# IEC 61156-4

Edition 3.0 2009-05

# INTERNATIONAL STANDARD

## Multicore and symmetrical pair/quad cables for digital communications – Part 4: Riser cables – Sectional specification

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch


### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

# IEC 61156-4

Edition 3.0 2009-05

# INTERNATIONAL STANDARD

## Multicore and symmetrical pair/quad cables for digital communications – Part 4: Riser cables – Sectional specification

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE P

ICS 33.120.20

ISBN 2-8318-1038-9

# CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

## Part 4: Riser cables – Sectional specification

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61156-4 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 standard is to be read in conjunction with IEC 61156-1: 2002.

This third edition cancels and replaces the second edition published in 2003. This edition constitutes a technical revision. This sectional specification relates to IEC 61156-1:2002. The cables are specifically intended for riser wiring up to category 5 (class D) as defined and specified in ISO/IEC 11801: 1995. The main changes can be found in subclauses 3.3.1.2, 3.3.2, 3.3.4, 3.3.5, 3.3.5.1, 3.3.5.2, 3.3.6 and 3.4.

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

| FDIS | Report on voting |
|---|---|
| 46C/884/FDIS | 46C/892/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..

A list of all 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.

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

## Part 4: Riser cables – Sectional specification

## 1 General

### 1.1 Scope

This part of IEC 61156 which is a sectional specification relates to IEC 61156-1:2002. The cables are specifically intended for riser wiring up to category 5 (class D) as defined and specified in ISO/IEC 11801:1995.

This specification defines individually screened or unscreened pairs/quads cables, with or without overall common screen. When installed vertically extra length requirements may be applicable and are defined in the relevant specifications. 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 normal operating temperature range is –40 °C to +60 °C. The actual temperatures range shall be indicated in the relevant detail specification.

### 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[1], *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, *Guide to calculation of resistance of plain and tinned copper conductors of lowfrequency cables and wires*

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

### 1.3 Installation considerations

See IEC 61156-1:2002.

---

[1] 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 Definitions, materials and cable construction

### 2.1 Definitions

See 2.1 of IEC 61156-1:2002.

### 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 flame propagation (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 bare or tinned copper.

The conductor shall be a solid annealed copper conductor, in accordance with 2.2.3 of IEC 61156-1:2002 and shall have a nominal diameter of between 0,5 mm and 0,65 mm. Conductor diameter up to 0,8 mm may be used if compatible with the connecting hardware.

#### 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 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 cabling 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 into a core or into units which are further assembled to form the cable core.

Each unit shall be helically wrapped with a colour coded, non-hygroscopic and non-wicking binder or as specified in the relevant detail specification. The colour code shall be indicated in the relevant detail specification. When required in the relevant detail specification a screen for the unit may be provided. The screen shall be in accordance with 2.2.7 of IEC 61156-1:2002.

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.

Where a copper braid is used, it shall have a minimum filling factor as indicated in the relevant detail specification.

### 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 uniform thickness.

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 supplier, 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 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.

A detail specification may be prepared to identify a specific product and its performance capabilities (see Clause 4).

Test methods shall be in accordance with Clause 3 of IEC 61156-1:2002.

## 3.2 Electrical characteristics

The tests shall be carried out on a minimum cable length of 100 m, unless otherwise specified..

### 3.2.1 Conductor resistance

The value 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

There shall be no failures when a test is performed on conductor/conductor and, where screen(s) are present, a conductor/screen with 1,0 kV d.c. for 1 min or, alternately, with 2,5 kV d.c. for 2 s. An a.c. voltage may be used. The a.c. voltage levels in these cases shall be 0,7 kV a.c. for 1 min or, alternately, 1,7 kV a.c. for 2 s.

### 3.2.4 Insulation resistance

The test shall be performed both on

– conductor/conductor;
– conductor/screen when present.

The minimum insulation resistance shall be not 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 shall not exceed 1 700 pF/500 m at a frequency of 800 Hz or 1 kHz.

### 3.2.7 Transfer impedance

For screened cables, the value shall not exceed:

– 50 mΩ/m at 1 MHz;
– 100 mΩ/m at 10 MHz
– 1000 mΩ/m at 100 MHz

### 3.3 Transmission characteristics

The test shall be carried out on a cable length of 100 m.

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

The maximum referenced frequencies for cables covered by this specification are:

– 16 MHz for category 3;

– 100 MHz for category 5.

#### 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 to 100 MHz.

For category 3 cables, a 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 ± 1) °C, (20 ± 1) °C and (60 ± 1) °C, the maximum differential phase delay (skew) for category 5 cables shall be not greater than 45 ns/100 m for frequencies from 1 MHz to the highest referenced frequency between any pairs connected to perform a unique transmission link.

For category 3 cables, a 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 by more than ±10 ns/100 m within the differential delay skew of 3.3.1.2.1. Environmental compatibility shall be within the temperature range from –40 °C to 60 °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 Table 1.

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

where $f$ is the frequency in MHz

**Table 1 – Constants**

| Category | *a* | *b* | *c* |
|---|---|---|---|
| Category 3 | 2,32 | 0,238 | 0 |
| Category 5 | 1,967 | 0,023 | 0,05 |

NOTE For low frequencies, the values are not specified, but may be indicated for system information purposes in the relevant detail specification.

### 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 be not less than, that obtained from equation (2) using constants from Table 2

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

where $f$ is the frequency in MHz.

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 obtained by equation (3) using constants from Table 2 and expressed in (dB/100 m).

