



BSI Standards Publication

Information technology - Generic cabling systems

Part 1: General requirements

National foreword

This British Standard is the UK implementation of EN 50173-1:2018. It supersedes BS EN 50173-1:2011, which is withdrawn.

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Anforderungen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European foreword

This document (EN 50173-1:2018) was prepared by CLC/TC 215, "*Electrotechnical aspects of telecommunication equipment*".

The following dates are fixed:

- latest date by which this document has to be (dop) 2019-03-19
implemented at national level by publication of
an identical national standard or by
endorsement
- latest date by which the national standards (dow) 2021-03-19
conflicting with this document have to be
withdrawn

This document supersedes EN 50173-1:2011.

The first edition of EN 50173-1, published in 2002, has been developed to enable the application-independent cabling to support ICT applications in office premises. Their basic principles, however, are applicable to other types of applications and in other types of premises.

This edition of EN 50173-1:

- a) introduces new balanced cabling component Categories 8.1 and 8.2 to support new channel Classes I and II;
- b) removes balanced cabling components and channel Class CCCB;
- c) removes the optical fibre Classes concept;
- d) defines a new cabled optical fibre Category OM5;
- e) updates Annex F "Supported applications";
- f) amends various other subclauses, tables and figures.

TC 215 has decided to establish relevant European Standards which address the specific requirements of these premises. In order to point out the commonalities of these cabling design standards, these ENs are published as individual parts of the series EN 50173, thus also acknowledging that standards users recognize the designation "EN 50173" as a synonym for generic cabling design.

At the time of publication of this European Standard, series EN 50173 comprises the following standards:

EN 50173-1	Information technology – Generic cabling systems – Part 1: General requirements
EN 50173-2	Information technology – Generic cabling systems – Part 2: Office spaces
EN 50173-3	Information technology – Generic cabling systems – Part 3: Industrial spaces
EN 50173-4	Information technology – Generic cabling systems – Part 4: Homes
EN 50173-5	Information technology – Generic cabling systems – Part 5: Data centre spaces
EN 50173-6	Information technology – Generic cabling systems – Part 6: Distributed building services

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

Introduction

This European Standard contains general requirements in support of the other standards in the EN 50173 series.

It should be noted that generic cabling is a passive system and cannot be tested for EMC compliance individually. Application-specific equipment, designed for one or more cabling media, is required to meet relevant EMC standards on those media. Care should be taken that the installation of any of those media in a cabling system does not degrade the characteristics of the system. The installation methods of EN 50174 series should be used to minimise the effect of electromagnetic disturbances. For EMC requirements of BCT cabling see EN 50083-8.

Figure 1 and Table 1 show the schematic and contextual relationships between the standards produced by TC 215 for information technology cabling, namely:

- 1) this and other parts of the EN 50173 series;
- 2) installation (EN 50174 series);
- 3) bonding (EN 50310).

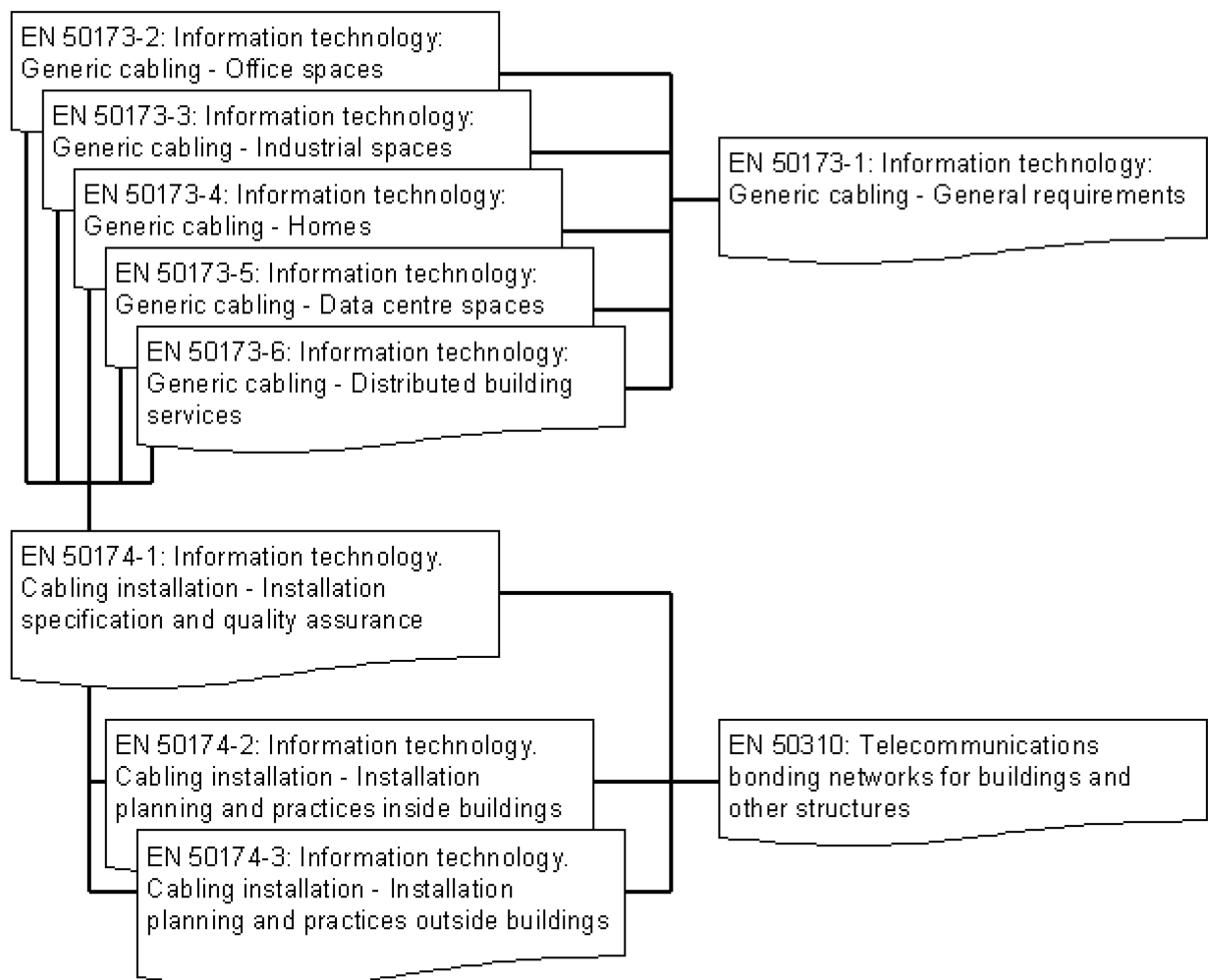


Figure 1 — Schematic relationship between the EN 50173 series and other relevant standards

Table 1 — Contextual relationship between EN 50173 series and other standards relevant for information technology cabling systems

Building design phase	Generic cabling design phase	Specification phase	Installation phase	Operation phase
EN 50310	EN 50173-2 EN 50173-3 EN 50173-4 EN 50173-5 EN 50173-6 (these ENs reference general requirements of EN 50173-1)	EN 50174-1	EN 50174-2 EN 50174-3 EN 50310	EN 50174-1
		Planning phase		
		EN 50174-2 EN 50174-3 EN 50310		

In addition, a number of Technical Reports have been developed to support or extend the application of these standards, including:

- CLC/TR 50173-99-1, *Cabling guidelines in support of 10 GBASE-T*;
- CLC/TR 50173-99-2, *Information technology — Implementation of BCT applications using cabling in accordance with EN 50173-4*;
- CLC/TR 50173-99-3, *Information technology — Generic cabling systems — Part 99-3: Home cabling infrastructures up to 50 m in length to support simultaneous and non simultaneous provision of applications*.

In addition, a number of cabling design standards have been developed using components of EN 50173-1 (e.g. EN 50098 series and EN 50700).

1 Scope and conformance

1.1 Scope

This European Standard specifies:

- a) the structure and configuration of the backbone cabling subsystems of generic cabling systems within the types of premises and/or spaces defined by the other standards in the EN 50173 series;
- b) channel transmission and environmental performance requirements in support of the standards in the EN 50173 series (which have taken into account requirements specified in application standards listed in Annex F);
- c) link performance requirements in support of the standards in the EN 50173 series;
- d) backbone cabling reference implementations in support of the standards in the EN 50173 series;
- e) component performance requirements in support of the standards in the EN 50173 series;
- f) test procedures to verify conformance to the cabling transmission performance requirements of the standards in the EN 50173 series.

Safety and electromagnetic compatibility (EMC) requirements are outside the scope of this European Standard and are covered by other standards and regulations. However, information given in this European Standard can be of assistance in meeting these standards and regulations.

1.2 Conformance

This European Standard does not contain specific conformance requirements. The other standards in the EN 50173 series incorporate the requirements of this standard as part of their individual conformance requirements.

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.

EN 50083 (all parts), *Cable networks for television signals, sound signals and interactive services*

NOTE EN 50083 series is gradually replaced by EN 60728 series.

