BS EN 50288-1:2013

BSI Standards Publication

# Multi-element metallic cables used in analogue and digital communication and control -

## Part 1: Generic specification

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**National foreword**

This British Standard is the UK implementation of EN 50288-1:2013. It supersedes BS EN 50288-1:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/46, Cables, wires and waveguides, radio frequency connectors and accessories for communication and signalling.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.



ISBN 978 0 580 77093 7

ICS 33.120.10

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2014.

**Amendments issued since publication**

| Date | Text affected |
|---|---|

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 50288-1

May 2013

ICS 33.120.10

Supersedes EN 50288-1:2003

English version

# Multi-element metallic cables used in analogue and digital communication and control - Part 1: Generic specification

Câbles métalliques à éléments multiples utilisés pour les transmissions et les commandes analogiques et numériques - Partie 1: Spécification générique

Mehradrige metallische Daten- und Kontrollkabel für analoge und digitale Übertragung - Teil 1: Fachgrundspezifikation



CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Ref. No. EN 50288-1:2013 E

## Contents

## Foreword

This document (EN 50288-1:2013) has been prepared by CLC/SC 46XC "Multicore, Multipair and Quad Data communication cables," of CLC/TC 46X, "Communication cables".

The following dates are fixed:

| | | |
|---|---|---|
| • latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2014-03-18 |
| • latest date by which the national standards conflicting with this document have to be withdrawn | (dow) | 2016-03-18 |

This document supersedes EN 50288-1:2003.

EN 50288-1:2013 includes the following significant technical changes with respect to EN 50288-1:2003:

- the addition of the MICE table;

- a number minor corrections and updating of references;

- the re-classification of ‘ELFEXT’ to ‘ACR-F’.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

## 1 Scope

When used together with EN 50290 and EN 50289, this European Standard covers cables for instrumentation, inter-connection of equipment and information technology cabling applications.

Cables for information technology cabling systems, covered by this and the sectional specification standards in the EN 50288 series are suitable for use in digital and analogue data systems meeting the requirements, for example, of EN 50090-2-1, EN 50090-3-1, EN 50098-1, EN 50098-2 and EN 50173.

Unless otherwise specified, all cables covered by this European Standard may be subjected to voltages greater than 50 V a.c or 75 V d.c. but not more than 300 V a.c. or 450 V d.c. and shall meet the essential requirements of the low voltage directive. Due to current limitation related to the conductor cross sectional area, they are not intended for direct connection to mains electricity supply. The maximum current rating per conductor is as stipulated in Table B.1 unless otherwise specified in the relevant sectional specification. IDCs are only designed for copper or metal coated copper.

Cabling elements as defined in 4.3 of this European Standard may be incorporated in hybrid construction cables together with coaxial or optical fibre cabling elements.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| | |
|---|---|
| EN 50173 series | *Information technology — Generic cabling systems* |
| EN 50289 series | *Communication Cables — Specifications for tests methods* |
| EN 50290-1-2 | *Communication cables — Part 1-2: Definitions* |
| EN 50290-2 series | *Communication cables — Part 2: Common design rules and construction* |
| EN 50290-4-1 | *Communication cables — Part 4-1: General considerations for the use of cables – Environmental conditions and safety aspects* |
| EN 60811 series | *Electrical and optical fibre cables —Test methods for non-metallic materials.* |
| EN ISO 6892-1 | *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1)* |
| HD 402 S2 | *Standard colours for insulation for low-frequency cables and wires (IEC 60304)* |
| IEC 60028 | *International standard of resistance for copper* |

## 3 Terms and Definitions

For the purposes of this document, the terms and definitions given in EN 50290-1-2 and EN 50173 series and the following apply:

**3.1**
**horizontal cable**
cable suitable for connecting a floor distributor to a telecommunications outlet. It is suitable for installation in ducts, trunking, suspended floors and ceiling cavities

**3.2**
**building backbone cable**
cable suitable for connecting a building distributor to a floor distributor and may also connect floor distributors in the same building. It is suitable for horizontal installation or vertical installation between floors provided the cable has adequate mechanical strength

Note 1 to entry: Horizontal cable as defined in **3.1** may also be used as building backbone cable provided that it has adequate mechanical strength and fire performance characteristics.

**3.3**
**work area cable**
cable connecting the telecommunications outlet to the terminal equipment

**3.4**
**patch cord cable**
flexible cable unit or element with connector(s) used to establish connections on a patch panel

Note 1 to entry: Work area cables, as defined in **3.3**, may be used as patch cord cable in any distributor of a generic building wiring system to interconnect with equipment or to cross-connect between cabling systems.

