BS EN 61784-5-1:2013

BSI Standards Publication

Industrial communication networks — Profiles

Part 5-1: Installation of fieldbuses — Installation profiles for CPF 1

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 61784-5-1:2013. It is identical to IEC 61784-5-1:2013.

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.

Published by BSI Standards Limited 2014

ISBN 978 0 580 75929 1
ICS 25.040.40; 35.100.40

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2014.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61784-5-1

December 2013

ICS 25.040.40; 35.100.40

English version

Industrial communication networks - Profiles - Part 5-1: Installation of fieldbuses - Installation profiles for CPF 1

(IEC 61784-5-1:2013)

Réseaux de communication industriels - Profils - Partie 5-1: Installation des bus de terrain - Profils d'installation pour CPF 1 (CEI 61784-5-1:2013)

Industrielle Kommunikationsnetze - Profile - Teil 5-1: Feldbusinstallation - Installationsprofile für die Kommunikationsprofilfamilie 1 (IEC 61784-5-1:2013)

This European Standard was approved by CENELEC on 2013-10-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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

Ref. No. EN 61784-5-1:2013 E

Foreword

The text of document 65C/738/FDIS, future edition 1 of IEC 61784-5-1, 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 61784-5-1:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-07-16
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-10-16

This standard is to be used in conjunction with EN 61918:2013.

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 61784-5-1:2013 was approved by CENELEC as a European Standard without any modification.

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.

Annex ZA of EN 61918:2013 applies, except as follows:

Publication	Year	Title	EN/HD	Year
Addition to Annex ZA of EN 61918:2013:				
IEC 61918	2013	Industrial communication networks - Installation of communication networks in industrial premises	EN 61918	2013

CONTENTS

INTRODUCTION

This International Standard is one of a series produced to facilitate the use of communication networks in industrial control systems.

IEC 61918:2013 provides the common requirements for the installation of communication networks in industrial control systems. This installation profile standard provides the installation profiles of the communication profiles (CP) of a specific communication profile family (CPF) by stating which requirements of IEC 61918 fully apply and, where necessary, by supplementing, modifying, or replacing the other requirements (see Figure 1).

For general background on fieldbuses, their profiles, and relationship between the installation profiles specified in this standard, see IEC 61158-1.

Each CP installation profile is specified in a separate annex of this standard. Each annex is structured exactly as the reference standard IEC 61918 for the benefit of the persons representing the roles in the fieldbus installation process as defined in IEC 61918 (planner, installer, verification personnel, validation personnel, maintenance personnel, administration personnel). By reading the installation profile in conjunction with IEC 61918, these persons immediately know which requirements are common for the installation of all CPs and which are modified or replaced. The conventions used to draft this standard are defined in Clause 5.

The provision of the installation profiles in one standard for each CPF (for example IEC 61784-5-1 for CPF 1), allows readers to work with standards of a convenient size.

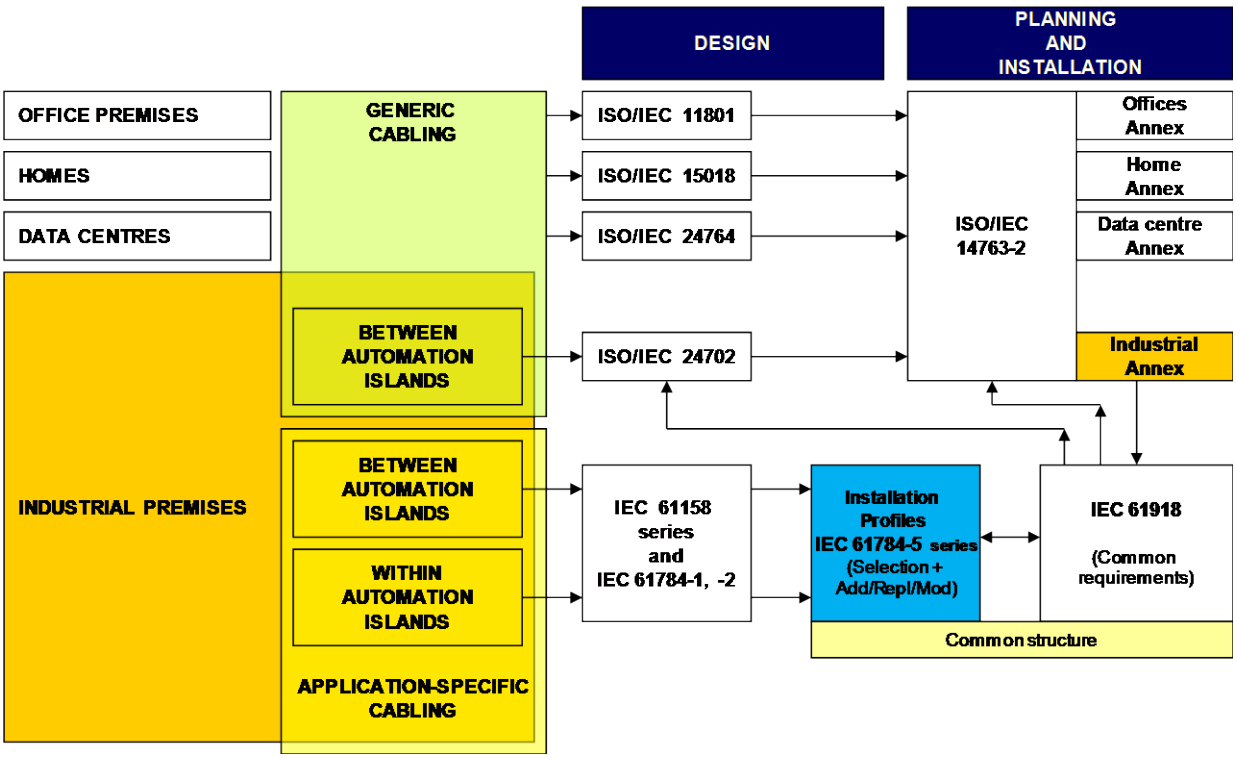


Figure 1 – Standards relationships

INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

Part 5-1: Installation of fieldbuses – Installation profiles for CPF 1

1 Scope

This part of IEC 61784-5 specifies the installation profiles for CPF 1 (FOUNDATION™ Fieldbus[1]).

The installation profiles are specified in Annexes A and B. These annexes are read in conjunction with IEC 61918:2013.

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.

IEC 61918:2013, *Industrial communication networks – Installation of communication networks in industrial premises*

The normative references of IEC 61918:2013, Clause 2, apply. For profile specific normative references, see Clause A.2

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in IEC 61918:2013, Clause 3, apply.

4 CPF 1: Overview of installation profiles

CPF 1 consists of two communication profiles as specified in IEC 61784-1.

The installation requirements for CP 1/1 (FOUNDATION™ H1) are specified in Annex A.

The installation requirements for CP 1/2 (FOUNDATION™ HSE) are specified in Annex B.

5 Installation profile conventions

The numbering of the clauses and subclauses in the annexes of this standard corresponds to the numbering of IEC 61918 main clauses and subclauses.

---

1 FOUNDATION™ fieldbus is the trade name of the non-profit consortium Fieldbus Foundation. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trademark holder or any of its products. Compliance does not require use of the trade name. Use of the trade name requires permission of the trade name holder.

The annex clauses and subclauses of this standard supplement, modify, or replace the respective clauses and subclauses in IEC 61918.

Where there is no corresponding subclause of IEC 61918 in the normative annexes in this standard, the subclause of IEC 61918 applies without modification.

The annex heading letter represents the installation profile assigned in Clause 4. The annex heading number shall represent the corresponding numbering of IEC 61918.

EXAMPLE "Subclause B.4.4" in IEC 61784-5-1 means that CP 1/2 specifies the subclause 4.4 of IEC 61918.