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

**Table 2 – NEXT, PSNEXT constants**

| Category | ***NEXT*(1)** dB | ***PSNEXT*(1)** dB |
|---|---|---|
| 3 | 41 | 41 |
| 5 | 62 | 62 |

### 3.3.5 Far-end crosstalk (FEXT)

The IO FEXT and EL FEXT coupling losses, respectively, are measured between any pair combination in the range from 1 MHz to the highest referenced frequency for the cable category specified.

The power sum, as defined in 2.1.10 of IEC 61156-1:2002 shall be not less than, that obtained from the curve defined by the values in Table 3 below.

**Table 3 – EL FEXT, IO FEXT values**

| Frequency MHz | EL FEXT dB/100 m | IO FEXT dB/100 m |
|---|---|---|
| | **Category 3** | |
| 1 | 39 | 42 |
| 4 | 27 | 33 |
| 10 | 19 | 29 |
| 16 | 15 | 28 |
| | **Category 5** | |
| 1 | 61 | 63 |
| 4 | 49 | 53 |
| 10 | 41 | 48 |
| 16 | 37 | 45 |
| 20 | 35 | 44 |
| 31,25 | 31 | 43 |
| 62,5 | 25 | 42 |
| 100 | 21 | 43 |

Requirements may be given either for IO FEXT or EL FEXT. The type of FEXT specified has to be clearly identified. For compliance testing IO FEXT is measured and EL FEXT may be derived.

### 3.3.6 Characteristic impedance

Compliance with this requirement shall be determined as follows.

#### 3.3.6.1 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 4.

**Table 4 – Input impedance values**

| Category | Frequency range MHz | Input impedance Ω |
|---|---|---|
| 3 | 1 – 16 | 100 ± 15 |
| 5 | 1 – 100 | 100 ± 15 |

#### 3.3.6.2 Function fitted impedance/mean characteristic impedance

When measured in accordance with 3.3.6.3, 3.3.6.3/3.3.6.2.3 of IEC 61156-1:2002 in the frequency range of 1 MHz to the maximum referenced frequency, the mean characteristic impedance shall be in the range defined in Table 5

**Table 5 – Function fitted impedance**

| Category 3 and 5 requirements | |
|---|---|
| **Minimum** | **Maximum** |
| 95 | $105 + 8/\sqrt{f}$ |
| NOTE $f$ is in MHz. | |

### 3.3.7 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 minimum SRL requirements are specified in Table 6.

**Table 6 – Structural return loss (dB min)**

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

## 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 be not less than 8 %.

### 3.4.3 Elongation at break of the insulation

The minimum value shall be not less than 100 %.

### 3.4.4 Elongation at break of the sheath

The minimum value shall be not less than 100 %.

### 3.4.5 Tensile strength of the sheath

The minimum value shall be not less than 9 MPa.

### 3.4.6 Crush test of the cable

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

### 3.4.7 Impact test of the cable

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

### 3.4.8 Repeated bending of the cable

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

### 3.4.9 Tensile performance of the cable

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

### 3.5 Environmental characteristics

#### 3.5.1 Shrinkage of insulation

When tested at (100 ± 2) °C for 1 h, the shrinkage of the insulation shall not exceed 5 %.

#### 3.5.2 Wrapping test of insulation after thermal ageing

Not applicable.

#### 3.5.3 Bending test of insulation at low temperature

The bending test of the insulated conductor shall be carried out at (–20 ± 2) °C. The mandrel diameter shall be 6 mm.

There shall be no cracks in the insulation.

#### 3.5.4 Elongation at break of the sheath after ageing

The ageing regime shall be 7 days at (100 ± 2) °C. The elongation shall be not less than 50 % of the unaged value.

#### 3.5.5 Tensile strength of the sheath after ageing

The ageing regime shall be 7 days at (100 ± 2) °C. The elongation shall be not less than 70 % of the unaged value.

#### 3.5.6 Sheath pressure test at high temperature

Not applicable.

#### 3.5.7 Cold bend test of the cable

The bending test shall be carried out at (–20 ± 2) °C. The mandrel diameter shall be eight times the overall diameter cable. There shall be no cracks in the sheath.

#### 3.5.8 Heat shock test

Not applicable.

#### 3.5.9 Flame propagation characteristics of a single cable

If required by local regulations and indicated in the relevant detail specification, the test shall be performed in accordance with IEC 61156-1:2002.

#### 3.5.10 Flame propagation characteristics of bunched cables

If required by local regulations and indicated in the relevant detail specification, the test shall be performed in accordance with IEC 61156-1:2002.

#### 3.5.11 Acid gas evolution

If required by local regulations and indicated in the relevant detail specification, the test shall be performed in accordance with IEC 61156-1:2002.

#### 3.5.12 Smoke generation

If required by local regulations and indicated in the relevant detail specification, the test shall be performed in accordance with IEC 61156-1:2002.

### 3.5.13 Toxic gas emission

If required by local regulations and indicated in the relevant detail specification, the test shall be performed in accordance with IEC 61156-1:2002.

### 3.5.14 Combined flame and smoke test for cables in environmental air handling space

If required by local regulations and indicated in the relevant detail specification, the test shall be performed in accordance with IEC 61156-1:2002.

## 4 Introduction to the blank detail specification

The blank detail specification for cables described in this standard is published as IEC 61156-4-1 and should be used to identify a specific product.

When completing the detail specification, the following information shall be supplied:

– conductor size;
– number of elements;
– cable construction details;
– category 3 or 5 number;
– transmission characteristics;
– characteristic impedance;
– flammability characteristics.

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch