Foreword

This European Standard has been prepared by Technical Committee CENELEC/TC 215 „Electrotechnical aspects of telecommunication equipment" under the framework of the Mandates M/212 on „Telecommunication cables and cabling systems" and M/239 on „Air traffic management equipment and systems".

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50174-1 on 2000-08-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at the national level by publication of an identical national standard or by endorsement (dop) 2001-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-08-01

This standard comprises three parts. All three parts support the specification, implementation and operation of information technology cabling using both balanced copper and optical fibre cabling components. These components are combined to provide cabling solutions either in accordance with the design requirements of EN 50173 or to meet the requirements of one or more application-specific standards (such as EN 50098-1 or EN 50098-2).

This part, EN 50174-1, is intended to be referenced in contracts between cabling installers and their customers. However, the range of options featured in many of the clauses make a single conformance statement impossible. For this reason the standard should be read carefully to ensure that the requirements of the standard (as defined by the use of the word ”shall”) are adhered to where conformance is required under the terms of any contract.

Annexes designated "informative" are given for information only.
In this standard, annexes A and B are informative.

Contents

Introduction

Within premises, the importance of the information technology cabling infrastructure is similar to that of other fundamental building utilities such as heating, lighting and mains power supplies. As with other utilities, interruptions to service can have 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 installation of information technology cabling. These are:

a) design - the selection of cabling components and their configuration;

b) specification - the detailed requirement for the cabling, its accommodation and associated building services addressing specific environment(s) identified within the premises together with the quality assurance requirements to be applied;

c) implementation - the physical 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, implementation and operational aspects. The design issues are covered in EN 50173 and / or other application standards.

This part, EN 50174-1, is intended to be used by personnel during the planning phase of the installation together with those responsible for the quality planning and operation of the installation. It contains requirements and guidance for the specification and quality assurance of the information technology cabling by defining:

– aspects to be addressed during the specification of the cabling;

– quality assurance documentation and procedures;

– requirements for the documentation and administration of cabling;

– recommendations for repair and maintenance.

EN 50174-2 and EN 50174-3 are intended to be used by the personnel directly involved in the implementation phase of the installation. EN 50174-2 is applicable inside buildings and EN 50174-3 is applicable outside buildings.

These standards contain detailed requirements and guidance relating to the installation planning and practices by defining:

1) planning strategy (road map) and guidance depending on the application, electromagnetic environment, building infrastructure and facilities, etc.

2) design and installation rules for metallic and optical fibre cabling depending on the application, electromagnetic environment, building infrastructure and facilities, etc.

3) requirements on satisfactory operation of the cabling depending on the application, electromagnetic environment, building infrastructure and facilities, etc.

4) the practices and procedures to be adopted to ensure that the cabling is installed in accordance with the specification.

In addition the information in EN 50174-2 and EN 50174-3 should be used to construct the detailed specification for the installation in accordance with this standard.

Figure 1 shows the relationships between the standards produced by TC 215 for information technology cabling, namely cabling design standards (EN 50098 series, EN 50173), cabling installation standards (EN 50174 series) and equipotential bonding requirements (EN 50310).

Building design phase	Cabling design phase	Planning phase	Implementation 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 **or (and)** EN 50098-1 **or (and)** EN 50098-2 **or (and)** Other application standards	EN 50174-1 4: Specification considerations 5: Quality assurance 7: Cabling administration **and** EN 50174-2 4: Safety requirements 5: General installation practices for metallic and optical fibre cabling 6: Additional installation practice for metallic cabling 7: Additional installation practice for optical fibre cabling **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 50174-1 6: Documentation 7: Cabling administration **and** EN 50174-2 4: Safety requirements 5: General installation practices for metallic and optical fibre cabling 6: Additional installation practice for metallic cabling 7: Additional installation practice for optical fibre cabling **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 50174-1 5: Quality assurance 7: Cabling administration 8: Repair and maintenance

Figure 1 - Relationship between EN 50174 series and other design standards

1 Scope

This European standard specifies the basic requirements for the planning, implementation and operation of information technology cabling using balanced copper cabling and optical fibre cabling. This standard is applicable to:

a) cabling designed to support particular analogue and digital telecommunications services including voice services;

b) generic cabling systems designed in accordance with EN 50173 and intended to support a wide range of telecommunications services.

This standard is intended for those involved in the procurement, installation and operation of information technology cabling. Furthermore this standard is addressed to:

– architects, building designers and builders;

– main contractors;

– designers, suppliers, installers, maintainers and owners of information technology cabling;

– public network providers and local service providers;

– end users.

This standard is applicable to certain hazardous environments but does not exclude additional requirements, which are applicable in particular circumstances, defined by e.g. electricity supply and electrified railways.

This part of the standard:

c) provides guidance on the preparation and agreement of an installation specification covering the information technology cabling, its accommodation and associated building services;

d) defines installation and acceptance testing practices enabling the agreement of a quality plan used to demonstrate conformance with the installation specification.

This standard does not contain requirements for cabling component performance, link design or installed performance - reference should be made to EN 50173, for generic cabling, or relevant application standards.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50173, *Information technology – Generic cabling systems.*

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

EN 50174-3 [1)], *Information technology – Cabling installation – Part 3: Installation planning and practices external to buildings.*

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

ISO/IEC 14763-1, *Information technology – Implementation and operation of customer premises – Part 1: Administration.*

[1)] At present committee draft

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this European standard the following definitions apply in addition to those of EN 50173.

NOTE As far as possible definitions of series IEC 60050 and of HD 384.2 S1 have been used; reference to these standards is indicated in square brackets.

3.1.1
acceptance test (of installed information technology cabling)
contractual test to prove to the customer that the installed cabling meets certain conditions of its specification

[derived from 151-15-20 of IEC 60050-151:1978]

3.1.2
active transmission equipment
equipment necessary to deliver a specific application (e.g. hubs, routers)

3.1.3
application specific cabling
cabling installed to meet the requirements of a specific transmission system and not necessarily guaranteed to support other transmission systems

3.1.4
back-up cabling
cabling that is installed specifically for use only when other cabling links become defective or unusable

3.1.5
balanced application
transmission system designed for use with balanced cabling

3.1.6
balun
device for transforming an unbalanced voltage to a balanced voltage or vice-versa

[161-14-37 of IEC 60050-161:1990]

3.1.7
builder
person commissioning the constructing of buildings. The builder gives the necessary allowance for the practical design of the telecommunication infrastructure within and between buildings

3.1.8
cabinet
enclosed construction providing additional security features intended for the housing of closures and other equipment including passive and active transmission equipment

3.1.9
cabling installer
person installing cabling and the associated material of the information technology cabling

3.1.10
cabling maintainer
person maintaining the information technology cabling

3.1.11
cabling owner
person who owns the information technology cabling

3.1.12
cabling component supplier
person providing cabling components and associated materials

3.1.13
cabling system
specific combination of cables, connecting hardware and other components that are supplied as a single entity

3.1.14
cabling system supplier
person that supplies the cabling components and associated materials in such a manner as to form a passive cabling system

3.1.15
closure
fixture or fitting of either open or closed construction intended to contain connecting hardware, both permanent, semi-permanent and demountable

3.1.16
connecting hardware
device or combination of devices used to connect two cables or cable elements

3.1.17
draw box
space in the pathway system which allows the routing of cables during the cable installation process such that bending and pulling requirements are met

3.1.18
electromagnetic compatibility
ability of a device, unit of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

3.1.19
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.

[161-11-05 of IEC 60050-161:1990]

3.1.20
end user
person who requests or makes use of telecommunications services

3.1.21
equipotential bonding
electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential

[826-04-09 of HD 384.2 S1:1986]

3.1.22
fire zone
clearly defined area, bounded by fire barriers

3.1.23
frame
open construction intended for the housing of closures and other equipment including both passive and active transmission equipment

3.1.24
identifier
unique item of information that enables a specific component of the telecommunications infrastructure to be distinguished in the administration records

3.1.25
immunity (to a disturbance)
ability of a device, equipment or system to perform without degradation in the presence of an electro-magnetic disturbance

[161-11-20 of IEC 60050-161:1990]

3.1.26
label
means to mark clearly a specific component of the telecommunications infrastructure with its identifier and (optionally) other information

3.1.27
link
transmission path between any two interfaces of cabling

NOTE The link definition of EN 50173 excludes equipment cables and work area cables.

3.1.28
main contractor
person responsible for the approval of subcontractors

3.1.29
main earthing terminal
terminal or bar provided for the connection of protective conductors, including equipotential bonding conductors and conductors for functional earthing if any, to the means of earthing

[826-04-08 of HD 384.2 S1:1986]

3.1.30
minimum bend radius (installation)
minimum radius, as defined by the cable manufacturer/ supplier, at which a cable is allowed to be bent during installation

3.1.31
minimum bend radius (operating)
minimum radius, as defined by the cable manufacturer/ supplier, at which a cable is allowed to be bent following installation and in its final operating position

3.1.32
passive transmission equipment
non-active equipment necessary to support a specific application in conjunction with active transmission equipment

NOTE Examples are baluns, filters, adapters and equipment cables.

3.1.33
pathway (cable route, cable way)
defined route for cables between termination points

3.1.34
pathway system
area or volume defined by markings or a specific cable management system including those specified in the EN 50085 and EN 50086 series of standards

3.1.35
public network provider
provider of public network services to end users who, for some distance, have to rely on the provision of information technology cabling within some part of the premises

3.1.36
record
collection of information about, or related to, a specific element of the telecommunications infrastructure

3.1.37
service provider
provider of telecommunications services to end users within the premises

3.1.38
space
enclosed area (e.g. closet, cabinet, maintenance hole, or equipment room) used to house cable terminations or equipment

3.1.39
termination point
connection, plug or socket (as appropriate) fitted to an installed cable and housed within a closure

3.1.40
transmission system
transmission equipment, both active and passive, together with the installed cabling necessary to deliver a specified application between two or more points

3.1.41
unbalanced application
application that requires a transmission system not specifically designed for balanced cabling and within which signals are transmitted asymmetrically with respect to earth

3.1.42
work order
document that records the changes requested and the operations carried out on the telecommunications infrastructure

3.1.43
zone
area containing termination points that are served by a group of cabinets or frames (acting as a floor distributor for generic cabling)

3.2 Abbreviations

For the purposes of this standard the abbreviations of EN 50173 apply in addition to the following ones:

CAD	Computer aided design
EMC	Electromagnetic compatibility
NTP	Network termination point

4 Specification considerations

4.1 Introduction

Correct specification of information technology cabling and its accommodation is vital during the design or refurbishment of premises and will ease the implementation and operation of both the cabling and the applications supported over the cabling. Consideration shall be given to the applications to be supported

taking care to observe the recommendations of annex A with regard to the delivery of multiple applications within a single cable.

Cabling components, closures, frames and cabinets require detailed specification in terms of location, space and environmental aspects (including physical and functional security). Failure to observe the installation dependent parameters, including environmental factors, specified by the cabling supplier and/or manufacturer could lead to inadequate performance.

Administration of the cabling shall be considered early in the specification process to ensure smooth transition from installation to operation of the cabling.

Effective specification also involves the co-ordination of other building services such as mains power distribution, earthing, circuits for smoke/fire detection and associated controls, atmospheric control systems and other relevant infrastructures.

4.2 Cabling infrastructure

4.2.1 General

Cables are installed between termination points. Termination points are distributed throughout the buildings or concentrated in areas of distribution. In some cases, termination points are associated with active and/or passive transmission equipment.

4.2.2 Generic cabling systems conforming to EN 50173

Generic cabling systems designed in accordance with EN 50173 feature termination points interconnected by well defined cabling sub-systems and located within a defined structure (see Figure 2).

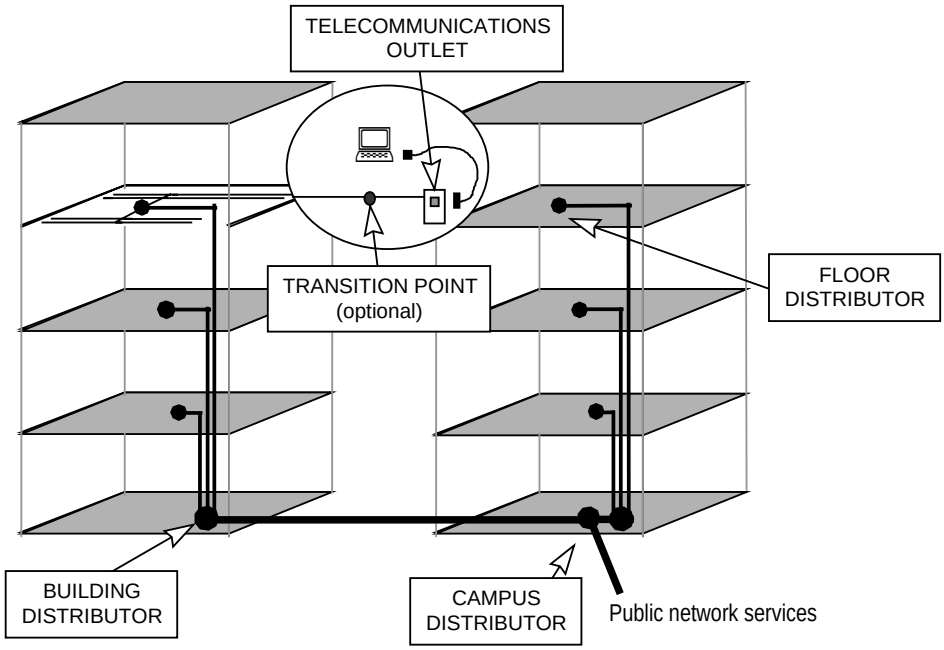

Figure 2 - Generic Cabling System

The physical realisations of the functional elements of generic cabling systems are detailed in Table 1.

Table 1 - Physical realisations of functional elements

Functional Elements	Physical Representation

Campus, building and floor distributor	Frames and/or cabinets containing closure(s) housing termination points. Distributors should be situated in purpose-built telecommunications closets and/or equipment rooms
Transition point	Closure containing termination or jointing components
Telecommunications outlet	A single termination point housed in a closure

EN 50173 defines specific implementations together with performance requirements of both components and installed links.

4.2.3 Application specific cabling

Application specific cabling provides dedicated links that meet the requirements of a specific application (such as ISDN Primary Rate or Basic Access). The relevant application standards (such as series EN 50098) or manufacturer's specifications define specific implementations together with performance requirements for components and/or installed links.

4.2.4 Work areas and work area cabling

Work areas are the spaces allocated throughout the premises to individuals or groups of individuals. There are no specific limits to the physical extent of the work area although local or national regulations may define minimum values.

The termination points within the work areas allow the provision of applications. The number of termination points within a given work area shall be in accordance with identified application requirements. Consideration shall be given to possible growth in demand and/or resilience requirements (see 4.9).

Work area cabling, in the form of both cables and, in some cases, passive transmission equipment (such as baluns and impedance matching devices) is used to connect terminal equipment to the termination points. Termination points should be positioned in order to minimise the length of work area cables.

4.2.5 Allowance for changes to requirements

The specification of cabling should reflect predicted expansion in both the quantity and type of applications to be supported. These factors influence both the number of and types of cables required and directly impact:

a) the choice of pathways and pathway systems (see 4.8);

b) the construction and layout of frames and cabinets (see 4.7);

c) the scale of the mains power supply infrastructure.