All main clauses of IEC 61918 are cited and apply in full unless otherwise stated in each normative installation profile annex.

If all subclauses of a (sub)clause are omitted, then the corresponding IEC 61918 (sub)clause applies.

If in a (sub)clause it is written "Not applicable.", then the corresponding IEC 61918 (sub)clause does not apply.

If in a (sub)clause it is written "*Addition:*", then the corresponding IEC 61918 (sub)clause applies with the additions written in the profile.

If in a (sub)clause it is written "*Replacement:*", then the text provided in the profile replaces the text of the corresponding IEC 61918 (sub)clause.

NOTE A replacement can also comprise additions.

If in a (sub)clause it is written "*Modification:*", then the corresponding IEC 61918 (sub)clause applies with the modifications written in the profile.

If all (sub)clauses of a (sub)clause are omitted but in this (sub)clause it is written "*(Sub)clause x has addition:"* (or "*replacement*:") or "(Sub)clause x is not applicable.", then (Sub)clause x becomes valid as declared and all the other corresponding IEC 61918 (sub)clauses apply.

6 Conformance to installation profiles

Each installation profile within this standard includes part of IEC 61918:2013. It may also include defined additional specifications.

A statement of compliance to an installation profile of this standard shall be stated[2] as either

Compliance to IEC 61784-5-1:2013[3] for CP 1/m <name> or

Compliance to IEC 61784-5-1 (Ed.1.0) for CP 1/m <name>

where the name within the angle brackets < > is optional and the angle brackets are not to be included. The m within CP 1/m shall be replaced by the profile number 1 or 2.

NOTE The name can be the name of the profile, for example FOUNDATION™ H1.

If the name is a trade name then the permission of the trade name holder shall be required.

---

2 In accordance with ISO/IEC Directives.

3 The date should not be used when the edition number is used.

Product standards shall not include any conformity assessment aspects (including quality management provisions), neither normative nor informative, other than provisions for product testing (evaluation and examination).

Annex A
(Normative)

CP 1/1 (FOUNDATION™ H1) specific installation profile

A.1 Installation profile scope

Addition:

This standard specifies the installation profile for Communication Profile CP 1/1 (FOUNDATION™ H1). The CP 1/1 is specified in IEC 61784-1.

A.2 Normative references

Addition:

IEC 60079-13:2010, *Explosive atmospheres – Part 13: Equipment protection by pressurized room "p"*

A.3 Installation profile terms, definitions, and abbreviated terms

A.3.1 Terms and definitions

A.3.2 Abbreviated terms

A.3.3 Conventions for installation profiles

Not applicable.

A.4 Installation planning

A.4.1 General

A.4.2 Planning requirements

A.4.2.1 Safety

A.4.2.1.1 General

A.4.2.1.2 Electrical safety

A.4.2.1.3 Functional safety

A.4.2.1.4 Intrinsic safety

A.4.2.1.5 Safety of optical fibre communication systems

Not applicable.

A.4.2.2 Security

A.4.2.3 Environmental considerations and EMC

A.4.2.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702

Not applicable.

