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REDLINE VERSION

INTERNATIONAL STANDARD

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Multicore and symmetrical pair/quad cables for digital communications – Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification

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MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

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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, RF connectors, RF and microwave passive components and accessories.

This fourth edition cancels and replaces the third edition published in 2010 and Amendment 1:2012. This edition constitutes a technical revision.

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

a) additional balance levels with respect to MICE implementation by certain cabling specifications;
b) reference to current standards and technical reports with respect to measurement techniques and remote powering.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
46C/1141/FDIS	46C/1145/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

This International Standard is to be used in conjunction with IEC 61156-1:2007 and IEC 61156-1:2007/AMD1:2009.

A list of all parts in the IEC 61156 series, published 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification

1 Scope

~~This part of IEC 61156 makes reference to IEC 61156-1. The cables described herein are intended primarily for work area wiring as defined in ISO/IEC 11801 and ISO/IEC 24702.~~

This part of IEC 61156 describes the cables intended primarily for working area wiring as defined in ISO/IEC 11801 (all parts).

It covers cable designs comprising individually screened, common screened and unscreened pairs or quads. The transmission characteristics and the frequency range (see Table 1) of the cables are specified at 20 °C.

Table 1 – Cable categories

Cable designation	Maximum referenced frequency MHz
Category 5e	100
Category 6	250
Category 6_A	500
Category 7	600
Category 7_A	1 000

These cables can be used for various communication channels which use as many as four pairs simultaneously. In this sense, this document provides the cable characteristics required by system developers to evaluate new systems.

The cables covered by this document are intended to operate with voltages and currents normally encountered in communication systems. While these cables are not intended to be used in conjunction with low impedance sources, for example the electric power supplies of public utility mains, they are intended to be used to support the delivery of low voltage ~~and~~ remote powering applications such as IEEE 802.3af (Power over Ethernet) ~~and~~ or further developments for example according to IEEE 802.3at ~~(Power over Ethernet Plus)~~ or IEEE 802.3bt. More information on the capacity to support these applications according to the installation practices are given in IEC 61156-1-4, IEC TR 61156-1-6 and ISO/IEC TS 29125.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 61156-1:2007, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*
IEC 61156-1:2007/AMD1:2009

~~IEC 61156-6-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 6-1: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Blank detail specification*~~

IEC 62153-4-3, *Metallic communication cables test methods – Part 4-3: Electromagnetic compatibility (EMC) – Surface transfer impedance – Triaxial method*

IEC 62153-4-5, *Metallic communication cables test methods – Part 4-5: Electromagnetic compatibility (EMC) – Coupling or screening attenuation – Absorbing clamp method*

IEC 62153-4-9, *Metallic communication cable test methods – Part 4-9: Electromagnetic compatibility (EMC) – Coupling attenuation of screened balanced cables, triaxial method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61156-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

4 Installation considerations

~~See Clause 4 of IEC 61156-1.~~

4.1 General remarks

Installation considerations are defined in IEC 61156-1:2007, Clause 4.

4.2 Bending radius of installed cable

The bending radius of the installed cable shall not be less than four times the outside diameter of the cable.

4.3 Climatic conditions

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

Under static conditions, the cable shall operate at least in the temperature range of the environment from –20 °C to +60 °C.

The attenuation increase due to the elevated operating temperature (temperature of the environment) is described in 6.3.3.2.

In the case of application of remote powering, the maximum temperature of the conductor shall not exceed the maximum operation temperature under static conditions in order to

maintain the integrity of the dielectric material performance which is aligned to the environmental temperature range.

Extended temperature ranges are permitted and may be specified in the relevant detail specification.

5 Materials and cable construction

5.1 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 EMC and fire performance (such as burning properties, smoke generation, evolution of halogen gas~~, etc.~~).

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

5.2 Cable construction

5.2.1 Conductor

The conductor shall be a solid or stranded annealed copper, in accordance with IEC 61156-1:2007, 5.2.1 and should have a nominal diameter between 0,4 mm and 0,65 mm. A conductor diameter of up to 0,8 mm may be used.

5.2.2 Insulation

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

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

5.2.3 Cable element

5.2.3.1 General

The cable element shall be a pair or quad and shall be twisted.

5.2.3.2 Screening of the cable element

When required, the screen for the cable element shall be in accordance with IEC 61156-1:2007, 5.2.3.~~1~~2.

5.2.4 Cable make-up

A spacer may be used to separate the cable elements. The cable elements, including spacers, 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.

5.2.5 Screening of the cable core

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

The screen shall be in accordance with IEC 61156-1:2007, 5.2.5.

5.2.6 Sheath

The sheath material shall consist of a suitable 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 ripcord may be provided. When provided, the ripcord shall be non-hygroscopic and non-wicking.

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

5.2.7 Identification

Each length of cable shall be identified with the supplier's details and, when required, by means of a traceability code, 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 If used, such markings ~~shall refer to this~~ should be indicated in the relevant detail specification.

