BS EN 50174-1:2009

BSI British Standards

Information technology — Cabling installation —

Part 1: Installation specification and quality assurance

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BSI British Standards

National foreword

This British Standard is the UK implementation of EN 50174-1:2009. It supersedes BS EN 50174-1:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee TCT/7, Telecommunications - Installation requirements

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.

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CENELEC

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 215, Electrotechnical aspects of telecommunication equipment.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50174-1 on 2009-05-01.

This European Standard supersedes EN 50174-1:2000.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-05-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-05-01

EN 50174 comprises three parts. All three parts support the specification, implementation and operation of information technology cabling. There are specific requirements for cabling systems that are in accordance with the design requirements of the EN 50173 series. However, the three parts also apply to cabling systems of any design including those in accordance with standards such as EN 50098-1 or EN 50098-2.

This part, EN 50174-1, is concerned with specification, quality assurance, documentation and administration of information technology cabling to be installed, together with its subsequent operation and maintenance. It sets out the responsibilities of information technology cabling installers and premises owners or appointed representatives separately, and is intended to be referenced in relevant contracts.

It does not cover those aspects of installation associated with the transmission of signals in free space between transmitters, receivers or their associated antenna systems (e.g. wireless, radio, microwave or satellite).

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Introduction

The importance of services delivered by information technology cabling infrastructure is similar to that of utilities such as heating, lighting and electricity supplies. As with those utilities, interruptions to service can have a serious impact. Poor quality of service due to lack of planning, use of inappropriate components, incorrect installation, poor administration or inadequate support can threaten an organisation's effectiveness.

There are four phases in the successful implementation of information technology cabling. These are:

a) design;

b) specification – the detailed requirement for the cabling, including the planning of its accommodation and associated building services addressing specific environments (e.g. electromagnetic) together with the quality assurance requirements to be applied;

c) installation – in accordance with the requirements of the specification;

d) operation – the management of connectivity and the maintenance of transmission performance during the life of the cabling.

This European Standard is in three parts and addresses the specification, installation and operational aspects. The EN 50173 series and other application standards cover design issues.

EN 50174-1 is used during the specification phase. It addresses the:

– installation specification, quality assurance documentation and procedures;

– documentation and administration;

– operation and maintenance.

This part, EN 50174-2 and EN 50174-3 are intended to be used by the personnel directly involved in the planning aspects (of the specification phase) and installation phase. EN 50174-2 is applicable inside buildings and EN 50174-3 is applicable outside buildings.

This European Standard is also relevant to:

- architects, building designers and builders;
- main contractors;
- designers, suppliers, installers, inspectors (auditors), maintainers and owners of information technology cabling;
- public network providers and local service providers;
- end users.

The requirements and recommendations of Clause 4 are primarily for owners of premises housing information technology systems. The owners may delegate selected responsibilities to designers, specifiers, operators and maintainers of installed information technology cabling.

The requirements and recommendations of Clause 5 are primarily for the installers of information technology cabling.

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

1) this and other parts of the EN 50174 series;

2) generic cabling design (EN 50173 series);

3) application dependent cabling design (e.g. EN 50098 series);

4) testing of installed cabling (EN 50346);

5) equipotential bonding requirements (EN 50310).

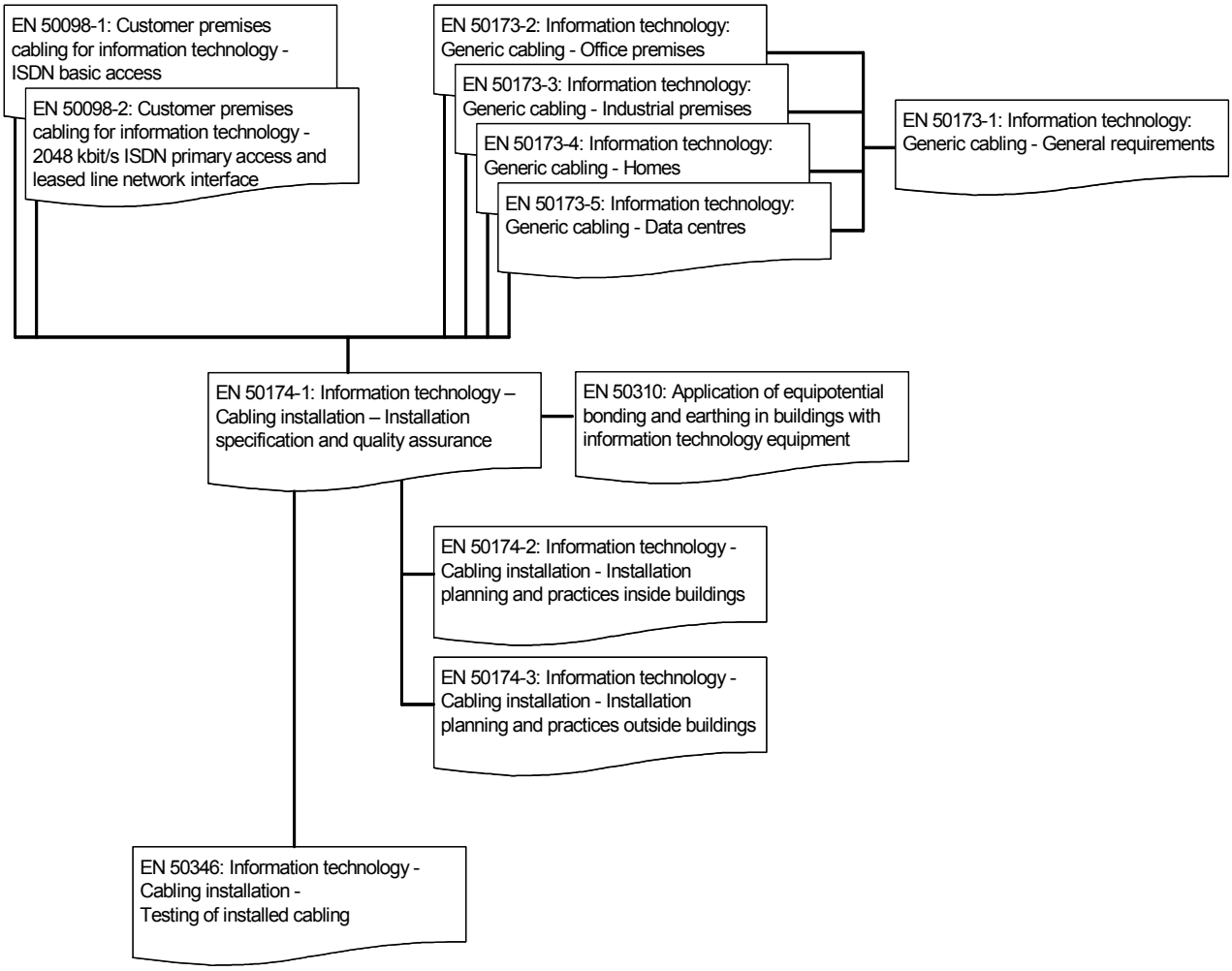


Figure 1 – Schematic relationship between the EN 50174 series and other relevant standards

Table 1 – Contextual relationship between EN 50174 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 5.2: Common bonding network (CBN) within a building 6.3: AC distribution system and bonding of the protective conductor (TN-S)	**EN 50173 series except EN 50173-4** 4: Structure 5: Channel performance 7: Cable requirements 8: Connecting hardware requirements 9: Requirements for cords and jumpers A: Link performance limits **and EN 50173-4** 4 and 5: Structure 6: Channel performance 8: Cable requirements 9: Connecting hardware requirements 10: Requirements for cords and jumpers A: Link performance limits	**EN 50174-1** 4: Requirements for specifying installations of information technology cabling 5: Requirements for installers of information technology cabling **Planning phase** **EN 50174-2** 4: Requirements for planning installations of information technology cabling 6: Segregation of metallic information technology cabling and mains power cabling 7: Electricity distr bution systems and lightning protection **and EN 50174-3** **and (for equipotential bonding) EN 50310** 5.2: Common bonding network (CBN) within a building 6.3: AC distribution system and bonding of the protective conductor (TN-S)	**EN 50174-2** 5: Requirements for the installation of information technology cabling 6: Segregation of metallic information technology cabling and mains power cabling **and EN 50174-3** **and (for equipotential bonding) EN 50310** 5.2: Common bonding network (CBN) within a building 6.3: AC distr bution system and bonding of the protective conductor (TN-S) **and EN 50346** 4: General requirements 5: Test parameters for balanced cabling 6: Test parameters for optical fibre cabling	**EN 50174-1** 4: Requirements for specifying installations of information technology cabling

1 Scope and conformance

1.1 Scope

This European Standard specifies requirements for the following aspects of information technology cabling:

a) installation specification, quality assurance documentation and procedures;

b) documentation and administration;

c) operation and maintenance.

This European Standard is applicable to all types of information technology cabling including generic cabling systems designed in accordance with the EN 50173 series.

Safety (electrical safety and protection, optical power, fire, etc.) 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 may be of assistance in meeting these standards and regulations.

1.2 Conformance

For a cabling installation to conform to this European Standard:

a) the specification of the installation shall meet the requirements of Clause 4;

NOTE The requirements and recommendations of Clause 4 are primarily for owners of premises housing information technology systems. The owners may delegate selected responsibilities to designers, specifiers, operators and maintainers of installed information technology cabling. The party responsible for demonstrating conformance should be clearly stated in the appropriate section of the documentation.

b) the installer shall meet the requirements of Clause 5;

c) the equipotential bonding system within the premises shall be in accordance with EN 50310;

d) where a lightning protection system is required, it shall conform to the “integrated lightning protection system” according to EN 62305-4;

e) other lightning protection systems, including the “isolated lightning protection system” according to EN 62305-3 are allowed provided that specific restrictions are applied both to the implementation of the information technology cabling and the requirements of EN 50310 as agreed between the planners of the lightning protection system and the information technology cabling;

f) local regulations, including safety, shall be met.

2 Normative references

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

EN 50173-1:2007, *Information technology – Generic cabling systems – Part 1: General requirements*

EN 50173-2, *Information technology – Generic cabling systems – Part 2: Office premises*

EN 50173-3, *Information technology – Generic cabling systems – Part 3: Industrial premises*

EN 50173-4, *Information technology – Generic cabling systems – Part 4: Homes*

EN 50173-5, *Information technology – Generic cabling systems – Part 5: Data centres*

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 50310, *Application of equipotential bonding and earthing in buildings with information technology equipment*

EN 50346, *Information technology – Cabling installation – Testing of installed cabling*

EN 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame* (IEC 60332-1-2)

EN 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures* (IEC 62305-4)

HD 384/HD 60364 (series), *Low-voltage electrical installations* (IEC 60364 series, mod.)

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Chapter 151: Electrical and magnetic devices*

IEC 60050-161:1990, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Where the cabling is designed in accordance with standards in the EN 50173 series, the additional definitions of those standards are applicable.