EN 50117-1, *Coaxial cables - Part 1: Generic specification*

EN 50117-4-1, *Coaxial cables - Part 4-1: Sectional specification for cables for BCT cabling in accordance with EN 50173 - Indoor drop cables for systems operating at 5 MHz - 3 000 MHz*

EN 50174-1, *Information technology - Cabling installation - Part 1: Installation specification and quality assurance*

EN 50174-2, *Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings*

EN 50174-3, *Information technology - Cabling installation - Part 3: Installation planning and practices outside buildings*

EN 50288-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 1: Generic specification*

EN 50288-2-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 2-1: Sectional specification for screened cables characterised up to 100 MHz - Horizontal and building backbone cables*

EN 50288-2-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 2-2: Sectional specification for screened cables characterised up to 100 MHz - Work area and patch cord cables*

EN 50288-3-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 3-1: Sectional specification for unscreened cables characterised up to 100 MHz - Horizontal and building backbone cables*

EN 50288-3-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 3-2: Sectional specification for unscreened cables characterised up to 100 MHz - Work area and patch cord cables*

EN 50288-4-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 4-1: Sectional specification for screened cables characterised up to 600 MHz - Horizontal and building backbone cables*

EN 50288-4-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 4-2: Sectional specification for screened cables characterised up to 600 MHz - Work area and patch cord cables*

EN 50288-5-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 5-1: Sectional specification for screened cables characterized up to 250 MHz - Horizontal and building backbone cables*

EN 50288-5-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 5-2: Sectional specification for screened cables characterized up to 250 MHz - Work area and patch cord cables*

EN 50288-6-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 6-1: Sectional specification for unscreened cables characterised up to 250 MHz - Horizontal and building backbone cables*

EN 50288-6-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 6-2: Sectional specification for unscreened cables characterised up to 250 MHz - Work area and patch cord cables*

EN 50288-9-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 9-1: Sectional specification for screened cables characterised up to 1 000 MHz - Horizontal and building backbone cables*

EN 50288-9-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 9-2: Sectional specification for screened cables characterized from 1 MHz up to 1 000 MHz for work area, patch cord and data centre applications*

EN 50288-10-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 10-1: Sectional specification for screened cables characterized up to 500 MHz - Horizontal floor and building backbone cables*

EN 50288-10-2, *Multi-element metallic cables used in analogue and digital communication and control - Part 10-2: Sectional specification for screened cables characterized from 1 MHz up to 500 MHz for work area, patch cord and data centre applications*

EN 50288-11-1, *Multi-element metallic cables used in analogue and digital communication and control - Part 11-1: Sectional specification for un-screened cables characterised up to 500 MHz - Horizontal and building backbone cables*

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EN 50289-1-14, *Communication cables - Specifications for test methods - Part 1-14: Electrical test methods - Coupling attenuation or screening attenuation of connecting hardware*

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¹⁾ In preparation by CLC/SC 46XC.

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EN 60352-3, *Solderless connections - Part 3: Solderless accessible insulation displacement connections - General requirements, test methods and practical guidance*

EN 60352-4, *Solderless connections - Part 4: Solderless non-accessible insulation displacement connections - General requirements, test methods and practical guidance*

EN 60352-5, *Solderless connections - Part 5: Press-in connections - General requirements, test methods and practical guidance*

EN 60352-6, *Solderless connections - Part 6: Insulation piercing connections - General requirements, test methods and practical guidance*

EN 60352-7, *Solderless connections - Part 7: Spring clamp connections - General requirements, test methods and practical guidance*

EN 60352-8, *Solderless connections - Part 8: Compression mount connections - General requirements, test methods and practical guidance*

EN 60512-3-1, *Connectors for electronic equipment - Tests and measurements - Part 3-1: Insulation tests - Test 3a: Insulation resistance*

EN 60512-4-1, *Connectors for electronic equipment - Tests and measurements - Part 4-1: Voltage stress tests - Test 4a: Voltage proof*

EN 60512-4-2, *Connectors for electronic equipment - Tests and measurements - Part 4-2: Voltage stress tests - Test 4b: Partial discharge*

EN 60512-6-2, *Connectors for electronic equipment - Tests and measurements - Part 6-2: Dynamic stress tests - Test 6b: Bump*

EN 60512-6-3, *Connectors for electronic equipment - Tests and measurements - Part 6-3: Dynamic stress tests - Test 6c: Shock*

EN 60512-6-4, *Connectors for electronic equipment - Tests and measurements - Part 6-4: Dynamic stress tests - Test 6d: Vibration (sinusoidal)*

EN 60512-11-4, *Connectors for electronic equipment - Tests and measurements - Part 11-4: Climatic tests - Test 11d: Rapid change of temperature*

EN 60512-11-7, *Connectors for electronic equipment - Tests and measurements - Part 11- 7: Climatic tests - Test 11g: Flowing mixed gas corrosion test*

EN 60512-11-9, *Connectors for electronic equipment - Tests and measurements - Part 11-9: Climatic tests - Test 11i: Dry heat*

EN 60512-11-10, *Connectors for electronic equipment - Tests and measurements - Part 11-10: Climatic tests - Test 11j: Cold*

EN 60512-11-12, *Connectors for electronic equipment - Tests and measurements - Part 11-12: Climatic tests - Test 11m: Damp heat, cyclic*

EN 60512-16-4, *Connectors for electronic equipment - Tests and measurements - Part 16-4: Mechanical tests on contacts and terminations - Test 16d: Tensile strength (crimped connections)*

EN 60512-17-2, *Connectors for electronic equipment - Tests and measurements - Part 17-2: Cable clamping tests - Test 17b: Cable clamp resistance to cable rotation*

EN 60512-17-4, *Connectors for electronic equipment - Tests and measurements - Part 17-4: Cable clamping tests - Test 17d: Cable clamp resistance to cable torsion*

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- EN 60512-23-3, *Electromechanical components for electronic equipment - Basic testing procedures and measuring methods - Part 23-3: Test 23c: Shielding effectiveness of connectors and accessories*
- EN 60512-25-1, *Connectors for electronic equipment - Tests and measurements - Part 25-1: Test 25a - Crosstalk ratio*
- EN 60512-25-2, *Connectors for electronic equipment - Tests and measurements - Part 25-2: Test 25b: Attenuation (insertion loss)*
- EN 60512-25-4, *Connectors for electronic equipment - Tests and measurements - Part 25-4: Test 25d - Propagation delay*
- EN 60512-25-5, *Connectors for electronic equipment - Tests and measurements - Part 25-5: Test 25e - Return loss*
- EN 60512-25-9, *Connectors for electronic equipment - Tests and measurements - Part 25-9: Signal integrity tests - Test 25i: Alien crosstalk*
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- EN 60603-7:2009, *Connectors for electronic equipment - Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*
- EN 60603-7-1, *Connectors for electronic equipment - Part 7-1: Detail specification for 8-way, shielded, free and fixed connectors*
- EN 60603-7-2, *Connectors for electronic equipment - Part 7-2: Detail specification for 8-way, unshielded, free and fixed connectors, for data transmissions with frequencies up to 100 MHz*
- EN 60603-7-3, *Connectors for electronic equipment - Part 7-3: Detail specification for 8-way, shielded, free and fixed connectors, for data transmission with frequencies up to 100 MHz*
- EN 60603-7-4, *Connectors for electronic equipment - Part 7-4: Detail specification for 8-way, unshielded, free and fixed connectors, for data transmissions with frequencies up to 250 MHz*
- EN 60603-7-41, *Connectors for electronic equipment - Part 7-41: Detail specification for 8-way, unshielded, free and fixed connectors, for data transmissions with frequencies up to 500 MHz*
- EN 60603-7-5, *Connectors for electronic equipment - Part 7-5: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 250 MHz*
- EN 60603-7-51, *Connectors for electronic equipment - Part 7-51: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 500 MHz*
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- EN 60603-7-71, *Connectors for electronic equipment - Part 7-71: Detail specification for 8-way, shielded, free and fixed connectors, for data transmission with frequencies up to 1 000 MHz*
- EN 60603-7-81, *Connectors for electronic equipment - Part 7-81: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 2 000 MHz*

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- EN 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres (IEC 60793-2-10)*
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- EN 61300-2-5, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-5: Tests - Torsion*
- EN 61300-2-9, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-9: Tests - Shock*
- EN 61300-2-18, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-18: Tests - Dry heat - High temperature endurance*
- EN 61300-2-22, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-22: Tests - Change of temperature*
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3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document and the other standards in the EN 50173 series, the following terms and definitions and those of EN 50174-1 apply.

3.1.1

administration

methodology defining the documentation requirements of a cabling system and its containment, the labelling of functional elements and the process by which moves, additions and changes are recorded

3.1.2

alien crosstalk

signal coupling from a disturbing pair of a channel to a disturbed pair of another channel

Note 1 to entry: This also applies to the signal coupling from a disturbing pair within a link or component, used to create a channel, to a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.3

alien far-end crosstalk loss

signal isolation between a disturbing pair of a channel and a disturbed pair of another channel, measured at the far-end

Note 1 to entry: This also applies to the measurement of the signal isolation between a disturbing pair within a link or component, used to create a channel, and a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.4

alien near-end crosstalk loss

signal isolation between a disturbing pair of a channel and a disturbed pair of another channel, measured at the near-end

Note 1 to entry: This also applies to the measurement of the signal isolation between a disturbing pair within a link or component, used to create a channel, and a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.5**application**

system, with its associated transmission and power feeding method that is supported by telecommunications cabling

3.1.6**attenuation**

decrease in magnitude of power of a signal in transmission between points

Note 1 to entry: Attenuation indicates the total losses on cable, expressed as the ratio of power output to power input.