A.4.3 Network capabilities

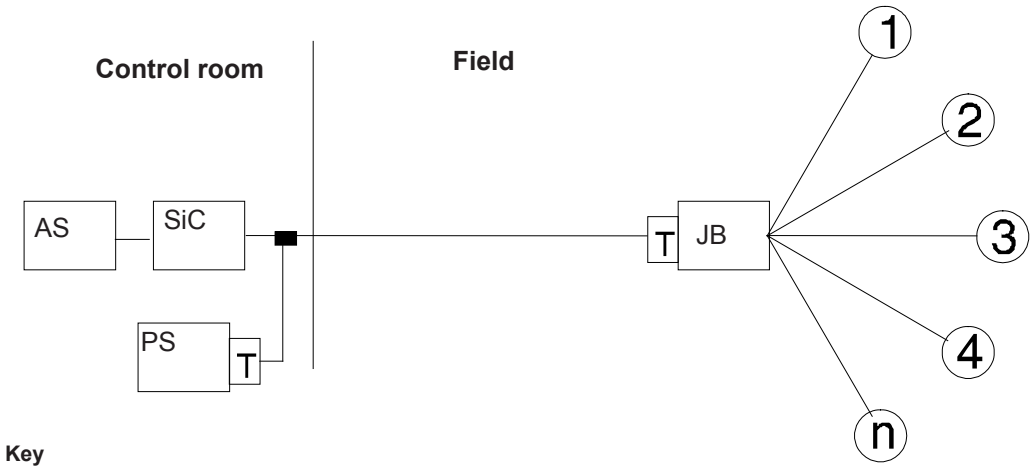
A.4.3.1 Network topology

A.4.3.1.1 Common description

A.4.3.1.2 Basic physical topologies for passive networks

Addition:

The tree topology (see Figure A.1) can be compared to classic field installation topology. The multi-wire trunk cable is replaced by the two-wire fieldbus trunk cable. The junction box retains its role as a central connection unit where all field devices are connected in parallel. The location of the power supply can be in the control room or field in any topology.

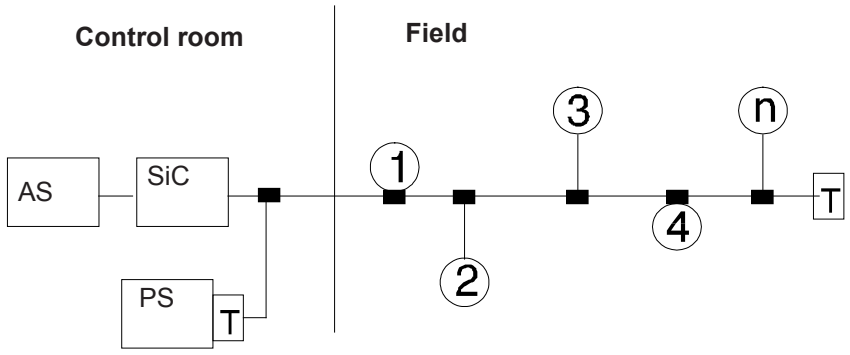


Key

AS	Automation system
SiC	Signal coupler
PS	Power suppy
T	Line terminator
JB	Junction box
(1)...(n)	Field devices

Figure A.1 – Tree topology

The bus topology (see Figure A.2) offers connection points (taps or passive couplers) along the fieldbus cable. The cable can be looped through the individual field devices. Field devices may also be connected to the trunk cable via spurs. The combination of tree topology and bus topology (see Figure A.3) permits the optimization of the fieldbus length and the adaptation to existing system structures. The restricting factor for fieldbus design is the attenuation of the communication signal between the fieldbus stations and the signal distortions caused by the concentration of fieldbus stations along the fieldbus cable. The location of the power supply can be in the control room or field. For more details, see IEC 61158-2.

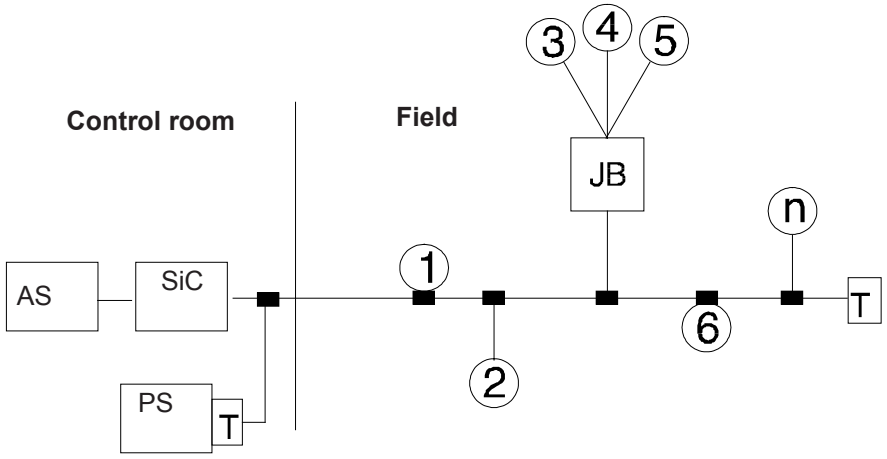


Key

AS	Automation system
SiC	Signal coupler
PS	Power suppy
T	Line terminator
(1)...(n)	Field devices

