

BS EN 61918:2013

Incorporating corrigendum May 2014



BSI Standards Publication

Industrial communication networks — Installation of communication networks in industrial premises

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National foreword

This British Standard is the UK implementation of EN 61918:2013, incorporating corrigendum May 2014. It is derived from IEC 61918:2013. It supersedes BS EN 61918:2008, which is withdrawn.

CENELEC corrigendum May 2014 corrects the EN Foreword and Introduction.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags **[C]** **[C]**.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications: process measurement and control, including fieldbus.

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

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Amendments/corrigenda issued since publication

Date	Text affected
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**Industrial communication networks -
Installation of communication networks in industrial premises
(IEC 61918:2013, modified)**

Réseaux de communication industriels -
Installation de réseaux de communication
dans des locaux industriels
(CEI 61918:2013, modifiée)

Industrielle Kommunikationsnetze –
Installation von Kommunikationsnetzen in
Industrieanlagen
(IEC 61918:2013, modifiziert)

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

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CENELEC

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 65C/737/FDIS, future edition 3 of IEC 61918, prepared by SC 65C, "Industrial networks", of IEC/TC 65, "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61918:2013.

A draft amendment, which covers common modifications to IEC 61918:2013, was prepared by CLC/TC 65X "Industrial-process measurement, control and automation" and approved by CENELEC.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-10-02
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2016-10-02

This document supersedes EN 61918:2008.

EN 61918:2013 includes the following significant technical changes with respect to EN 61918:2008:

- some terms and abbreviated terms have been added to Clause 3;
- Subclauses 4.4.3.4.1, 4.4.7.2.1, and 4.4.7.3 have been updated;
- Subclause 5.7.4.3 has been updated as result of the revision of the installation profiles;
- Subclause 6.2.3.1 has been updated;
- Subclause 8.1 has been updated;
- Figure 2, Figure 13, Figure 15, Figure 29, Figure H.1, Table 3, Table 6, Table 7, Table 14, Table B.3 and Table B.5 have been updated;
- a new Figure 35 has been added;
- a new Table 10 has been added;
- Annex D and Annex M have been extended to cover additional communication profile families;
- Annex F has been extended to cover conductor sizes in electrical cables;
- Annex H has been made normative; some common requirements are extended as result of the revision of the installation profiles;
- a new informative Annex O has been added.

This standard is to be used in conjunction with the EN 61784-5 series with regard to the installation of communication profiles (CPs). This standard is to be used in conjunction with 50174 series, in particular with EN 50174-2, with regard to the installation of generic cabling.

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

Endorsement notice

The text of the International Standard IEC 61918:2013 was approved by CENELEC as a European Standard with common modifications.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
-	-	Multi-element metallic cables used in analogue and digital communication and control	EN 50288	Series
-	-	Application of equipotential bonding and earthing in buildings with information technology equipment	EN 50310	-
IEC 60364-1 (mod) + corr. August	2005 2009	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1	2008
IEC 60364-4-41	-	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41	-
IEC 60364-4-44	-	Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances	HD 60364-4-442	-
IEC 60364-5-54	-	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors	HD 60364-5-54	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	EN 60529	-
IEC 60603	Series	Connectors for frequencies below 3 MHz for use with printed boards	EN 60603	Series
IEC 60603-7	Series	Connectors for electronic equipment - Part 7: Detail specification for 8-way, shielded, free and fixed connectors	EN 60603-7	Series
IEC 60757	-	Code for designation of colours	HD 457 S1	-
IEC 60793	Series	Optical fibres	EN 60793	Series
IEC 60793-2-10	-	Optical fibres - Part 2-10: Product specifications - Sectional specification for category A1 multimode fibres	EN 60793-2-10	-
IEC 60794	Series	Optical fibre cables	EN 60794	Series
IEC 60807-2	-	Rectangular connectors for frequencies below 3-MHz - Part 2: Detail specification for a range of connectors, with assessed quality, with trapezoidal shaped metal shells and round contacts - Fixed solder contact types		-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60807-3	-	Rectangular connectors for frequencies below 3-MHz - Part 3: Detail specification for a range of connectors with trapezoidal shaped metal shells and round contacts - Removable crimp types with closed crimp barrels, rear insertion/rear extraction		-
IEC 60825-2	-	Safety of laser products - Part 2: Safety of optical fibre communication systems (OFCS)	EN 60825-2	-
IEC 60950-1	-	Information technology equipment - Safety - Part 1: General requirements	EN 60950-1	-
IEC 61076-2-101	-	Connectors for electronic equipment - Product requirements - Part 2-101: Circular connectors - Detail specification for M12 connectors with screw-locking	EN 61076-2-101	-
IEC/PAS 61076-2-109	-	Connectors for electronic equipment - Product requirements - Part 2-109: Circular connectors - Detail specification for connectors M12 x 1 with screw-locking, for data transmissions with frequencies up to 500 MHz		-
IEC 61076-3-106	-	Connectors for electronic equipment - Product requirements - Part 3-106: Rectangular connectors - Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface	EN 61076-3-106	-
IEC 61076-3-117	-	Connectors for electronic equipment - Product requirements - Part 3-117: Rectangular connectors - Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface - Variant 14 related to IEC 61076-3-106 - Push pull coupling	EN 61076-3-117	-
IEC 61158	Series	Industrial communication networks - Fieldbus specifications	EN 61158	Series
IEC 61158-2	201X ¹⁾	Industrial communication networks - Fieldbus specifications - Part 2: Physical layer specification and service definition	EN 61158-2	201X ¹⁾
IEC 61169-8	-	Radio-frequency connectors - Part 8: Sectional specification - RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock - Characteristics impedance 50 ohms (type BNC)	EN 61169-8	-
IEC 61753	Series	Fibre optic interconnecting devices and passive components performance standard	EN 61753	Series

¹⁾ To be published.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61754-2	-	Fibre optic connector interfaces - Part 2: Type BFOC/2,5 connector family	EN 61754-2	-
IEC 61754-4	-	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 4: Type SC connector family	EN 61754-4	-
IEC 61754-20	-	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 20: Type LC connector family	EN 61754-20	-
IEC 61754-22	-	Fibre optic connector interfaces - Part 22: Type F-SMA connector family	EN 61754-22	-
IEC 61754-24	-	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 24: Type SC-RJ connector family	EN 61754-24	-
IEC 61784	Series	Industrial communication networks - Profiles	EN 61784	Series
IEC 61784-1	-	Industrial communication networks - Profiles - Part 1: Fieldbus profiles	EN 61784-1	-
IEC 61784-2	201X ¹⁾	Industrial communication networks - Profiles - Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3	EN 61784-2	201X ¹⁾
IEC 61784-3	-	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions	EN 61784-3	-
IEC 61784-5	Series	Industrial communication networks - Profiles - Part 5-2: Installation of fieldbuses - Installation profiles for CPF 2	EN 61784-5	Series
IEC 61935-1 (mod) + corr. October	2009 2010	Specification for the testing of balanced and coaxial information technology cabling - Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards	EN 61935-1	2009
IEC 61935-2	-	Specification for the testing of balanced and coaxial information technology cabling - Part 2: Cords as specified in ISO/IEC 11801 and related standards	EN 61935-2	-
IEC 62026-3	-	Low-voltage switchgear and controlgear - Controller-device interfaces (CDIs) - Part 3: DeviceNet	EN 62026-3	-
IEC 62439	Series	Industrial communication networks - High availability automation networks	EN 62439	Series
IEC 62443	Series	Industrial communication networks - Network and system security	-	-
ISO/IEC 8802-3	-	Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications	-	-
ISO/IEC 11801 + corr. October + corr. December + A1 + A2	2002 2002 2002 2008 2010	Information technology - Generic cabling for customer premises	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO/IEC 14763-2	2012	Information technology - Implementation and operation of customer premises cabling - Part 2: Planning and installation	-	-
ISO/IEC 14763-3	-	Information technology - Implementation and operation of customer premises cabling - Part 3: Testing of optical fibre cabling	-	-
ISO/IEC 24702 +A1	2006 2009	Information technology - Generic cabling - Industrial premises	-	-
IEEE 802.3	-	Standard for Information Technology – Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	-	-
IEEE 802.3at	-	Standard for Information Technology – Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Amendment 3: Data Terminal Equipment (DTE) Power Via the Media Dependent Interface (MDI) Enhancements	-	-
ANSI/NFPA T3.5.29 R1	2007	Fluid power systems and components - Electrically-controlled industrial valves - Interface dimensions for electrical connectors	-	-

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INTRODUCTION

Process and factory automation are increasingly relying on communication networks and fieldbuses that are inherently designed to cope with the specific environmental conditions of the industrial premises. The networks and fieldbuses provide for an effective integration of applications among the several functional units of the plant/factory. One of the benefits of integrating field-generated data with higher-level management systems is to reduce production costs. At the same time, integrated data helps maintain or even increase the quantity and quality of production. A correct network installation is an important prerequisite for communications availability, reliability, and performance. This requires proper consideration of safety and security conditions and environmental aspects such as mechanical, liquid, particulate, climatic, chemicals and electromagnetic interference.

The specifications of these communication networks are provided in the following standards.

ISO/IEC 24702 specifies design of generic telecommunications infrastructures within industrial premises and provides the foundations for some of the transmission performance specifications of this standard. ISO/IEC 24702 specifies only the raw bandwidth capability of a channel; it does not specify useful data transfer rate for a specific network using that channel or expected errors after taking account of interference during the communication process.