5.2.8 Finished cable

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

6 Characteristics and requirements

6.1 General remarks

Clause 6 lists the characteristics and minimum requirements of a cable complying with this document. Test methods shall be in accordance with IEC 61156-1:2007 and IEC 61156-1:2007/AMD1:2009, Clause 6.

The tests according to 6.2 shall be carried out on a cable length of not less than 100 m, unless otherwise specified.

All the tests according to 6.3 should be carried out on a cable length of 100 m, unless otherwise specified. If suitable, respective lengths correction formulas according to IEC 61156-1 shall be used. For Category 7_A, unless the test is performed with very sensitive test equipment, it is recommended to limit the cable length to 50 m for a better accuracy in high frequencies.

In case balunless measurements are made, the procedures should be as per IEC TR 61156-1-2:2009 and IEC TR 61156-1-2:2009/AMD1:2014 which covers the application of balunless measurement technology.

6.2 Electrical characteristics and tests

~~NOTE The tests should be carried out on a cable length of not less than 100 m, unless otherwise specified.~~

6.2.1 Conductor resistance

The maximum conductor resistance at, or corrected to, 20 °C shall not exceed 14,5 Ω/100 m of cable.

6.2.2 Resistance unbalance

6.2.2.1 Resistance unbalance within a pair

The resistance unbalance shall not exceed 2,0 %.

6.2.2.2 Resistance unbalance between pairs

The pair-to-pair resistance unbalance shall not exceed ~~4 %~~ 5,0 %.

6.2.3 Dielectric strength

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

6.2.4 Insulation resistance

The test shall be performed on

– conductor/conductor;

– conductor/screen (when present).

The minimum insulation resistance at or corrected to 20 °C shall be not less than ~~5 000 MΩ.m~~ 5 000 MΩ · km.

6.2.5 Mutual capacitance

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

6.2.6 Capacitance unbalance

The maximum capacitance unbalance pair to ground shall not exceed 1 600 pF/km at a frequency of 800 Hz or 1 000 Hz.

6.2.7 Transfer impedance

For cables containing a screen or screens, two grades of performance are recognized for transfer impedance. The transfer impedance measured using the triaxial method (IEC 62153-4-3) shall not exceed the values shown in Table 2 ~~at the discrete frequencies~~ indicated for each grade.

Table 2 – Transfer impedance

~~Frequency~~ ~~MHz~~	~~Maximum surface transfer impedance~~ ~~mΩ/m~~	
	~~Grade 1~~	~~Grade 2~~
~~1~~	~~10~~	~~50~~
~~10~~	~~10~~	~~100~~
~~30~~	~~30~~	~~200~~
~~100~~	~~100~~	~~1 000~~

Frequency range MHz	Maximum surface transfer impedance mΩ/m	
	Grade 1	Grade 2
1 to 10	$Z_t \leq 15 \times f^{0,176}$	$Z_t \leq 50 \times f^{0,301}$
10 to 30	$Z_t \leq 10 \times f/10$	$Z_t \leq 23{,}392 \times f^{0,6309}$
30 to 100	$Z_t \leq 10 \times f/10$	$Z_t \leq 2{,}120\ 6 \times f^{1,3368}$

NOTE The screen longitudinal DC resistance of 30 mΩ/m or less is an indicator for fulfilling the transfer impedance requirement of Grade 2. A measurement of DC resistance cannot replace a transfer impedance measurement.

6.2.8 Coupling attenuation

~~Three~~ Four types of performance are recognized for coupling attenuation. When measured using the absorbing clamp method (IEC 62153-4-5) or the triaxial method (IEC 62153-4-9), the coupling attenuation in the frequency range from f = 30 MHz to 1 000 MHz shall meet the requirements indicated in Table 3. For screened cables, Type II is the minimum coupling attenuation requirement.

Table 3 – Coupling attenuation in dB

~~Coupling attenuation type~~	~~Frequency range~~ ~~MHz~~	~~Coupling attenuation~~ ~~dB~~
~~Type I~~	~~30 to 100~~	~~≥85~~
	~~100 to 1 000~~	~~≥85 – 20 × log$_{10}$ (f/100)~~
~~Type II~~	~~30 to 100~~	~~≥55~~
	~~100 to 1 000~~	~~≥55 – 20 × log$_{10}$ (f/100)~~
~~Type III~~	~~30 to 100~~	~~≥40~~
	~~100 to 1 000~~	~~≥40 – 20 × log$_{10}$ (f/100)~~
~~NOTE For screened cables, the triaxial method of IEC 62153-4-9 may also be used.~~		

Coupling attenuation type	Frequency range MHz	
	30 to 100	100 to 1 000
Type I	≥ 85	≥ 85 – 20 × log$_{10}$ (f/100)
Type Ib	≥ 70	≥ 70 – 20 × log$_{10}$ (f/100)
Type II	≥ 55	≥ 55 – 20 × log$_{10}$ (f/100)
Type III	≥ 40	≥ 40 – 20 × log$_{10}$ (f/100)