**3.5**
**campus backbone cable**
cable suitable for connecting a campus distributor to a building distributor(s). If used outdoors or for direct burial, it shall have adequate protection for its operational environment

**3.6**
**equipment cable**
cable connecting equipment to a distributor

**3.7**
**instrumentation cable**
multi-element cable suitable for connecting instruments and control systems. It may incorporate screening, armouring and/or moisture barriers or environmental protection layers

**3.8**
**MICE**
classification system that describes the environment conditions that are local to a channel based upon the following factors: mechanical (**M**), ingress (**I**), climatic and chemical (**C**) and electromagnetic (**E**) (see Annex B)

[SOURCE: ISO/IEC/TR 29106]

**3.9**
**Blank Detail Specification (BDS)**
customer or manufacturer defined set of requirements that are agreed which are outside of the scope in the sectional specifications. It may contain additional requirements where the cable is not being installed in a normal office "environment"

Note 1 to entry: All sectional specifications for the EN 50288 series have a Blank Detail Specification in Annex B.

# 4 Requirements for cable construction

## 4.1 Conductors

Conductors are to be solid or stranded copper as specified in the relevant EN 50288 sectional specification.

The conductivity of copper conductors shall be in accordance with IEC 60028.

Stranded conductors shall consist of wires circular in section and assembled, without insulation between them, by concentric stranding or bunching. As most of these cables are used together with insulation displacement connecting devices (IDC), a maximum of seven strands should be used.

The solid conductors or the individual wires of stranded conductor may be plain or metal-coated.

There shall be no joint in the wire made subsequent to the last wire drawing operation.

Joints in individual strands of a stranded copper inner conductor shall be cold pressure welded, brazed or silver soldered using a non acid flux such that the strand diameter shall not be increased.

No joint in an individual strand shall be within 0,3 m of a joint in any other individual strand.

The nominal conductor diameter is given in the relevant sectional specification. Other diameters or stranded conductors are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

## 4.2 Insulation

The choice of the insulating material shall take into account electrical and environmental requirements.

The insulation material(s) shall meet the requirements of the relevant part or parts of EN 50290-2, or otherwise as detailed in the relevant sectional specification. Conductor insulation shall be composed of one or more suitable dielectric materials. The insulation may be solid, cellular or composite (e.g. foam-skin).

The insulation shall be continuous, having a thickness as uniform as possible. When required, the thickness of the insulation shall be measured in accordance with the method specified in EN 60811-201.

The insulation shall be applied to fit closely to the conductor. When required, the stripping properties of the insulation shall be checked in accordance with the method specified in EN 50289-3-17. When not used with IDC termination, it shall be possible to strip the insulation from the conductor easily and without visible damage to the conductor, its coating, or the insulation remaining on the conductor.

## 4.3 Cable elements

The cable element is

- a single insulated wire, or
- a pair consisting of two insulated conductors twisted together and designated wire “a” and wire “b”, or
- a triple consisting of three insulated conductors twisted together and designated wire “a”, wire “b” and wire “c” in order of rotation, or
- a quad consisting of four insulated conductors twisted together and designated wire “a”, wire “c”, wire “b” and wire “d” in order of rotation. Wires “a” and “b” form pair 1 and wires “c” and “d” form pair 2.

The choice of the lay length of the cable elements in the finished cable shall take into account the transmission requirements, handling performance and identification.

### 4.4 Identification of cabling elements

When required, the insulated conductors shall be identified by colours and/or additional ring markings and/or symbols achieved by the use of coloured insulation or by a coloured surface using extrusion, printing or painting. Colours shall be clearly identifiable and shall correspond reasonably with the standard colours shown in HD 402 S2.

The colour(s) or the symbol used for core identification shall be durable such that it cannot be removed when tested to EN 50289-3-8.

### 4.5 Screening of cabling elements

When required by the relevant sectional specification the cabling elements shall be screened by one or any combination of the following:

- a metal tape;
- a metal tape laminated to a plastic tape;
- a plain or coated metal braid;
- a helical wrap of parallel copper wires;
- a semi-conducting layer.

If a drain wire is incorporated, it shall be in contact with the screen element. The drain wire shall be either solid or stranded, made of plain or metal coated copper wire.

Care should be taken when placing dissimilar metals in contact with each other. Coatings or other methods of protection may be necessary to prevent galvanic interaction.

A protective wrapping may be applied under and/or over the screen.