IEC 61158 fieldbus standard and IEC 62026-3 and their companion standard IEC 61784-1 and IEC 61784-2 jointly specify several CPs suitable for industrial automation. These CPs specify a raw bandwidth capability and in addition, they specify bit modulation and encoding rules for their fieldbus. Some profiles also specify target levels for useful data transfer rate, and maximum values for errors caused by interference during the communication process.

This standard provides a consistent set of installation rules for industrial premises concerning both generic cabling (of the telecommunication infrastructures) and fieldbuses. In addition, it offers support for the definition and installation of the interfaces between automation island networks and generic cabling. One of the problems it seeks to solve is the situation created when different parts of a large automation site are provided by suppliers that use non-homogeneous installation guidelines having different structures and contents. This lack of consistency greatly increases the potential for errors and mismatch situations liable to compromise the communication system.

This standard was developed by harmonising the approaches of several user groups and industrial consortia.

This standard provides a common point of reference for the installation of the media of most used industrial communication networks for most industrial sites. The standard covers the life cycle of an installation in the following clauses (see the map of the standard in Figure 1):

- Clause 4: Installation planning;
- Clause 5: Installation implementation;
- Clause 6: Installation verification and acceptance test;
- Clause 7: Installation administration;
- Clause 8: Installation maintenance and installation troubleshooting.

The methods described in these clauses are written in such a way as to provide installation guidance for a wide range of technician skills.

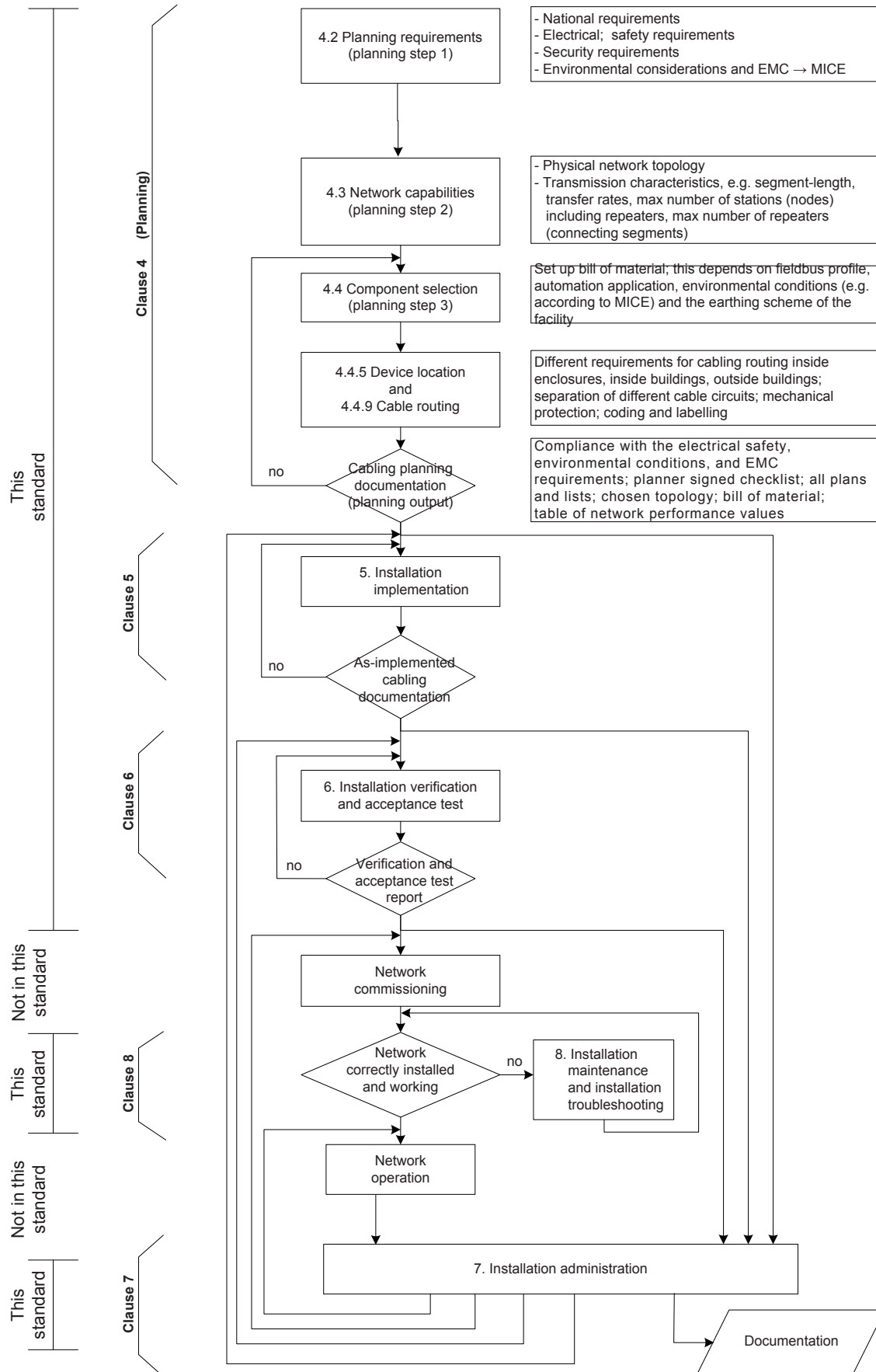


Figure 1 – Industrial network installation life cycle

The installation of a communication system is supported by this standard used in conjunction with the relevant installation profile. The installation profile establishes the technology-specific requirements in terms of which requirements apply as they are in this standard, or which have been extended, modified, or replaced.

For the fieldbuses that are defined in the IEC 61784 series as communication profiles (CPs) of the communication profile families (CPF), the installation is specified in the installation profiles that are available in the IEC 61784-5-n series, where n is the CPF number. IEC 61158-1 describes the relationship between the fieldbus and the CPs and the relevant installation profiles (see Figure 2).

For the installation of generic cabling this standard is to be used in conjunction with EN 50174 series, in particular with EN 50174-2 (see Figure 2).

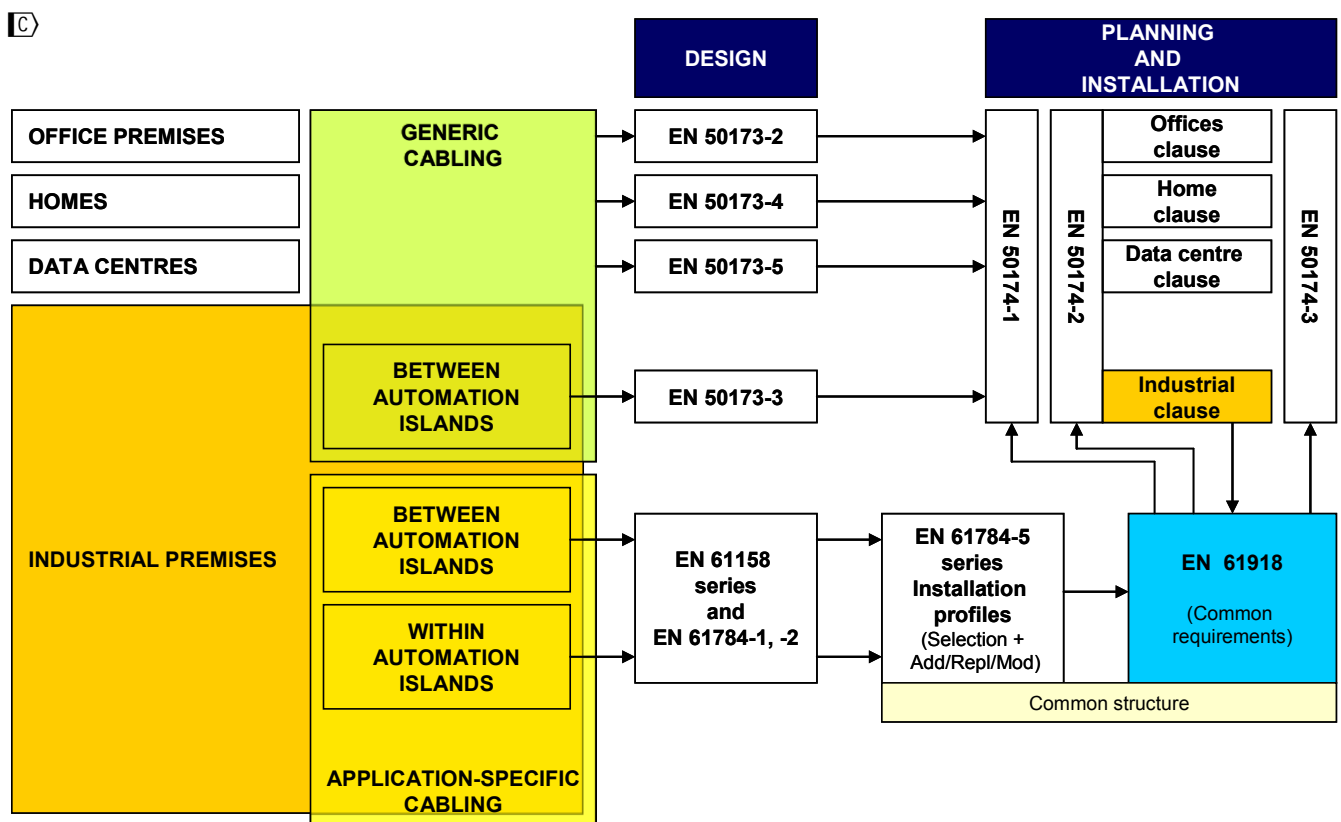


Figure 2 - Network installation: Standards relationships at European level

One of the advantages of this structure is that the users of a network know which installation requirements are common to most networks and which are specific to a particular network.