4.3 Building environment (environmental aspects)

The satisfactory transmission of the applications supported by the cabling requires that the cabling is able to provide the required installed link performance between the termination points when subjected to the environmental conditions present at the termination points and throughout the pathways within which the cable is installed.

Physical and climatic environment

A number of recognised standards exist for the classification of environments relevant to telecommunications components and equipment. Reference should be made to EN 60721 series, HD 384.3 S2, ETS 300 019-1-1 (for storage) and ETS 300 019-1-3 (for operation).

The environmental factors that shall be considered include:

a) pressure;

b) vibration;

c) exposure to ultraviolet radiation and thermal effects;

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

e) chemical or biological attack;

f) physical damage (accidental or malicious) including damage caused by animals;

g) presence, or potential presence, of hazards (such as contaminating, toxic or explosive materials);

h) the movement of air (e.g. fans, heating and ventilation systems).

i) temperature range;

j) humidity range including condensation and icing effects;

k) impact of a lightning strike;

l) wind effects.

Electromagnetic environment

Control of the electromagnetic environment should be such that the electromagnetic emissions from operational information technology systems remain below specified limits and the operational information technology system exhibits the specified immunity.

An information technology system comprises active equipment, complying to relevant European EMC standards for information technology, properly connected to information technology cabling. The relevant European EMC standards include EN 300386 (for public network apparatus and large tele-communications systems), EN 55022, EN 55024, EN 50082-1 and EN 50082-2.

The cabling itself is considered to be constructed of passive components only and is not subject to EMC standards. However, in order to maintain the electromagnetic performance of the information technology system (which comprises both passive cabling and active equipment), the installation requirements of this clause and the relevant clauses in EN 50174-2 and EN 50174-3 shall be observed.

Premises earthing systems for screened copper cabling

EN 50174-2 and EN 50174-3 as well as EN 50310 provide information regarding aspects relevant to the specification phase.

4.4 Cabling component choice

4.4.1 Introduction

The performance specification of the cabling components shall ensure that the performance of the installed cabling meets the requirements of the applications to be supported. The types and performance of cables and connecting hardware used will depend upon the bandwidth requirements and the distances over which the applications have to be supported.

The choice of cables and connecting hardware used within generic cabling shall be in accordance with EN 50173. For application specific cabling within the scope of this standard (i.e. not coaxial cabling), balanced copper or optical fibre cables shall be chosen to meet the specific application requirement.

Components shall be chosen in order to be compatible with the environmental conditions (see 4.3.1) during both the installation and the subsequent operation of the cabling. Consideration shall also be given to any requirement to maintain performance when subjected to abnormal environmental conditions that are possible on a temporary basis (e.g. immersion in fluids following the operation of sprinkler systems).

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

4.4.2 Component compatibility for screened cabling components

The cable and connecting hardware shall be selected to ensure that the cable screens are able to be terminated in such a way that the screening effectiveness is maintained over the intended life of the cabling.

The screening effectiveness of the cabling can be adversely effected by poor screen termination practices.

General recommendations for screening termination to equipment and the building earthing system are to be found in EN 50174-2.

The cable shall be terminated using the instructions provided by the manufacturer of the connecting hardware.

For example:

a) for braid or composite foil/braided screened cable, the braid should be used to provide an effective termination;

b) for foil-only screened cable incorporating a drain wire, combinations of foil and drain wire should be used to provide an effective termination (since foil alone may not provide adequate electrical contact).

The screen connection shall always be firmly fixed, for instance by strapping or clamping. The screen shall not be used as a strain relief.

4.4.3 Connecting hardware within generic cabling

Annex B gives information about possible connections between the wires and the pins of telecommunications outlets within generic cabling systems. The cabling installer should ensure that the connecting hardware conforms to the appropriate design throughout the installation.

NOTE The same pin-pair combination should be used throughout the whole cabling installation.

4.4.4 Storage of components

The environmental conditions under which cabling components are stored shall be compatible with the manufacturers recommended storage conditions.

Appropriate levels of security should be provided.

NOTE It is recommended that the end of stored cable be sealed to prevent ingress of contaminants.

The cabling installer shall determine the proposed locations at which drums (or equivalent) are to be positioned during the installation programme and establish the accessibility and availability of those locations.

4.5 Termination points

4.5.1 Location

Termination points shall be located with due regard to link performance requirements that limit the length of cables between the termination points and between the termination point and either terminal or transmission equipment.

The location and design of the termination points shall also be consistent with the space, floor loading and other services required for all necessary active transmission equipment together with any passive transmission equipment (such as baluns or impedance matching devices) required for a specific application.

The location of termination points shall allow safe access during:

a) installation of the closure and termination of the cable;

b) the delivery and installation of active transmission equipment;

c) operation of the cabling (disconnection, reconnection and testing of terminal or transmission equipment cables).

Consideration shall be given to requirements for the provision of facilities necessary to support the installation of additional termination points over the intended operational life of the installed cabling.

Before the installation commences, the cabling installer shall confirm proposed locations of closures and establish their accessibility and availability in accordance with the cabling installation programme, and with due regard to any main contractor's programme or other subcontractor's programme.

4.5.2 Distribution

Termination points within the work area enable the attachment of terminal equipment to the installed cabling.

The size and distribution of work areas shall be determined following consideration of the proposed occupancy of the premises, based upon floor area or upon a specific application requirement.

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.

The quantity of termination points within a work area shall:

a) reflect the predicted requirements of that work area;

b) for generic cabling, be in accordance with EN 50173.

It should be noted that subsequent installations of cabling to provide additional termination points tends to be both costly and disruptive and it is recommended that:

c) planning decisions reflect predicted expansion requirements;

d) the detailed design and planning of pathways and pathway systems servicing the work areas should aim to minimize the cost and disruption associated with unscheduled installation activity.

4.5.3 Space

The space allocated to the termination point shall allow adequate clearances for the closure containing the termination point (meeting the requirements of 4.6) to be installed without damage to cabling components and while maintaining the minimum bend radii (operating) as specified in the relevant standards or by the cable supplier. Where multiple cable types are involved, the largest minimum bend radius shall apply.

4.5.4 Physical and climatic environment

The closures, housing termination points, shall provide the necessary levels of physical and climatic protection for the cables and the connecting hardware. Protection is achieved either by choice of appropriate location or by specific design features within either the connecting hardware or the closure and shall address the appropriate aspects listed in 4.3.

4.5.5 Electromagnetic environment

Termination points shall be located to minimise the effect of electromagnetic disturbances (see EN 50174-2 and EN 50174-3).

4.5.6 Mains power

See EN 50174-2 for the separation of power and information technology cabling in order to minimize the effects of electromagnetic disturbances at termination points.

4.5.7 Termination points within generic cabling systems

The location of the floor distributor and the physical route of the horizontal cables shall be planned in such a way that the maximum cable lengths between the termination points in the floor distributor and the telecommunications outlets are in accordance with EN 50173.

The termination points within the distributors shall be arranged in such a way that the length of patch cords, cross connect jumpers and interconnects associated with equipment cabling are in accordance with EN 50173.

4.6 Closures

4.6.1 Location

Closures shall be located so that subsequent measurements, repair, expansion or extension of the installed cabling may be undertaken without risk of injury to personnel.

4.6.2 Physical and climatic environment

Closures should provide strain relief for the cables terminated within them and should enable the secure storage of service loops associated with termination points.

See 4.5.4 for climatic environmental requirements.

4.6.3 Electromagnetic environment

Closures containing mains power outlets shall be designed to maintain the mains power/information technology cabling segregation requirements as defined in EN 50174-2 and EN 50174-3.

4.7 Frames and cabinets

4.7.1 Introduction

The requirements of 4.7.2 to 4.7.7 apply to all frames and cabinets.

Specific requirements applicable to the frames and cabinets forming floor distributors within generic cabling are detailed in 4.7.8. Specific requirements applicable to the frames and cabinets forming building and campus distributors within generic cabling are detailed in 4.7.9.