NOTE As far as poss ble definitions of series IEC 60050 have been used; reference to these standards is indicated in square brackets.

3.1.1
acceptance test of installed cabling
contractual test to prove to the customer that the installed cabling meets specific conditions of its specification

[derived from IEC 60050-151:2001, 151-16-23]

3.1.2
array connector
an optical fibre connector containing a single ferrule with multiple terminated fibres arranged in a line or a series of lines

3.1.3
building entrance facility
space that provides all necessary mechanical and electrical services for the entry of cables into a building

[EN 50173-1:2007, 3.1.6, modified]

3.1.4
cabinet
enclosed construction for housing closures and other information technology equipment

3.1.5
cable element
smallest construction unit in a cable

NOTE 1 A cable element may have a screen.

NOTE 2 A pair, a quad, a single isolated lead with coaxial screen and a single optical f bre are examples of a cable element.

[EN 50173-1:2007, 3.1.9, modified]

3.1.6
cable management system
system used for the support and/or containment, retention, protection of all types of cables, information and communication lines, electrical power distribution conductors and their associated accessories (includes ducts and tubes housing, or intended to house, blown information technology cables and/or cable elements)

3.1.7
cabling component
any product associated with the cabling installation including cables, connecting hardware, closures, cabinets, frames, racks and pathway systems together with components used to provide earth connections for the cabling installation

3.1.8
closure
fixture or fitting of either open or closed construction intended to contain connecting hardware

3.1.9
draw-box
space in a pathway that allows the routing of cables during the cable installation process

3.1.10
electrostatic discharge
transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact

[IEC 60050-161:1990, 161-01-22]

3.1.11
electromagnetic disturbance
any electromagnetic phenomenon which may degrade the performance of a device, equipment or system, or adversely affect living or inert matter

NOTE An electromagnetic disturbance may be an electromagnetic noise, an unwanted signal or a change in the propagation medium itself.

[IEC 60050-161:1990, 161-01-05]

3.1.12
frame
rack
open construction for housing closures and other information technology equipment

3.1.13
identifier
unique item of information to distinguish a specific component of the cabling installation

3.1.14
information technology
telecommunications
branch of technology concerned with the transmission, emission and reception of signs, signals, writing, images and sounds; that is, information of any nature by cable, radio, optical or other electromagnetic systems

[EN 50173-1:2007, 3.1.50, modified]

3.1.15
information technology equipment
active or passive equipment necessary to deliver a specific application

NOTE Examples include hubs, switches, routers, adapters.

3.1.16
installer
person installing cabling components

NOTE No design functions are assumed.

3.1.17
jumper
one or more cable elements without connectors used to make a connection between terminated cables

3.1.18
label
means of marking a specific component of the information technology infrastructure with its identifier and (optionally) other information and intended to be fixed to, or be part of, the component

3.1.19
minimum bend radius during installation
minimum radius as specified by the cable manufacturer, supplier or in accordance with the relevant product standard to which a cable or cable element is allowed to be subjected during installation

3.1.20
minimum bend radius during operation – static
minimum radius as specified by the cable manufacturer, supplier or in accordance with the relevant product standard to which a cable or cable element is allowed to be subjected following installation and fixed in its final operating position

3.1.21
minimum bend radius during operation – dynamic
minimum radius as specified by the cable manufacturer, supplier or in accordance with the relevant product standard to which a cable or cable element is allowed to be subjected under conditions where the cable or cable element is subject to movement

3.1.22
pathway
defined route for cables between termination points

3.1.23
pathway system
cable management system, or other area or volume defined by markings

3.1.24
record
collection of information about, or related to, a specific element of the information technology infrastructure

3.1.25
scope of work
the detailed definition of the tasks involved in an installation or particular phase of an installation

3.1.26
service loop
excess length of cable or cable element(s)

3.1.27
space
specified volume

NOTE Examples include room, maintenance hole or part thereof, housing closures and/or other information technology equipment.

3.1.28
termination point
free or fixed connectors (e.g. plugs or sockets) fitted to an installed cable

3.1.29
transition assembly
assembly of optical fibres and connectors, with an array connector on one end and simplex or duplex connectors on other end

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

Where the cabling is designed in accordance with standards in the EN 50173 series, the additional abbreviations of those standards are applicable.

ENI External network interface

ESD Electrostatic discharge

4 Requirements for specifying installations of information technology cabling

4.1 Documentation

4.1.1 Installation specification

4.1.1.1 Requirements

An installation specification shall be prepared in accordance with the requirements of this clause. The installation specification shall be agreed with the installer prior to the commencement of the installation.

The installation specification shall comprise:

a) the technical specification (see 4.1.2);
b) the scope of work (4.1.3).

The installation specification shall detail how the following have been taken into account:

1) other building services such as mains power distribution and earthing systems;
2) circuits for smoke/fire detection and associated controls;
3) heating, ventilation and air conditioning (HVAC) infrastructures;
4) piping systems (water supply and waste, fire suppression);
5) other relevant infrastructures.

The installation specification shall detail the applicable legislation, regulations and compliance statements including:

– building regulations relating to the installation;
– specific site regulations;
– safe working practices;
– external network service protection;
– contractors' authorization.

The installation specification shall detail the site contacts with responsibilities for:

- operational requirements;
- site information (including access and applicable restrictions, knowledge of relevant hazardous areas);
- technical requirements;
- documentation of existing cabling, if relevant;
- compatibility of existing information technology cabling components;
- items to be issued to the information technology cabling installer by, or on behalf of the premises owner or appointed representative;
- storage of materials;
- installation of cabling by a third party;
- main contractor and/or sub-contractors;
- transfer of property and/or responsibility.

4.1.1.2 Recommendations

The installation specification should reflect predictable expansion to the cabling system, whether from the need to support additional users or increases in quantity or type of applications, with reference to:

a) pathways and pathway systems;
b) cabinets, frames and racks;
c) termination points;
d) the mains power supply system.

The quantity of termination points should reflect the predicted requirements over the intended life of information technology cabling.

The installation specification should contain the elements of the information technology strategy that include details of:

1) the application(s) to be supported by the installed cabling highlighting, where relevant, current and future requirements for compliance with information technology standards;
2) external network service provision and its interface(s) to the information technology cabling (see 4.4);
3) resilience planning;
4) security requirements/access restrictions.

4.1.2 Technical specification

4.1.2.1 General

The requirements of 4.1.2.2 and 4.1.2.3 apply in all cases. The minimum requirements for the development of a technical specification, based upon the installation complexity level of Clause 6, are detailed in Annex A.

4.1.2.2 Safety

The technical specification shall (with reference to EN 50174-2 and EN 50174-3):

a) identify and classify any hazardous areas within the pathways and at termination points;
b) detail the boundaries of hazardous, or potentially hazardous areas.

4.1.2.3 Performance and configuration

4.1.2.3.1 Requirements

The technical specification shall detail the required transmission performance of the cabling to be installed:

a) when subject to the defined operational environment (see 4.1.2.5);

b) in conjunction with existing cabling.

NOTE The required transmission performance may be achieved by the selection of components with appropriate environmental performance or by mitigation products or techniques that modify the defined environment including:

– isolation from the defined environment (by means of protection/segregation);

– separation from the defined environment.

The technical specification shall detail any mitigation products or techniques necessary to allow the components selected to be installed and operate as specified when subjected to the defined environmental conditions.

The technical specification shall detail the:

1) presentation of cable elements at interfaces to the installed cabling;

2) treatment of cable elements not terminated within connecting hardware.

NOTE 1 Annex B contains requirements and recommendations for the maintenance of polarity within cabling terminated with connecting hardware housing multiple optical fibres.

NOTE 2 Annex C provides information about possible connections between the wires and the pins of information technology outlets within generic cabling systems in accordance with the EN 50173 series. The same set of combinations between wires and pins should be used throughout the whole cabling installation.

The technical specification shall contain the requirements for:

– the pathways, pathway systems, cables, cabinets, frames, racks, closures and termination points (see 4.3);

– installation accessories and processes to be used during the installation;

– the protective earthing, functional earthing and equipotential bonding of cabling components and accessories. See HD 384/HD 60364 series, EN 50174-2, EN 50174-3 and EN 50310.

4.1.2.3.2 Recommendations

The technical specification should reflect the recommendations of Annex D where multiple applications are to be transmitted within a single cable.

4.1.2.4 Ancillary information

4.1.2.4.1 Requirements

The technical specification shall detail:

a) the requirements for the operational lifetime of the cabling installation;

b) any measures required to prevent unauthorised access to pathways, pathway systems, cabinets, frames, racks, closures and cords;

c) the location of, and requirements for, any relevant external network interfaces (ENIs) (see 4.4);

d) infrastructure requirements necessary to support planned extensions of the installation;

e) the requirements to maintain supply of the cabling components or suitable alternatives during maintenance, repair and extensions throughout the operational lifetime of the installed cabling.

The technical specification shall define the:

1) level of administration system to be applied to the cabling infrastructure (see 4.5.2);

2) range of documentation to be supplied by the installer including any requirements to link records to each other and to other building services records;

3) format of the documentation (e.g. to match the administration system);
4) labelling to be undertaken by the installer (see EN 50174-2 and EN 50174-3);
5) specification of labels (as a minimum, meeting the requirements of 5.2.5);
6) requirements for inspection and testing;
7) format of inspection and test documentation;
8) requirements for acceptance of the installation;
9) format of acceptance test result documentation (e.g. to match the administration system) together with other information relating to the test e.g. type of tester used, date of test, operator, termination point identifier, remedial action taken in the event of failed test, re-test results.

4.1.2.4.2 Recommendations

The format of the final cabling documentation should facilitate changes to be made to the installed cabling throughout its intended operational life.

Where used, drawings should use commonly understood, unique and unambiguous symbols (an example of such a system is IEC 60617).

4.1.2.5 Environmental conditions

4.1.2.5.1 Requirements

The technical specification shall detail, where known, the intended installation and operational environmental conditions taking into account:

a) mechanical effects:
   – shock/bump, vibration, tensile force, crush, impact, bending and flexing;
b) ingress of contaminants:
   – immersion;
c) climatic and chemical effects:
   – temperature range, rate of change of temperature;
   – humidity range including condensation and icing effects;
   – solar radiation;
   – liquid or gaseous chemical pollution;
d) electromagnetic effects.

NOTE The list above is based on the environmental classification of EN 50173-1.

In addition, the technical specification shall detail, where known, the intended installation and operational environmental conditions taking into account:

1) atmospheric pressure;
2) biological attack (e.g. mould or fungal growth);
3) physical damage (accidental or malicious) including damage caused by animals;
4) presence, or potential presence, of hazards (such as contaminating, toxic or explosive materials);
5) the movement of air (e.g. caused by fans, heating and ventilation systems);
6) wind effects;
7) impact of both direct lightning strike and lightning induced overvoltages.

