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Multicore and symmetrical pair/quad cables for digital communications –

Part 7: Symmetrical pair cables with transmission characteristics up to 1 200 MHz – Sectional specification for digital and analog communication cables

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 7: Symmetrical pair cables with transmission characteristics up to 1 200 MHz – Sectional specification for digital and analog communication cables

FOREWORD

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International Standard IEC 61156-7 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.

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

FDIS	Report on voting
46C/573/FDIS	46C/591/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 standard is to be read in conjunction with IEC 61156-1.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2008. 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- withdrawn;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.

The contents of the corrigendum of September 2003 have been included in this copy.

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 7: Symmetrical pair cables with transmission characteristics up to 1 200 MHz – Sectional specification for digital and analog communication cables

1 General

1.1 Scope

This sectional specification relates to IEC 61156-1.

The cables described herein may be used for various communication systems as well as for analog systems, such as video, that exist or are under development and which may use as many as four pairs simultaneously. In this sense, this sectional specification provides the cable characteristics required by system developers to evaluate new systems as well as to enhance present systems.

It covers a cable having four individually screened (STP) pairs. The cable may be provided with a common screen over the cable core.

The transmission characteristics are specified up to a frequency of 1 200 MHz and at a temperature of 20 °C.

The cables covered by this sectional specification are intended to operate with voltages and currents normally encountered in communication systems. These cables are not intended to be used in conjunction with low impedance sources, for example, the electric power supply of public utility mains.

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 60189-1:1986, *Low-frequency cables and wires with PVC insulation and PVC sheath – Part 1: General test and measuring methods*

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

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

IEC 61156-7-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 7-1: Symmetrical pair cables with transmission characteristics up to 1 200 MHz – Blank detail specification for digital and analog communication cables* [1]

IEC 62153-4-2, *Metallic telecommunication cable test methods – Part 4-2: Screening and coupling attenuation – Injection clamp method*

1.3 Installation considerations

Under consideration.

1.4 Climatic conditions

Under static conditions, the cables shall operate in the temperature range from –20 °C to +60 °C. The temperature dependence of the cables is specified for screened cables and should be taken into account for the design of actual cabling systems.

The recommended temperature range during installation should be indicated in the relevant detail specification.

2 Definitions, materials and cable construction

2.1 Definitions

See 2.1 of IEC 61156-1.

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.). A detail specification may be prepared.

2.2.2 Cable construction

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

2.2.3 Conductor

The conductor shall be a solid annealed copper conductor, in accordance with 2.2.3 of IEC 61156-1, and shall have a diameter between 0,5 mm and 0,8 mm.

2.2.4 Insulation

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

– polyolefin;

– 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 the insulation shall be compatible with the method of conductor termination.

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 tested pair.

2.2.7 Screening of the cable element

The screen for the cable element shall be in accordance with 2.2.7 of IEC 61156-1. If a braid is used, the minimum braid coverage shall be such as to meet the screening requirements of this standard. The individual components used to screen the cable element shall be in electrical contact.

2.2.8 Cable make-up

The core of the cable may be protected by wrappings of a non-hygroscopic tape.

2.2.9 Screening of cable core

A screen for the cable core may be provided. The screen shall be in accordance with 2.2.9 of IEC 61156-1.

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 ripcord may be provided. When provided, the ripcord shall be non-hygroscopic.

2.2.11 Colour of sheath

The colour of the sheath is not specified, but it should be stated in the relevant detail specification.

2.2.12 Identification

Each length of cable shall be identified as to the manufacturer and, when indicated in the relevant detail specification, the year of manufacture, using one of the following methods:

– appropriately coloured threads or tapes;
– with a printed tape;
– printing on the cable core wrapping;
– marking on the sheath.

Additional markings, such as length marking etc., are permitted on the cable sheath. When used, such markings should 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. A detail specification may be prepared to identify a specific product and its performance capabilities (see Clause 4).

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

When measured in accordance with 5.1 of IEC 60189-1, the maximum loop-resistance shall not exceed 17,0 Ω/100 m of cable.

3.2.2 Resistance unbalance

When measured in accordance with 2.1.1 of IEC 61156-1, the resistance unbalance of a pair shall not exceed 2,0 %.