4.7.2 Function

Transmission equipment and cabling are contained within groups of frames and/or cabinets that contain one or more of the following:

a) closures presenting termination points of installed cabling;

b) closures presenting termination points of equipment cabling from local equipment;

NOTE In certain cases, for reasons of security or environmental control, information technology equipment is located within a room separate from, but in close proximity to, the area containing telecommunications frames and cabinets.

c) closures presenting application specific cabling from remote equipment;

d) transmission equipment or other information technology equipment;

e) management of patch cords and other interconnections between the above;

f) expansion due to increased connectivity or change in application requirements.

4.7.3 Location

The location of frames and cabinets shall allow the installation of the necessary cabling together with the delivery and removal of larger items of apparatus. It is essential that a safe route should be established with suitable access and adequate floor loading to allow the passage of apparatus together with any mechanical aid and personnel required to undertake the delivery or removal.

In particular, frames and cabinets shall not be installed:

a) in toilet facilities and kitchens;

b) in emergency escape ways;

c) in ceiling or sub-floor spaces;

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

4.7.4 Space

Frames and cabinets shall be positioned to allow access and be provided with illumination and temperature conditions suitable to allow installation and operation of the equipment and cabling contained therein.

The following requirements shall be met:

a) the minimum clearance on all faces of the frames and cabinets where access is required shall be 1,2 m;

b) connection points shall be set at a safe working height to allow measurement, repair and reconfiguration;

c) connection points shall be set at a height to prevent ingress of dust, fluids (including flooding) or other contaminants.

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

d) the mains power/information technology cabling segregation requirements of EN 50174-2 and EN 50174-3 are taken into account;

e) the initial quantity of cables is able to be installed maintaining the minimum bend radii (operating) specified by the supplier or by the relevant standard. Where multiple cable types are involved, the largest minimum bend radius shall apply;

f) additional cables can be subsequently installed, as defined in the installation specification (see clause 6), maintaining the minimum bend radii (operating) specified by the supplier or by the relevant standard. Where multiple cable types are involved, the largest minimum bend radius shall apply;

g) provision for the management of incoming cables and patch cords is provided.

The manner and care with which patch cord and equipment cables are installed and maintained is a significant factor in the performance and ease of administration of installed cabling systems. The design of the frames and/or cabinets shall allow effective cable management of the patch cords and equipment cables. The routeing of patch cords should be planned before the installation begins. Doing so minimizes cable congestion and eases the task of tracing patch cord connections later on.

Planning of the layout of the cabinets or frames is vital to ensure that:

h) the length of patch cords and equipment cables is minimized;

i) the routeing of patch cords and equipment cables is simplified, minimizing the risk of their damage;

j) cable installation requirements are able to be observed including:

   1) bend radius

   2) tensile loading

   3) crushing;

k) adequate space has been allocated to the provision of horizontal and vertical cable routeing and dressing fixtures used for effective organisation and management of the different types of cables;

l) adequate space has been allocated to the storage of any spare cable length without obstructing access to other termination points.

The use of jumper cable is limited to low frequency services because the symmetry of the jumper cable is not specified. It is recommended that the termination of jumper cables uses the IDC technique. The length of the jumper cable is determined by the requirements of the application. The length of the jumper cable is limited by the need to maintain good administration of the patching environment (see clause 7). Pairs or groups of jumper cables for a particular destination or service should be identified for administration purposes and to assist later additions or changes. Single jumper cables should be secured in such a way that mechanical damage is avoided during later access to the patch panel.

4.7.5 Physical and climatic environment

Frames and cabinets (or the closures within them) shall provide the necessary levels of physical and environmental protection for the equipment installed. Protection is achieved either by choice of appropriate location or by specific design features within the frame or cabinet and should address the appropriate aspects listed in 4.3.

In certain cases, security or safety considerations result in the cabinets being located in a room or other suitable area where access is restricted to authorised personnel.

Adequate lighting shall be provided to allow installation, operation and maintenance of the equipment. However, the localised heating effects caused by exposure to direct sunlight should be avoided.

Where necessary, atmospheric control shall be provided to protect electronic equipment associated with the cabling.

4.7.6 Electromagnetic environment

Frames and cabinets shall be located to minimize the effect of electromagnetic disturbances. Further details are included in EN 50174-2.

4.7.7 Mains power

The installation of power cables and their connection to transmission equipment within cabinets or equipment rooms shall be in accordance with local regulations meeting the requirements of HD 384 series. The frames and cabinets shall be earthed.

Frames and cabinets shall be designed to maintain the power and information technology cabling separation rules of EN 50174-2 and EN 50174-3 in order to minimize the effects of electromagnetic disturbances.

4.7.8 Floor distributors within generic cabling

4.7.8.1 Distribution

A floor distributor comprises a number of cabinets or frames that serve one or more defined areas or zones within the building. Each zone contains a number of telecommunications outlets.The zones served by a floor distributor typically cover all or part of a single floor but it is possible for zones to be distributed over two or more adjacent floors subject to the length restrictions detailed in EN 50173.

The length restrictions of EN 50173 covering flexible cables (work area cables, patch cords and equipment cables) limit the complexity of the groups of cabinets or frames and the maximum number of telecommunications outlets served within a zone.

The zones served by each floor distributor should be divided into sub-zones each of which is served by a single cable bundle as shown in Figure 3. Each bundle should be served by a single closure in the frame or cabinet.

This modular approach:

a) ensures a logical presentation of the telecommunications outlets within the floor distributor;

b) aids both the installation and administration of the cabling;

c) simplifies access to the closure and/or bundle during repair or rework.

Long parallel runs where cables lie in a fixed physical relationship to each other may induce additional crosstalk and should be avoided unless the impact has been taken into account in the specification of the cables and the installation.

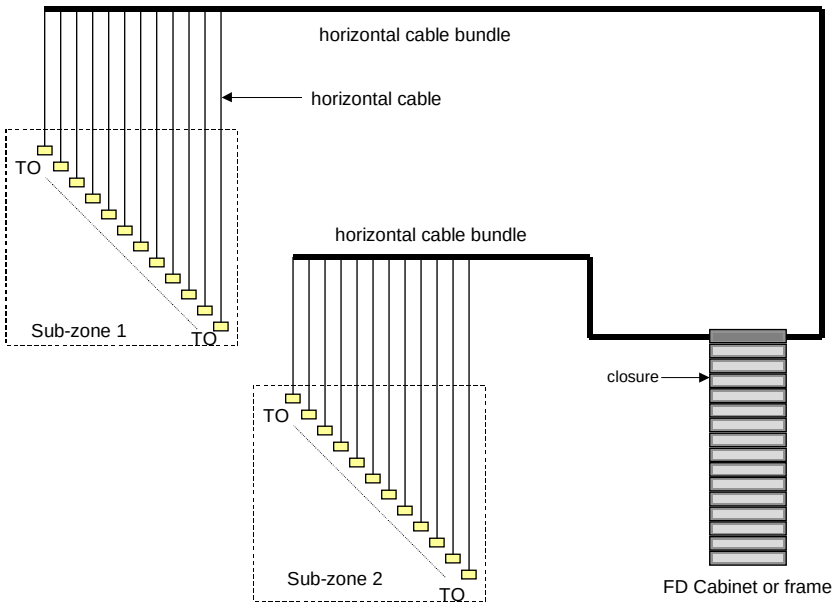

Figure 3 - Example of sub-zone cabling

4.7.8.2 Location

The cable types and volumes within a generic backbone cabling sub-system should be reviewed on a regular basis to determine if additional installation is required as the applications supported change over time. Floor distributors shall be positioned to allow ease of access for installation of more backbone cabling without the need for major disruption.