Every single plant/factory has its own installation needs in accordance with the specific critical conditions that apply to the specific application. This standard and its companion standards described above provide a set of mandatory installation requirements ("shalls") and a number of recommendations ("shoulds"). It is up to the owner of the specific industrial enterprise to explicitly request that the cabling installation be implemented in accordance with these standards and to list all recommendations that shall be considered as mandatory requirements for the specific case.

INDUSTRIAL COMMUNICATION NETWORKS –

Installation of communication networks in industrial premises

1 Scope

This International Standard specifies basic requirements for the installation of media for communication networks in industrial premises and within and between the automation islands, of industrial sites. This standard covers balanced and optical fibre cabling. It also covers the cabling infrastructure for wireless media, but not the wireless media itself. Additional media are covered in the IEC 61784-5 series.

This standard is a companion standard to the communication networks of the industrial automation islands and especially to the communication networks specified in the IEC 61158 series and the IEC 61784 series. In addition, this standard covers:

- the installation of generic telecommunication cabling for industrial premises as specified in ISO/IEC 24702;
- the connection between the generic telecommunications cabling specified in ISO/IEC 24702 and the specific communication cabling of an automation island, where an automation outlet (AO) replaces the telecommunication outlet (TO) of ISO/IEC 24702.

NOTE If the interface used at the AO does not conform to that specified for the TO of ISO/IEC 24702, the cabling no longer conforms to ISO/IEC 24702 although certain features, including performance, of generic cabling may be retained.

This standard provides guidelines that cope with the critical aspects of the industrial automation area (safety, security and environmental aspects such as mechanical, liquid, particulate, climatic, chemicals and electromagnetic interference).

This standard does not recognise implementations of power distribution through Ethernet balanced cabling systems that are not specified in IEEE 802.3 and in IEEE 802.3at.

This standard deals with the roles of planner, installer, verifier, and acceptance test personnel, administration and maintenance personnel and specifies the relevant responsibilities and/or gives guidance.

2 Normative references

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

☐ HD 60364☐-1:2005, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

☐ HD 60364☐-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

☐ HD 60364☐-4-44, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

☐ HD 60364-5-54, *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60603 (all parts), *Connectors for electronic equipment*

IEC 60603-7 (all subparts), *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

IEC 60757, *Code for designation of colours*

IEC 60793 (all parts), *Optical fibres*

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60794 (all parts), *Optical fibre cables*

IEC 60807-2, *Rectangular connectors for frequencies below 3 MHz – Part 2: Detail specification for a range of connectors, with assessed quality, with trapezoidal shaped metal shells and round contacts – Fixed solder contact types*

IEC 60807-3, *Rectangular connectors for frequencies below 3 MHz – Part 3: Detail specification for a range of connectors with trapezoidal shaped metal shells and round contacts – Removable crimp contact types with closed crimp barrels, rear insertion/rear extraction*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61076-2-101, *Connectors for electronic equipment – Product requirements - Part 2-101: Circular connectors – Detail specification for M12 connectors with screw-locking*

IEC/PAS 61076-2-109, *Connectors for electronic equipment – Product requirements – Part 2-109: Circular connectors – Detail specification for connectors M12 x 1 with screw-locking, for data transmissions with frequencies up to 500 MHz*

IEC 61076-3-106, *Connectors for electronic equipment – Product requirements – Part 3-106: Rectangular connectors – Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface*

IEC 61076-3-117, *Connectors for electronic equipment – Product requirements – Part 3-117: Rectangular connectors – Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating IEC 60603-7 series interface – Variant 14 related to IEC 61076-3-106 – Push-pull coupling*

☐ EN 50288 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

IEC 61158-2:____, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*¹

IEC 61169-8, *Radio-frequency connectors – Part 8: Sectional specification – RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock – Characteristic impedance 50 ohm (type BNC)*

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components performance standard*

IEC 61754-2, *Fibre optic connector interfaces – Part 2: Type BFOC/2,5 connector family*

IEC 61754-4, *Fibre optic connector interfaces – Part 4: Type SC connector family*

IEC 61754-20, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 20: Type LC connector family*

IEC 61754-22, *Fibre optic connector interfaces – Part 22: Type F-SMA connector family*

IEC 61754-24, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 24: Type SC-RJ connector family*

IEC 61784 (all parts), *Industrial communication networks – Profiles*

IEC 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 61784-2:____, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*²

IEC 61784-3, *Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions*

IEC 61784-5 (all subparts), *Industrial communication networks – Profiles – Part 5: Installation of fieldbuses*

IEC 61935-1:2009, *Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards*

IEC 61935-2, *Specification for the testing of balanced and coaxial information technology cabling – Part 2: Cords as specified in ISO/IEC 11801 and related standards*

IEC 62026-3, *Low-voltage switchgear and controlgear – Controller-device interfaces (CDIs) – Part 3: DeviceNet*

IEC 62439 (all parts), *Industrial communication networks – High availability automation networks*

IEC 62443 (all parts), *Industrial communication networks – Network and system security*³

¹ To be published.

² To be published.

³ Check <http://webstore.iec.ch> for the published parts. Other parts are under consideration

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*⁴

Amendment 1:2008

Amendment 1:2010

ISO/IEC 14763-2:2012, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

ISO/IEC 14763-3, *Information technology – Implementation and operation of customer premises cabling – Part 3: Testing of optical fibre cabling*

ISO/IEC 24702:2006, *Information technology – Generic cabling – Industrial premises*

Amendment 1:2009

EN 50310, *Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment*

IEEE 802, *Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*

IEEE 802.3at, *Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications – Amendment 3: Data Terminal Equipment (DTE) Power Via the Media Dependent Interface (MDI) Enhancements*

ANSI/NFPA) T3.5.29 R1-2007, *Fluid power systems and components – Electrically-controlled industrial valves – Interface dimensions for electrical connectors*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions contained in the IEC 61158 series, the IEC 61784 series, ISO/IEC 8802-3, ISO/IEC 11801, and ISO/IEC 24702, some of which have been repeated here for convenience, and the following terms and definitions apply.

NOTE Some terms and definitions in ISO/IEC 11801 have been modified in ISO/IEC 24702. In such cases, the latter publication takes precedence.

3.1.1

acceptance test

contractual test to prove to the customer that the installed cabling meets certain conditions of its specification

Note 1 to entry: The network owner or a third party usually performs this action.

⁴ There exists a consolidated edition 2.2 (2011) comprising ISO/IEC 11801:2002, its Amendment 1:2008 and its Amendment 2:2010.

[SOURCE: IEC 60050-151:2001, 151-16-23, modified – Note 1 to entry has been added.]

3.1.2

active network element

network element containing electrically and/or optically active components that allows extension of the network

Note 1 to entry: Examples of active network elements are repeaters and switches.

3.1.3

active network

network in which data transmission between non-immediately-connected devices is dependent on active elements within those intervening devices that form the connection path

Note 1 to entry: A failure of an active network element may disrupt the network communications.

3.1.4

administration

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

[SOURCE: ISO/IEC 11801:2002, 3.1.1]

3.1.5

apparatus

one or more pieces of equipment having specific and defined overall functions within industrial premises served by one or more network interfaces

Note 1 to entry: This definition applies only to IT equipment. It does not apply to automation devices.

[SOURCE: ISO/IEC 24702:2006, 3.1.1]

3.1.6

automation island

AI

premises where combination of all systems that control, monitor, and protect the process of a plant is installed

Note 1 to entry: A plant may contain one or more AIs. Examples of a plant that has more than one AI are: a plant that is divided in various distinct physical (geographical) areas, or a plant that is composed of several distinct processes, or a plant where a large process is divided in various distinct sub-processes.

3.1.7

automation island network

network used for the communication within and among systems of an AI

Note 1 to entry: A plant may contain one or more AIs. Examples of cases where there are more than one AI are: when a plant is divided in various distinct physical (geographical) areas, or when a plant is composed of several distinct processes.

3.1.8

automation outlet

AO

fixed connecting hardware where the AI network terminates, that provides the interface at which an industrial communication device is connected to the installed cabling.

Note 1 to entry: For generic cabling [E] in accordance with EN 50173-3 [C], the AO replaces the TO and is the demarcation point between the generic communications cabling and the automation specific cabling.

Note 2 to entry: Where the interface used at the AO does not conform to that specified for the TO of ISO/IEC 24702 the generic cabling no longer conforms to ISO/IEC 24702.

3.1.9

balanced cable

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

[SOURCE: ISO/IEC 11801:2002, 3.1.13]

3.1.10

bonding

act of connecting together exposed conductive parts and extraneous conductive parts of apparatus, systems, or installations that are at essentially the same potential

Note 1 to entry: For safety purposes, bonding generally involves (but not necessarily) a connection to the immediately adjacent earthing system.