3.1.7**attenuation to alien crosstalk ratio at the far-end**

difference, in dB, between the alien far-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair in another channel

Note 1 to entry: This also applies to the calculation using the alien far-end crosstalk loss from a disturbing pair within a link or component, used to create a channel, and the insertion loss of a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.8**attenuation to alien crosstalk ratio at the near-end**

difference, in dB, between the alien near-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair in another channel

Note 1 to entry: This also applies to the calculation using the alien near-end crosstalk loss from a disturbing pair within a link or component, used to create a channel, and the insertion loss of a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.9**attenuation to crosstalk ratio at the far-end**

difference, in dB, between the far-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair of the same channel

Note 1 to entry: This also applies to the calculation using the far-end crosstalk loss from a disturbing pair within a link or component, used to create a channel, and the insertion loss of a disturbed pair within the link or component, of the same channel.

3.1.10**attenuation to crosstalk ratio at the near-end**

difference, in dB, between the near-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair of the same channel

Note 1 to entry: This also applies to the calculation using the near-end crosstalk loss from a disturbing pair within a link or component, used to create a channel, and the insertion loss of a disturbed pair within the link or component, of the same channel.

3.1.11**average alien near-end crosstalk loss**

calculated average of the alien near-end crosstalk loss of the pairs of a disturbed channel

Note 1 to entry: This also applies to the calculation using the pairs within a link, used to create a channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.12

average power sum alien near-end crosstalk loss

calculated average of the power sum alien near-end crosstalk loss of the pairs of a disturbed channel

Note 1 to entry: This also applies to the calculation using the pairs within a link, used to create a channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.13

average power sum attenuation to alien crosstalk ratio far-end

calculated average of the power sum attenuation to alien crosstalk ratio at the far-end of the pairs of a disturbed channel

Note 1 to entry: This also applies to the calculation using the pairs within a link, used to create a channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.14

balanced cable

cable consisting of one or more symmetrical metallic cable elements (twisted pairs or quads)

3.1.15

broadcast and communication technologies

group of applications including radio, TV and two-way data services, as well as for in-home inter-networking

3.1.16

building backbone cable

cable that connects the building distributor to a subsidiary distributor

3.1.17

building distributor

distributor in which the building backbone cable(s) terminate(s) and at which connections to the campus backbone cable(s) can be made

3.1.18

building entrance facility

facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and which can enable transition from outdoor to indoor cable

3.1.19

cable

assembly of one or more cable units in an overall sheath

Note 1 to entry: A cable can include an overall screen.

3.1.20

cable element

smallest construction unit in a cable

Note 1 to entry: A cable element can have a screen.

Note 2 to entry: A pair, a quad, a single isolated lead with coaxial screen and a single optical fibre are examples of a cable element.

3.1.21

cable sharing

using a single cable to support the simultaneous transmission of more than one application

3.1.22**cable unit**

single assembly of one or more cable elements usually of the same type

Note 1 to entry: A cable unit can have a screen.

3.1.23**cabling**

system of telecommunications cables, cords and connecting hardware that supports the operation of information technology equipment

3.1.24**campus**

premises containing one or more buildings

3.1.25**campus backbone cable**

cable that connects the campus distributor to the building distributor(s)

3.1.26**campus distributor**

distributor from which the campus backbone cabling emanates

3.1.27**channel**

any transmission path comprising passive cabling components between application-specific equipment or between application-specific equipment and an external network interface

Note 1 to entry: Differing definitions of the term “channel” as given in other standards (such as series EN 50083) are not applicable in series EN 50173.

3.1.28**coaxial cable**

cable in which the transmission line is in the form of two coaxial conductors (unbalanced cable)

3.1.29**connector**

component normally attached to a cable or mounted on a piece of apparatus (excluding an adapter) for joining separable parts of a cabling system

3.1.30**connecting hardware**

device or combination of devices used to connect cables or cable elements

3.1.31**connection**

mated device or combination of devices including terminations used to connect cables or cable elements to other cables, cable elements or application specific equipment

3.1.32**connector sharing**

using connecting hardware to support the simultaneous transmission of more than one application

3.1.33**cord**

cable unit or element with a minimum of one termination

3.1.34

coupling attenuation

ratio, in dB, of the differential power in the signal pairs to the power generated by the excited common mode currents

3.1.35

cross-connect

passive connection between cabling subsystems using a patch cord or jumper

3.1.36

cross-connection

connection by means of a cross-connect

3.1.37

data centre

a structure, or group of structures, dedicated to the centralized accommodation, interconnection and operation of information technology and network telecommunications equipment providing data storage, processing and transport services, together with all the facilities and infrastructures for power distribution and environmental control, together with the necessary levels of resilience and security required to provide the desired service availability

Note 1 to entry: A structure can consist of multiple buildings and/or spaces with specific functions to support the primary function

Note 2 to entry: The boundaries of the structure or space considered the data centre which includes the information and communication technology equipment and supporting environmental controls can be defined within a larger structure or building

[SOURCE: EN 50600-1:2012, 3.1.9 – modified: added NOTE 2]

3.1.38

disaster recovery

use of a complete redundant architecture designed and operated to provide a minimum service level pending repairs following damage to the primary architecture

3.1.39

distributor

functional element enabling the termination and connection of cabling subsystems to other cabling subsystems or transmission equipment

3.1.40

equipment cord

cord connecting one end of the cabling subsystem in a distributor to transmission equipment

3.1.41

equipment interface

point at which application-specific equipment can be connected to the generic cabling or network access cabling

3.1.42

external network interface

termination point providing demarcation of external telecommunications service provision

3.1.43

fixed connector

balanced cabling jack, coaxial cabling adapter (either integrated with or housing a coaxial free connector) or optical fibre adapter (either integrated with or housing an optical fibre connector plug)

3.1.44**free connector**

balanced, coaxial or optical fibre cabling plug

3.1.45**functional performance**

level of transmission performance able to support an intended Class of applications

3.1.46**generic cabling**

structured telecommunications cabling system, that is capable of supporting a wide range of standardised applications

Note 1 to entry: Application-specific hardware is not a part of generic cabling.

Note 2 to entry: Generic cabling can be installed without prior knowledge of the required applications.

3.1.47**hybrid cable**

assembly of two or more cable units of different types in an overall sheath

Note 1 to entry: It can be covered by an overall screen.

3.1.48**information and communication technologies**

group of applications using information and communications (telecommunications) technologies

3.1.49**information technology****telecommunications**

technology concerned with the transmission, emission and reception of signs, signals, writing, images and sounds by cable, radio, optical or other electromagnetic systems

Note 1 to entry: The term telecommunications has no legal meaning when used in this document.

3.1.50**insertion loss**

loss incurred by inserting a device between a source and load of equal impedance. The device itself may have a different impedance from the load and source impedance

Note 1 to entry: The terms operational attenuation or operational insertion loss are sometimes associated with this definition.

3.1.51**insertion loss deviation**

difference between the measured insertion loss of cascaded components and the insertion loss determined by the sum of the individual component insertion losses

3.1.52**interconnect**

passive connection to a cabling subsystem without the use of a patch cord or jumper

3.1.53**jack**

balanced cabling socket connector

3.1.54**jumper**

cable, cable unit or cable element without connectors used for a cross-connection

3.1.55

keying

mechanical feature of a connector system that guarantees correct orientation of a connection or prevents the connection to an inappropriate interface

3.1.56

link

transmission path between two specified test interfaces of generic cabling

3.1.57

localised security

protection of data within a given cabling subsystem

3.1.58

longitudinal conversion loss

logarithmic ratio expressed in decibels of the common mode injected signal at the near end to the resultant differential signal at the near end of a balanced pair

3.1.59

longitudinal conversion transfer loss

logarithmic ratio expressed in decibels of the common mode injected signal at the near end to the resultant differential signal at the far end of a balanced pair

3.1.60

multi-unit cable

balanced cable containing more than four pairs

3.1.61

network access cable

cable connecting an external network interface to a generic cabling distributor

3.1.62

operating temperature

stabilised temperature of the cabling, measured on the outside of the cable sheath, combining ambient temperature with any increase due to the application being supported

3.1.63

optical fibre cable

cable comprising one or more optical fibre cable elements

3.1.64

pair

two conductors of a balanced transmission line

Note 1 to entry: Examples are a twisted pair cable element or one side circuit in a quad cable element.

3.1.65

patch cord

cord used for a cross-connection

3.1.66

patch panel

panel at a distributor presenting the interface(s) of cabling subsystems to facilitate administrative moves, adds and changes using patch cords or jumpers

Note 1 to entry: The panel also enables interfaces to be connected to transmission equipment using interconnect cords.