4.7.8.3 Layout

Lack of performance within the flexible cabling at distributors can reduce the ability of installed cabling to support the proposed applications. Causes include:

a) physical damage to the terminations;

b) excessive bending or other damage to the cables;

c) the use of cables of lengths in excess of the values specified for the installation;

d) the use of patch cords with inadequate transmission performance;

e) the lack of cable management fixtures.

The layout of the cabinets or frames within the floor distributor should be designed to limit the lengths and complexity of patch and equipment cabling thereby reducing the risk of the above.

4.7.9 Building and campus distributors within generic cabling

4.7.9.1 Introduction

Building and campus distributors are generally housed within equipment rooms and generally contain a larger number of frames and/or cabinets than floor distributors together with a wider range of transmission equipment.

4.7.9.2 Location

The recommendations of 4.7.8.2 apply also to the positioning of building and campus distributors.

4.7.9.3 Layout

See 4.7.8.3.

4.8 Pathways

4.8.1 Location of pathways

Pathways should not be contained within lightning conductor voids or lift shafts.

The entry points to the pathways 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 apparatus;

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

d) enable installation of the cables whilst maintaining the minimum bend radii (installation) specified by the supplier or by the relevant standard. Where multiple cable types are involved, the largest minimum bend radius shall apply.

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. For example, pathways shall not run adjacent to heating pipes unless appropriate components or protection is provided. The cabling installer shall ensure that all necessary guards, protective structures and warning signs are used to protect both the cabling and third parties as required by local or national legislation.

Where possible incompatibility exists then alternative pathways, pathway systems or components with enhanced environmental (or other) characteristics should be considered. Alternatively, atmospheric control of the internal pathways environment should be considered.

Pathway systems shall be designed and installed to eliminate the risk of sharp edges or corners that could damage the cabling installed within or upon them.

Pathways constructed using traywork should use pre-formed bends, compatible with the trays, to perform changes in pathway direction and shall be located to:

e) provide a minimum clearance of 25 mm from the fixing surface;

f) provide the greatest working space possible subject to a minimum of 150 mm above the tray to enable access during installation;

g) prevent damage to the installed cabling.

Indoor pathways constructed using cable trunking, ducting or conduit systems should provide access at intervals of not greater than 12 m to enable the use of draw boxes. The draw boxes shall be large enough to maintain the minimum bend radii (installation) specified by relevant standards or by the supplier. Where multiple cable types are involved, the largest minimum bend radius shall apply.

Pathway systems should be selected and installed to ensure that water or other contaminant liquids cannot collect. Where conducting pathway systems are used, the electrical continuity of the installed sections shall be maintained and bonded to earth in accordance with relevant national or local regulations. The use of hidden pathways (such as within plastered wall surfaces) is not recommended but, if used, cabling should be installed in either vertical or horizontal pathways.

The cabling installer shall establish that the pathways defined in the installation specification are accessible and available in accordance with the installation programme (see 5.2.3.1). The cabling installer shall advise the cabling owner of all proposed deviations. The cabling installer shall ensure that pathways are left clean and free from obstruction with all separators and bridging pieces in place before the installation of information technology cabling commences. Access points shall not be obstructed.

4.8.2 Usable space within pathway system

The minimum bend radii (installation) of the cables (where multiple cable types are involved, the greatest minimum bend radius shall apply) may limit the usable space within a pathway. Where, for

example, a tight bend occurs, only a percentage of the total space is usable to allow the minimum bend radii to be maintained.

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

4.8.3 Physical and climatic environment

The installation and operating environments within the pathways or created by the type of pathway systems to be used shall be compatible with both the cables and the proposed methods of installation. Protection is achieved either by choice of appropriate location or by specific design features within the pathway systems and shall address the appropriate aspects listed in 4.3.

NOTE Certain environments place restrictions on the use of fusion splicing of optical fibres (which generally uses an open electric arc). In such cases mechanical splices, direct termination or pre-terminated fibre should be used.

Pathways shall allow the fixing of the selected cable management systems and subsequent loading of those systems due to:

a) the installation methods used;

b) the weight of the proposed quantities of cable;

c) the possibility of additional loads being applied due to other services or third parties.

Appropriate pathway systems should be chosen to protect installed cables in order to prevent damage and consideration shall be given to measures to restrict unauthorised access.

Cable management systems should be selected and installed to prevent longitudinal transmission of acoustic noise.

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

4.8.4 Electromagnetic environment

Pathways should be chosen to avoid sources of electromagnetic disturbance. Further details are included in EN 50174-2 and EN 50174-3.

4.9 Resilience

Damage to cabling frequently results in disruption of the service(s) provided by the installed cabling. The design of the cabling infrastructure should reflect repairability and redundancy that are intended to reduce the cost and inconvenience of disruption.

4.10 Wide area connections

The public network provider(s) should be advised by the cabling owner, the builder or the end user of the foreseeable public network circuit requirements. It is essential that sufficient notice of installation is given to the network operator by the end user (or the end user's agent).

Certain national regulations require protection against high currents or high voltages at the customer's side of the public network termination point (NTP). Protection devices are also required for certain private network terminations. The provision and performance of such protection devices lie outside the scope of this European standard.

The supplier of the apparatus shall provide advice on the permissible distances (cable length or physical separation) between items of apparatus.

The cabling owner (or agent) normally in consultation with the cabling installer shall agree with the public network provider(s):

a) the precise physical location of the NTP(s);

b) the supply and capacity of the apparatus that provides the NTP(s);

c) the identification and numbering of individual circuits at each NTP;

d) any additional options required (e.g. night busy, meter pulses);

e) the technical and operational maintenance of boundaries between public and private networks;

f) the liaison arrangements whereby the public network provider(s), the cabling owner and, where appropriate, the cabling maintainer contact each other;

g) the procedures to be followed by the cabling owner in reporting all types of faults and reacting to all types of faults;

h) access arrangements.

See annex A for recommendations for the delivery of multiple applications within a single cable.

5 Quality assurance

5.1 General

The purpose of quality assurance is to ensure that the installed cabling is in accordance with stated requirements.

Quality assurance is implemented by the use of an installation specification and a quality plan. The quality plan specifies the procedures to be implemented to demonstrate compliance with the installation specification.

Both the installation specification and quality plan shall be agreed between the cabling owner and the cabling installer before the installation.

Following due consideration of the design issues, an installation specification should be produced by, or on behalf of the cabling owner. The installation specification shall comprise:

a) the technical specification.

b) the scope of work;

c) contractual requirements;

and should contain

d) the information technology strategy.

Guidance on the preparation of an installation specification is outlined in 5.2.1 to 5.2.5.

5.2 Installation specification

5.2.1 Overall information technology strategy

Where included in the installation specification, the information technology strategy section shall detail the requirements for both the infrastructure and the applications to be supported.

See Table 2 for a list of the infrastructure requirements and Table 3 for a list of application support requirements.

Table 2 - Infrastructure requirements

No	Aspect	Requirements
a)	Pathways and pathway systems	The pathways and the pathway systems to be used within each pathway shall be detailed. See 4.8 for guidance on the planning of pathways and the selection of pathway systems.
b)	Resilience	See 4.9.
c)	Ancillary equipment	Refer to local and national regulations and consult manufacturer's documentation.
d)	Lifetime	The requirements for the physical and operational lifetime of the installed cabling infrastructure shall be detailed.
e)	Hazards	Hazardous areas within the proposed pathway routes and termination points shall be identified and classified. The cabling owner shall provide relevant information and drawings clearly identifying the boundaries of hazardous, or potentially hazardous areas together with the classification of those areas. The design of installed cabling shall limit unauthorised access to closures, frames and cabinets and cable assemblies according to the requirements of the end user.
f)	Environmental aspects	The installation environment throughout the pathway routes shall be defined stating any conditions that assist in the choice of cabling components or affect the cabling both during and following installation. See 4.3.1 for guidance.