Elements of screening construction (e.g. drain wire, metal tape, helical wrapping), materials (e.g. plain or plated copper) and dimensions, if required for screening efficiency are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

### 4.6 Cable make-up

The cable elements may be laid up in concentric layers or in unit construction. The cable core assembly may be protected by wrappings of non-hygroscopic tape.

NOTE When required by the sectional specification, units are identified by the use of coloured or numbered non-hygroscopic binders.

### 4.7 Filling compounds

When required by the relevant sectional specification, the interstices of the cable core shall be filled continuously with a compound suitable to prevent water penetration within the cable. The filling compound shall meet the requirements specified in EN 50290-2-28.

Alternatively, water swellable tapes, water swellable non-toxic powder or a combination of materials may be used.

Details on construction and materials are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

### 4.8 Interstitial fillers

In order to provide a compact and reasonably circular cable fillers may be used. The filler material shall be non-hygroscopic.

### 4.9 Screening of the cable core

When required by the relevant sectional specification, the cable core assembly shall be screened by one or any combination of the following:

- a metal tape;
- a metal tape laminated to a plastic tape;
- a plain or coated metal braid;
- a helical wrap of parallel copper wires;
- a semi-conducting layer.

If a drain wire is incorporated, it shall be in contact with the main screen element. The drain wire shall be either solid or stranded, made of plain or metal-coated copper.

Care should be taken when placing dissimilar metals in contact with each other. Coatings or other methods of protection may be necessary to prevent galvanic interaction.

A protective wrapping may be applied under and/or over the screen.

Elements of screening construction (e.g. drain wire, metal tape, helical wrapping), materials (e.g. plain or plated copper) and dimensions, if required for screening efficacy, are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

### 4.10 Moisture barriers

To minimise moisture permeation through the sheath, a longitudinal overlapped metallic foil may be used which is bonded to the inner surface of an extruded plastic sheath.

### 4.11 Protective wrappings

When required by the relevant sectional specification, a protective wrapping shall be provided.

### 4.12 Sheath

Sheath material(s) shall meet the requirements of the relevant part of EN 50290-2 or otherwise as detailed in the relevant sectional specification.

The sheath shall be continuous, having a thickness as uniform as possible. The thickness of the sheath shall be determined according to the method specified in EN 60811-202.

### 4.13 Bedding layers for metallic protection

When metallic protection is required, the relevant sectional specification shall give details of the bedding.

### 4.14 Metallic protection

When required by the relevant sectional specification or otherwise specified in Annex B of the relevant sectional specification, and according to 4.1.6 of EN 50290-2-1, the armouring shall consist of one or more of the following:

- a layer of round or flat galvanised steel wires (a counter helix of tape is permitted)

- a single or a double layer of steel or brass tapes
- a galvanised steel or tinned copper wire braid

### 4.15 Integral suspension strand

When required, the integral suspension strand shall be in accordance with 4.1.5 of EN 50290-2-1 and shall meet the requirements of the relevant sectional specification

### 4.16 Oversheath

The choice of the sheath material shall take into account electrical and environmental requirements.

Sheath material(s) shall meet the requirements of the relevant part of EN 50290-2 series or otherwise as detailed in the relevant sectional specification.

The sheath shall be continuous, having a thickness as uniform as possible. The thickness of the sheath shall be determined according to the method specified in EN 60811-202.

### 4.17 Fauna protection

The relevant sectional specification shall indicate details of the protection required to protect the cable against attack by fauna (such as rodents or insects). The protection may be a choice of armouring (**4.14**), special wrapping tape (**4.11**), outer sheath material (**4.16**) or any combination of these. Relevant details if required are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

### 4.18 Chemical and /or environmental protection

When required, a protection against chemical hazards and/or environmental effects shall be provided.

It may consist of one or more of the following:

- a metallic sheath of lead or suitable lead alloy;
- a multi-layer sheath of an aluminium tape and polyolefin, e.g. high density polyethylene or polyamide.

The sheath shall be continuous, having a thickness as uniform as possible. The thickness of the sheath shall be determined according to the method specified in EN 60811-202.

NOTE Other designs are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant detail specification.

## 5 Test methods for completed cables

As required by the relevant sectional specification or otherwise specified in Annex B of the relevant sectional specification, test methods selected from those listed below shall be applied. All values or limits are given for 20 °C if not otherwise specified in Annex B of the relevant sectional specification.

Different requirements or limits, supplements or otherwise shall be described in Annex B of the relevant sectional specification.

