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Multicore and symmetrical pair/quad cables for digital communications – Part 2: Symmetrical pair/quad cables with transmission characteristics up to 100 MHz – Horizontal floor wiring – Sectional specification

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FOREWORD

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International Standard IEC 61156-2 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 and constitutes a technical revision. This new edition includes category 3 and 5 cables.

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

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

FDIS	Report on voting
46C/911/FDIS	46C/914/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 the parts in 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 stability 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- withdrawn;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 2: Symmetrical pair/quad cables with transmission characteristics up to 100 MHz – Horizontal floor wiring – Sectional specification

1 General

1.1 Scope and object

This sectional specification relates to IEC 61156-1:2002. The cables are specifically intended for horizontal floor wiring as defined in ISO/IEC 11801:1995.

This specification defines individually screened or unscreened pair/quad cables, with or without overall common screen for horizontal floor 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 normal operating temperature range is –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 60304, *Standard colours for insulation for low-frequency cables and wires*

IEC 61156-1:2002[1)], *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC 61156-2-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 2-1: Horizontal floor wiring – Blank detail specification*

1.3 Installation considerations

The recommended temperature range during installation is –10 °C to +60 °C. The actual temperature range during installation may be indicated in the relevant detail specification. Under static conditions, the normal operating temperature range shall be –40 °C to +60 °C.

See 1.3 of 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 and requirements

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 performance (such as burning properties, smoke generation, evolution of halogen gas, etc.) as well as requirements to meet environmental regulations.

2.2.2 Cable construction

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

2.2.3 Conductor

The conductor shall consist of annealed 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 between 0,5 mm and 0,65 mm. A 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.

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. The number and type of elements shall be given in the relevant detail specification.

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 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.

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 cable length of not less than 100 m, unless otherwise specified.

3.2.1 Conductor resistance

The conductor resistance is not specified but shall be indicated in the relevant detail specification.

3.2.2 Resistance unbalance

The conductor resistance unbalance within an element 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, screen/screen when present.

The minimum insulation resistance value 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 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;

– 300 mΩ/m at 30 MHz;

– 1 000 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)

The requirement 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 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 differential phase delay (skew) for category 5 cables shall not be greater than 45 ns for frequencies from 1 MHz to the highest referenced frequency between all pairs connected to provide 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 phase delay (skew) between all pair combinations due to the temperature shall not vary more than ±10 ns within the differential delay skew of 3.3.1.2. Environmental compatibility shall be within the temperature range from –40 °C to 60 °C.

3.3.2 Attenuation

The maximum attenuation α 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.

$$\alpha = \mathrm{a} \cdot \sqrt{f} + \mathrm{b} \cdot f + \frac{\mathrm{c}}{\sqrt{f}} \quad (1)$$

where f is the frequency in MHz, and attenuation is given in dB/100 m.

Table 1 – Constants

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

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 equal to, or greater than, that obtained from equation (2) using the corresponding values of the constants given in Table 2.

$$NEXT = NEXT(1) - 15\log_{10}(f) \quad (2)$$

where f is the frequency in MHz, and *NEXT* is given in dB.

Table 2 – *NEXT* constants

Category	*NEXT*(1)
3	41
5	62

3.3.5 Far-end crosstalk

Not applicable.

3.3.6 Characteristic impedance

3.3.6.1 General

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

Compliance with this requirement shall be determined as follows.

3.3.6.2 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 MHz	Input impedance Ω
3	1 to 16	100 ± 15
5	1 to 100	100 ± 15

3.3.6.3 Function fitted impedance / mean characteristic impedance

When measured in accordance with 3.3.6.2.3 and 3.3.6.3 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 4.

Table 4 – Function fitted impedance

Category 3 and 5 requirement	
Min.	**Max.**
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 5.

Table 5 – 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	$23–10\times\log(f/20)$
"NA" means "not applicable".				

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 8 %.

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 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 Bending under tension

The bending under tension 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.

NOTE During installation, the value of the pulling force (in Newtons) based on the cross-sectional area of all the conductors should not exceed 50 N/mm².

3.5 Environmental characteristics

3.5.1 Shrinkage of insulation

When tested at 100 °C ± 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 °C ± 2 °C. The elongation shall not be 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 °C ± 2 °C. The elongation shall not be 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 °C ± 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 61156-2-1 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.

Bibliography

ISO/IEC 11801:1995, *Information technology – Generic cabling for customer premises*

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