Table 3 - Application support requirements

No	Aspect	Requirements
a)	Application mix	The application(s) to be supported by the installed cabling shall be detailed highlighting, where relevant, current and future requirements for compliance with information technology standards.
b)	Installed cabling performance requirements	The cabling performance requirements for the operation of the application(s) shall be detailed.
c)	Wide area connections	See 4.10.
d)	Security	See 4.3.1 and 4.7.2.
e)	Multiple applications within a single cable	See annex A.

5.2.2 Technical specification

The technical specification forms a basis against which all components and techniques used within the installation are assessed. See Table 4 for a typical list of requirements.

Table 4 - Technical specification

No	Aspect	Requirements
a)	Cable specifications	Balanced copper, optical fibre and associated cables
b)	Connecting hardware specifications	Balanced copper and optical fibre
c)	Termination points	The locations to be interconnected by the cabling infrastructure shall be detailed. See 4.5 for guidance on the requirements for termination points.
d)	Frames and cabinets	The structures to be used shall be detailed. See 4.7
e)	Closures	The housing(s) of the termination points shall be detailed. See 4.6.
f)	Earthing and equipotential bonding	The requirements for the protective and functional earthing and equipotential bonding of cabling components and accessories shall be detailed. See EN 50174-2 and EN 50174-3.
g)	Cable accessories	Other items required specifically to support the installation of the cabling.

5.2.3 Scope of work

The scope of work shall be clearly defined. It shall include all relevant items from 5.2.3.1 to 5.2.3.3.

5.2.3.1 Installation phases

A list of items to be considered within the pre-installation, installation and post-installation phases of the installation are shown in Tables 5, 6 and 7.

Table 5 - Pre-installation tasks within the scope of work

No	Aspect	Requirements
a)	Civil works and preliminary actions	Any building work required on each pathway shall be detailed together with a statement of responsibility for the identification, design and completion of the works involved. The responsibility for obtaining all necessary clearances and permits shall also be defined. Site plans should be marked up to show the works required
b)	Pathways	The requirements for pathway preparation and the installation of pathway systems shall be detailed. A statement of responsibility for the identification, design and completion of the works shall be included.
c)	Earthing and equipotential bonding	The provision of an earthing and equipotential bonding system shall be detailed. Arrangements shall be made for connection to the building main earth terminal and the possible location of a telecommunication earth-electrode system. Guidelines for earthing and equipotential bonding can be found in EN 50310, EN 50174-2 and EN 50174-3.
d)	Building entrance facility	The accommodation of the terminating devices for external and internal cables shall be detailed. See EN 50174-2 and EN 50174-3.
e)	List of materials	This shall detail exact quantities of all cabling components and installation accessories and indicate those areas requiring evaluation and/or verification.
f)	Survey status	The need for a survey by the cabling installer and, where relevant, the areas to be assessed during such a survey shall be detailed.
g)	Installers facilities	The provision of facilities (such as telephone and accommodation) to support the cabling installer should be agreed.
h)	Control of materials	The location for materials shall be defined. A system of stock control on site should be agreed. A system for the disposal of waste components and installation materials shall be agreed.

Table 6 - Installation tasks within the scope of work

No	Aspect	Requirements
a)	Safety	Specific requirements for equipment and warning signs required to ensure safe working shall be detailed. The cabling installer and cabling maintainer shall be advised of fire precautions, be aware of escape routes and be encouraged to join in fire drills.
b)	Security	Security and site access arrangements.
c)	Connectivity	The requirements for jointing and/or termination at each termination point shall be detailed. See 4.4.3. in the case of generic cabling.
d)	Attendance at contract inspection points	Requirements for attendance should be determined and agreed with all relevant parties.
e)	Programme	The required programme of installation shall be detailed. Implications of other works shall be made known to the cabling installer where they affect the programme. Any limitations to access together with restrictions on personnel movement, vetting and clearance levels shall be stated. Requirements for progress meetings shall be detailed.
f)	In-service date	The date the installation is to be brought into service shall be detailed.
g)	Labelling	The requirements for marking and labelling shall be detailed. See clause 7.
h)	Testing	The requirements for visual inspection and acceptance testing of the cabling shall be detailed. The number and type of tests required in a cabling installation depends on the applications that are intended to operate over the cabling links. For low frequency applications (such as analogue telephony) a continuity test is adequate in many cases. In the case of generic cabling systems more comprehensive testing is required. For application-specific cabling guidance should be sought from the relevant application standards or equipment manufacturers. 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 unknown installation. The number (or sample level) and types of tests to be applied shall be specified in the quality plan (see 5.3).
i)	Documentation	Levels of documentation as well as its format to be supplied both after the design of the installation and during and following installation shall be detailed. See clause 6.
j)	Documentation hand-over date	The date the documentation is to be handed over shall be detailed.

Table 7 - Post-installation tasks within the scope of work

No	Aspect	Requirements
a)	Reinstatement	Requirements for the reinstatement shall be detailed. A statement of responsibility for the identification, design and completion of the works shall be included. The responsibility for obtaining all necessary clearances and permits shall also be defined.
b)	Spares	A recommended list should be provided of spare materials to be supplied such as cable, cable assemblies, closures, connecting hardware, tools, test equipment and test leads.
c)	Support services	Ancillary repair and maintenance contracts, safety training, fault analysis training and end user-based maintenance training should be established between the cabling installer and the cabling owner/ cabling maintainer, where appropriate.
d)	Administration	A maintenance and control procedure for the final cabling documentation shall be established

5.2.3.2 Regulatory issues

Applicable legislation and regulations and compliance statements shall be stated including:

a) building regulations relating to the installation;

b) specific site regulations;

c) safe working practices;

d) public telecommunication network protection;

e) contractors authorization.

5.2.3.3 Site contacts

The cabling owner shall provide details of the site contacts with responsibilities for:

a) operational requirements;

b) site information (including knowledge of all hazardous areas);

c) technical requirements;

d) documentation of existing cabling, if relevant;

e) providing compatibility of existing cabling components and items to be issued to the cabling installer by, or on behalf of the cabling owner;

f) storage of materials;

g) installation of cabling by a third party;

h) main contractor and/or sub-contractors.

5.2.4 Contractual requirements

Contract terms and conditions shall be defined within the installation specification.

Contract terms shall be agreed by all parties before installation.

5.2.5 Changes and deviations to installation specification

All modifications, changes and deviations shall be documented in an agreed manner.

5.3 Quality plan

5.3.1 General

The quality plan specifies the procedures to demonstrate compliance with the installation specification. The quality plan shall reflect the contractual interfaces that relate to the task defined within the installation specification and shall identify the measures to be adopted to facilitate straightforward transfer of responsibilities at these interfaces.

It is recognised that the cabling installer, operating a quality assurance system in accordance with the EN ISO 9000 series has a common approach to all installation projects. However, installations vary with regard to the contractual interfaces present. If required, a quality plan that is relevant to that installation shall be submitted to the cabling owner, before the installation of the cabling infrastructure.

The following aspects of the quality plan relate to the installation of the cabling:

a) cabling component acceptance: acceptance test methods and inspection criteria for cabling components, if required;

b) installation competence;

c) inspection;

d) installed cabling acceptance: acceptance test methods and inspection criteria for installed cabling, if required;

e) documentation of installed cabling;

f) identifiers;

g) repair and maintenance philosophy, including change control.

5.3.2 Cabling component acceptance

The quality plan specifies the procedures for the acceptance of cabling components. This includes verification of physical, mechanical, optical and/or electrical specifications based on the relevant standards or manufacturer's specifications. Early diagnosis of faults is essential and in the interest of both cabling owner and cabling installer alike. In some cases evidence of conformance against the specification obtained from the cabling supplier is necessary. Where testing is specified, sampling plans shall be stated and details of the measurement procedure shall be provided. Any non-compliance shall be recorded and appropriate action shall be taken.