[SOURCE: IEC/TR 61000-5-2:1997, 3.1]

3.1.11

bridge

device, operating at the data link layer of the OSI model, used to connect two networks

3.1.12

bulkhead

wall or barrier which maintains the ingress and climatic environmental classification applicable on either side

[SOURCE: ISO/IEC 24702:2006, 3.1.4]

3.1.13

bulkhead connector

connector assembly mounted to a bulkhead which provides electrical or optical signal pass-through while maintaining environmental integrity

3.1.14

bulkhead connection

connection through a bulkhead connector

3.1.15

bulkhead cable gland

hardware at an enclosure bulkhead that provides cable passage for power or signals while maintaining environmental integrity

Note 1 to entry: This hardware has no electrical connections.

3.1.16

bus

passive network having a long trunk and a number of spurs where each spur is used to connect a device to the trunk

Note 1 to entry: In a bus, all the communicating devices share a common medium to transfer data.

3.1.17

bus bar

low-impedance conductor to which several electric circuits can be connected at separate points

Note 1 to entry: In many cases, the bus bar consists of a bar.

[SOURCE: IEC 60050-151:2001, 151-12-30]

3.1.18**cable**

assembly of one or more conductors and/or optical fibres, with a protective covering and possibly filling, insulating and protective material

[SOURCE: IEC 60050-151:2001, 151-12-38]

3.1.19**cable gland**

installation hardware designed to permit the entry of a cable into an enclosure and which provides sealing and retention

[SOURCE: IEC 60670-1:2002, Amendment 1:2008, 3.10, modified – Definition has been adapted for all kinds of cables.]

3.1.20**cabling**

system of communication cables, cords and connecting hardware that can support the connection of automation equipment

[SOURCE: ISO/IEC 11801:2002, 3.1.21, modified – A reference to automation equipment has been added.]

3.1.21**channel**

end-to-end transmission path connecting any two pieces of application specific equipment

Note 1 to entry: Equipment cords are included in the channel, but not the connecting hardware into the application specific equipment.

Note 2 to entry: This is a modification to the definition of ISO/IEC 24702 in order to allow it be used for the CPs in accordance with IEC 61784-5 series.

[SOURCE: ISO/IEC 24702: 2006, 3.1.5, modified – Note 1 to entry and Note 2 to entry have been added.]

3.1.22**condition-based (conditional) maintenance**

preventive activity performed on the basis of the documentation of the performance degradation of an item (as results of, for example, auto diagnostic or wear measurement)

Note 1 to entry: It is based on a proper visibility of performance degradation or intermittent failures.

3.1.23**connection (of conductors)**

intentional electric contact between conductors

[SOURCE: IEC 60050-151:2001, 151-12-07, modified – Text referring to conductors has been selected.]

3.1.24**connection (of optical fibres)**

intentional alignment between optical fibres to allow light to pass through

[SOURCE: IEC 60050-151:2001, 151-12-07, modified – Text has been adapted to cover optical fibres.]

3.1.25

connector (for conductors)

component providing conductor connection and disconnection

Note 1 to entry: The connector is the mated pair.

Note 2 to entry: A connector has one or more contact members.

[SOURCE: IEC 60050-151:2001, 151-12-19, modified – The definition has been adapted and Note 1 to entry has been added.]

3.1.26

connector (for optical fibres)

component normally attached to an optical cable or piece of apparatus, for the purpose of providing optical interconnection/disconnection of optical fibres or cables

Note 1 to entry: The connector is the mated pair.

Note 2 to entry: The connector usually consists of two plugs mated together in an adaptor.

3.1.27

corrective maintenance

maintenance carried out after a fault recognition and intended to put an item into a state in which it can perform a required function

Note 1 to entry: In French, the term "dépannage" sometimes implies a provisional restoration.

[SOURCE: IEC 60050-191:1990, 191-07-08]

3.1.28

daisy chain

bus where each passive network interface connects two trunk sections and provides a d.c. coupling between those sections

Note 1 to entry: One of the sections may be a bus terminator.

Note 2 to entry: With regard to the use of "daisy chain" term for active networks, see the definition given for linear topology.

3.1.29

device

physical entity connected to the fieldbus composed of communication element and possibly other functional elements

[SOURCE: IEC 61158-2:2010, 3.1.13, modified – Some details have been deleted.]

3.1.30

earth (noun), en GB

ground (noun), en US

conductive mass of the earth, whose electric potential at any point is conventionally taken as zero

[SOURCE: IEC 61131-2:2007, 3.16]

3.1.31

earth (verb), en GB

ground (verb), en US

make an electric connection between a given point in a system or in an installation or in equipment and a local earth

Note 1 to entry: The connection to local earth may be intentional, or unintentional or accidental.

Note 2 to entry: The connection may be permanent or temporary.

[SOURCE: IEC 60050-195:1998, 195-01-08]

3.1.32

enclosure

housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 61131-2:2007, 3.19]

3.1.33

end-to-end link

end to end transmission path including the plug at each end

3.1.34

equipotential bonding

provision of electric connections between conductive parts, intended to achieve equipotentiality

[SOURCE: IEC 60050-195:1998, 195-01-10]

3.1.35

equipotential bonding system

interconnection of conductive parts providing equal potential between those parts

Note 1 to entry: If an equipotential bonding system is earthed, it forms part of an earthing arrangement.

[SOURCE: IEC 60050-195:1998, 195-02-22]

3.1.36

failure

termination of the ability of an item to perform a required function

Note 1 to entry: After failure, the item has a fault.

Note 2 to entry: Failure is an event, as distinguished from fault, which is a state.

[SOURCE: IEC 60050-191:1990, 191-04-01]

3.1.37

fault

state characterized by the inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

Note 1 to entry: IEC 61508-4 defines fault as an abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function.

[SOURCE: IEC 60050-191:1990, 191-05-01, modified – Note 1 to entry has been changed and Note 2 to entry has been deleted.]

3.1.38

functional earthing, en GB

functional grounding, en US

earthing a point or points in a system or in an installation or in equipment, for purposes other than electrical safety

[SOURCE: IEC 60050-195:1998, 195-01-13]

3.1.39**high flex cable**

cable that can withstand high number of repeated flexes (usually millions of cycles) while maintaining the specified performance

3.1.40**inactive metal part**

any non-current carrying metal that may be contacted by a person

3.1.41**inspection**

taking measures for the observation and evaluation of the actual condition

3.1.42**jack**

part of the connector which mates with a plug

[SOURCE: IEC 60050-581:2008, 581-26-24, modified – Text adapted for automation applications.]

3.1.43**jack-to-jack adaptor****J-J adaptor**

back-to-back jacks that are not on an enclosure/environmental barrier

3.1.44**linear topology**

topology where the nodes are connected in series, with two nodes connected to only one other node and all others each connected to two other nodes (that is, connected in the shape of a line)

Note 1 to entry: This topology corresponds to that of an open ring.

3.1.45**maintenance**

combination of all technical and corresponding administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

Note 1 to entry: See "preventive maintenance", and "corrective maintenance", for a more detailed definition of maintenance.

Note 2 to entry: The required function may be defined as a stated condition.

[SOURCE: IEC 60050-191:1990, 191-07-01]

3.1.46**maintenance intervention**

taking measures for retaining the specified condition

3.1.47**mean time between failures****MTBF**

expectation of the time between failures

[SOURCE: IEC 60050-151:2001, 191-12-08]

3.1.48**mean time to recovery****MTTR**

expectation of the time to restoration

Note 1 to entry: In IEC 60050-191:1990, 191-13-08, the use of "mean time to repair" (MTTR) is deprecated.

[SOURCE: IEC 60050-191:1990, 191-13-08]

3.1.49**network**

all of the media, connectors, repeaters, routers, gateways and associated node communication elements by which a given set of communicating devices are interconnected

[SOURCE: IEC 61158-2:____, 3.1.30]

3.1.50**node**

end-point of a branch in a network

3.1.51**passive network**

network in which data transmission is independent of active elements within the device attached to the network

Note 1 to entry: Failure of a device does not affect the propagation of information.

3.1.52**pathway**

cable route used to accommodate cables between termination points

Note 1 to entry: The cable route (e.g., conduit, ductwork, tray, or tube) is defined by a physical structure.

[SOURCE: ISO/IEC 14763-2:2012, 3.1.43, modified – Note 1 to entry has been added.]

3.1.53**permanent link**

transmission path between the telecommunications/automation outlet and the intermediate distributor or equivalent location

Note 1 to entry: It excludes apparatus attachment cords, equipment cords, patch cords and jumpers but includes the connection at each end.

Note 2 to entry: This is a modification to the definition of ISO/IEC 11801 in order to allow it be used for the CPs in accordance with IEC 61784-5 series.

[SOURCE: ISO/IEC 11801:2002, Amendment 1:2008, 3.1.63, modified – The definition and Note 1 to entry have been adapted and Note 2 to entry has been added.]

3.1.54**plug**

connector attached to a cable

[SOURCE: IEC 60050-151:1990, 151-12-21]

3.1.55

preventive maintenance

maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item

[SOURCE: IEC 60050-191:1990, 191-07-07]

3.1.56

protective earthing conductor

protective conductor provided for protective earthing

[SOURCE: IEC 60050-195:1998, 195-02-11]

3.1.57

RC earthed

earthed via a parallel RC circuit

3.1.58

recovery (of a high resilience item)

event when an item regains its specified degree of communication performance and fault resilience after correction of a fault

Note 1 to entry: High availability networks provide resilience to enable acceptable communication to continue after one fault and possibly after multiple faults.