NOTE A number of standards exist for the classification of environments relevant to information technology components and equipment. Reference should be made to EN 60721 series, HD 60364-1:2008, EN 300 019-1-1 (for storage) and EN 300 019-1-3 (for operation).

4.1.2.5.2 Recommendations

The technical specification should include a risk assessment including abnormal environmental conditions such as:

a) flooding;
b) immersion in fluids following the operation of sprinkler systems;
c) lightning strike;
d) earthquake.

The risk assessment should take into account the nature and duration of such conditions and should result in a risk management plan that may have an effect on the requirements for component performance or mitigation.

4.1.3 Scope of work

4.1.3.1 Pre-installation

4.1.3.1.1 Requirements

The scope of work shall detail requirements for:

a) any building work required on each pathway;
b) pathway preparation and the installation of pathway systems;
c) accommodation of the terminating devices for external and internal cables at building entrance facilities;
d) the quantities of cabling components and installation accessories;
e) additional surveys to be undertaken to supplement information in the scope of work.

The scope of work shall define:

1) the responsibilities for the identification, design and completion of the works involved;
2) the responsibilities for obtaining all necessary clearances and permits;
3) the location of storage facilities for cabling components and installation accessories;
4) a system for the disposal of waste components and/or installation materials.

4.1.3.1.2 Recommendations

The scope of work should contain:

a) site plans that are marked up to show the works required;
b) details of the facilities (such as telephone and accommodation) to be used by the installer;
c) details of the materials control system.

4.1.3.2 Installation

4.1.3.2.1 Requirements

The scope of work shall detail locations of:

a) spaces;
b) pathways;
c) cabinets, frames and racks;
d) closures;
e) termination points.

The scope of work shall detail requirements for:

1) warning signs and equipment to ensure safe working (including participation in fire drills);
2) the pathway systems to be used in each pathway;
3) the cables to be installed in each pathway;
4) jointing and/or termination at each termination point;
5) marking and labelling the cabling components;
6) the quantity and type(s) of inspection and testing to be applied to the cabling installation.

The scope of work shall define an installation programme detailing key dates including:

– requirements for site-specific safety instructions and training;
– requirements for progress meetings;
– attendance at contract inspection points;
– the date that the installation documentation is to be supplied;
– the date that the installation is to be brought into service;
– handover date(s).

The scope of work shall detail:

- items to be provided by the information technology cabling installer;
- items to be issued to the information technology cabling installer by, or on behalf of the premises owner or appointed representative;
- other works with potential to affect the programme;
- access limitations together with restrictions on personnel movement, vetting and clearance levels;
- the responsibilities for the identification, design and completion of the works involved;
- the responsibilities for obtaining all necessary clearances and permits;
- applicable fire precautions and escape routes;
- site access and security arrangements.

4.1.3.2.2 Recommendations

The scope of work should contain:

a) site plans that are marked up to show the works required;
b) details of the facilities (such as telephone and accommodation) to be used by the installer;
c) details of the materials control system.

During the development of the scope of work, testing should be considered:

1) where application-specific cabling is to be used to support a more demanding application;
2) where extending or modifying an undocumented installation.

4.1.3.3 Post-installation

4.1.3.3.1 Requirements

The scope of work shall detail requirements for reinstatement and shall define:

a) the responsibilities for the identification, design and completion of the works involved;
b) the responsibilities for obtaining all necessary clearances and permits;
c) a maintenance and control procedure for the final cabling documentation.

4.1.3.3.2 Recommendations

The scope of work should detail requirements for:

a) operational training including safety;

b) maintenance training for the premises owner, an appointed representative and/or the designated cabling maintainer;

c) fault analysis training;

d) repair and maintenance contracts;

e) spares e.g. cable, cords, closures, connecting hardware, tools, test equipment and test leads.

4.1.4 Quality plan

The quality plan is the responsibility of the installer (see 5.1.2) and shall be agreed before the installation commences.

4.2 Planning

4.2.1 Mains power/information technology cabling segregation requirements

Pathways, cables, cabinets, frames, racks, closures and termination points shall be located to minimize the effect of electromagnetic disturbances and meet the mains power/information technology cabling segregation requirements as defined by reference to EN 50174-2 and EN 50174-3.

4.2.2 Entrance facilities inside buildings

4.2.2.1 Requirements

The space allocated to the entrance facilities inside buildings may be a room or an open area based upon the following considerations:

a) security;

b) environment:
   – entrance facilities shall be located in dry areas that are not subject to flooding;

c) the required volume taking into account the foreseen requirements for:
   – external network interfaces and associated equipment;
   – lightning and over-voltage protection equipment (see EN 50174-2 and EN 50174-3);
   – additional components in accordance with local regulations.

Information technology cables that do not comply with EN 60332-1-2 shall either be:

1) terminated inside the building, within 2 m (or an alternative distance if specified by local regulations) of the point of internal penetration of the fire barrier (e.g. floor/ceiling/wall);

   or

2) installed within trunking or conduit that is considered as fire barrier in accordance with local fire regulations.

4.2.2.2 Recommendations

The location of the entrance facilities should minimise, as far as practicable:

a) the length of equipotential bonding conductors to the main building earthing point;

b) the electromagnetic interference produced by electrical service room.

4.2.3 Pathways

4.2.3.1 Requirements

The locations of entry points to pathways, including draw-boxes, shall:

a) be accessible and not be covered with permanent building installations;

b) allow installation, repair and maintenance to be undertaken without risk to personnel or equipment;

c) provide adequate space for any equipment required for installation (including cable drums and drum stands).

Pathways and/or the pathway systems within the pathways shall provide the cabling components with the necessary levels of physical and climatic protection (during installation and operation). Protection shall address the appropriate aspects listed in 4.1.2.4. Pathway systems shall achieve the necessary protection by their location, design features or a combination of both.

Elements of other supply systems such as water, heating, HVAC or sprinklers shall not be used as pathway or support for pathways systems due to the potential environmental impact and the risk that cable support will disappear by changes made to the supporting system.

Pathway systems shall be used to provide protection to the installed cabling except in areas (e.g. risers, above suspended ceiling, below access floors, equipment rooms) where the cabling can neither be damaged nor have its transmission properties adversely affected.

Pathways shall allow the fixing of the selected pathway systems (see 4.3.2, 5.2.4, EN 50174-2 and EN 50174-3) and subsequent loading of those systems due to:

1) the installation methods used;

2) the weight of the proposed quantities of cable;

3) the possibility of additional loads being applied by other services or third parties.

The pathway systems shall:

– have smooth surfaces and be free of burrs, sharp edges or projections that can damage the cables;

– be free of pressure points that may degrade the transmission performance of the installed system.

The earthing of, and the continuity between, installed sections of electrically conducting pathway systems shall be in accordance with EN 50174-2.

4.2.3.2 Recommendations

The location of pathways should avoid localised sources of heat, humidity or vibration that increase the risk of damage to either the cable construction or performance. Pathways should not be contained within lightning conductor voids or lift shafts.

The location of existing pathways should be verified to avoid accidental damage during the construction of new pathways and spaces.

Where hidden pathways are necessary, they should have either horizontal or vertical orientation.

Cables to be installed to provide redundancy should be installed in separate pathways.

The detailed design and planning of pathways and pathway systems should aim to minimize the cost and disruption associated with unscheduled installation activity.

Fire barriers should be designed to facilitate their refurbishment following cable installation. Cables passing through fire barriers should be segregated to minimise disruption to the fire barriers during any subsequent installation (or removal) of cables.

4.2.4 Information technology cabling recommendations

Parallel runs where cables lie in a fixed physical relationship to each other should be avoided unless the impact on transmission performance has been taken into account in the specification of the cables and the installation.

4.2.5 Cabinets, frames and racks

4.2.5.1 Requirements

The location of cabinets, frames and racks shall:

a) allow subsequent measurements, repair, expansion or extension of the installed cabling to be undertaken without risk of injury to personnel;

b) be consistent with the space, floor loading and other services required for information technology equipment;

c) allow the installation of the necessary cabling together with the delivery and removal of larger items of apparatus;

d) provide a minimum clearance of 1,2 m on all faces where access is required;

e) allow for the installation of additional cabling without major disruption.

Cabinets, frames and racks shall not be installed:

1) in toilet facilities and kitchens;

2) in emergency escape ways;

3) in ceiling or sub-floor spaces;

4) within cabinets or closures containing fire hose reels or other fire-extinguishing equipment.

Cabinets, frames and racks (or the closures within them) shall provide the necessary levels of physical and environmental protection for the information technology cabling and equipment installed. Protection shall address the appropriate aspects listed in 4.1.2.4. Cabinets, frames and racks shall achieve the necessary protection by their location, design features or a combination of both. Where necessary, atmospheric control shall be provided within the space and/or the cabinets, frames and racks.

The design and dimensions of the cabinets, frames and racks, together with clearances (including those above and below them, as appropriate) shall ensure that:

– it is possible to install the initial quantity of cables in accordance with the minimum bend radii (during installation, during operation – static and, if relevant, during operation – dynamic). Where multiple cable types are involved, the largest minimum bend radius shall apply;

– additional cables, as defined in the installation specification (see 4.1.1), can be subsequently installed in accordance with the minimum bend radii (during installation, during operation – static and, if relevant, during operation – dynamic). Where multiple cable types are involved, the largest minimum bend radius shall apply;

– facilities for the management of cables and cords are provided.

4.2.5.2 Recommendations

The layout of cabinets, frames and racks and the closures and information technology equipment within them should be planned to ensure that the length of cords is optimised and:

a) the routing of cords is simplified;

b) cords may be installed in accordance with the manufacturers'/suppliers' specification for:

   – minimum bend radius during operation – static and dynamic;

   – tensile load;

   – crush;

c) adequate space has been allocated to the provision of horizontal and vertical routing and dressing fixtures for cables and cords;

d) adequate space has been allocated to enable the management of lengths of cords and service loops of incoming cable without causing obstruction.

Jumpers should be terminated using an insulation displacement connection technique.

Termination points served by cabinets, frames and racks should be grouped into zones. Each zone should be served by a single cable bundle. Each bundle should be served by a single closure within the frame or cabinet.

4.2.6 Closures

4.2.6.1 Requirements

The location of closures shall allow subsequent measurements, repair, expansion or extension of the installed cabling to be undertaken without risk of injury to personnel.

Closures shall provide the necessary levels of physical and climatic protection for the cables and the connecting hardware. Protection shall address the appropriate aspects listed in 4.1.2.4. The closures or the connecting hardware shall achieve the necessary protection by their location, design features or a combination of both.

Where required by the design of the connection, closures shall be designed to provide adequate strain relief and cable support at the point of termination.

4.2.6.2 Recommendations

Where required, closures should enable the secure storage of service loops associated with termination points.