3.1.67**permanent link**

transmission path between the two test interfaces at the ends of a cabling subsystem including the connecting hardware at those interfaces

Note to entry: Premises-specific definitions are found in other standards in the EN 50173 series.

3.1.68**power sum alien far-end crosstalk loss**

power sum of the signal isolation between multiple disturbing pairs of one or more channels and a disturbed pair of another channel, measured at the far-end

Note 1 to entry: This also applies to the calculation using the multiple disturbing pairs within one or more links or components and a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.69**power sum alien near-end crosstalk loss**

power sum of the signal isolation between multiple disturbing pairs of one or more channels and a disturbed pair of another channel, measured at the near-end

Note 1 to entry: This also applies to the calculation using the multiple disturbing pairs within one or more links or components and a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.70**power sum attenuation to alien crosstalk ratio at the far-end**

difference, in dB, between the power sum alien far-end crosstalk loss from multiple disturbing pairs of one or more channels and the insertion loss of a disturbed pair in another channel

Note 1 to entry: This also applies to the calculation using the multiple disturbing pairs within one or more links or components and the insertion loss of a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.71**power sum attenuation to alien (exogenous) crosstalk ratio at the near-end**

difference, in dB, between the power sum alien near-end crosstalk loss from multiple disturbing pairs of one or more channels and the insertion loss of a disturbed pair in another channel

Note 1 to entry: This also applies to the calculation using the multiple disturbing pairs within one or more links or components and the insertion loss of a disturbed pair within a link or component, used to create another channel.

Note 2 to entry: Alien crosstalk is also known as exogenous crosstalk.

3.1.72**power sum attenuation to crosstalk ratio at the far-end**

difference, in dB, between the power sum far-end crosstalk loss from multiple disturbing pairs of a channel and the insertion loss of a disturbed pair in the same channel

Note 1 to entry: This also applies to the calculation using the multiple disturbing pairs within one or more links or components, used to create a channel, and the insertion loss of a disturbed pair within a link or component, of the same channel.

3.1.73

power sum attenuation to crosstalk ratio at the near-end

difference, in dB, between the power sum near-end crosstalk loss from multiple disturbing pairs of a channel and the insertion loss of a disturbed pair in the same channel

Note 1 to entry: This also applies to the calculation using the multiple disturbing pairs within one or more links or components, used to create a channel, and the insertion loss of a disturbed pair within a link or component, of the same channel.

3.1.74

quad

cable element that comprises four insulated conductors twisted together

Note 1 to entry: Two diametrically facing conductors form a transmission pair also referred to as a side circuit.

3.1.75

redundancy

multiple paths, at interface, cable or pathway level, within which one path is active and other paths provide an equivalent capacity

3.1.76

resilience

multiple active transmission paths where each path provides an adequate level of service in case of failure of one or more of the other paths

3.1.77

requirement met by design

requirement that does not require testing and where conformance can be achieved either by selection of appropriate components and their installation techniques or by conformance of a related parameter

3.1.78

screened (balanced) cable

assembly of two or more balanced twisted pair cable elements or one or more quad cable elements where each element is individually screened and/or the elements are contained within an overall screen

3.1.79

screened cabling

system of telecommunications cables, cords and connecting hardware each of which contains screens and within which the screens are interconnected

3.1.80

splice

joining of conductors or fibres, generally from separate cables

3.1.81

subsidiary distributor

the distributor of the relevant premises-specific standards in the EN 50173 series to which the building backbone cabling is connected

3.1.82

terminal equipment

active equipment at a terminal equipment outlet used to access information provided by transmission equipment

3.1.83

terminal equipment outlet

fixed connector, unless otherwise specified, providing connection to terminal equipment within the other standards of the EN 50173 series

3.1.84**test interface**

point at which test equipment is connected to generic cabling under test

3.1.85**tie cable**

cable that connects distributors of the same hierarchical level

3.1.86**transmission equipment**

equipment used to distribute information from distributors to other distributors and to terminal equipment outlets

3.1.87**transverse conversion loss**

ratio between the common mode signal power and the injected differential mode signal power

3.1.88**twisted pair**

cable element that consists of two insulated conductors twisted together in a determined fashion to form a balanced transmission line

3.1.89**unscreened (balanced) cable**

assembly of two or more balanced twisted pair cable elements or one or more quad cable elements which are not screened and are not contained within an overall screen

3.1.90**unscreened cabling**

system of telecommunications cables, cords and connecting hardware none of which contain screens that are interconnected

3.2 Abbreviations

For the purposes of this document and the other standards in the EN 50173 series, the following abbreviations apply.

AACR-F	Attenuation to alien (exogenous) crosstalk ratio at the far-end
AACR-N	Attenuation to alien (exogenous) crosstalk ratio at the near-end
a.c., AC	Alternating current
ACR-F	Attenuation to crosstalk ratio at the far-end
ACR-N	Attenuation to crosstalk ratio at the near-end
AFEXT	Alien (exogenous) far-end crosstalk loss
ANEXT	Alien (exogenous) near-end crosstalk loss
APC	Angled physical contact
BCT	Broadcast and Communications Technologies
BD	Building distributor
BEF	Building entrance facility
CD	Campus distributor
CSMA/CD	Carrier sense multiple access with collision detection
DAB	Digital Audio Broadcast
d.c., DC	Direct current

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DCLR	Direct current loop resistance
DVB	Digital Video Broadcast
DVB-C	Digital Video Broadcast, cabled
DVB-S	Digital Video Broadcast, satellite
DVB-T	Digital Video Broadcast, terrestrial
EFT	Electrical fast transient
EFT/B	Electrical fast transient/Burst
EI	Equipment interface
ELTCTL	Equal level transverse conversion transfer loss
EMC	Electromagnetic compatibility
EQP	Transmission equipment
FEXT	Far-end crosstalk loss
ffs	For further study
FOIRL	Fibre optic inter-repeater link
HF	High frequency
ICT	Information and Communication Technologies
IDC	Insulation displacement connection
IL	Insertion loss
ILD	Insertion loss deviation
IPC	Insulation piercing connection
ISDN	Integrated services digital network
LAN	Local area network
MICE	Mechanical, Ingress, Climatic and chemical, Environmental
N/A	Not applicable
NEXT	Near-end crosstalk loss
PBX	Private branch exchange
PC	Physical contact
PL	Permanent link
PP	Patch panel
PSAACR-F	Power sum attenuation to alien (exogenous) crosstalk ratio at the far-end
PSAACR-F _{avg}	Average power sum attenuation to alien (exogenous) crosstalk ratio at the far-end
PSAACR-N	Power sum attenuation to alien (exogenous) crosstalk ratio at the near-end
PSAACR-N _{avg}	Average power sum attenuation to alien (exogenous) crosstalk ratio at the near-end
PSACR-F	Power sum attenuation to crosstalk ratio at the far-end
PSACR-N	Power sum attenuation to crosstalk ratio at the near-end
PSAFEXT	Power sum alien (exogenous) far-end crosstalk loss
PSAFEXT _{norm}	Normalised power sum alien (exogenous) far-end crosstalk loss
PSANEXT	Power sum alien (exogenous) near-end crosstalk loss
PSANEXT _{avg}	Average power sum alien (exogenous) near-end crosstalk loss
PSFEXT	Power sum far-end crosstalk loss

PSNEXT	Power sum near-end crosstalk loss
RL	Return loss
TCL	Transverse conversion loss
TCTL	Transverse conversion transfer loss
TE	Terminal equipment
TI	Test interface
TV	Television

3.3 Symbols

For the purposes of this document and the other standards in the EN 50173 series, the following symbols apply.

α	Insertion loss
$\alpha_{\text{ACR-F}}$	ACR-F
$\alpha_{\text{ACR-N}}$	ACR-N
α_{ANEXT}	ANEXT
α_{AFEXT}	AFEXT
α_{avg}	Average insertion loss
α_{FEXT}	pair-to-pair FEXT
α_{NEXT}	pair-to-pair NEXT
$\alpha_{\text{PSAACR-F}}$	PSAACR-F
$\alpha_{\text{PSACR-N}}$	PSACR-N
$\alpha_{\text{PSACR-F}}$	PSACR-F
α_{PSAFEXT}	PSAFEXT
α_{PSANEXT}	PSANEXT
α_{PSNEXT}	PSNEXT
c	Velocity of propagation in free space
$\boxed{C}$	Connection
$\lg$	$\log_{10}$

4 Structure of generic backbone cabling

4.1 General

This clause identifies the functional elements of generic backbone cabling, independent of the type of premises within which the cabling is installed, describes how they are connected together to form backbone cabling subsystems and identifies the interfaces at which application-specific components are connected by the generic cabling. Each type of premises contains additional functional elements.

Channels, created by connecting application-specific cabling components to the generic cabling, are used to support applications. Applications listed in Annex F are supported by connecting active equipment at the distributors.