Figure A.2 – Bus topology

Tree topology, bus topology or a combination of both can be used as the fieldbus structure for the CP 1/1 shown in Figure A.3.



Key

AS	Automation system
SiC	Signal coupler
PS	Power suppy
T	Line terminator
JB	Junction box
(1)...(n)	Field devices

Figure A.3 – Combination of the tree topology and the bus topology

The topology can be extended through the use of repeaters for CP 1/1 as shown in Figure A.4.

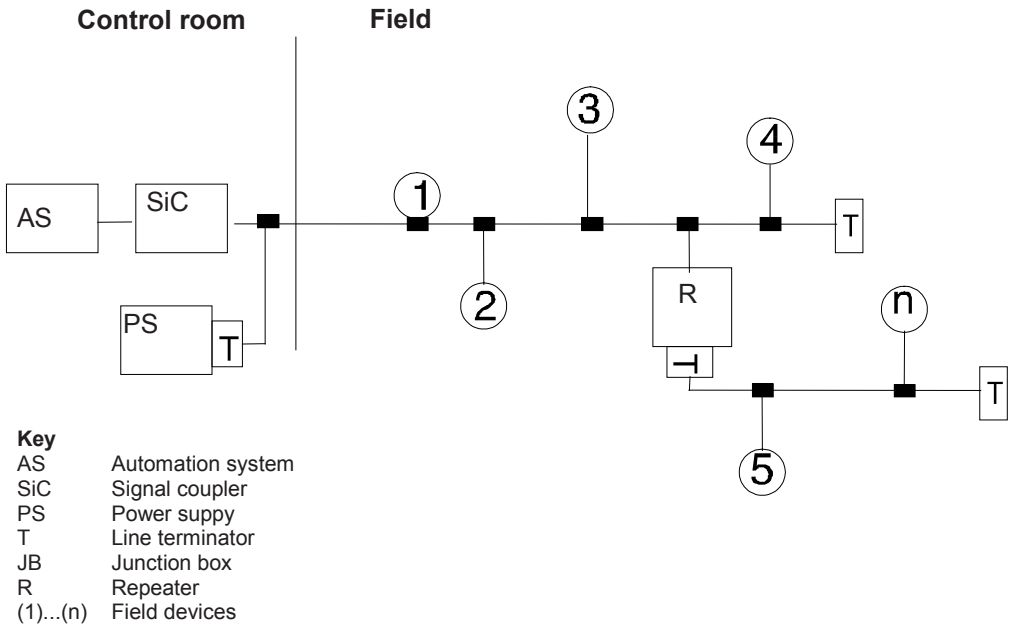


Figure A.4 – Fieldbus extension

The number of field devices that can be used on the fieldbus depends on the supply voltage, the current consumption of the field devices and the extension of the fieldbus.

A.4.3.1.3 Basic physical topologies for active networks

Not applicable.

A.4.3.1.4 Combination of basic topologies

See A.4.3.1.2.

A.4.3.1.5 Specific requirements for CPs

Not applicable.

A.4.3.1.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.3.2 Network characteristics

A.4.3.2.1 General

A.4.3.2.2 Network characteristics for balanced cabling not based on Ethernet

Replacement:

Every fieldbus installation shall comply with certain rules (that means the network configuration rules). The rules in 12.3.3 of IEC 61158-2:2010 specify the limit values for attenuation, reflection and distortions in rule 8 and the maximum signal delay in rule 4 that are permitted in the network. Table A.1 summarizes these values.