4.2.7 Termination points

4.2.7.1 Requirements

The location and design of the termination points shall:

a) allow safe access during:
   - installation of the closure and termination of the cable;
   - the delivery and installation of information technology equipment;
   - operation of the cabling (disconnection and reconnection of cords);
   - maintenance and repair;

b) ensure that link performance requirements are met;

c) prevent ingress of dust, fluids (including flooding) or other contaminants;

d) take into account the level of security required for the attached information technology equipment (e.g. termination points to which networking equipment such as wireless access points is attached may need to be protected or located to prevent unauthorised access);

e) be in accordance with local regulations.

The space allocated to termination points shall allow adequate clearances for the closure containing the termination point to be installed without damage to cabling components and in accordance with the minimum bend radii (during installation, during operation – static and, if relevant, during operation – dynamic). Where multiple cable types are involved, the largest minimum bend radius shall apply.

4.2.7.2 Recommendations

The location of termination points should:

a) minimise the length of cords attached to them;

b) ensure that channel performance requirements are achievable;

c) reflect the proposed need for information technology services of the premises, based upon floor area or upon a specific application requirement but allowing for any foreseeable future variations;

NOTE In certain cases, local regulations set minimum figures for the area or volume associated with the space allocated to a person within an office environment.

d) minimise the risk of damage due to external events (protection is an alternative to relocation).

4.3 Products and processes

4.3.1 General requirements

The components shall be selected and specified to ensure that the required cabling performance (as defined in the technical specification) is met after the components have been subjected to the predicted environmental conditions during installation and when subjected to them during operation of the cabling.

Consideration shall also be given to the potential risks associated with fire and explosion and appropriate steps taken to minimize such risk.

4.3.2 Pathways

4.3.2.1 Requirements

The pathway systems selected shall be in accordance with the instructions supplied by the manufacturers or suppliers of the cabling components.

In fixed installations where impact to the installed cabling can occur, protection shall be afforded by one or more of the following:

a) the mechanical characteristics of the pathway system;

b) the location selected;

c) the provision of additional local or general mechanical protection.

The pathway systems selected shall:

1) be in accordance with the instructions supplied by the manufacturers or suppliers of the cabling components;

2) enable the installation of fire barriers, if required.

Pathways constructed using tray-work shall be located to:

- provide a minimum clearance of 25 mm from the fixing surface;
- provide the greatest working space possible subject to a minimum of 150 mm above the tray to enable access during installation;
- meet the applicable cable minimum bend radius requirement;
- prevent damage to the installed cabling.

Draw-boxes shall be large enough to enable the installation of information technology cables in accordance with their minimum bend radii during installation. Where multiple cable types are involved, the largest minimum bend radius shall apply.

4.3.2.2 Recommendations

Where changes in pathway direction are required, they should be implemented using components recommended by the supplier of the pathway system.

Indoor pathways constructed using ducting or conduit systems should provide access at intervals of not greater than 12 m to enable the use of draw-boxes.

Pathway systems should be selected to ensure that water or other contaminant liquids cannot collect.

The selection of pathway systems should take into account the possibility of transmission of acoustic noise.

The usable space within the chosen pathway systems should be twice that necessary to accommodate the initial quantity of cables.

4.3.3 Components

4.3.3.1 Requirements

Confirmation shall be obtained from manufacturers or suppliers of cables and connecting hardware that the components selected are compatible and that performance of cable elements, screens and earth connections (as appropriate), will be achieved over the intended life of the cabling.

Labels shall be durably affixed. Labels shall be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and shall have a design life equal to or greater than that of the labelled component.

Non-machine readable labels shall:

a) feature readable text (by use of appropriate size, colour and contrast);
b) be printed, machine-generated or manufactured as part of the component.

Machine readable labels shall be printed, machine-generated or manufactured as part of the component.

4.3.3.2 Recommendations

For cables containing multiple cable elements, each element should be identified by colour coding or other permanent marking.

4.4 External network service provision

4.4.1 Requirements

Information shall be obtained from, and agreement reached with, the external network service provider(s) with respect to:

a) the precise physical location of the ENI(s);
b) the quantity and capacity of the components that provide the ENI(s);
c) the identification and numbering of individual circuits at each ENI;
d) any additional options required;
e) the responsibility of the technical and operational maintenance of the boundary of the external network service provision;
f) the liaison arrangements for the external network service provider(s) and the premises owner or an appointed representative;
g) the procedures to be followed by the premises owner or an appointed representative in reporting and reacting to faults in the external network service provision;

h) arrangements for access to the premises;

i) technical requirements for equipment supplied by the external network service provider(s).

4.4.2 Recommendations

External network service provider(s) should be advised of the foreseeable service requirements.

4.5 Operating procedures

4.5.1 General requirements

Records shall be kept of:

a) acceptance tests at the time of commissioning the installation;

b) all subsequent tests.

4.5.2 Administration requirements

An administration system shall be specified to enable effective operation, maintenance and repair of the cabling infrastructure. All information produced for or by the administration system shall be dated. Change control shall be exercised and records shall be retained for a specified minimum period.

The administration system shall meet the requirements of:

a) Table 2 based upon the installation complexity level determined from Table 4;

b) Table 3 based upon the operational complexity level of Table 5.

Table 2 and Table 3 define the minimum requirements that apply to Levels 1 to 4.

Table 2 – Minimum requirements of administration systems

	Administration system			
IDENTIFIERS				
Installation complexity level	**1**	**2**	**3**	**4**
Bonds – functional earth	-	-	Yes	Yes
Cabinets, racks and frames	Yes	Yes	Yes	Yes
Cables	Yes	Yes	Yes	Yes
Closures	-	Yes	Yes	Yes
Pathways	-	-	Yes	Yes
Spaces	-	Yes	Yes	Yes
Termination points including joints	Yes	Yes	Yes	Yes
LABELS (fixed to the item or are part of the item)				
Installation complexity level	**1**	**2**	**3**	**4**
Bonds – functional earth [a]	-	-	-	-
Cabinets, racks and frames	Yes	Yes	Yes	Yes
Cables [b]	-	-	-	Yes
Closures (unless indicated by vis ble termination point labelling)	-	Yes	Yes	Yes
Pathways	-	-	Yes	Yes
Spaces (at entrances)	-	Yes	Yes	Yes
Termination points including joints [c]	Yes	Yes	Yes	Yes
RECORDS (AND/OR DRAWINGS) that provide information about the item together with other items related to it – where used, drawings should use commonly understood, unique and unambiguous symbols (an example of such a system is IEC 60617)				
Installation complexity level	**1**	**2**	**3**	**4**
Fixed cabling	Manual	Manual	Electronic	Electronic
NOTE Manual records include paper-based systems. Electronic records include spreadsheets, databases etc.				
[a] National or local regulation may require labels to identify their function.				
[b] Labels at both ends.				
[c] Indicating the treatment of cable elements at the joint.				

The additional features provided by “Enhanced” administration systems may be required by local regulations regarding security of information technology service delivery.

Table 3 – Minimum requirements of operational administration systems

	Administration system				
IDENTIFIERS					
Operational complexity level	**1**	**2**	**3**	**4**	**Enhanced**
Cords/jumpers	-	-	-	Yes	Yes
LABELS (fixed to the item or are part of the item)					
Operational complexity level	**1**	**2**	**3**	**4**	**Enhanced**
Cords/jumpers [a]	-	-	-	Yes	Yes
RECORDS (AND/OR DRAWINGS) that provide information about the item together with other items related to it – where used, drawings should use commonly understood, unique and unambiguous symbols (an example of such a system is IEC 60617)					
Operational complexity level	**1**	**2**	**3**	**4**	**Enhanced**
Cord connections	None	Manual	Electronic	Electronic	Electronic
Service delivery	None	None	None	None	Automated
NOTE Manual records include paper-based systems. Electronic records include spreadsheets, databases etc. Automated records include systems that detect disconnection/reconnection of cords and/or services provided over the cabling.					
[a] Labels at both ends					

The administration level shall be specified in the technical specification (see 4.1.2).

4.5.3 Protection from electrostatic discharge (ESD)

4.5.3.1 General

There is a risk of potential danger for ESD disturbances in the following situations:

a) raised floors which are charged due to air circulation (for climatic reasons) within a multi-storey building;

b) electrostatically charged objects or persons approaching uncharged equipment.

An ESD threat comprises a voltage level, normally between 2 kV and 8 kV (and in exceptional circumstances up to 40 kV) and a discharge current level of up to 50 A with a rise time of nanoseconds. The most common source of danger from static electricity is the retention of charge on a conductor or on insulating sheath where virtually all the stored energy can be released in a single spark to earth or to another conductor.

NOTE CLC/TR 50404 provides additional information for avoiding ignition and electric shock hazards arising from static electricity.

4.5.3.2 Requirements

Where a risk of electrostatic discharge exists:

a) all partially conductive and non-metallic cable management systems shall be connected to each other and to earth by electrical paths to permit the relaxation of any electrostatic charges ($\leq 10\ \Omega$);

b) anti-static or conductive flooring materials shall be earthed to avoid the retention of static electricity and the resistance to earth from all parts of these materials shall be in the range 1 MΩ to 10 MΩ.

4.5.3.3 Recommendations

The build-up of charge can be reduced by consideration of the following aspects:

a) flooring surfaces:
   - rough surfaces are better than polished;
   - if carpets are used, acrylic or vinyl materials should be avoided and replaced with anti-static products.

b) humidification:
   – the real humidity range should be in the range from 40 % to 60 %.

NOTE High levels of humidity can cause other problems such as corrosion.

The draining-off of charge can be improved by consideration of the following aspects:

1) conductive floor mats;
2) conductive chairs;
3) the provision of touchplates.

Charges can be neutralised by consideration of the following aspects:

– restrictions on the use of non-conductor objects;
– the use of ionizers (both positive and negative ions).

Personnel in the areas affected can also contribute to reduction of risk by choice of clothing (cotton is best, wool fair, synthetics poor) and footwear (leather soled shoes are preferable, plastic and rubber are the worst) and by wearing ESD wrist straps with 1 MΩ series resistors and quick disconnects.

Where a risk of electrostatic discharge exists, the magnitude of the electrostatic field and the discharge effects can be reduced by making the immediate environment around static-sensitive devices suitably conductive.

NOTE In some cases, a metal surface may not be the best choice because discharge can be too fast and therefore current too high. Dissipative surface with conductivity in the range of 10^5 Ω to 10^9 Ω will be a better choice.

4.6 Maintenance

4.6.1 Requirements

Where a preventive maintenance programme is required, it shall specify the following:

a) the activities to be performed e.g. cleaning;
b) how often maintenance checks are to be made;
c) what will be inspected during each maintenance check (for example, cabling in use, redundant cabling, pathways, pathway systems, earthing systems, fire barriers);
d) how much of the installed information technology cabling will be inspected during each maintenance check;
e) planned replacement of cabling components.

4.6.2 Recommendations

It is recommended that a preventative maintenance programme be established by means of visual examination for installation complexity levels of 2 and above.