4.2 Functional elements

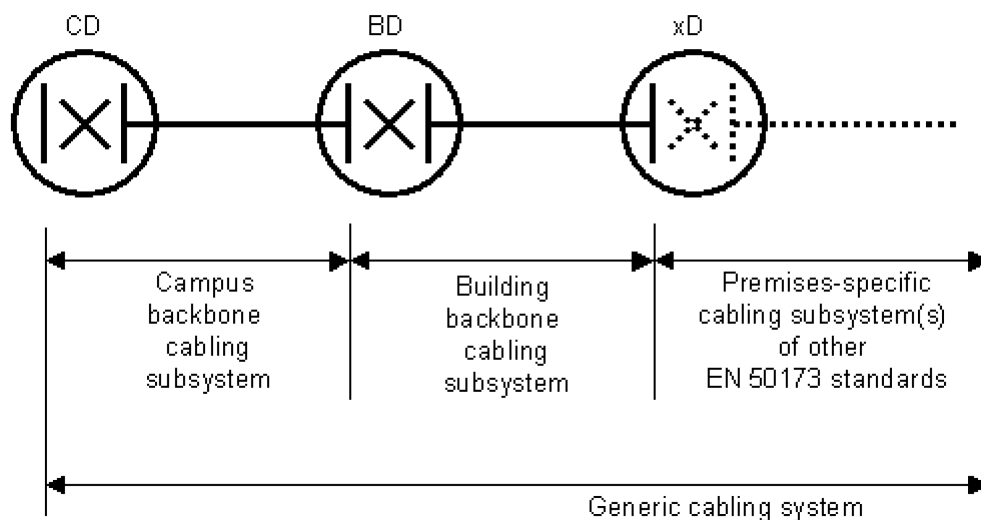
The backbone functional elements of generic cabling to support ICT applications are as follows:

- a) campus distributor (CD);
- b) campus backbone cable;
- c) building distributor (BD);
- d) building backbone cable;
- e) subsidiary distributor (designated xD in Figure 2, Figure 3 and Figure 5) in other standards of the EN 50173 series as follows:
 - floor distributor of EN 50173-2;
 - floor distributor of EN 50173-3;
 - primary home distributor of EN 50173-4;
 - service distributor of EN 50173-6.

Groups of these functional elements are connected together to form backbone cabling subsystems (see 4.3).

4.3 Structure and hierarchy

Generic cabling systems contain up to two types of backbone cabling subsystems: campus backbone and building backbone. The cabling subsystems are connected together to create a generic cabling system with a structure as shown in Figure 2.

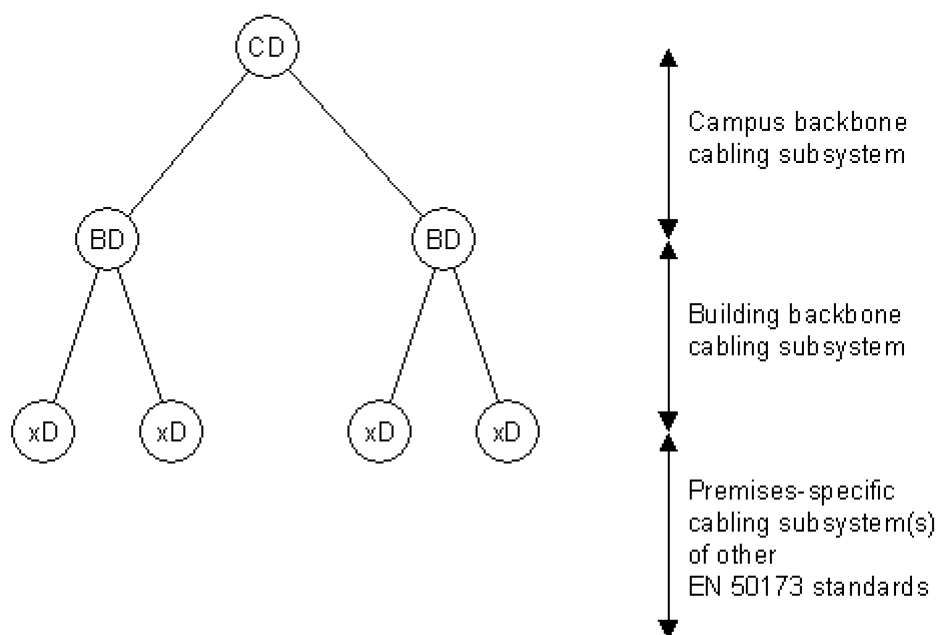


NOTE Data centre cabling in accordance with EN 50173-5 can be connected to any of the distributors.

Figure 2 — Structure of generic cabling

The composition of the subsystems is described in 4.4.1 and 4.4.2. The functional elements of the cabling subsystems are interconnected to form a basic hierarchical topology as shown in Figure 3.

Where the functions of distributors are combined the cabling subsystems linking them are not required.



NOTE Data centre cabling in accordance with EN 50173-5 can be connected to any of the distributors.

Figure 3 — Hierarchical structure of generic cabling

Connections between cabling subsystems are either active, requiring application-specific equipment, or passive.

Connection to application-specific equipment adopts either an interconnect or a cross-connect approach (see Figure 4).

Passive connections between cabling subsystems adopt either a cross-connect approach, by way of either patch cords or jumpers, or an interconnect approach.

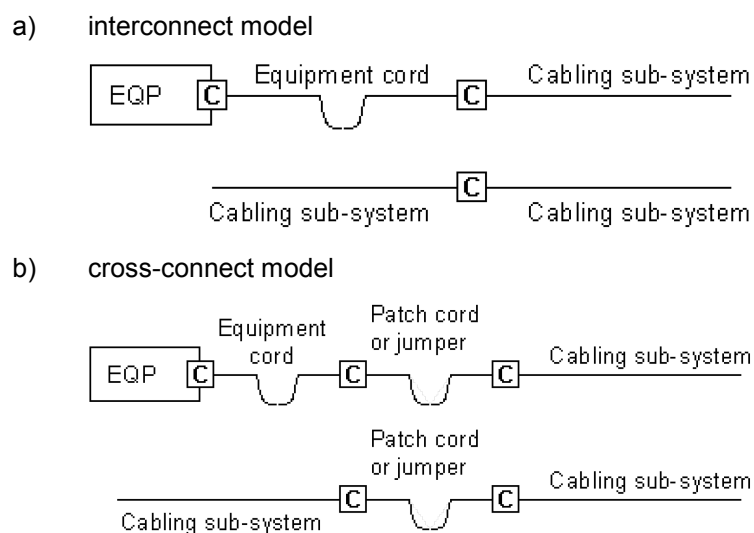


Figure 4 — Interconnect and cross-connect models

4.4 Cabling subsystems

4.4.1 Campus backbone cabling subsystem

The campus backbone cabling subsystem extends from the CD to the BD(s) connected to it usually located in separate buildings. When present, the subsystem includes:

- a) the campus backbone cables including any cabling components within the building entrance facilities;
- b) the mechanical termination of the campus backbone cables at both the CD and BDs together with associated patch cords and/or jumpers at the CD.

Although equipment cords are used to connect transmission equipment to the cabling subsystem, they are not considered part of the cabling subsystem because they are application-specific.

4.4.2 Building backbone cabling subsystem

The building backbone cabling subsystem extends from BD to the subsidiary distributors connected to it. When present, the subsystem includes:

- a) the building backbone cables;
- b) the mechanical termination of the building backbone cables at both the BD and subsidiary distributors together with associated patch cords and/or jumpers at the BD.

Although equipment cords are used to connect transmission equipment to the cabling subsystem, they are not considered part of the cabling subsystem because they are application-specific.

4.5 Design objectives

4.5.1 General

The design objectives should address the performance and capacity aspects described in 4.5.2.

In addition, the design should support objectives of reliability (by means of design choices addressing resilience, redundancy and disaster recovery) and any requirements for localised security. Measures that can be considered (see Figure 5) include:

- a) multiple and physically separated building entrances;
- b) facilities served by multiple service providers;
- c) multiple and physically separated distributors;
- d) diversely routed cabling between distributors;
- e) tie cabling as described in the other standards of the EN 50173 series.