3.1.59

repair

take measures for the re-establishment of the specified condition

3.1.60

repeater

two-port active physical layer device that receives and retransmits all signals to increase the distance and number of devices for which signals can be correctly transferred for a given medium

[SOURCE: IEC 61158-2:____, 3.1.38]

3.1.61

resistance to earth

real part of an impedance to earth

[SOURCE: IEC 60050-195:1998, 195-01-18]

3.1.62

restoration

state when a communication network regains its designed level of resilience redundancy

3.1.63

ring

active network where each node is connected in series to two other nodes

3.1.64

scheduled maintenance

preventive activity (time or number-of-actions directed) performed either on predefined schedule or on units of use (e.g. number of start-ups)

[SOURCE: IEC 60050-191:1990, 191-07-10, modified – The definition has been adapted and a reference to units of use has been added.]

3.1.65

segment

collection of trunk-cable sections of a network that is terminated at both ends by its characteristic impedance

Note 1 to entry: Segments are linked by repeaters within a logical link and by bridges to form a network.

[SOURCE: IEC 61158-2:____, 3.1.39 modified – The definition has been adapted.]

3.1.66

shield (of a cable), en US

screen (of a cable), en GB

surrounding metallic layer to confine the electromagnetic field within the cable and to protect the cable from external electrical influence

Note 1 to entry: Metallic sheaths, armours and earthed concentric conductors may also serve as a shield.

Note 2 to entry: For generic cabling in industrial premises ISO/IEC 24702 uses the term screen instead of shield.

[SOURCE: IEC 61158-2:____, 3.1.41 modified – The definition has been adapted and the term screen has been added.]

3.1.67

(optical fibre or electrical conductor) splice

a permanent, or semi-permanent, joint whose purpose is to couple optical power between two optical fibres or to joint two electrical conductors

Note 1 to entry: Joining without connectors.

3.1.68

spur

branch-line (i.e. a link connected to a larger one at a point in its route) that is a final circuit

Note 1 to entry: The alternative term “drop cable” is used in IEC 61158.

[SOURCE: IEC 61158-2:____, 3.1.42]

3.1.69

star

network of three or more devices where all devices are connected to a central point (which may be active or passive)

3.1.70

tap

point of attachment from a node or spur to the trunk cable

Note 1 to entry: A tap provides easy removal of a node without disrupting the link.

[SOURCE: IEC 61158-2:____, 3.3.34]

3.1.71

telecommunication outlet

TO

fixed connecting device where the intermediate cable terminates and which provides the interface to the apparatus attachment cabling

[SOURCE: ISO/IEC 24702:2006, 3.1.15]

3.1.72**terminator**

entity used to terminate a transmission line in its characteristic impedance to prevent reflections

Note 1 to entry: In some instances, the terminator may be embedded in an end device or in a connector.

[SOURCE: IEC 61158-2:____, 3.1.43, modified – The definition and Note 1 to entry have been modified.]

3.1.73**topology of a network**

pattern of the relative positions and interconnections of the individual elements of the network

Note 1 to entry: The term topology is sometimes overloaded to include considerations of the delay, attenuation and physical media classes of the paths interconnecting network nodes.

[SOURCE: IEC 60050-131:2002, 131-13-02, modified – Text has been adapted for communication networks and a Note 1 to entry has been added.]

3.1.74**troubleshooting**

locating the fault(s)

3.1.75**trunk**

main communication highway acting as a source of main supply to a number of other lines (spurs)

[SOURCE: IEC 61158-2:____, 3.1.46]

3.1.76**validation**

part of the acceptance test that is solved with measurements

3.1.77**verification**

action to assess that an installation is in accordance with its specification

Note 1 to entry: The installer usually performs this action.

Note 2 to entry: This action usually covers verification of component correct selection, physical layout, communication earthing, isolation and continuity of network components.

3.1.78**wire map**

mapping of connector pin-to-pin terminations of a cable

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

a.c.	Alternating current
A.I.	Action item
AI	Automation island
AO	Automation outlet
BD	Building distributor (ISO/IEC 24702)
BER	Bit error rate
BFOC	Bayonet fibre optic connector
BNC	Bayonet Neill Concelman (connector for coaxial cable having a bayonet-type shell)
CBN	Common bonding network
CP	Communication profile (IEC 61784-1)
CPF	Communication profile family (IEC 61784-1)
d.c.	Direct current
DCR	Direct current resistance
EFT	Electrical fast transient
EFT/B	Electrical fast transient / burst (IEC 61000-4-4)
ELFEXT	Equal level far-end crosstalk
ELTCTL	Equal level transverse conversion transfer loss
EMC	Electromagnetic compatibility (IEC 60050-161, 161-01-07)
EMI	Electromagnetic interference (IEC 60050-161, 161-01-06)
ESD	Electrical static discharge
E2E	End-to-end
FD	Floor distributor (ISO/IEC 24702)
ffs	For further study
FI	Fieldbus interface
FOC	Fibre optical connector
F-SMA	Fibre sub miniature version A (IEC 61754-22)
HP	Horse power
ID	Intermediate distributor (ISO/IEC 24702)
IDC	Insulation displacement contact
IP	International protection (IEC 60529)
J-J	Jack-to-jack
kbit/s	One thousand bits per second
LC	Optical fibre connector in accordance with IEC 61754-20
LSOH	Low smoke zero halogen
LV	Low voltage
Max.	Maximum
Mbit/s	Million bits per second
MD	Machine distributor (ISO/IEC 24702)
MHV	Medium high voltage
MICE	Mechanical, Ingress, Climatic and Chemical, Electromagnetic (ISO/IEC 24702)
Min.	Minimum
MTBF	Mean time between failures
MTTR	Mean time to repair (use deprecated in IEC 60050-191:1990, 191-13-08) replaced with mean time to recovery
N	Neutral
NA	Numerical aperture (IEC 60793 series)
na	Not available

NEXT	Near end crosstalk loss
NI	Network Interface (ISO/IEC 24702)
No.	Number
OF	Optical fibre
OMx	Cabled multimode optical fibre category x; where x=1, 2, 3, 4
OSx	Cabled single mode optical fibre category x; where x=1, 2
PE	Protective earthing conductor (IEC 60050-195:1998, 195-02-11)
P&ID	Pipe and Instrumentation Diagram
PoE	Power over Ethernet
POF	Plastic optical fibre
PSELFEXT	Power sum equal-level far-end crosstalk loss
RC	Resistor-capacitor (circuit)
Rep	Repeater
SC	Optical fibre connector in accordance with IEC 61754-4
SC-RJ	Optical fibre connector in accordance with IEC 61754-24
STP	Cable with either foil shielded balanced cable elements and/or an overall braided or foil shield (ISO/IEC 11801, modified)
TCL	Transverse conversion loss
TNC	Threaded Neill Concelman (threaded version of the BNC connector)
TO	Telecommunication outlet
UTP	Unshielded cable with unshielded balanced cable elements (U/UTP in ISO/IEC 11801)
UV	Ultraviolet
Var.	Variant

3.3 Conventions for installation profiles

Conventions for installation profiles are described in IEC 61784-5 series.

4 Installation planning

4.1 General

4.1.1 Objective

Clause 4 addresses the planning of cabling and associated infrastructures to support communication networks in industrial premises.

4.1.2 Cabling in industrial premises

The cabling may comprise:

- specific communication cabling for use within or between AIs as specified in the communication profiles of IEC 61784-1 or IEC 61784-2 and in the relevant installation profiles of the IEC 61784-5 series;
- generic telecommunications cabling for industrial premises as specified in ISO/IEC 24702;
- elements of generic cabling modified to meet the needs of specific communication cabling within an AI in accordance with the installation profiles of the IEC 61784-5 series;
- the apparatus attachment cabling between the TO and the AI  in accordance with EN 5013-3  with regard to the connection and with this standard with regard to the cables;

- the AI attachment cabling between the AO and the AI in accordance with this standard and the relevant installation profile(s) of the IEC 61784-5 series.

The design of generic cabling for industrial premises, specified in ISO/IEC 24702, provides a flexible cabling structure comprising a series of cabling sub-systems of specified transmission performance that are connected together either passively, using cords, or actively, using transmission equipment (see Annex A). Figure 3 (from ISO/IEC 24702) shows the structure of generic cabling connected to an AI where the TO interface allows connection of wide range of networking equipment.

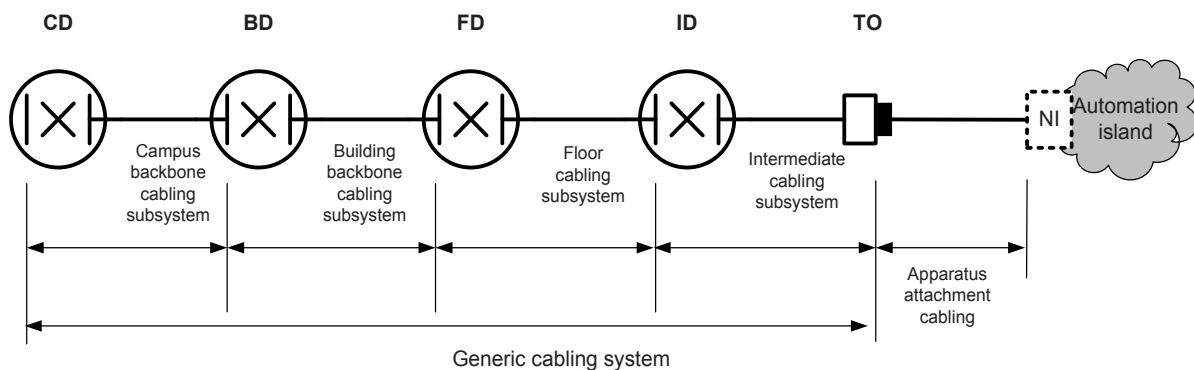


Figure 3 – Structure of generic cabling connected to an automation island

Where a designated connection from generic cabling to specific communication cabling within an AI is desired, an AO specified within this standard may replace the TO, as shown in Figure 4.