The items to be included in a visual inspection should comprise:

a) physical damage to components;
b) disconnection of balanced pairs at termination points;
c) disconnection of grounding components;
d) missing or illegible/unreadable labels;
e) changes to the environmental risk assessment relating to the cabling.

5 Requirements for installers of information technology cabling

5.1 Documentation and administration

5.1.1 Installation specification requirements

The installation specification prepared by the premises owner or an appointed representative (see 4.1.1) shall be agreed before the installation commences.

5.1.2 Quality plan

5.1.2.1 Requirements

A quality plan shall be prepared that details the measures and procedures to be adopted to demonstrate compliance with:

a) the requirements and recommendations of this standard;

b) the requirements of the referenced cabling design document (e.g. EN 50173-2);

c) the installation specification.

Where elements of 5.1.2.1 are contained within the installation specification, the installer shall confirm that those elements shall be complied with.

The quality plan shall be agreed with the premises owner or an appointed representative before the installation commences.

The quality plan shall detail the procedures:

a) for the transfer of responsibilities between the installer, premises owner or an appointed representative and, where relevant, other contractors;

b) for the acceptance of cabling components and the cabling installation (including verification of physical, mechanical, optical and/or electrical specifications based on the manufacturers' or suppliers' specifications or relevant standards);

c) to be adopted to ensure compatibility between cabling components to be used during the installation;

d) to be adopted to ensure compatibility with any existing installed cabling;

e) to address the impact of any potential component incompatibilities.

Where, at any point during the installation process, inspection and/or testing of cabling components or installed cabling is specified in the installation specification, or by local regulations, the quality plan shall detail the:

1) inspection and test equipment;

2) the calibration status of the inspection and test equipment;

3) sampling plans (see EN 50346 for further information);

4) measurement procedures;

5) treatment of results which are non-compliant or marginal (i.e. within the specified measurement accuracy of the test system) as described in EN 50346.

The minimum requirements for the development of a quality plan, based upon the installation complexity level of Clause 6, are detailed in Annex A.

The quality plan shall detail the competency of personnel to undertake the installation in accordance with the installation specification.

5.1.2.2 Recommendations

Installation personnel should be qualified according to a relevant training scheme of national, industry or manufacturer origin.

5.1.3 Installation schedule requirements

An installation schedule shall be prepared in response to the installation programme contained in the installation specification.

The installation schedule shall be agreed with the premises owner or an appointed representative before the installation commences.

5.1.4 Installation instructions requirements

Specifications for the cabling components to be used shall be obtained from manufacturers or suppliers including:

a) environmental requirements (storage, installation and operation);

b) cable and cable element minimum bend radii (during installation, during operation – static and, if relevant, during operation – dynamic);

c) cable tensile load;

d) cable crush resistance.

Instructions for the storage, installation and operation of the cabling components shall be obtained from manufacturers or suppliers including:

1) pathways and pathway systems;

2) installation tools and installation equipment;

3) termination of cables to connecting hardware.

Method statements shall be prepared for the processes to be applied during the installation.

5.1.5 Change control requirements

All modifications, changes and deviations shall be documented in a manner agreed with the premises owner or an appointed representative.

5.1.6 Documentation of the installed cabling

Installed cabling documentation and test result records shall be compatible with the administration system to be operated as defined in the installation specification (see 4.1.2.1).

The location, dimensions and/or capacity of pathways into which information technology cabling has been installed shall be recorded together with details of any mitigation measures applied to provide the required environment.

5.2 Products and processes

5.2.1 Compatibility of cabling components

Procedures detailed in the quality plan shall be applied to ensure components to be used are compatible with each other and existing cabling.

5.2.2 Cabling component acceptance

Procedures detailed in the quality plan shall be applied to ensure components to be used are in accordance with their specification.

5.2.3 Calibration and normalisation of inspection and test equipment

5.2.3.1 Requirements

See EN 50346.

5.2.3.2 Recommendations

See EN 50346.

5.2.4 Pathway systems

Pathway systems shall be selected in accordance with the installation requirements of the information technology cabling manufacturer or supplier.

5.2.5 Labelling

The labelling of the installation shall be in accordance with the installation specification.

Labelling shall be implemented in such a manner that, for the anticipated lifetime of the cabling, the labels are accessible, legible and, where necessary, able to be modified.

5.3 Power supplies

No requirements or recommendations.

5.4 Surveys

5.4.1 Pathways

The accessibility and availability of pathways in accordance with the installation specification and the installation schedule shall be confirmed to the premises owner or an appointed representative.

The accessibility and availability of locations at which drums (or equivalent) are to be positioned in accordance with the installation specification and installation schedule shall be confirmed to the premises owner or an appointed representative.

The premises owner or an appointed representative shall be advised of all deviations and associated actions required.

5.4.2 Cabinets, frames and racks

The accessibility and availability of locations at which cabinets, frames and racks shall be positioned in accordance with the installation specification and the installation schedule shall be confirmed to the premises owner or an appointed representative. The premises owner or an appointed representative shall be advised of all deviations and associated actions required.

5.4.3 Closures

The accessibility and availability of locations at which closures shall be positioned in accordance with the installation specification and the installation schedule shall be confirmed to the premises owner or an appointed representative. The premises owner or an appointed representative shall be advised of all deviations and associated actions required.

6 Installation complexity

6.1 Requirements

The installation complexity level and operational complexity level to be applied shall be selected by the premises owner or an appointed representative. The selected levels shall take into account any foreseen expansion of the infrastructure in terms of both the number of fixed cable elements (see Table 4) and administered ports (see Table 5).

6.2 Recommendations

The installation complexity level is based upon the type of premises and quantity of cable elements in the fixed cables comprising the installation and should be determined by reference to Table 4. The levels shown are based upon implementations of structured cabling in accordance with the EN 50173 series. Other implementations of fixed cabling may require other levels to be applied.

Where areas may have multiple functions (e.g. homes that can be converted to office premises) the more demanding level should apply.

Table 4 – Level of installation complexity

Number of fixed cable elements	2 to 200	201 to 1 000	> 1 000
Office	Level 2	Level 2	Level 3
Industrial	Level 3	Level 3	Level 4
Homes	Level 1	Level 1	Level 1
Multi-tenant residential premises	Level 2	Level 2	Level 3
Data centres	Level 2	Level 2	Level 3
NOTE This is the number of fixed cables multiplied by the number of cable elements per cable. It is the total for all cables (coaxial, balanced pair and optical fibre).			

The operational complexity level is based upon the type of premises and quantity of administered ports and should be determined by reference to Table 5. The number of administered ports is defined as the number of user-accessible equipment interfaces including those on the connected equipment.

Table 5 – Level of operational complexity

Number of administered ports	2 to 100	101 to 500	501 to 5 000	> 5 000
Office	Level 1	Level 1	Level 2	Level 3
Industrial	Level 1	Level 1	Level 2	Level 3
Homes	Level 1	Level 1	Level 1	Level 1
Multi-tenant residential premises	Level 1	Level 1	Level 2	Level 3
Data centres	Level 2	Level 3	Level 4	Level 4

Annex A
(normative)

Minimum requirements for technical specifications and quality plans

A.1 General

This annex specifies the minimum content of technical specifications (see 4.1.2) and quality plans (see 5.1.2) based on the installation complexity level of Clause 6.

A.2 Technical specification

The minimum requirements for the contents of a technical specification based on the installation complexity level of Clause 6 are detailed in Table A.1.

Table A.1 – Minimum requirements for technical specification

Installation complexity level	Technical specification			
	1	2	3	4
Requirements detailed in 4.1.2.2	Yes	Yes	Yes	Yes
Requirements detailed in 4.1.2.3	Yes	Yes	Yes	Yes
Requirements detailed in 4.1.2.4	–	Yes	Yes	Yes
Requirements detailed in 4.1.2.5	–	Yes	Yes	Yes

A.3 Quality plan

The minimum requirements for the contents of a quality plan based on the installation complexity level of Clause 6 are detailed in Table A.2.

Table A.2 – Minimum requirements for quality plan

Installation complexity level	Quality plan			
	1	2	3	4
100 % testing of cable element polarity	Yes	Yes	Yes	Yes
Treatment of marginal test results	–	Yes	Yes	Yes
Treatment of failed test results	Yes	Yes	Yes	Yes
Documentation of test results	–	Yes	Yes	Yes

Annex B
(normative)

Polarity maintenance: Connecting hardware for multiple optical fibres

B.1 General

Optical fibre cables typically contain optical fibres with coloured buffers or coatings for identification purposes. A colour scheme for cables containing up to twelve optical fibres is described in EN 60794-2:2003, Table 1, and shown in Table B.1. Other conventions exist for the colour-based identification of optical fibres. The requirements and recommendations of this annex are applicable independent of the actual colour scheme adopted.

Table B.1 – Optical fibre colour code scheme of EN 60794-2

Colour	Optical fibre number
Blue	01
Yellow	02
Red	03
White	04
Green	05
Violet	06
Orange	07
Grey	08
Turquoise	09
Black	10
Brown	11
Pink	12

NOTE 1 The figures in this annex show connectors labelled with position numbers. This is done for reference only; it is not a requirement of this annex that connectors be labelled with a position number.

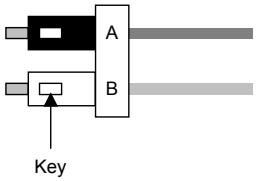
NOTE 2 This colour code is applied in Figures B.5 to B.11.

Where cables do not contain coloured optical fibres then the requirements of this annex shall be applied via the optical identification system present in the cable being used.

B.2 Duplex connecting hardware interfaces

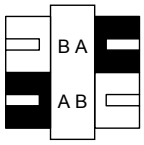
B.2.1 Duplex plugs, adapters and cords

A duplex connector plug and a duplex adapter are shown in Figures B.1 and B.2. When looking at the duplex connector plug head-on (into the fibres) with the raised keys on top, the left position is A and the right position is B, as shown in Figure B.1. The raised keys on the plug, and the keyways in the adapter, allow the plug to be inserted into the adapter in only one orientation so that plug A inserts into adapter position A and plug B into adapter position B.



NOTE Shading is for illustration clarity only.

Figure B.1 – Duplex connecting hardware plug



NOTE Shading is for illustration clarity only.

Figure B.2 – Duplex connecting adapter

The adapter provides a crossover between two mated plugs because the keyways on the front and back halves of the adapter are oriented the same direction (for example, on top) as shown in Figure B.2. When looking into the front of the adapter, this construction causes the right position (labelled A) to mate to the left position (labelled B) as viewed when looking into the back of the adapter. Thus position A on one plug mates to position B on the other plug, and vice versa, which provides the crossover in the adapter. The letters A and B are generally marked on the plug and on the adapter for identification.

A-to-B patch cords shall be built as shown in Figure B.3.