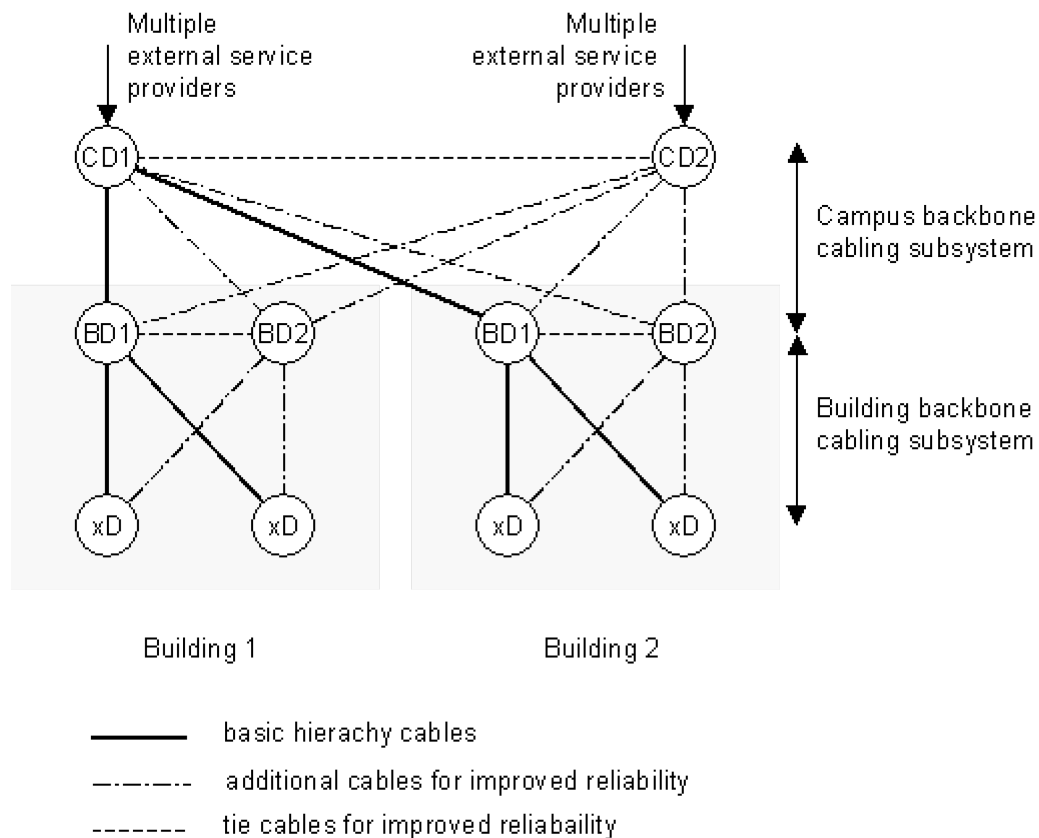


Figure 5 — Examples of backbone cabling implementations to improve reliability

4.5.2 Backbone cabling

It is generally not possible or economically viable to install backbone cabling for the entire life of the generic cabling system. Instead, the design should be based on current and foreseeable application requirements. Such short-term selection criteria are often appropriate for building backbone cabling where there is good physical access to pathways for future changes.

The selection of campus backbone cabling should consider a longer term approach than that adopted for the building backbone, particularly if access to pathways is more limited.

4.6 Accommodation of functional elements

4.6.1 Distributors

The requirements for the accommodation of distributors are specified in EN 50174-2.

4.6.2 Cables

The requirements for pathways and pathway systems accommodating cables are provided in EN 50174-2 and EN 50174-3.

4.7 Interfaces

4.7.1 Equipment interfaces and test interfaces

Equipment interfaces (EIs) to generic cabling are located at the ends of each backbone cabling subsystem.

Distributors can have an EI to an external service at any port, and can use either interconnects or cross-connects (see Figure 4). Figure 6 shows the potential EIs to the backbone cabling subsystems.

Test interfaces (TIs) to generic cabling are located at the ends of each backbone cabling subsystem. Figure 6 shows the potential TIs to the backbone cabling subsystems.

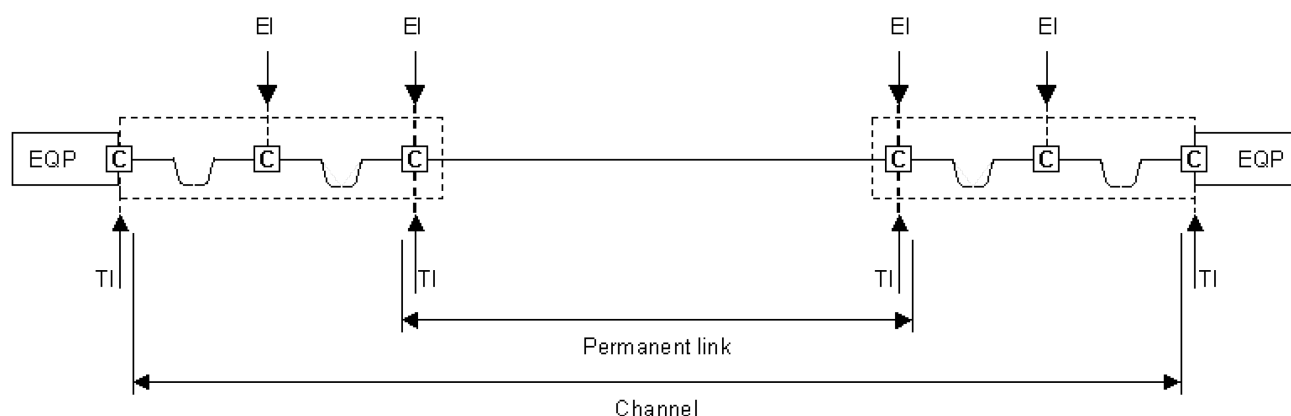


Figure 6 — Test and equipment interfaces for backbone cabling

4.7.2 Channels and links

4.7.2.1 Channels

The transmission performance requirements of channels are detailed in Clause 5.

The channel is the transmission path between transmission equipment (EQP in Figure 6). A typical channel consists of a backbone cabling subsystem together with patch and equipment cords. For longer reach services the channel would be formed by the connection of two or more subsystems (including all cords). It is important that the generic cabling channel is designed to meet the required performance for the applications that are to be run.

For the purposes of testing, the channel excludes the connections at the application-specific equipment (see Figure 6).

4.7.2.2 Links

The transmission performance requirements and relevant configurations of links are specified in Annex A.

The links within backbone cabling subsystems are designated as permanent links.

For the purposes of testing the link includes the connections at the ends of the cabling link under test (see Figure 6).

4.8 Dimensioning and configuring

4.8.1 External network interface

The location of external network interfaces, if present, and the facilities which shall be provided can be regulated by national, regional, and local regulations. If the external network interface is not connected directly to a generic cabling interface the performance of the network access cabling should be taken into account and should be considered as part of the initial design and implementation of customer applications. The type of cross-connect and the network access cable can be governed by national regulations, in which case they shall be taken account of in the design of the generic cabling.

4.8.2 Building entrance facilities

Building entrance facilities are required whenever cables (including those from antennae) enter buildings. The facilities comprise an entrance point for the incoming cable and access to the pathway leading to the campus or building distributor.

Local regulations can require a change from outdoor to indoor cable which require facilities to accommodate the connecting hardware for such a transition.

5 Channel performance

5.1 Environmental performance

5.1.1 General

The environmental performance specifications of channels are classified to cover the different conditions under which channels are required to operate in the types of premises defined in the other standards of the EN 50173 series.

The local conditions, to which the cabling components within the channel are exposed, shall be used to determine the applicable environmental classification(s) of this clause. With regard to temperature the local environment is considered to be the operating temperature of the cabling.

The environmental classifications described in this clause shall be used for the selection of:

- a) components and/or protection afforded to them;
- b) installation techniques to be applied to the channel in order to provide protection against extreme environments.

It is possible for the different locations within a channel to be subject to different environmental conditions. The local environment along the channel shall be classified accordingly. For each M, I, C or E group, the classification of a given environment shall be determined by the most demanding parameter within the M, I, C or E group. However, the selection of components shall be based on the specific demands of each of the parameters within the M, I, C or E group, which can be less demanding than the overall classification of the group.

5.1.2 Environmental classifications

Table 2 lists the environmental classifications for channels. The details of the environmental classifications are set out in Table 3.

Generally, it is possible to classify a channel environment by using any combination of the MICE designations, e.g. M₂I₁C₃E₁. However, certain environments (e.g. nuclear, chemical, fire, explosive, damage risk from animals, salt mist) demand additional requirements beyond those of this clause. Further details on specific environments are shown in Annex G.

Table 2 — Channel environments

Parameter	Environmental class		
	1	2	3
Mechanical rating	M ₁	M ₂	M ₃
Ingress rating	I ₁	I ₂	I ₃
Climatic and chemical rating	C ₁	C ₂	C ₃
Electromagnetic rating	E ₁	E ₂	E ₃

The requirements of a given classification cover the requirements of a lower classification, i.e. channels designed to operate under environmental conditions defined by M₂ shall continue to operate under environmental conditions defined by M₁.

The parameters of the environmental classifications are defined in Table 3.