The specific requirements and recommendations for planning of generic cabling in industrial premises detailed in Clause 4 shall be followed. In addition, the general recommendations of ISO/IEC 14763-2 should be considered.

An AI may contain (see Figure 5)

- one or more industrial automation apparatus conforming to generic cabling requirements,
- one or more industrial automation applications implemented with an AI network that uses Ethernet (ISO/IEC 8802-3)-based and non-Ethernet-based cabling that conform to IEC 61784-1 or IEC 61784-2.

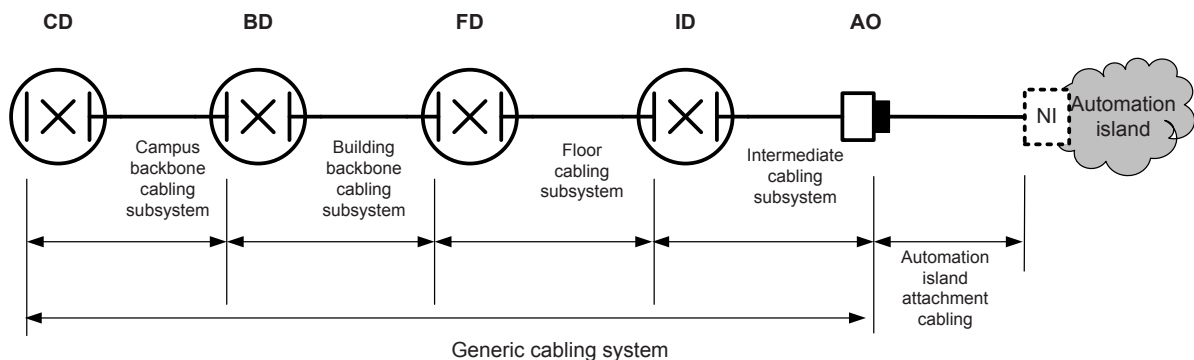


Figure 4 – Automation island cabling attached to elements of generic cabling

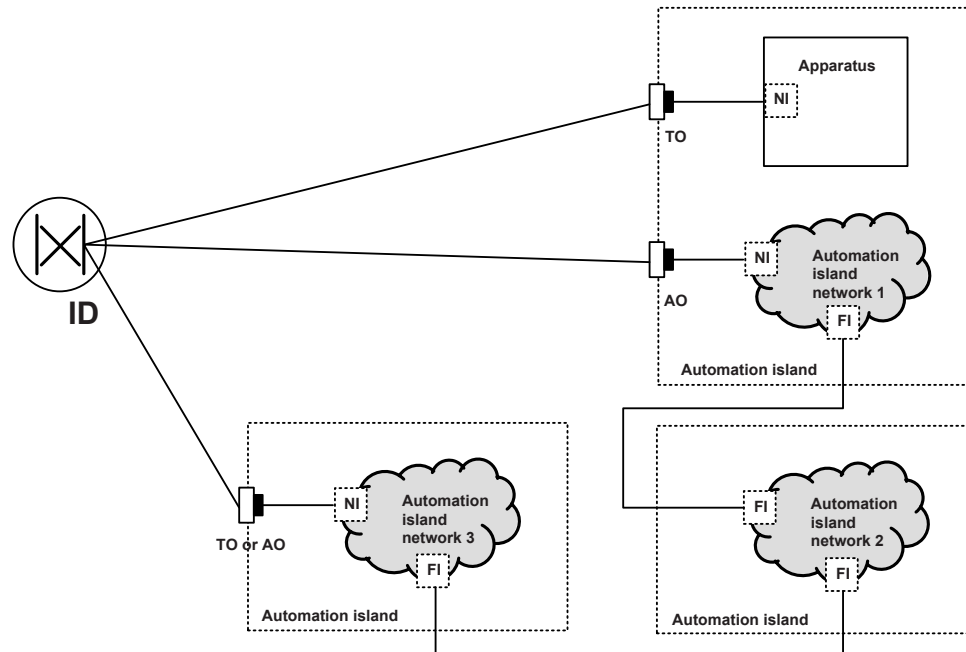


Figure 5 – Automation islands

The interconnections between the AI network and the generic cabling may be achieved through an appropriate converter/adapter (see Figure 6). While the connections among AIs may be achieved through one or more fieldbus to fieldbus connections (defined in the installation profiles IEC 61784-5 series) and appropriate converter/adapters or through the generic cabling (see Figure 5).

In general, converter/adapters, such as routers, bridges, and gateways, shall be used to provide physical conversion and protocol transformation between different fieldbuses as specified in the relevant CP installation profiles.

If the two interconnected interfaces (NI and FI) have matching specifications, then the converter/adapter function may not be necessary. If the interconnection between the AIs is through the ID, it is the responsibility of the planner to check the suitability of the generic cabling to support the requirements for the installation of the communication networks as defined by this standard. In this case, the channel performance shall be met from the ID up to the NI (excluding the connector interface at the NI).

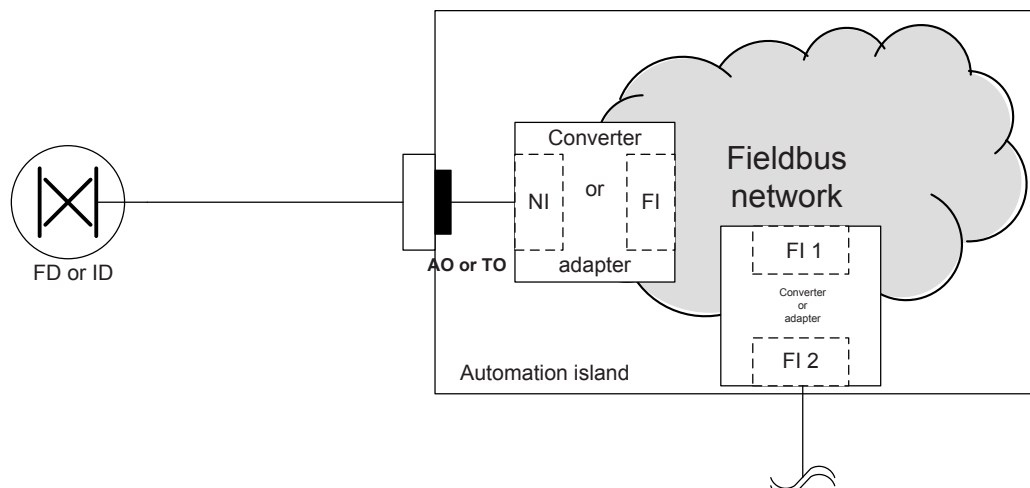


Figure 6 – Automation island network external connections

4.1.3 The planning process

The planning of the communication of an automation system is the responsibility (see Annex L) of one or more of the following: building network designer, automation designer and or machine designer.

The input for the installation planning depends on the kind of industrial automation application. This input is made up of design drawings, functional descriptions for machines or process and instrumentation diagrams (P&ID) for process installations.

Installation planning of industrial communication networks is accomplished through three basic steps.

Step 1 addresses the following installation-specific factors (see 4.2):

- safety
 - the solutions shall comply with existing local and national regulations. Under this condition, safety requirements specified in IEC 60950-1 may be taken into consideration;
 - if a communication network is installed with easily accessible terminals and wires, IEC 60364-4-41 concerning protection against electrical shock and EMC requirements should be applied;
- security;
- environmental
 - the use of the MICE (Mechanical, Ingress, Climatic and Chemical, and Electromagnetic) methodology for description of environmental performance, as described in 4.2.3, is recommended;
 - distinctive of industrial sites is the presence of low voltage (LV) and medium-high-voltage (MHV) power networks in close neighbourhood of the communication network. The RF influence of neighbouring high-power transmitters (e.g. TV transmitters) shall be taken into account;
- electromagnetic compatibility.

Step 2 addresses the capabilities of the different communication networks (see 4.3):

- topologies;
- network characteristics.

Step 3 addresses the selection and use of cabling components in response to steps 1 and 2 (see 4.4).

The result of the planning process in 4.2, 4.3 and 4.4 is the production of the cabling planning documentation described in 4.5, which shall comprise:

- a) a statement, signed by the responsible planner, explaining how the planned installation complies with the safety and security requirements and environmental conditions such as mechanical, liquid, particulate, climatic, chemicals and electromagnetic interference and including all necessary documents (e.g. plans and lists) for the installation that result from step 1;
- b) a documentation of the planned network topology, characteristics, physical extension and transmission performances that results from step 2;
- c) the component specifications, where the conformity of the component data with the planned network requirements (functional and electrical safety, environmental conditions, and EMC requirements) is documented as result of step 3;
- d) a table for comparison of nominal and actual network performance values.