Figure B.3 – Duplex patch cord

Figure B.4 illustrates how duplex patch cords provide a crossover, since the optical fibres are attached to opposite plug positions from one end to the other. To illustrate this more clearly, the same crossover patch cord is shown in three different orientations. In all three views, each of the two fibres is attached to plug position A on one end and position B on the other end. Note the positions of the keyways on the connectors.

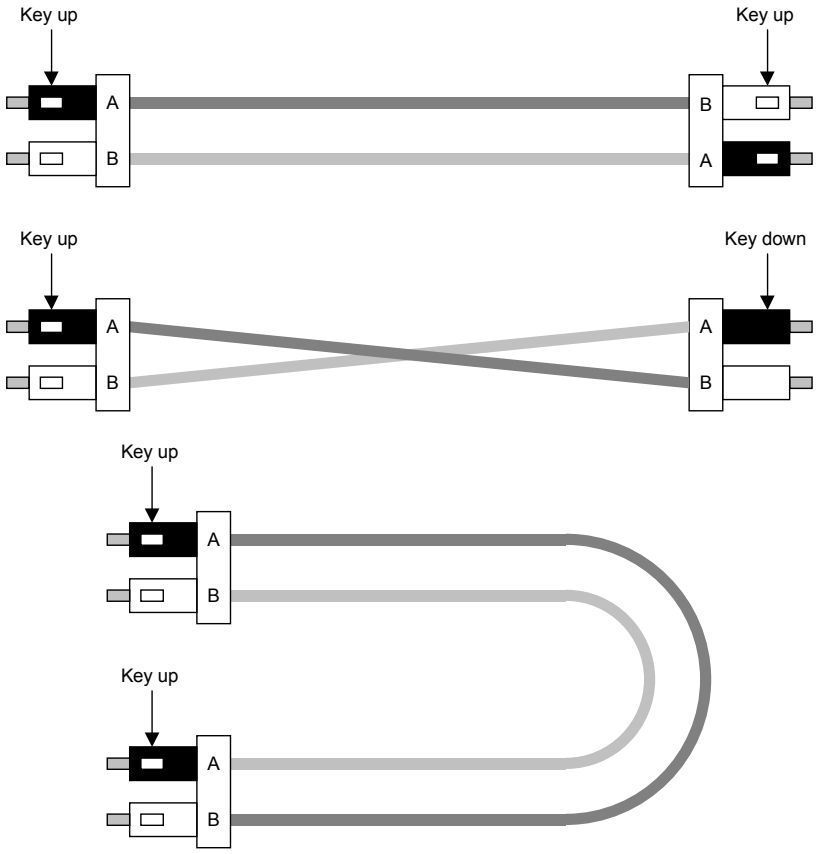


Figure B.4 – Views of crossover patch cords

B.2.2 Polarity of installed cabling segments

Permanent cable segments shall be installed with a crossover in each optical fibre pair such that each optical fibre of a pair is plugged into an adapter position A on one end and an adapter position B on the other end.

There are two methods available to achieve proper polarity when terminating cables at patch panels. The first method is preferred, as it provides more straightforward administration for applications that operate on other than two fibres, such as surveillance video on one fibre, or high-resolution component video that operates on three fibres (for R, G, B signals). This method is referred to as Symmetrical Positioning and it maintains the same order of the fibres at both ends of the cable. The alternate method, called Reverse-Pair Positioning, is used when the adapter orientation in patch panels is fixed.

Following either of these methods ensures that each fibre will be plugged into position A on one end and position B on the other end, thus providing the required crossover. Figure B.5 illustrates the Symmetrical Positioning Method and Figure B.6 illustrates the Reverse-Pair Positioning Method.

B.2.3 The Symmetrical Positioning Method

In the Symmetrical Positioning Method, adapters are inserted in the patch panel at one end of the cable with the opposite orientation of the adapters at the other end of the cable. At one end of the cable, adapters are installed such that adapter position A corresponds to odd numbered panel positions (A-B, A-B order), and on the other end of the cable, adapters are installed in the opposite orientation such that adapter position B corresponds to odd numbered panel positions (B-A, B-A order).

Optical fibres are plugged into the adapters with the same number (or colour code) sequence on both ends of the cable (that is, 1 (blue), 2 (yellow), 3 (red), 4 (white), etc.) so that the fibre number (or colour code) sequence is symmetric with respect to the panel positions.

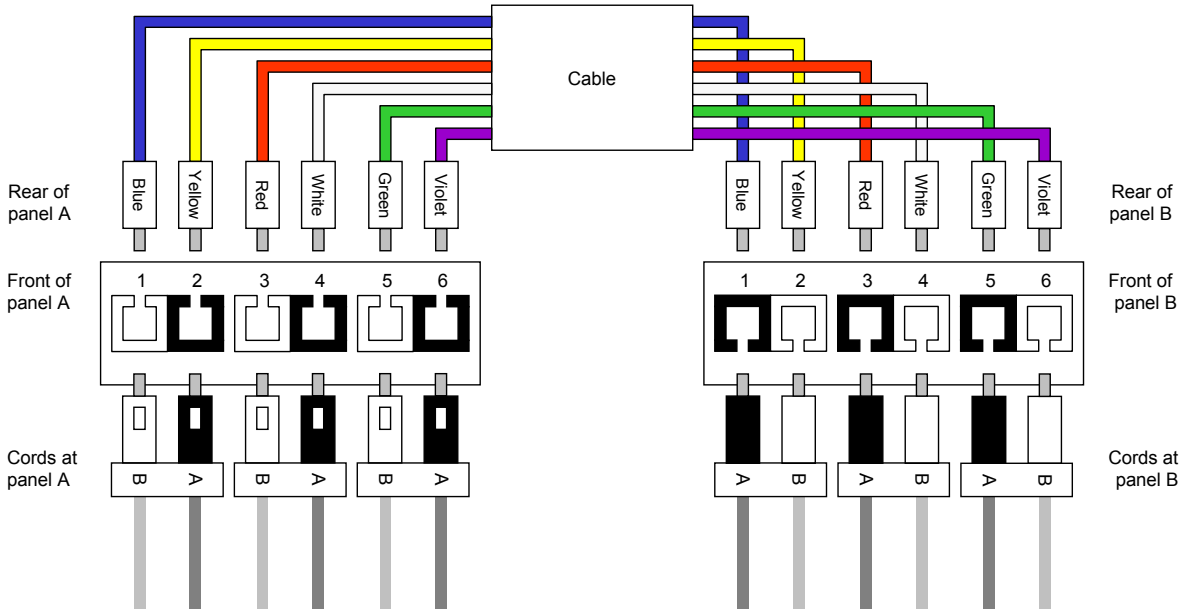


Figure B.5 – Optical fibre sequences and adapter orientation in patch panel for the Symmetrical Position Method

B.2.4 The Reverse-Pair Positioning Method

In the Reverse-Pair Positioning Method, adapters are inserted (or are pre-installed) in the patch panel at one end of the cable with the same orientation of the adapters at the other end of the cable. They may be installed either in A-B, A-B order or B-A, B-A order.

Optical fibres are plugged into the adapters with normal number (or colour code) sequence on one end of the cable (that is, 1 (blue), 2 (yellow), 3 (red), 4 (white, etc.), and with pair-reversed ordering on the other end (that is, 2 (yellow), 1 (blue), 4 (white), 3 (red), etc.).

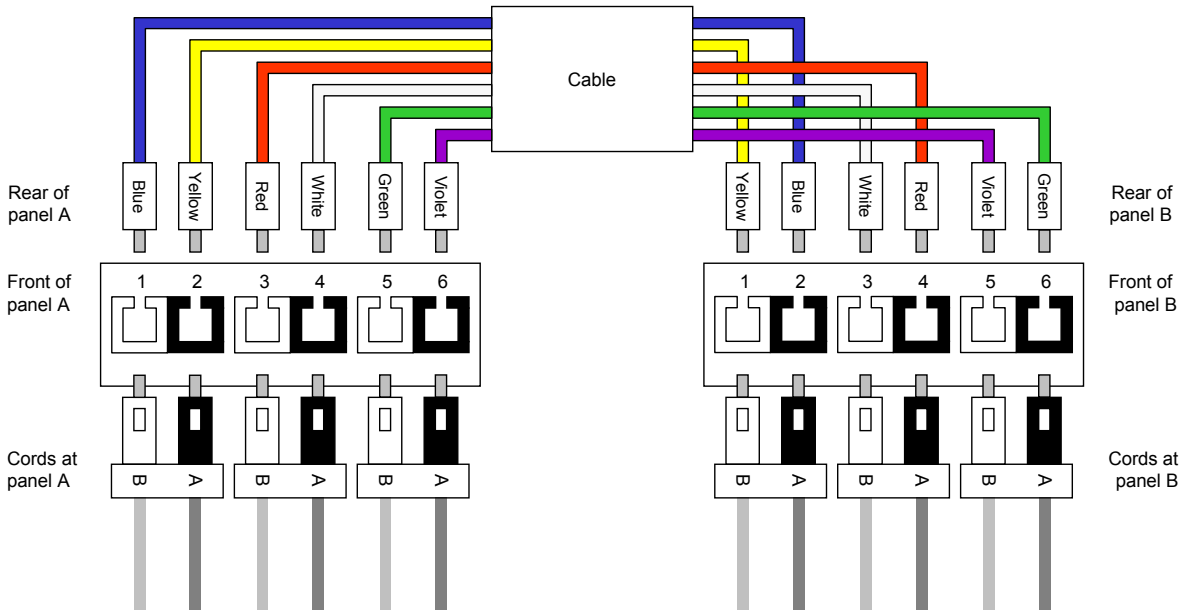


Figure B.6 – Optical fibre sequences and adapter orientation in patch panel for the Reverse-Pair Position Method

B.3 Array connecting hardware interfaces

B.3.1 General

Array connecting hardware enables the installation of pre-terminated cables containing multiple optical fibres. The optical fibres within the cables may be presented at panels in a number of ways including the use of:

a) transition assemblies for the creation of duplex optical fibre channels;

b) array interfaces for onward connection to transmission equipment that uses array connecting hardware for applications that make use of several parallel optical fibre channels.

An implementation of the type described in B.3.2 and B.3.3 is recommended to provide the required control of optical fibre polarity through array interfaces, transition assemblies and attached cords.

Where the array connection is created using a combination of pinned and unpinned connectors, the pinned connector is typically located where the risk of damage is least (e.g. inside panels, transition assemblies and transceivers) whereas the connector that is frequently removed and handled is unpinned.

This convention leads to the following recommendations:

1) patch cords (from transceiver to panel) should be unpinned on both ends;

2) transition assemblies (mounted behind the panel) should be pinned;

3) cables from panel to panel should be unpinned on both ends.

NOTE Flat-polished array connectors do not optically mate with angle-polished array connectors.