Table 3 — Details of Environmental Classification

Mechanical	M ₁	M ₂	M ₃
Shock/bump ^a			
Peak acceleration	40 m/s ²	100 m/s ²	250 m/s ²
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 m/s ²	20 m/s ²	50 m/s ²
Tensile force	See Note	See Note	See Note
Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.
Impact	1 J	10 J	30 J
Bending, flexing and torsion	See Note	See Note	See Note
Ingress	I ₁	I ₂	I ₃
Particulate ingress (max. diameter)	12,5 mm	0,05 mm	0,05 mm
Immersion	None	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance and immersion (≤1 m for ≤ 30 min)
Climatic and chemical	C ₁	C ₂	C ₃
Ambient temperature	- 10 °C to + 60 °C	- 25 °C to + 70 °C	- 40 °C to + 70 °C
Rate of change of temperature	0,1 °C/min	1,0 °C/min	3,0 °C/min
Humidity	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)
Solar radiation	700 W/m ²	1 120 W/m ²	1 120 W/m ²
Liquid pollution Contaminants	Concentration x 10 ⁻⁶	Concentration x 10 ⁻⁶	Concentration x 10 ⁻⁶
Sodium chloride (salt/sea water)	0	< 0,3	< 0,3
Oil (dry-air concentration)	0	< 0,005	< 0,5
Sodium stearate (soap)	None	> 5 × 10 ⁴ aqueous non-gelling	> 5 × 10 ⁴ aqueous gelling
Detergent	None	ffs	ffs
Conductive materials in solution	None	Temporary	Present
Gaseous pollution Contaminants	Mean/Peak (Concentration × 10 ⁻⁶)	Mean/Peak (Concentration × 10 ⁻⁶)	Mean/Peak (Concentration × 10 ⁻⁶)
Hydrogen sulphide	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50
Sulphur dioxide	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15

Sulphur trioxide (ffs)	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Chlorine wet (>50% humidity)	< 0,000 5 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3
Chlorine dry (<50% humidity)	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0
Hydrogen chloride	- / < 0,06	< 0,06 / < 0,3	< 0,6 / 3,0
Hydrogen fluoride	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0
Ammonia	< 1 / < 5	< 10 / < 50	< 50 / < 250
Oxides of Nitrogen	< 0,05 / < 0,1	< 0,5 / < 1	< 5 / < 10
Ozone	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1
Electromagnetic	E ₁	E ₂	E ₃
Electrostatic discharge – Contact (0,667 µC)	4 kV	4 kV	4 kV
Electrostatic discharge – Air (0,132 µC)	8 kV	8 kV	8 kV
Radiated radio frequency, amplitude modulated (RF – AM)	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	10 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz
Conducted radio frequency (RF)	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz
Electrical fast transient/Burst (EFT/B) AC mains power including the protective earth	1 000 V	1 000 V	2 000 V
EFT/B I/O (signal/data/control)	500 V	500 V	1 000 V
Surge (transient ground potential difference) - signal, line to earth	500 V	1 000 V	1 000 V
Magnetic Field (50/60 Hz)	1 A/m	3 A/m	30 A/m
Magnetic Field (60 Hz to 20 000 Hz)	ffs	ffs	ffs
^a The repetitive nature of the shock experienced by the channel shall be taken into account.			
NOTE This aspect of environmental classification is installation-specific and should be considered in association with EN 50174-2 and the appropriate component specification.			

5.2 Transmission performance

5.2.1 General

The required transmission performance Class of this clause shall be met for all environmental classifications specified for the channel.

5.2.2 Balanced cabling channel performance

5.2.2.1 General

This standard specifies the following classes for balanced cabling:

- a) Class A: specified up to 0,1 MHz;

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- b) Class B: specified up to 1 MHz;
- c) Class C: specified up to 16 MHz;
- d) Class D: specified up to 100 MHz;
- e) Class E: specified up to 250 MHz;
- f) Class E_A: specified up to 500 MHz;
- g) Class F: specified up to 600 MHz;
- h) Class F_A: specified up to 1 000 MHz.

A Class A channel is specified so that it will provide the minimum transmission performance to support Class A applications. Similarly, Class B, C, D, E, E_A, F and F_A channels provide the transmission performance to support Class B, C, D, E, E_A, F and F_A applications respectively. Channels of a given class will support all applications of a lower class. Class A is regarded as the lowest class.

This standard specifies the following additional Classes for balanced cabling in support of specific types of transmission system described in other standards in the EN 50173 series:

- i) Class BCT-B specified up to 1 000 MHz.

The insertion loss and other length-related parameter performance of BCT-B cabling is further subdivided into two sub-Classes, L and M. These sub-Classes have identical performance requirements for all other transmission parameters.

- j) Class I and II specified up to 2 000 MHz.

The required transmission performance Class of this clause shall be met for all environmental classifications that are applicable to the channel.

Annex F lists balanced cabling applications by Class. The channels specified in 5.2.2 are not guaranteed to support the simultaneous transmission of different applications, of the same or different application Classes, within a cable or at an interface to the generic cabling. The sharing of components by applications (to, for example, maximise the capacity of cable management systems) can require additional performance requirements to be applied to the channel. These requirements are not included in this standard.

NOTE In the case of cable sharing, additional performance requirements are specified in 7.3.3.

The parameters specified in this subclause apply to channels with screened or unscreened cable elements, with or without an overall screen, unless explicitly stated otherwise.

The nominal impedance of channels is 100 Ω . This is achieved by suitable design, and appropriate choice of cabling components (irrespective of their nominal impedance).

5.2.2.2 Return loss

The variation of the input impedance of a channel is characterised by the return loss (RL). The RL parameter is applicable to Classes C, D, E, E_A, F, F_A, BCT-B, I and II only. The RL for each pair of a channel shall meet the limits computed, to one decimal place, using the formulae of Table 4. The limits shown in Table 5 are derived from the formulae at key frequencies only.

Values of RL at frequencies for which the measured channel insertion loss is below 3,0 dB are for information only.

When required, the RL shall be measured according to EN 61935-1. Terminations of 100 Ω shall be connected to the cabling elements under test at the remote end of the channel. The return loss requirements shall be met at both ends of the cabling.

Table 4 — Formulae for RL limits for a channel

Class	Frequency MHz	Minimum RL dB
C	$1 \leq f \leq 16$	15,0
D	$1 \leq f \leq 20$	17,0
	$20 < f \leq 100$	$30 - 10 \times \lg f$
E	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 250$	$32 - 10 \times \lg f$
E _A	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 398,1$	$32 - 10 \times \lg f$
	$398,1 < f \leq 500$	6,0
F	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 251,2$	$32 - 10 \times \lg f$
	$251,2 < f \leq 600$	8,0
F _A	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 251,2$	$32 - 10 \times \lg f$
	$251,2 < f \leq 631$	8,0
	$631 < f \leq 1\,000$	$36 - 10 \times \lg f$
BCT-B	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 251,2$	$29 - 7,5 \times \lg f$
	$251,2 < f \leq 600$	$17,2 - 2,6 \times \lg f$
	$600 < f \leq 1\,000$	$35 - 9 \times \lg f$
I	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 130$	16,0
	$130 < f \leq 1\,000$	$35 - 9 \times \lg f$
	$1\,000 < f \leq 1\,600$	8,0
	$1\,600 < f \leq 2\,000$	$8 - 19 \times \lg(f / 1600)$

Class	Frequency MHz	Minimum RL dB
II	$1 \leq f \leq 10$	19,0
	$10 < f \leq 40$	$24 - 5 \times \lg f$
	$40 < f \leq 130$	16,0
	$130 < f \leq 1\,000$	$35 - 9 \times \lg f$
	$1\,000 < f \leq 1\,600$	8,0
	$1\,600 < f \leq 2\,000$	$8 - 19 \times \lg(f / 1600)$

Table 5 — RL limits for a channel at key frequencies

Frequency MHz	Minimum RL dB									
	0,1	1,0	16,0	100,0	250,0	500,0	600,0	1 000, 0	1 600,0	2 000,0
Class C	N/A	15,0	15,0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class D	N/A	17,0	17,0	10,0	N/A	N/A	N/A	N/A	N/A	N/A
Class E	N/A	19,0	18,0	12,0	8,0	N/A	N/A	N/A	N/A	N/A
Class E _A	N/A	19,0	18,0	12,0	8,0	6,0	N/A	N/A	N/A	N/A
Class F	N/A	19,0	18,0	12,0	8,0	8,0	8,0	N/A	N/A	N/A
Class F _A	N/A	19,0	18,0	12,0	8,0	8,0	8,0	6,0	N/A	N/A
Class BCT-B	N/A	19,0	18,0	14,0	11,0	10,2	10,0	8,0	N/A	N/A
Class I	N/A	19,0	18,0	16,0	13,4	10,7	10,0	8,0	8,0	6,2
Class II	N/A	19,0	18,0	16,0	13,4	10,7	10,0	8,0	8,0	6,2

5.2.2.3 Insertion loss

The insertion loss (IL) α for each pair of a channel shall meet the limits computed, to one decimal place, using the formulae of Table 6. The limits shown in Table 7 are derived from the formulae at key frequencies only.

For a given Class, the requirement shall be met for all operating temperatures to which the channel is intended to be subjected. Where doubt exists, the de-rating factors of Table 45 shall be employed.

When required, the IL of the channel shall be measured according to EN 61935-1.