3.2.3 Dielectric strength

The test shall be performed on conductor/conductor and 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.

NOTE When installed in conjunction with power cables, local regulations may require a higher test voltage.

3.2.4 Insulation resistance

The test shall be performed both on

– conductor/conductor;
– conductor/screen.

The minimum insulation resistance at 20 °C shall not be less than 5 000 MΩ·km.

3.2.5 Mutual capacitance

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

3.2.6 Capacitance unbalance pair to ground

The maximum capacitance unbalance pair to ground shall not exceed 1 200 pF/km at a frequency of 1 kHz.

3.2.7 Transfer impedance

The transfer impedance shall not exceed the values listed in Table 1 at the indicated frequencies.

Table 1 – Transfer impedance

Frequency MHz	Max. surface transfer impedance mΩ/m
1	10
10	10
30	30
100	60

3.2.8 Resistance of the screen

The d.c. resistance of the individual screens or an overall screen is not specified but may be indicated in the relevant detail specification.

3.3 Transmission characteristics

All the tests shall be carried out on a cable length of 100 m unless otherwise specified.

3.3.1 Velocity of propagation, delay and differential delay (delay skew)

3.3.1.1 Velocity of propagation

The minimum velocity of propagation for any screened cable element shall be equal to, or greater than $0{,}6 \times c$ (c is the speed of light in vacuum) for all frequencies between 4 MHz and 1 200 MHz.

NOTE The velocity of propagation, group velocity and phase velocity are approximately equal for frequencies greater than 4 MHz when measured on symmetric cables, i.e. when the cables are operated in a balanced mode.

3.3.1.2 Delay

The delay for a specified length of cable is understood as the inverse of the velocity of propagation. The maximum delay shall be less than or equal to:

$$\text{delay} = 500 + \frac{36}{\sqrt{f}} \quad [\text{ns}/100\,\text{m}] \qquad (1)$$

where f is the frequency in MHz.

3.3.1.3 Differential delay (delay skew)

Differential delay (delay skew) is the difference in delay between any two screened cable elements.

When the delay is measured at –20 ° ± 2 °C, 20 °C ± 3 °C and 60 °C ± 1 °C, the maximum differential delay (delay skew) at a given temperature shall not be greater than 25,0 ns/100 m in the frequency range from 4 MHz to 1 200 MHz.

3.3.1.4 Environmental effects

The differential delay (delay skew) due to temperature shall not vary by more than ±10 ns/100 m over the temperature range from –20 °C to +60 °C while still meeting the differential delay (delay skew) of 3.3.1.3

3.3.2 Attenuation

The maximum attenuation α of any pair in the frequency range 4,0 to 1 200 MHz shall be less than, or equal to, the value obtained from equation (2) using the corresponding values of the constants given in Table 2.

$$\alpha = A \times \sqrt{f} + B \times f + \frac{C}{\sqrt{f}} \qquad [\text{dB}/100\,\text{m}] \qquad (2)$$

Table 2 – Attenuation, constant values

Constants		
A	**B**	**C**
1,645	0,01	0,25

The values in Table 3 are for information only.

Table 3 – Attenuation values

Frequency MHz	**Attenuation at 20 °C** dB/100 m
4	3,5
10	5,4
16	6,8
31,25	9,6
62,5	13,7
100	17,5
200	25,3
300	31,5
600	46,3
900	58.3
1 000	62,0
1 200	69,0

3.3.2.1 Environmental effects

The increase in attenuation due to elevated temperature shall not be greater than 0,2 %/°C.

NOTE The method for determining compliance with this requirement is under consideration.

3.3.3 Unbalance attenuation

The minimum unbalance attenuation near-end (transverse conversion loss or TCL) shall be equal to, or greater than, the value obtained from equation (3) for the frequency range from 1 MHz to 200 MHz.

Unbalance attenuation near-end (TCL):

$$\text{TCL} = 40{,}0 - 10 \times \log_{10}(f) \qquad [\text{dB}] \qquad (3)$$

where f is the frequency in MHz.

NOTE The need for ELTCTL and TCL values above 200 MHz are under consideration.