B.3.2 Array connecting hardware components

B.3.2.1 General

Subclause B.3.2.2 describes an approach for the termination of cables and patch cords. Subclause B.3.2.3 describes an approach for the configuration of array connection adaptors. Subclause B.3.2.4 describes an approach for the implementation of duplex transition assemblies.

The use of these components as described in B.3.3 ensures the maintenance of the correct optical fibre polarity using the minimum number of component configurations.

Alternative approaches to those described in B.3.2.2 to B.3.2.4 may be applied but will require implementations other than those of B.3.3 in order maintain the correct optical fibre polarity. In addition, a greater number of component configurations may be required e.g. different designs of transition assembly or patch cord at each end.

B.3.2.2 Cables and array connector patch cords

As shown in Figure B.7, array connector cables have a sequential number assigned to each optical fibre which are then inserted into the array connectors as follows:

a) within the array connector, the optical fibres are fixed within the array connector in consecutive number (1,2,3,4…12) from left to right as viewed looking at the end-face of the connector with the connector key up;

b) on the other end of the cable, the optical fibres are fixed within the array connector in reverse consecutive number (12,11,10,9…1) from left to right as viewed looking at the end-face of the connector with the connector key up.

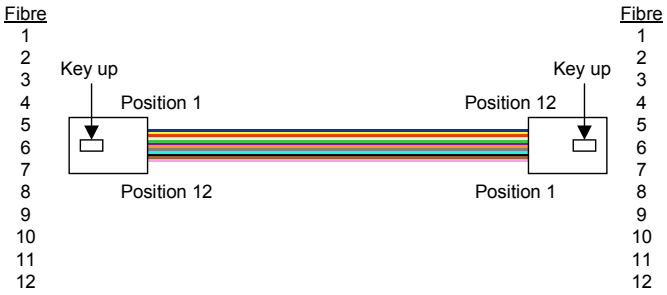


Figure B.7 – Array connector cable or patch cord (key-up to key-up)

NOTE The cable shown is unpinned on both ends, following the gender convention described in B.3.1. In some instances (such as when supporting parallel signals as shown in Figure B.11) it will be necessary to use a combination of unpinned and pinned array connectors on cables and patch cords.

B.3.2.3 Array adapters

Array adapters shall be built such that they mate two array connectors with the connector keys aligned (i.e. key-up to key-up) as depicted in Figure B.8.

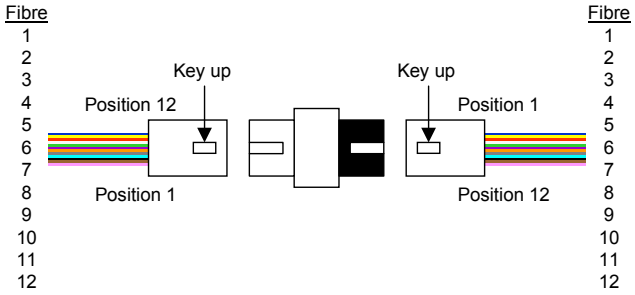


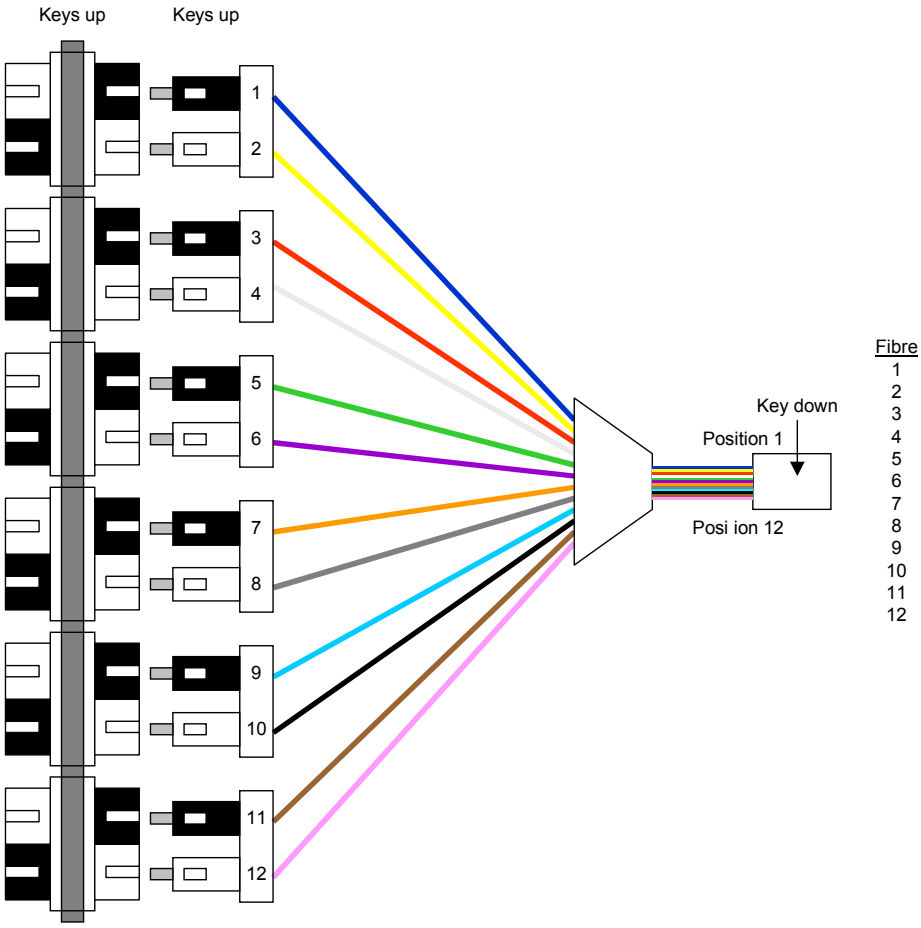
Figure B.8 – Array adapter with aligned keyways

B.3.2.4 Transition assemblies for duplex cabling

As shown in Figure B.9, transition assemblies have a sequential number assigned to each optical fibre which are then inserted into the connectors as follows:

a) within the array connector the optical fibres are fixed in consecutive number (1,2,3,4…12) from right to left as viewed looking at the end-face of the connector with the connector key down;

b) in the duplex connecting hardware the optical fibres are fixed in consecutive numbering (1,2,3,4,5,6…11,12) from left to right as viewed looking through the adapters with keys up.



NOTE For ease of illustration, this transition assembly is shown with duplex adapters, although they are not necessarily part of the assembly.

Figure B.9 – Transition assembly

B.3.3 Array Connectivity Method

B.3.3.1 Duplex cabling

Implementation of the array connectivity method for duplex signals is shown in Figure B.10.

When connecting multiple duplex optical transceiver ports, the backbone (composed of one or many array connector cables mated with array adapters) is connected on each end to a transition assembly. The transition assemblies are mounted in two orientations such that their duplex adapter key orientation on one end of the backbone is rotated 180 degrees relative to their adapter key orientation on the other end of the backbone. For example, one transition assembly is installed with keys up and the other with keys down. If the 180-degree rotation of one of the transition assemblies is not feasible, a port mapping labelling scheme shall be implemented. Duplex patch cords as specified in B.2.1 are used to connect ports on the transition assembly to their respective duplex transceiver ports.

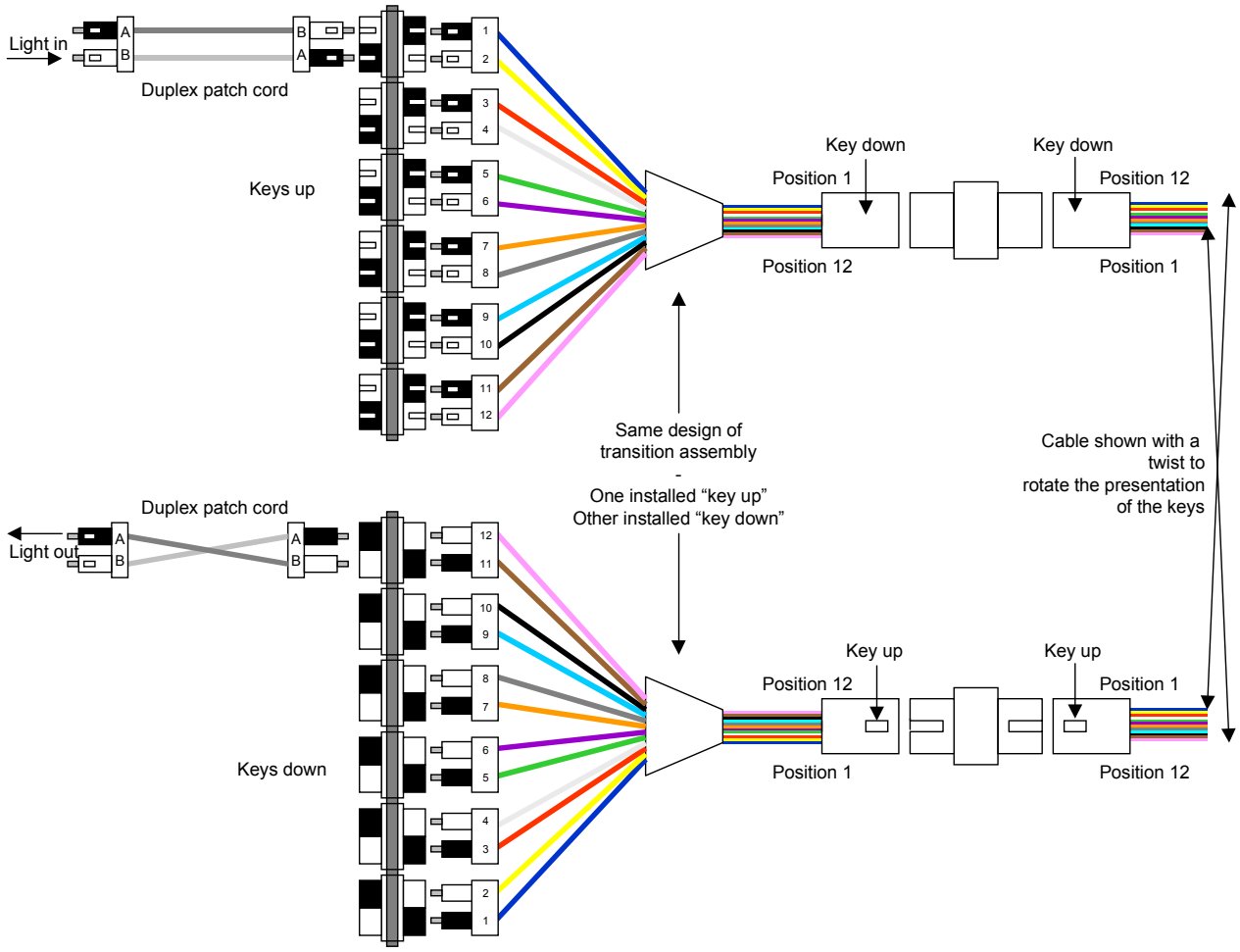
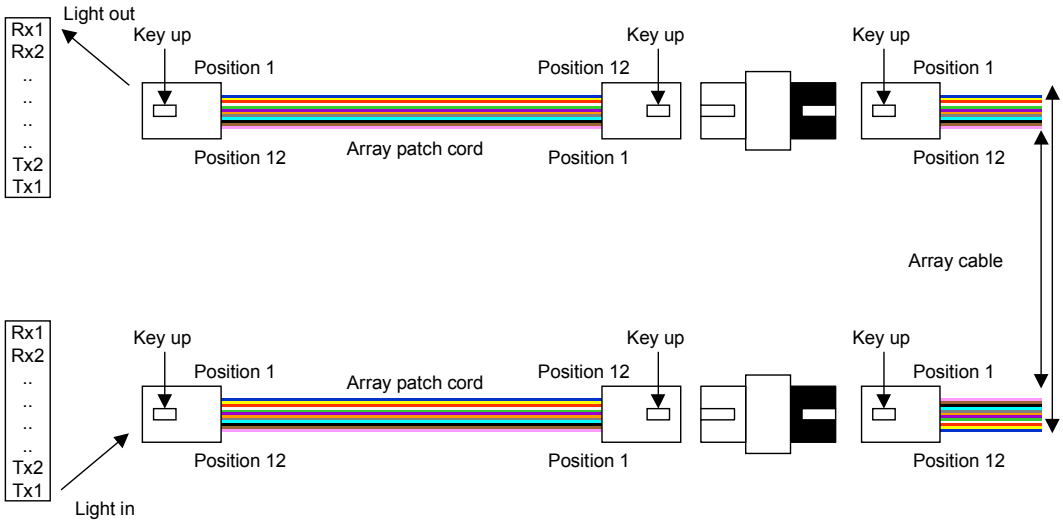