4.1.4 Specific requirements for CPs

Additional information for a specific industrial network may be found in the respective installation profile.

4.1.5 Specific requirements for generic cabling [C] in accordance with EN 50173-3 [C]

See ISO/IEC 14763-2.

4.2 Planning requirements

4.2.1 Safety

4.2.1.1 General

The planner shall take into consideration regulations for safety in communication networks with specific attention to mounting, cabling, verification, and validation.

The planner shall include all applicable requirements for safety in the cabling planning documentation.

4.2.1.2 Electrical safety

The proper implementation of the requirements of this standard assumes that electrical installations are in accordance with the relevant standards within IEC 60364 series or local and national regulations as required.

4.2.1.3 Functional safety

Where digital communications are used to contribute to one or more safety functions, the communication system should have sufficient integrity (taking into account hardware, software, and the specified environment) to meet the safety integrity requirements of every safety function.

The requirements for safety integrity may include special measures applicable to the several phases of the life cycle of the related communication media (see the relevant technology parts of IEC 61784-3 and/or IEC 61784-5 series). The planner shall apply such special measures.

4.2.1.4 Intrinsic safety

Where required, the planner shall plan the network in accordance with applicable intrinsic safety standards and IEC 61158-2 and the applicable CPs of IEC 61784-1.

4.2.1.5 Safety of optical fibre communication systems

Optical fibre cabling shall be planned in accordance with the safety requirements of IEC 60825-2 or local regulations.

4.2.2 Security

Where communication networks in accordance with the IEC 62443 are planned, the planner shall apply all additional requirements for security.

EXAMPLE A typical request is to use additional protection against mechanical manipulation and electromagnetic emission.

The universal nature of generic cabling produces additional security concerns since the cabling may be used to provide applications that are managed by different groups within industrial premises. For example, generic cabling may provide basic telephony services, information technology and building control services in addition to the connections to the Al-

The prevention of accidental disruption to any of these services requires careful consideration.

Physical security requires the application of requirements described in 4.4.9.1, 4.4.9.6, 4.4.11, 5.2.1.2.

4.2.3 Environmental considerations and EMC

4.2.3.1 Description methodology

The planner shall provide a precise description of the environment to be used as a basis for the selection of components and for the mitigation requirements.

ISO/IEC 24702 applies an environmental assessment called “MICE” classification. This approach is recommended for all CPs because it allows the planner to describe the environmental conditions in a precise and unambiguous way.

The use of this approach is explained here and in Annex B for the benefit of the planner and the installer.

NOTE 1 The MICE classification system of ISO/IEC 24702 is not a component test specification.

NOTE 2 The MICE classification system of ISO/IEC 24702 does not replace existing international or national standards.

NOTE 3 Existing international or national standards for components contain the test requirements and schedules for product qualification.

4.2.3.2 Use of the described environment to produce a bill of material

The planner shall produce a bill of material of components that meets the targeted environment through the following steps.

- a) Establish the ambient environmental conditions for each significantly different region within the application space (for example, beside the machine, in the control room, between the above).
- b) Define the components that make up the communications system including their environmental specifications.
- c) Define the additional mitigation to bridge between the component(s) specifications and the targeted environment, if the component does not meet the targeted environment.

The planner shall provide the environmental description either through the use of the MICE tables (that provides a precise classification of the environment) or by an equivalent methodology. The planner shall address the environmental requirements by specifying a combination of component selection and mitigation techniques to be applied (see Figure 7).

Products, such as enclosures, necessary to provide mitigation shall also be included in the bill of material.

Compatibility of components can be met by any combination of the following three methods:

- installation related isolation (for example protection with enclosure);
- separation (for example physical separation from other components);
- component enhancement (design enhancement of the component parameters, for example by adding a cable shield or external shield). The supplier of the equipment may provide enhancements to the components reducing the installation requirements.

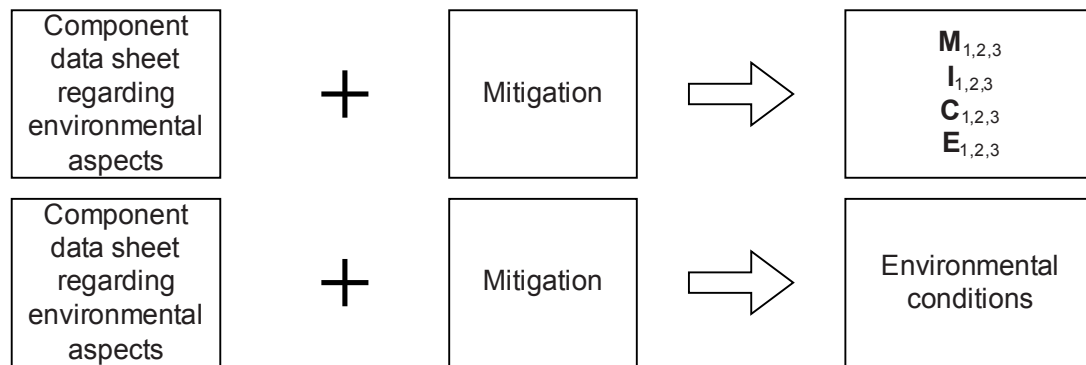


Figure 7 – How to meet environmental conditions

Figure 8 shows how the three methods (isolation, separation and enhancement) work together to provide a cost effective, technically feasible solution for a given application with regard to the environment. Examples of use of the MICE concept are provided in Annex B.

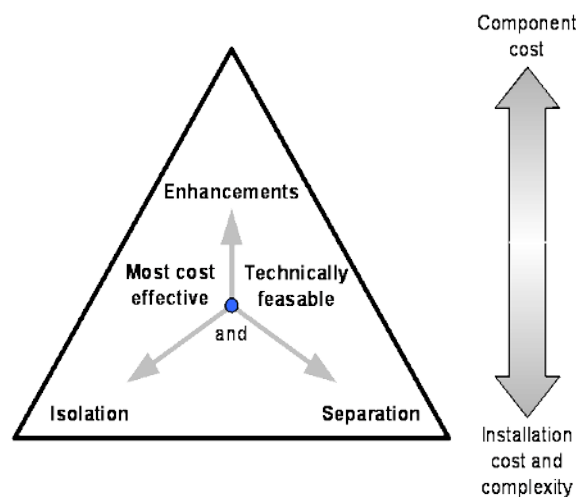


Figure 8 – How enhancement, isolation and separation work together

4.2.4 Specific requirements for generic cabling [C] in accordance with EN 50173-3 [C]

See ISO/IEC 14763-2.

4.3 Network capabilities

4.3.1 Network topology

4.3.1.1 Common description

For the industrial AI networks, there are two fundamental themes.

- a) Physical topology of the communication network, from a physical composition standpoint.
Hereafter the basic physical topologies of a network are divided in two groups:
 - physical topology for passive networks;
 - physical topology for active networks.
- b) Logical topology of the communication network, from an information propagation standpoint. This is outside the scope of this standard.

NOTE 1 As an example of the difference between the physical and the logical topology, a planner can select a physical star to be installed in order to support a logical ring topology.

The planner shall select the most appropriate physical topology on the basis of the application requirements (see also Annex C) and according to the topologies that are specified for the specific CP. The basic topologies defined in 4.3.1.2 and in 4.3.1.3, and combinations of them (see 4.3.1.4) are the appropriate physical topologies for AI networks.

NOTE 2 Not all fieldbuses support all the basic topologies and combination of them.

4.3.1.2 Basic physical topologies for passive networks

The basic physical topologies for passive network, represented in Figure 9, are the following.

- Bus
- Star

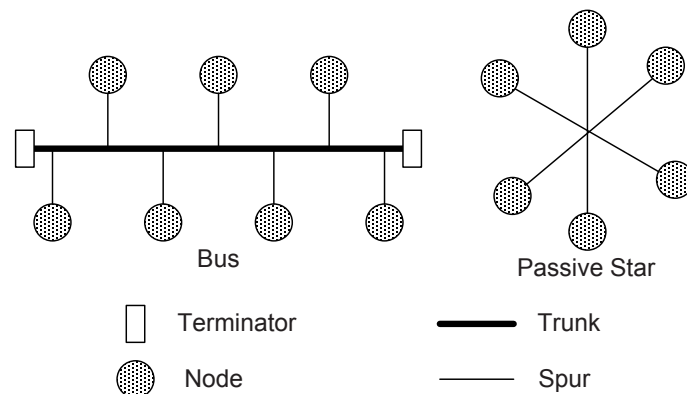


Figure 9 – Basic physical topologies for passive networks

4.3.1.3 Basic physical topologies for active networks

The basic physical topologies for active networks, represented in Figure 10, are the following.

- Star
- Ring
- Linear

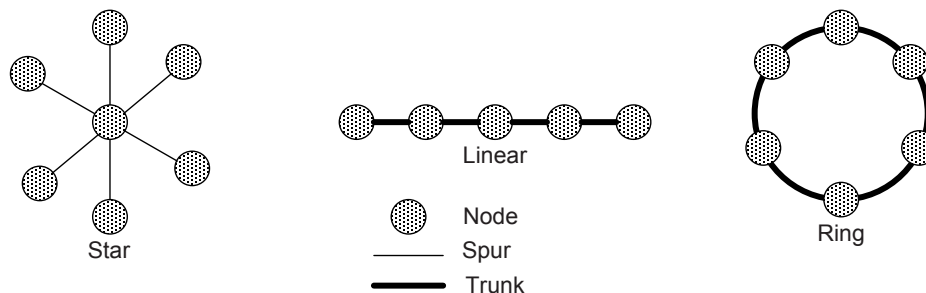


Figure 10 – Basic physical topologies for active networks

4.3.1.4 Combination of basic topologies

Combinations of basic topologies are permitted and are defined in the CP installation profile.