Table 6 — Formulae for IL limits for a channel

Class	Frequency MHz	Maximum IL dB
A	$f = 0,1$	16,0
B	$f = 0,1$	5,5
	$f = 1$	5,8
C	$1 \leq f \leq 16$	$1,05 \times (3,23 \times \sqrt{f}) + 4 \times 0,2$
D	$1 \leq f \leq 100$	$1,05 \times (1,910 \times \sqrt{f} + 0,022 \times f + 0,2/\sqrt{f}) + 4 \times 0,04 \times \sqrt{f}, 4,0 \text{ min.}$
E	$1 \leq f \leq 250$	$1,05 \times (1,82 \times \sqrt{f} + 0,016 \times f + 0,25/\sqrt{f}) + 4 \times 0,02 \times \sqrt{f}, 4,0 \text{ min.}$
E _A	$1 \leq f \leq 500$	$1,05 \times (1,82 \times \sqrt{f} + 0,009 \times f + 0,25/\sqrt{f}) + 4 \times 0,02 \times \sqrt{f}, 4,0 \text{ min.}$
F	$1 \leq f \leq 600$	$1,05 \times (1,8 \times \sqrt{f} + 0,01 \times f + 0,2/\sqrt{f}) + 4 \times 0,02 \times \sqrt{f}, 4,0 \text{ min.}$
F _A	$1 \leq f \leq 1\,000$	$1,05 \times (1,8 \times \sqrt{f} + 0,005 \times f + 0,25/\sqrt{f}) + 4 \times 0,02 \times \sqrt{f}, 4,0 \text{ min.}$
BCT-B-L	$1 \leq f \leq 1\,000$	$0,138 \times (1,8 \times \sqrt{f} + 0,005 \times f + 0,25/\sqrt{f}) + 2 \times 0,02 \times \sqrt{f}, 2,0 \text{ min.}$
BCT-B-M	$1 \leq f \leq 1\,000$	$0,27 \times (1,8 \times \sqrt{f} + 0,005 \times f + 0,25/\sqrt{f}) + 2 \times 0,02 \times \sqrt{f}, 2,0 \text{ min.}$
I	$1 \leq f \leq 500$	See ^a
	$500 < f \leq 2\,000$	See ^b
II	$1 \leq f \leq 2\,000$	$0,32 \times (1,8 \times \sqrt{f} + 0,005 \times f + 0,25/\sqrt{f}) + 2 \times 0,02 \times \sqrt{f}, 3,0 \text{ min.}$
^a		$0,312 \times (1,8 \times \sqrt{f} + 0,005 \times f + 0,25/\sqrt{f}) + 2 \times 0,02 \times \sqrt{f} + 0,0324 \times \sqrt{f}, 3,0 \text{ min.}$
^b		$0,312 \times (1,8 \times \sqrt{f} + 0,005 \times f + 0,25/\sqrt{f}) + 2 \times (0,00649 \times \sqrt{f} + 0,000605 \times f) + 0,0324 \times \sqrt{f}$
NOTE The slope (difference in attenuation) between 47 MHz and 862 MHz is critical for BCT- B applications. See F.1 for additional information regarding supported applications.		

Table 7 — IL limits for a channel at key frequencies

Frequency MHz	Maximum insertion loss dB									
	0,1	1,0	16,0	100,0	250,0	500,0	600,0	1 000,0	1 600,0	2 000,0
Class A	16,0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class B	5,5	5,8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class C	N/A	4,2	14,4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class D	N/A	4,0	9,1	24,0	N/A	N/A	N/A	N/A	N/A	N/A
Class E	N/A	4,0	8,3	21,7	35,9	N/A	N/A	N/A	N/A	N/A
Class E _A	N/A	4,0	8,2	20,9	33,9	49,3	N/A	N/A	N/A	N/A
Class F	N/A	4,0	8,1	20,8	33,8	49,3	54,6	N/A	N/A	N/A
Class F _A	N/A	4,0	8,0	20,3	32,5	46,7	51,4	67,6	N/A	N/A
Class BCT-B-L ^a	N/A	2,0	2,0	3,0	4,7	6,8	7,5	9,8	N/A	N/A
Class BCT-B-M _a	N/A	2,0	2,1	5,4	8,6	12,4	13,7	18,0	N/A	N/A
Class I ^a	N/A	3,0	3,0	6,5	10,4	15,0	16,5	22,0	28,7	32,7
Class II ^a	N/A	2,0	3,0	6,3	10,1	14,6	16,1	21,1	27,2	30,8

^a The values reflect reduced channel lengths of reference implementations compared to other Classes (see Clause 6).

5.2.2.4 Near-end crosstalk loss

5.2.2.4.1 Pair-to-pair near-end crosstalk loss

The pair-to-pair near-end crosstalk loss (NEXT) parameter is applicable to all Classes. The pair-to-pair NEXT α_{NEXT} for each pair combination of a channel shall meet the limits computed, to one decimal place, using the formulae of Table 8. The limits shown in Table 9 are derived from the formulae at key frequencies only.

When required, the NEXT shall be measured according to EN 61935-1. The NEXT requirements shall be met at both ends of the cabling.

Values of NEXT at frequencies for which the measured channel insertion loss is below 4,0 dB are for information only.

Table 8 — Formulae for NEXT limits for a channel

Class	Frequency MHz	Minimum NEXT dB
A	$f = 0,1$	27,0
B	$0,1 \leq f \leq 1$	$25 - 15 \times \lg f$
C	$1 \leq f \leq 16$	$39,1 - 16,4 \times \lg f$
D	$1 \leq f \leq 100$	$-20 \times \lg \left(10^{\frac{65,3 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{83 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
E	$1 \leq f \leq 250$	$-20 \times \lg \left(10^{\frac{74,3 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{94 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
E _A ^{a, c}	$1 \leq f \leq 500$	$-20 \times \lg \left(10^{\frac{74,3 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{94 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
F	$1 \leq f \leq 600$	$-20 \times \lg \left(10^{\frac{102,4 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{102,4 - 15 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
F _A ^{b, c}	$1 \leq f \leq 1\,000$	$-20 \times \lg \left(10^{\frac{105,4 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{116,3 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
BCT-B ^{b, c, d}	$1 \leq f \leq 1\,000$	$-20 \times \lg \left(10^{\frac{105,4 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{116,3 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
I	$1 \leq f \leq 500$	$-20 \times \lg \left(10^{\frac{75,3 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{94 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
	$500 < f \leq 2\,000$	$-20 \times \lg \left(10^{\frac{75,3 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{40 - 38 \times \lg(f/500)}{-20}} \right), 65,0 \text{ max.}$
II	$1 \leq f \leq 1\,000$	$-20 \times \lg \left(10^{\frac{105,4 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{116,3 - 20 \times \lg f}{-20}} \right), 65,0 \text{ max.}$
	$1\,000 < f < 1\,600$	$-20 \times \lg \left(10^{\frac{105,4 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{56,3 - 90 \times \lg(f/1000)}{-20}} \right), 65,0 \text{ max.}$
	$1\,600 < f \leq 2\,000$	$-20 \times \lg \left(10^{\frac{105,4 - 15 \times \lg f}{-20}} + 2 \times 10^{\frac{37,93 - 40 \times \lg(f/1600)}{-20}} \right), 65,0 \text{ max.}$
^a Where the channel insertion loss at 450 MHz is less than 12 dB, the requirement is reduced by $1,4((f - 450)/50)$ for $f \geq 450$ MHz.		
^b Where the channel insertion loss at 900 MHz is less than 17 dB, the requirement is reduced by $2,8((f - 900)/100)$ for $f \geq 900$ MHz.		
^c The terms in the formulae are not intended to imply component performance.		
^d This requirement does not apply to 1-pair BCT-B channels.		

Table 9 — NEXT limits for a channel at key frequencies

Frequency MHz	Minimum NEXT dB									
	0,1	1,0	16,0	100,0	250,0	500,0	600,0	1 000,0	1 600,0	2 000,0
Class A	27,0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class B	40,0	25,0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class C	N/A	39,1	19,4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Class D	N/A	63,3	43,6	30,1	N/A	N/A	N/A	N/A	N/A	N/A
Class E	N/A	65,0	53,2	39,9	33,1	N/A	N/A	N/A	N/A	N/A
Class E _A	N/A	65,0	53,2	39,9	33,1	27,9	N/A	N/A	N/A	N/A
Class F	N/A	65,0	65,0	62,9	56,9	52,4	51,2	N/A	N/A	N/A
Class F _A	N/A	65,0	65,0	65,0	59,1	53,6	52,1	47,9	N/A	N/A
Class BCT-B	N/A	65,0	65,0	65,0	59,1	53,6	52,1	47,9	N/A	N/A
Class I	N/A	65,0	53,9	40,5	33,6	28,4	26,2	19,6	12,9	9,6
Class II	N/A	65,0	65,0	65,0	59,1	53,6	52,1	47,9	31,5	27,7

5.2.2.4.2 Power sum near-end crosstalk loss

The power sum near-end crosstalk loss (PSNEXT) parameter is applicable to Classes D, E, E_A, F, F_A, BCT-B, I and II only. The PSNEXT α_{PSNEXT} for each pair of a channel shall meet the limits computed, to one decimal place, using the formulae of Table 10. The limits shown in Table 11 are derived from the formulae at key frequencies only.

The PSNEXT requirements shall be met at both ends of the cabling. Values of PSNEXT at frequencies for which the measured channel insertion loss is below 4,0 dB are for information only.

PSNEXT of pair k , $\alpha_{PSNEXT}(k)$, is computed from pair-to-pair NEXT $\alpha_{NEXT}(i,k)$ of the adjacent pairs i , $i = 1 \dots n$, as follows:

$$\alpha_{PSNEXT}(k) = -10 \lg \sum_{i=1, i \neq k}^n 10^{-0,1 \times \alpha_{NEXT}(i,k)} \quad [\text{dB}] \quad (1)$$

where

$\alpha_{NEXT}(i,k)$ is the pair-to-pair NEXT of pair k to adjacent pair i in dB.