## 5.1 Electrical test methods

### 5.1.1 Low-frequency and d.c. electrical measurements

**Table 1 - Low-frequency and d.c. electrical measurements**

| EN 50288 series sub-clause n° | Parameter | Test method standard |
|---|---|---|
| 5.1.1.1 | Conductor loop resistance | EN 50289-1-2 |
| 5.1.1.2 | Conductor resistance unbalance | EN 50289-1-2 |
| 5.1.1.3 | Dielectric strength | EN 50289-1-3 |
| 5.1.1.4 | Insulation resistance | EN 50289-1-4 |
| 5.1.1.5 | Mutual capacitance | EN 50289-1-5 |
| 5.1.1.6 | Capacitance unbalance | EN 50289-1-5 |
| 5.1.1.7 | Inductance | EN 50289-1-12 |
| 5.1.1.8 | Inductance to resistance ratio | EN 50289-1-12 |

### 5.1.2 High-frequency electrical and transmission measurements

**Table 2 - High-frequency electrical and transmission measurements**

| EN 50288 series sub-clause n° | Parameter | Test method standard |
|---|---|---|
| 5.1.2.1 | Velocity of propagation | EN 50289-1-7 |
| 5.1.2.2 | Propagation delay difference (skew) | EN 50289-1-7 |
| 5.1.2.3 | Longitudinal attenuation | EN 50289-1-8 |
| 5.1.2.4 | Longitudinal conversion loss (LCL) | EN 50289-1-9 |
| 5.1.2.5 | Near-end crosstalk (NEXT) | EN 50289-1-10 |
| 5.1.2.6 | Equal Level Far-end crosstalk (ACR-F)[1)] | EN 50289-1-10 |
| 5.1.2.7 | Power sum (PS) of crosstalk loss | EN 50289-1-10 |
| 5.1.2.8 | Characteristic impedance | EN 50289-1-11 |
| 5.1.2.9 | Return loss | EN 50289-1-11 |
| 5.1.2.10 | Coupling attenuation | EN 50289-1-6 |
| 5.1.2.11 | Transfer impedance | EN 50289-1-6 |
| 5.1.2.12 | Screening attenuation | EN 50289-1-6 |
| 5.1.2.13 | Exogenous crosstalk | prEN 50289-1-17 |

[1)] Equal Level Far-end crosstalk (ELFEXT) is now re-classified as ACR-F see Annex A for explanation.

## 5.2 Mechanical test methods

Mechanical tests described in the relevant sectional specification for office application, in the MICE table or other special mechanical tests, their requirements and the limits for these products used in industrial or environmentally demanding areas are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

**Table 3 – Mechanical test methods**

| **EN 50288 series sub-clause n°** | **Parameter** | **Test method standard** |
|---|---|---|
| 5.2.1 | Conductor elongation at break | EN ISO 6892-1 |
| 5.2.2 | Shrinkage of insulation | EN 50289-3-4 |
| 5.2.3 | Crush resistance of the cable | EN 50289-3-5 |
| 5.2.4 | Impact resistance of the cable | EN 50289-3-6 |
| 5.2.5 | Abrasion resistance of the sheath marking | EN 50289-3-8 |
| 5.2.6 | Simulated installation testing of the cable | EN 50289-3-9 |
| 5.2.7 | Tensile performance of the cable | EN 50289-3-16 |
| 5.2.8 | Flexing performance of the cable | EN 50289-3-10 |

## 5.3 Environmental test methods

All environmental tests of the relevant sectional specification are applicable. Other special tests, requirements and limits for these products used in industrial or environmentally demanding areas are to be agreed between manufacturer and purchaser and specified in Annex B of the relevant sectional specification.

**Table 4 – Environmental test methods**

| **EN 50288 series sub-clause n°** | **Parameter** | **Test method standard** |
|---|---|---|
| 5.3.1 | Cold bend performance of the cable | EN 60811-504 |
| 5.3.2 | Water penetration test | EN 50289-4-2 |
| 5.3.3 | Moisture permeation test | EN 60811-402 |
| 5.3.4 | Resistance to solvents and contaminating fluids | EN 50289-4-4 |
| 5.3.5 | Temperature cycling | EN 50289-4-6 |
| 5.3.6 | Heat shock performance (test) | EN 50290-2-27 |

## 5.4 Fire performance test methods

The choice of the tests to be performed shall be made according to EN 50290-4-1.