Figure 11 provides an example of a common configuration of two passive bus segments interconnected by an active bus repeater.

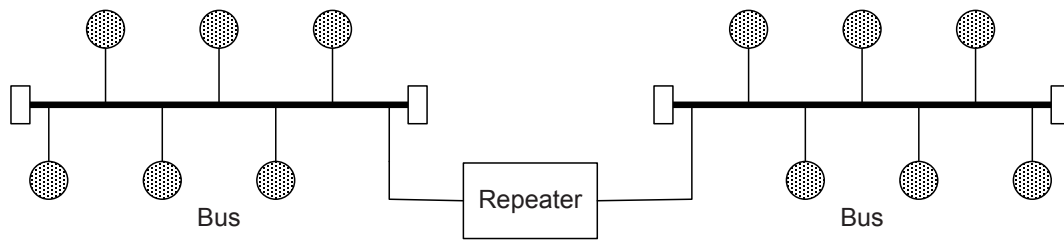


Figure 11 – Example of combination of basic topologies

4.3.1.5 Specific requirements for CPs

Additional information regarding topology requirements for a specific industrial network may be found in the respective installation profile.

4.3.1.6 Specific requirements for generic cabling in accordance with EN 50173-3

Generic cabling channels  in accordance with EN 50173-3  may constitute elements of the networks described in 4.3.1.2 to 4.3.1.5. Specific restrictions are detailed in ISO/IEC 24702.

4.3.2 Network characteristics

4.3.2.1 General

It is common practice to subnet an industrial AI network when there are a large number of devices to be connected.

Every network specification consists of the following basic characteristics:

- transfer rates;
- media type and performance;
- maximum number of devices (nodes) including repeaters;
- maximum number of repeaters (that connect segments);
- maximum segment length.

NOTE Transfer rates may be expressed as bandwidth capacity or effective data throughput rates using the modulation and encoding methods of a specific Fieldbus technology. Requirements for effective data rate values may also include statements of maximum acceptable values for BER and burst errors (such as in Clause 5 of IEC 61784-2:___).

4.3.2.2 Network characteristics for balanced cabling not based on Ethernet

For balanced cabling not based on Ethernet, the planner shall use the basic network characteristics defined in the respective installation profile according to the templates given in Table 1.

Table 1 – Basic network characteristics for balanced cabling not based on Ethernet

Characteristic	CP x/y
Basic transmission technology	
Length / transmission speed	Segment length m
9 kbit/s to 33 kbit/s	
33 kbit/s to 93 kbit/s	
125 kbit/s	
187 kbit/s	
250 kbit/s	
500 kbit/s	
1,5 Mbit/s	
2 Mbit/s	
3 Mbit/s, 6 Mbit/s, 12 Mbit/s	
5 Mbit/s	
8 Mbit/s	
16 Mbit/s	
Maximum capacity	Max. No.
Devices/segment	
Devices/network	

4.3.2.3 Network characteristics for balanced cabling based on Ethernet

For balanced cabling based on Ethernet, the planner shall use the basic network characteristics defined in the respective installation profile according to the template given in Table 2.

NOTE The letter X in the Table 2 is the reference to the Annex X of the installation profile where the profile is specified.

Table 2 – Network characteristics for balanced cabling based on Ethernet

Characteristic	CP x/y
Supported data rates (Mbit/s)	
Supported channel length (m) ^b	
Number of connections in the channel (max.) ^{a b}	
Patch cord length (m) ^a	
Channel class per ISO/IEC 24702 (min.) ^b	
Cable category per ISO/IEC 24702 (min.) ^c	
Connecting HW category per ISO/IEC 24702 (min.)	
Cable types	
^a See X. 4.4.3.2. ^b For the purpose of this table, the channel definitions of ISO/IEC 24702 are applicable. ^c For additional information, see IEC 61156 series.	

4.3.2.4 Network characteristics for optical fibre cabling

For optical fibre cabling, the planner shall use the basic network characteristics for each wavelength defined in the respective installation profile according to the templates given in Table 3 and to the following conditions.

For the purpose of this standard, channel insertion loss and optical power budget are considered to be equivalent. The connecting hardware used for optical fibre cabling is as specified in X.4.4.2.5 of the relevant installation profile.

NOTE The letter X is the reference to the Annex X of the installation profile where the profile is specified.

Table 3 – Network characteristics for optical fibre cabling

CP x/y		
Optical fibre type	Description	
Single mode silica	Bandwidth (MHz) or equivalent at λ (nm)	
	Minimum length (m)	
	Maximum length ^a (m)	
	Maximum channel insertion loss/optical power budget (dB)	
	Connecting hardware	See X.4.4.2.5
Multimode silica	Modal bandwidth (MHz × km) at λ (nm)	
	Minimum length (m)	
	Maximum length ^a (m)	
	Maximum channel insertion loss/optical power budget (dB)	
	Connecting hardware	See X.4.4.2.5
POF	Modal bandwidth (MHz × 100 m) at λ (nm)	
	Minimum length (m)	
	Maximum length ^a (m)	
	Maximum channel insertion loss/optical power budget (dB)	
	Connecting hardware	See X.4.4.2.5
Hard clad silica	Modal bandwidth (MHz × km) at λ (nm)	
	Minimum length (m)	
	Maximum length ^a (m)	
	Maximum channel insertion loss/optical power budget (dB)	
	Connecting hardware	See X.4.4.2.5
^a This value is reduced by connections, splices and bends in accordance with formula (1) in 4.4.3.4.1.		

4.3.2.5 Specific network characteristics

Additional information regarding the characteristics of a specific industrial network may be found in the respective installation profile.

4.3.2.6 Specific requirements for generic cabling in accordance with EN 50173-3

Certain generic cabling channels  in accordance with EN 50173-3  may provide transmission performance in support of the networks described by reference to the templates of 4.3.2.2 to 4.3.2.5. See ISO/IEC 24702 for further details.

4.4 Selection and use of cabling components

4.4.1 Cable selection

4.4.1.1 Common description

The planner shall ensure that cables provide the required transmission performance in the specified environment (by reference to the MICE classification system or equivalent, see 4.2.3.1).

Industrial cables can be subjected to extreme mechanical stresses.

EXAMPLE The cable can provide connectivity for festooning, “C” track (drag chains) or robotic flexing applications.

In these cases, the planner shall select the cabling in accordance with the needs of the intended application. The respective manufacturer's instructions shall be observed.

The planner may decide to use part of an existing generic cabling system to connect AI networks. In this case, it is the planner's responsibility to make sure that this cabling system meets the requirements for the application.

NOTE Generic cabling [C] in accordance with EN 50173-3 [C] may not be suitable for some CPs.

The planner shall ensure that cables to be installed underground are suitable and satisfy the following requirements:

- local regulations;
- safety from lightning;
- resistance to damage from rodents;
- chemical resistance.

Metal cladding on optical fibre cables provides additional mechanical protection. The planner should select metal clad optical fibre cables for direct burial applications and other areas where mechanical protection is necessary.

If the equipment location requires the use of special cables and/or connecting elements not complying with the network-related requirements of this specification, the planner shall consult the cable/connector manufacturer to obtain the information necessary for determining the channel/permanent link length.

4.4.1.2 Copper cables

4.4.1.2.1 Balanced cables for Ethernet-based CPs

Balanced cables for Ethernet-based CPs shall meet the requirements of Table 2.

The planner shall review the relevant installation profile for additional requirements or recommendations for balanced cables.

The planner shall have considered the following information when specifying the number of pairs in each balanced cable:

- all cables within a channel should be of the same pair count;
- two pair cabling is not generic and cannot support all applications (for example, if future plans are to migrate to higher data rates or PoE, then four pair cables should be considered);
- high pair count cables are not recommended for control applications;

- in an active channel and with cabling that uses mixed 2 and 4 pair cable elements in the same channel, all un-used pairs shall be terminated with the differential or common mode impedance of the cable at both ends (i.e. four pair cables shall not be housed in two pair connecting hardware). This requirement does not apply to cable constructions that use individual shielded pairs.

NOTE The balanced cables specified in the reference implementations of ISO/IEC 24702 contain 4 pairs and provide channel length of 100 m maximum.

For the channels where there is a power sourcing equipment (PSE) connected to non-powered devices, the planner shall specify that the PSE function is disabled to prevent application of power.

The planner shall use the data defined in the respective installation profile according to the templates given in Table 4 and Table 5.

Table 4 – Information relevant to copper cable: fixed cables

Characteristic	CP x/y
Nominal impedance of cable (tolerance)	
DCR of conductors	
DCR of shield	
Number of conductors	
Shielding	
Colour code for conductor	
Jacket colour requirements	
Jacket material	
Resistance to harsh environment (e.g. UV, oil resist, LSOH)	
Agency ratings	
Other characteristics ^a	
^a Replace "Other characteristics" with the name of the other needed characteristics (one or more, as needed). Otherwise delete the row.	