Where it is necessary to test incoming goods, all items of inspection and test equipment to be used shall be defined and information provided. All items of test equipment should be covered by a calibration regime. Information regarding the calibration status of the test equipment shall be provided within the quality plan.

The cabling installer shall ensure the compatibility of the cabling components to be used. Where existing cabling components are to be provided by, or on behalf of the cabling owner, the cabling installer shall agree the procedures to be adopted to ensure compatibility between those components and any others used during the installation. Where doubt exists on the compatibility of the components supplied, the possible non-compliance shall be agreed with the cabling owner prior to the installation.

5.3.3 Installation competence

The cabling installation shall be carried out by competent staff. Training shall be up-to-date and in accordance with relevant practices and regulations. Installer qualification under relevant national schemes should be taken into account. Documentary evidence shall be provided if required by the cabling owner.

5.3.4 Inspection

The quality plan shall specify requirements for on-site inspection before, during and after installation of the cabling infrastructure to ensure that the installation is prepared and executed as agreed upon in the installation specification.

5.3.5 Installed cabling acceptance

The quality plan shall specify the procedures for the acceptance of installed cabling and earthing and equipotential bonding systems, where specified. These include physical checks, visual inspection and transmission performance tests. Where testing is specified, sampling plans shall be agreed and details of the measurement procedure shall be provided. The measurement limits shall be specified by reference to EN 50173 for generic cabling or the relevant application standard. The treatment of marginal results shall be defined. Any non-compliance shall be recorded and appropriate action shall be taken.

The quality plan shall include procedures to tackle situations where non-compliances are discovered.

The quality plan shall define accommodation and environmental requirements for test equipment on site.

5.3.6 Documentation

The quality plan specifies the format of documentation to be provided. Clause 6 provides guidance on documentation of installed cabling.

5.3.7 Identifiers

The quality plan specifies the use of identifiers.

6 Documentation

6.1 General requirements

The requirements of this clause are based upon the general requirements for administration systems specified in ISO/IEC 14763-1.

The proposed level of documentation to be provided both during and following the installation shall be detailed within the installation specification.

This clause details the recommended level of documentation throughout the design and installation stages.

Commercial documentation should cover all technical and contractual aspects relating to the end user requirements and the installation undertaken and shall include:

– the installation specification (see 5.2);

– the quality plan (see 5.3);

– final cabling documentation (see 6.2).

Where appropriate, the documentation supplied shall include component acceptance test documentation. Such documentation includes:

a) evidence of conformance of cables, connectors, cable assemblies etc.

b) cable acceptance test records and other information;

c) cable assembly acceptance test records and other information;

d) delivery information (e.g. dates of receipt and batch numbers or other unique product identifiers of cables and accessories).

6.2 Final cabling documentation

The final cabling documentation includes:

a) site plans to include the identifications and locations of nodes, pathways, cables, termination points, closures, patch panels, protection devices;

b) as-built information to include nodal, route and cable connectivity, closures (in a schematic or report based format);

c) installed cabling acceptance test records;

d) evidence of conformance to the installation specification from cabling installer or main contractor;

e) handover certification;

f) other information as required;

g) earthing and equipotential bonding details.

A maintenance and change control procedure should be established. The documentation formats should facilitate changes to be made to the installed cabling throughout its intended operational life.

Possible documentation formats can be:

h) reports, lists, card files, etc.

i) schematic diagrams (on paper or electronic based);

j) electronic based applications and systems (e.g. spreadsheets, databases, CAD).

Whichever system is used it is of utmost importance that maintenance data are kept consistent and not duplicated. Guidance to the design and use of a cabling administration system can be found in clause 7.

7 Cabling administration

7.1 Introduction

The reliability of a telecommunications infrastructure depends upon effective administration. For the purposes of this clause the term "telecommunications infrastructure" covers both the information technology cabling and the applications/equipment connected to it.

The requirements of this clause are based upon the general requirements for administration systems specified in ISO/IEC 14763-1.

No cabling system can be properly managed without a clear and logical labelling and record strategy and procedures to ensure the administration system is kept up to date. This clause describes documentation, identifiers, labels, and records that can be used to catalogue information technology cabling and from which moves and changes to the telecommunications infrastructure are managed. This clause does not recommend a particular regime of cabling administration, rather, basic principles are established from which a suitable administration system should be developed or procured. Unless explicitly stated, the guidance in this clause is applicable equally to optical fibre and balanced copper cabling.

It is not essential that the administration system is procured from the same supplier as the cabling, but the following points shall be considered:

a) care shall be taken that the administration system is compatible with the cabling system and with the documentation prepared during the installation;

b) the design of the administration system is, in certain cases, dependent upon the method of identification and labelling of the components of the cabling system;

c) the requirements for identifiers and labels shall be clearly stated in the installation specification.

For simple infrastructures a well-designed paper based administration system is often adequate. However, it is recommended that the principles of administration outlined in this clause be implemented using a computer based administration system.

The complexity of the computer based administration system will depend upon the complexity of the information to be recorded. In many cases, customised commercial database programmes are adequate but large organisations shall consider the use of a more sophisticated database and efficient data retrieval program that contains additional features.

These features include:

– importing of drawings directly from CAD programs;

– exporting reports to external packages or E-mail work orders;

– automatic updating of records on completion of work.

In some cases the cabling administration system is capable of being used as a cabling design tool.

7.2 Identifiers

In certain cases, identifiers are coded to indicate other relevant information about the component. For example, where a 4 pair category 5 cable installed in the horizontal cabling is identified according to its type and location in the building using an appropriate coding method. 7.5 indicates the cabling components for which identification shall be considered.

Labels are either fixed to the component or are part of the component itself. Certain components are labelled more than once. For example, a cable generally needs to be labelled at both ends as a minimum requirement.

In all cases:

a) care shall be taken that labels are applied such that they are easily accessed, read and modified if required;

b) labels shall be robust and the markings shall remain readable for the anticipated lifetime of the cabling

c) labels shall not be affected by dampness nor smudge when handled;

d) labels used in an outdoor or other harsh environment shall be designed to withstand the rigours of that environment;

e) if changes are made (for example, at a patch panel), labels shall be inspected to determine if the information recorded on the labels requires to be updated.

7.3 Records

A record takes a variety of forms including:

– a set of fields on a computer screen

– a drawing

– a paper pro-forma.

Consideration shall be given to the need for cabling administration records to be linked to each other and to other building services records such as those for lighting, power, heating, site drawings etc.

As appropriate:

a) records should be kept of the installed cabling and test results (see 7.5);

b) all end user connections should be traceable via the records;

c) as changes are made to the telecommunications infrastructure the appropriate records should be updated.

Appropriately designed records assist in the preparation of reports and the monitoring of end user connections. The basic concept is illustrated in Figure 4.

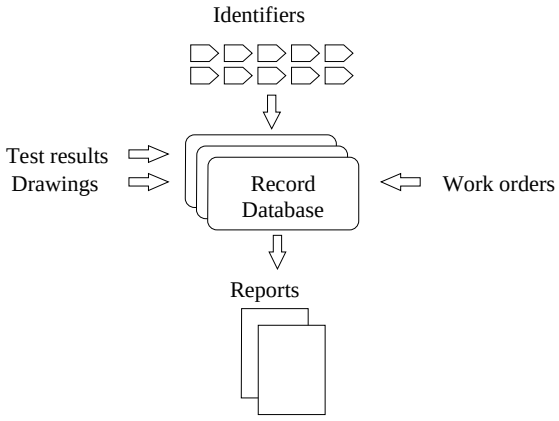

Figure 4 - Basic cabling administration concept

7.4 Documentation

7.4.1 Reports

Reports present information selected from the records. In some cases, reports take the form of diagrams to illustrate a particular aspect of the telecommunications infrastructure e.g. a local area network. Computer based administration systems are particularly suitable for the preparation of reports generated from end user entered criteria.