Figure B.10 – Connectivity method for duplex cabling

B.3.3.2 Array cabling

Implementation of the connectivity method for parallel signals is shown in Figure B.11.

When connecting parallel signals, the array backbone (composed of one or many array connector cables mated in array adapters) is connected on each end to a patch panel. Array patch cords are then used to connect the patch panel ports to their respective parallel transceiver ports.



NOTE This connectivity method will also work with other types of array transmitter and receiver devices.

Figure B.11 – Connectivity method for array cabling

Annex C
(informative)

Terminating balanced cables on terminating blocks in distributors

C.1 General

It is possible for the pair and pin arrangement for a generic cabling system according to the EN 50173 series to be realised in different ways. Some implementations use the same type of connector for the termination at both ends of the cable. Other implementations use terminating blocks in the distributors.

C.2 The use of the same type of connector at each end of a cable

When the same type of connector (same wire termination layout) is used at each end of the cable a systematic termination of pairs at the two ends will ensure a pin-to-pin correspondence of the two connectors.

It is possible that connectors according to EN 60603-7 from different manufacturers (and even from the same manufacturer) have a different layout for the termination of the wires. If both ends of the cable are terminated by two such different connectors, problems with pin-to-pin correspondence between these two connectors can arise.

C.3 The use of a different type of connector at each end of a cable

There should be a fixed relation between the tags of the terminating blocks and the pins of the termination points.

C.4 Relation between the pins of connectors according to EN 60603-7 and the tags of a terminating block

Examples of the relations between the pins of connectors according to EN 60603-7 and the tags of the terminating block are given in Table C.1. Most connectors are suited to only one of the options in Table C.1.

Table C.1 – Examples of the relations between the EN 60603-7 series pins and the tags of the terminating block

Terminating block	Pins of the termination points (EN 60603-7)	
Pair identification [a]	Option A	Option B
Pair 1, a-lead	5	5
Pair 1, b-lead	4	4
Pair 2, a-lead	3	1
Pair 2, b-lead	6	2
Pair 3, a-lead	1	3
Pair 3, b-lead	2	6
Pair 4, a-lead	7	7
Pair 4, b-lead	8	8

[a] The terms ‘pair’ and ‘lead’ strictly refer to the terminating block and do not necessarily reflect the use of balanced pairs in the cable.

Rearrangement of the pin configuration by means of inserts or other modular connecting hardware is allowed. Thus no normative correlation between the leads at the terminating block and the pins of the termination points exists. Table C.1 shows only two of many options.

Annex D
(informative)

Compatibility between transmission systems (balanced and unbalanced) sharing the same cable sheath within information technology cabling

D.1 Introduction

This annex is intended for use by those designing, planning, procuring, managing or installing cabling where multiple types of transmission systems share the same cable sheath. It is also intended for those wishing to install information technology equipment and who wish to ensure its compatibility with existing equipment with which it shares the same cable sheath.

There are often economic advantages in sharing the same cable sheath between different types of transmission systems especially when the cabling is already installed or when installing cabling without prior knowledge of the types of transmission system that will be required.

It is costly and disruptive to install additional cabling for each additional transmission application. In many cases existing cabling will give satisfactory performance if certain precautions are taken. In the backbone or where the existing cabling system is poorly documented it is generally preferable to install new cabling.

NOTE Balanced cabling channels specified in EN 50173-1 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.

D.2 Recommendations concerning cable sharing

The following recommendations concerning cable sharing are explained in more detail in the following text:

a) local regulations concerning the sharing of cables with other services shall be taken into account;

b) it is recommended that equipment using shared cabling should have adequate protection against contact with voltages of other services within the cable in accordance with local regulations;

c) in cases where standardised transmission systems are inadequately specified for sharing it is recommended that equipment and cable manufacturer's advice should be sought;

d) it is recommended that only balanced transmission systems be used when sharing in the same cable sheath unless the individual pairs or quads are screened;

e) it is not recommended to use the same cable for both analogue telephone and digital transmission systems unless this type of operation is guaranteed by the equipment manufacturers over the cable to be used;

f) better crosstalk noise immunity is achieved by segregating different transmission systems in different binder groups.

Recording and labelling is of particular importance when sharing. Information regarding the limitations on sharing should be recorded. Where different transmission systems are segregated into different binder groups attention should be given to the identification and marking of which pairs belong to each binder group.

D.3 Factors to be taken into account to ensure satisfactory performance

D.3.1 General

Various parameters concerning the disturbing and disturbed transmission system, as well as the cabling itself, need to be taken into account to ensure satisfactory transmission performance when sharing a cable sheath. Not all parameters are important in all cases depending on the types of transmission systems considered. Often standardised transmission systems and cables are inadequately specified for sharing particularly parameters concerning the receiver sensitivity to out of band noise and out of band signal emission. In these cases equipment and cabling manufacturer's recommendations concerning sharing should be taken into account.

D.3.2 Factors concerning the disturbing transmission system

The following factors should be considered with respect to a disturbing transmission system:

a) the number of disturbers of each type;

b) correlation between disturbing transmitters;

c) the transmitted common mode frequency and/or temporal waveform characteristics;

d) the transmitted differential mode frequency and/or temporal waveform characteristics;

e) common mode and differential mode impulse noise emission characteristics – including remote power feeding source and load switching and analogue ringing and dialling voltages;

f) transmitter duty factor.

D.3.3 Cabling characteristics

D.3.3.1 Crosstalk loss

Crosstalk loss comprises:

a) differential mode to differential mode;

b) common mode to differential mode;

c) differential mode to common mode;

d) common mode to common mode.

The relative importance of these different types of crosstalk depends on the type of disturbed and disturbing transmission system. For example if the disturbing transmission system is unbalanced it will generate both common mode and differential mode voltages with similar amplitudes. As the differential mode crosstalk loss of twisted pair cable is very much higher than the common mode crosstalk loss it will be the common mode crosstalk characteristics of the transmitter that will offer the highest risk of interference and the contribution of the differential mode crosstalk can be neglected.

It is however difficult to measure the common mode crosstalk loss of installed cabling or of a cable in laboratory conditions. The measured crosstalk loss depends very much on the position of the cable with respect to earth, how the unused pairs and cable screen (if any) are connected and the common mode terminating impedance with respect to earth that is provided by the attached equipment. In the case of installed cabling the common mode crosstalk loss depends very much on the earth reference point that is used and that differ for the transmitter and receiver.

Because of the unpredictable nature of common mode crosstalk loss it is recommended that only balanced transmission systems be used when sharing the same cable sheath unless the individual pairs are screened.

D.3.3.2 Insertion loss

Often receiver noise sensitivity is specified as a parameter that is independent of the received signal level. In such a case cabling insertion loss is not an important factor for sharing when both disturbing transmitter and disturbed receiver are at the same end of a cabling link and provided that the insertion loss is less than the specified maximum for each type of transmission system. Other transmission systems will be less sensitive to noise when the received signal level increases (although often effectively specified at the minimum received signal level only). In this case cabling insertion loss is an important parameter for sharing. In certain cases, insertion loss is also important where the disturbing transmitter and disturbed receiver are at opposite ends of the cabling.

D.3.3.3 Termination

Crosstalk loss depends on the differential and common mode impedances terminating the cabling. These terminations are usually provided by the attached equipment and, in the case of common mode impedance, are not always specified and are frequency dependent.

D.3.4 The disturbed transmission system

The following aspects should be taken into account:

a) receiver sensitivity to common mode noise as a function of frequency;

b) receiver sensitivity to differential mode noise as a function of frequency. In certain cases, receiver noise sensitivity depends on the received signal level (e.g. where the receiver incorporates adjustable thresholds or an automatic gain control);

c) common mode to differential mode conversion at the receiver or transmitter of the disturbed transmission system;

d) the performance requirement of the disturbed transmission system (error rate, signal to noise ratio).

D.4 Guidelines for reducing interference between transmission systems within the same cable sheath

The following methods can be considered to reduce interference between transmission systems within the same cable sheath:

a) screening of the individual cable elements, i.e. of pairs or quads;

b) in certain cases, the construction of binder groups within cables allows the selection of individual pairs during termination in order that their position within a given connection system provides optimum crosstalk loss - this is particularly true when each binder group has its own screen;

c) consideration should be given to the use of a cable that has more stringent (i.e. better) crosstalk loss values and more stringent (i.e. lower) insertion loss values.

In all cases, information should be obtained from cable manufacturers.

D.5 Cabling qualification

Particular attention should be given to the measurement of crosstalk loss and insertion loss when sharing a cable sheath. Specialist advice should be sought on the limits that should be applied.

D.6 Particular installation requirements and recommendations

Where it is necessary to segregate the different transmission system types into separate binder groups attention should be given to the identification and marking of these binder groups.

D.7 Cable management

The possibility of damage due to erroneous connections is more likely when different types of transmission systems share the same cable sheath. Recording and labelling of each circuit is therefore of particular importance. Also information regarding the limitations on sharing should be recorded (number and types of circuit within the cable, allocation of binder groups where necessary etc.).

D.8 Regulatory aspects

In certain cases, local regulations concerning the sharing of cables with other services restrict the use of a cable for other services and impose segregation of certain services.

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