indicated in the relevant detail specification.

#### 3.3.1.2.2 Environmental effects

The differential delay (skew) between all pair combinations due to the temperature shall not vary more than  $\pm 10$  ns/100 m within the differential delay skew of 3.3.1.2.1. Environmental compatibility shall be within the temperature range from  $-20 ^\circ\text{C}$  to  $60 ^\circ\text{C}$ .

### 3.3.2 Attenuation

The maximum attenuation  $\alpha$  of any pair in the frequency range 1 MHz to the maximum referenced frequency shall not exceed the values obtained from equation (1) using the corresponding values of the constants given in the Table 1.

$$\alpha = a \cdot \sqrt{f} + b \cdot f + \frac{c}{\sqrt{f}} \quad [\text{dB}/100\text{m}] \quad (1)$$

**Table 1 – Constants**

| Constant   | <i>a</i> | <i>b</i> | <i>c</i> |
|------------|----------|----------|----------|
| Category 3 | 3, 48    | 0, 43    | 0        |
| Category 5 | 2, 95    | 0, 034   | 0, 075   |

### 3.3.3 Unbalance attenuation

The unbalance attenuation near-end and unbalance attenuation far-end is not specified but may be indicated in the relevant detail specification.

### 3.3.4 Near-end crosstalk (NEXT)

The NEXT coupling loss between any pair combination in the range from 1 MHz to the highest referenced frequency for the cable category specified shall not be less than, that obtained from equation (2) using constants from Table 2.

$$NEXT = NEXT(1) - 15 \log_{10}(f) \quad [\text{dB}], \quad [f] = \text{MHz} \quad (2)$$

For cables larger than 4 pairs/2 quads, the power sum of near-end crosstalk loss, as defined in 2.1.10 of IEC 61156-1:2002 shall be equal to, or greater than, that obtain by equation (3) using constants from Table 2 and expressed in (dB/100 m).

$$PSNEXT = PSNEXT(1) - 15 \log_{10}(f) \quad [\text{dB}/100 \text{ m}], \quad [f] = \text{MHz} \quad (3)$$

**Table 2 – NEXT, PSNEXT constants**

| Category | <i>NEXT</i> (1)<br>dB | <i>PSNEXT</i> (1)<br>dB |
|----------|-----------------------|-------------------------|
| 3        | 41                    | 41                      |
| 5        | 62                    | 62                      |

### 3.3.5 Characteristic impedance

#### 3.3.5.1 General

The characteristic impedance measured between 1 MHz and the highest referenced frequency for the category specified shall be 100  $\Omega$  (other values as 120  $\Omega$  or 150  $\Omega$  may be specified in the relevant detail specification).

Compliance with this requirement shall be determined as follows.

#### 3.3.5.2 Input impedance

The magnitude of the input impedance, when measured in a swept frequency mode (open-short circuit method per 3.3.6.2.2 of IEC 61156-1:2002) over the frequency range from 4 MHz to the maximum referenced frequency shall meet the requirements given in Table 3.

**Table 3 – Input impedance values**

| Category | Frequency range<br>[MHz] | Input impedance [ $\Omega$ ] |
|----------|--------------------------|------------------------------|
| 3        | 1 to 16                  | 100 $\pm$ 15                 |
| 5        | 1 to 100                 | 100 $\pm$ 15                 |

#### 3.3.5.3 Function fitted impedance / mean characteristic impedance

When measured in accordance with 3.3.6.3 or 3.3.6.3/3.3.6.2.3 of IEC 61156-1:2002, the mean characteristic impedance shall be in the range defined in Table 4

**Table 4 – Function fitted impedance**

| Nominal impedance<br>$\Omega$ | Category 3,5 requirement |                     |
|-------------------------------|--------------------------|---------------------|
|                               | Min                      | Max                 |
| 100                           | 95                       | 105 + 8/ $\sqrt{f}$ |
| NOTE $f$ is in MHz.           |                          |                     |

### 3.3.6 Structural Return Loss (SRL)

The fluctuation in input impedance is related to SRL, for a cable that is terminated in its own characteristic impedance. The values of the minimum SRL requirement are defined in Table 5.

**Table 5 – Structural return loss (dB min)**

| Category   | Frequency $f$<br>MHz |                             |                  |                             |
|------------|----------------------|-----------------------------|------------------|-----------------------------|
|            | $1 \leq f \leq 10$   | $10 < f \leq 16$            | $16 < f \leq 20$ | $20 < f \leq 100$           |
| Category 3 | 12                   | $12 - 10 \times \log(f/10)$ | NA               | NA                          |
| Category 5 | 23                   | 23                          | 23               | $23 - 10 \times \log(f/20)$ |

NOTE 1 Where appropriate, transmission characteristics are specified by categories which depend on application and system requirements.

The maximum referenced frequencies covered by this specification are:

- 16 MHz for category 3;
- 100 MHz for category 5.

NOTE 2 The transmission characteristics of non category cables may be defined in the relevant detail specification.

NOTE 3 Unless otherwise specified the tests shall be carried out on a cable length of not less than 100 m.

### **3.4 Mechanical and dimensional characteristics and requirements**

#### **3.4.1 Dimensional requirements**

The overall diameter of insulation, the nominal thickness of the sheath and the maximum overall diameter of the sheath are not specified but shall be indicated in the relevant detail specification.

#### **3.4.2 Elongation at break of the conductors**

The minimum value shall not be less than 10 %.

#### **3.4.3 Elongation at break of the insulation**

The minimum value shall not be less than 100 %.

#### **3.4.4 Elongation at break of the sheath**

The minimum value shall not be less than 100 %.

#### **3.4.5 Tensile strength of the sheath**

The minimum value shall not be less than 9 MPa.

#### **3.4.6 Crush test of the cable**

The crush of the cable is not specified, but may be indicated in the relevant detail specification.

#### **3.4.7 Impact test of the cable**

The impact of the cable is not specified, but may be indicated in the relevant detail specification.

#### **3.4.8 Repeated bending of the cable**

The cable shall withstand 500 cycles of repeated bending without jacket, screen or insulation cracking using a:

- mandrel diameter of 50 mm for unscreened cable.
- mandrel diameter of 100 mm for screened cable.