Reports shall be dated and consideration shall be given to the need to retain reports for a specified minimum period.

7.4.2 Drawings

Drawings are normally provided as part of the final documentation (see clause 6) of the cabling planning and installation. In certain cases, these drawings become part of the cabling administration system.

Drawings shall be kept up to date and the appropriate change control shall be exercised.

7.4.3 Work orders

It is vital that all relevant records be updated each time a change is implemented and in a manner to prevent multiple untracked updates.

7.5 Guidance on cabling administration system design

7.5.1 General

Elements of information technology cabling that should be catalogued in the administration system include pathways, spaces, cables, termination points, the earthing and equipotential bonding of the cabling and the results of link performance tests.

7.5.2 Pathways

a) Each pathway should have a unique identifier which is generally linked to the points at which it emerges into a telecommunication closet, equipment room or entrance facility.

b) Pathways should be labelled particularly if more than one pathway appears in a space.

c) The administration system should include records and/or drawings containing each pathway identifier linked with other information about the pathway e.g. pathway type, spaces at which the pathway appears, fill, location of earthing points.

7.5.3 Spaces

a) Each space should have a unique identifier.

b) All spaces should be labelled at a suitable place such as the entry to the space.

c) The administration system should include each space identifier linked with other information about the space e.g. space type, location, pathways leading from the space, cable terminations, equipment located in the space, links to other building records (power, ventilation etc.).

d) The work area is a special case of a space. The work area identifier should be linked with its location and the termination points that have been installed in that work area.

7.5.4 Cables

This subclause can also be applied to patch cords used for cross-connection at patch panels.

a) Each cable should have a unique identifier.

b) All cables should be labelled at both ends as a minimum.

c) The administration system should include each cable identifier linked with other information about the cable e.g. cable type, length, installation date, termination point identifiers, pathway(s) used, earthing point (for shielded cable).

d) Multipair balanced copper cables should be labelled at each joint. Separate records should be considered to enable the control of pairs entering and leaving joints on multipair cables.

e) For optical fibre cables containing multiple fibres it is recommended that individual fibres are identified either by colour coding or labelling.

7.5.5 Termination points

a) Each termination point (for example, at a cross-connect or transition point) should have a unique identifier.

b) All termination points should be labelled.

c) The administration system should include each termination point identifier linked with other information about the termination point e.g. termination point type, connector type (if used), space identifier, cable identifier, link test result, equipment connection identifier, service carried etc.

7.5.6 Earthing and equipotential bonding

a) Each element of the earthing and equipotential bonding system of this standard should have a unique identifier.

b) Each element of the earthing and equipotential bonding system should be labelled.

c) The administration system should include each earthing and equipotential bonding element identifier linked with other information about the earthing and equipotential bonding element e.g. element type, location, connections, earth test results.

7.5.7 Test results

a) Records should be kept of all acceptance tests made at the time of commissioning the installation and of all tests carried out subsequently.

b) Records should be kept of links that fail to meet the required performance.

c) Test results should be linked in the administration system 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.

8 Repair and maintenance

8.1 Introduction

Repair and maintenance are generally captured by the contract between the cabling owner and the cabling maintainer. In certain countries legal requirements apply that require the cabling maintainer to be suitably qualified and registered.

It is important to note that after any repair or maintenance is carried out, the operation of the system, as it was originally specified, should be restored. For example, after a repair has been made it is vital to ensure that the earth connections have been re-instated as in the original system. This will ensure that any intended earth network remains effective. This is only one example and there are many other aspects of a system that should be considered during a repair or maintenance phase to ensure that the integrity of the original system design is not compromised.

It is recommended that the final cabling documentation (see 6.2) is consulted before the beginning of a repair process or maintenance phase. This would give, or confirm, the basic parameters of the system as installed. Procedures should be in place to check these parameters after the repair or maintenance has been carried out. Tests undertaken at this stage are identical to the acceptance tests indicated in 5.3.5 and described in EN 50346.

Maintenance is usually either reactive or preventative. In either instance the principle is maintaining system performance in a changing environment.

8.2 Maintenance

8.2.1 Reactive maintenance

In this case the cabling maintainer reacts to the cabling owners call for assistance. The magnitude of the problem is determined on site. Appropriate remedial action is taken at that time.

8.2.2 Preventive maintenance

This form of maintenance is a much more considered approach and is most likely to be instigated where the cabling owner needs to be assured of continuous operation.

Effective preventive maintenance demands early consideration of resilience issues (see 4.9) and, in certain cases, is supported by the establishment of a formal maintenance contract. The scope and extent of the maintenance contract are designed, usually in collaboration with the cabling maintainer, to meet the specific requirements of the cabling owner.

If preventive maintenance is required then the following shall be considered:

a) how often maintenance checks are to be made;

b) how much of the cabling system will be inspected/replaced during each maintenance check (since, for a large system, it would be impractical to check all the system every time);

c) what will be inspected during each maintenance check (for example, cabling in use, redundant cabling, pathways, pathway systems, earthing systems, fire barriers).

Consideration of these issues allows the development of an agreed programme of maintenance and generates an agreed schedule and a work programme checklist.

Annex A (informative)

Compatibility between transmission systems sharing the same cable sheath within information technology cabling

A.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 transmission 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, especially in the horizontal cabling subsystem 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.

A.2 Recommendations concerning cable sharing

Some requirements for cable sharing are given in EN 50173. 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;

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.

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

A.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.

A.3.2 Factors concerning the 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.

A.3.3 Cabling characteristics

A.3.3.1 Crosstalk loss (differential mode to differential mode, common mode to differential mode, differential mode to common mode and 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.

A.3.3.2 Attenuation

Often receiver noise sensitivity is specified as a parameter that is independent of the received signal level. In such a case cabling attenuation 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 attenuation 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 attenuation is an important parameter for sharing. In certain cases, attenuation is also important where the disturbing transmitter and disturbed receiver are at opposite ends of the cabling.

A.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.

A.3.4 The disturbed transmission system

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).

A.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. Information from cable manufacturers should be sought.

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) attenuation values.

A.5 Cabling qualification

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

A.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.

A.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.).

A.8 Protection requirements when sharing the same cable sheath

During installation and maintenance short circuits often occur between circuits especially those within the same cable sheath. It is possible for these circuits to operate at substantially different voltages (for example the voltage levels applied to ringing circuits in analog telephone systems) and this risks damage to transmission interfaces. Equipment used in these cases should have adequate protection against voltages applied in the case of accidental contact with other services in the same cable.

A.9 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.

Annex B (informative)

Terminating cables on terminating blocks in floor distributors

B.1 General

It is possible for the pair and pin arrangement for a generic cabling system according to EN 50173 to be realised in different ways. Some implementations use the same type of connector (EN 60603-7 or IEC 60807-8) for the termination at both ends of the horizontal cable. Other implementations use terminating blocks in the floor distributor.

B.2 The same type of connector used both at the floor distributor and at the telecommunication outlets

When the same type of connector (same wire termination layout) is used at both ends of the horizontal 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 horizontal cable are terminated by two such different connectors, problems with pin-to-pin correspondence between these two connectors can arise.

B.3 Use of terminating blocks in the horizontal subsystem

In some cases the horizontal cables are terminated on terminating blocks. In such cases there should be a fixed relation between the tags of the terminating blocks and the pins of the telecommunication outlets.

Relations between the TO pins and the tags of the terminating block

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

Table B.1 - Examples of the relations between the TO pins and the tags of the terminating block

Terminating block	Pins of the telecommunication outlet (EN 60603-7)	
Pair identification [1)]	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
1) The terms ‘pair’ and ‘lead’ strictly refer to the terminating block and do not necessarily reflect the use of balanced pairs in the horizontal 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 telecommunications outlet exists. Table B.1 shows only two of many options.

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[2)] In preparation by TC 215