# Annex A
(informative)

# ELFEXT re-classification to ACR-F

ELFEXT Equal Level Far End Crosstalk is now re-classified as ACR-F Attenuation to Crosstalk Ratio at the Far end.

For telephone cables and the type of measuring devices then known ELFEXT was a very useful measurement required for engineering long lines. Since the arrival of Data Cables, required to carry much higher frequencies, using tightly twisted pairs and the introduction of s-parameter test analysers ELFEXT was not actually being measured in the same way anymore. Due to some complicated chip designs and the introduction of using all 4 pairs at the same instant a better method of extracting information became necessary. To the cable maker there is minimal change as the limits remain the same.

The term ELFEXT is replaced here by the definition of ACR–F. While the first relates the FEXT to the propagation constant of the **DISTURBING** pair, the ACR–F relates the FEXT to the propagation constant of the **DISTURBED** pair, and gives as such directly the signal to noise ratio as a result of the FEXT.

# Annex B
(informative)

# MICE Table

(Extracted from ISO/IEC/TR 29106)

**Table B.1 - Classification**

| | 1 | 2 | 3 |
|---|---|---|---|
| Mechanical Rating | $M_1$ | $M_2$ | $M_3$ |
| Ingress Rating | $I_1$ | $I_2$ | $I_3$ |
| Climatic Rating | $C_1$ | $C_2$ | $C_3$ |
| Electromagnetic Rating | $E_1$ | $E_2$ | $E_3$ |

**Table B.2 - Characteristics**

| | | **Classification** | | |
|---|---|---|---|---|
| **Mechanical characteristics** | | **1** | **2** | **3** |
| Crush test of the cable | 5.2.3 | $M_1 \geq 45$ N | $M_2 \geq 100$ N | $M_3 \geq 200$ N |
| Impact test of the cable | 5.2.4 | $M_1 \geq 1$ J | $M_2 \geq 10$ J | $M_3 \geq 20$ J |
| Shock | EN 62012 | $M_1 \geq$ NA | $M_2 \geq 15$ g/11 ms | $M_3 \geq 50$ g/11 ms |
| Bump | EN 62012 | $M_1$ NA | $M_2 \geq 15$ g/11 ms | $M_3 \geq 50$ g/11 ms |
| Vibration | EN 62012 | NA | 10-500 Hz with 10 g | 10-2000 Hz with 20 g |
| Water immersion | 5.3.2 | $C_1$ NA | $C_2$ NA | $C_3$ 1 m/30 mn |
| Damp heat steady state | EN 62012 | $C_1$ NA | $C_2$ 60-90-10 | $C_3$ 60-90-56 |
| Solar radiation | Uc | $C_1$ NA | $C_2$ UC | $C_3$ UC |
| UV Test | | $C_1$ 700 $Wm^{-2}$ | $C_2$ 1 120 $Wm^{-2}$ | $C_3$ 1 120 $Wm^{-2}$ |
| Solvents and contaminating fluids | 5.3.4 | $C_1$ | $C_2$ | $C_3$ |

| | | | | |
|---|---|---|---|---|
| Salt mist and sulphur dioxide tests | | $C_1$ NA | $C_2$ NA | $C_3$ 4 jours |
| Climatic sequence | 5.3.5 | -40 °C to +60 °C | -40 °C to +70 °C | -40 °C to +70 °C |
| Hygroscopicity | | | | |
| Wicking | | | | |
| Flame propagation characteristics of a single cable | 5.4 | | | |
| Flame propagation characteristics of bunched cable | 5.4 | | | |
| Halogen gas evolution | 5.4 | | | |
| Smoke generation | 5.4 | The requirement and the test method shall be specified in the detailed specification | | |
| Toxic gas emission | 5.4 | | | |
| Integrated Fire Test | 5.4 | | | |
| Spark test | | | | |

## Bibliography

The following standards are referenced but do not constitute a normative part of the standard:

EN 50090-2-1 *Home and Building Electronic Systems (HBES) — Part 2-1: System overview — Architecture*

EN 50090-3-1 *Home and Building Electronic Systems (HBES) — Part 3-1: Aspects of application — Introduction to the application structure*

EN 50098-1 *Customer premises cabling for Information Technology — Part 1: ISDN basic access*

EN 50098-2 *Customer premises cabling for Information Technology — Part 2: 2 048 kbit/s ISDN primary access and leased line network interface*

IEC 60189-1 *Low-frequency cables and wires with PVC insulation and PVC sheath — Part 1: General test and measuring methods*

ISO/IEC 24702 *Information Technology — Generic cabling — Industrial Premises*

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