Table A.1 – Limit values for distortion, reflection and signal delay

Attribute	Value
Attenuation between any two fieldbus interfaces (at 31,25 kHz)	10,5 dB
Attenuation distortion $a(f$ = 39 kHz) - $a(f$ = 7,8 kHz) , ascending monotonically with f	6 dB
Mismatching distortion at any point (7,8 kHz to 39 kHz)	0,2
Maximum propagation delay between any two devices	640 μs

In a non-hazardous area all topologies of A.4.3.1.2 and all cables are permitted within the framework of these limit values.

Since individual calculation of the above four parameters for all possible connections between two fieldbus interfaces to obtain the optimal layout is very time-consuming, rules have been specified for a basic topology which, although below the optimum, will ensure that the above limit values will not be exceeded.

A tree topology was selected as the basic model of a network. This network consists of a main cable (that means trunk), a number of stub cables (that means spurs), connection elements (that means splices), and two line terminators. The total cable length is the sum of the lengths of the main cable and all spurs.

IEC 61158-2 requires not exceeding the values listed in Table A.2, Table A.3, and Table A.4.

Although different cable types can be mixed in one network segment, this should be avoided. Determining the maximum cable lengths for such mixed structures is more time-consuming and less accurate than using structures consisting of only one type of cable.

Table A.2 – Recommended maximum cable lengths including spurs

Type of cable	Total cable length m
A	1 900
B	1 200
C	400
D	200

Table A.3 – Recommended length of the spurs

Number of stub cables	Length of one stub cable (Intrinsically safe) m	Length of one stub cable (Not intrinsically safe) m
25 to 32	—	—
19 to 24	30	30
15 to 18	30 [a]	60
13 to 14	30 [a]	90
1 to 12	30 [a]	120
Spurs ≤ 1 m shall be considered as splices.		
[a] Preliminary values in accordance with FISCO.		

Table A.4 – Maximum length of the splices

Total cable length m	Total length of the splices
≥ 400	8 m
< 400	2 %

The network can be enlarged with repeaters. The above limit values then apply to each individual network segment, and only the maximum signal delay shall be calculated for the total network.

A.4.3.2.3 Network characteristics for balanced cabling based on Ethernet

Not applicable.

A.4.3.2.4 Network characteristics for optical fibre cabling

Not applicable

A.4.3.2.5 Specific network characteristics

Not applicable.

A.4.3.2.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4 Selection and use of cabling components

A.4.4.1 Cable selection

A.4.4.1.1 Common description

Addition:

Generic cabling in accordance with ISO/IEC 24702 is not suitable for the cabling of CP 1/1 networks.

CP 1/1 networks only can be connected to the generic cabling via converter/adapter as specified in IEC 61918:2013, 4.1.2.

A.4.4.1.2 Copper cables

A.4.4.1.2.1 Balanced cables for Ethernet-based CPs

Not applicable

A.4.4.1.2.2 Copper cables for non-Ethernet-based CPs

Replacement:

CP 1/1 according to IEC 61784-1 requires that a two-wire cable shall be used as the transmission medium for the fieldbus. Although the electrical data is not specified, this data influences the performance that can be achieved by the fieldbus (that means distances which can be covered, number of stations, electromagnetic compatibility). Subclause 13.8.2 in IEC 61158-2:2010 is required for fieldbus tests and IEC 61158-2:2010, Annex B (informative) is recommended. Table A.5 distinguishes between four types of cables for a temperature of 25 °C.

Table A.5 – Information relevant to copper cable: fixed cables

Characteristic	Type A (Reference)	Type B	Type C	Type D
Cable description	Twisted pair, shielded	One or more twisted pairs, total shielding	Several twisted pairs, not shielded	Several non-twisted pairs, not shielded
Nominal conductor cross sectional area	0,8 mm^2 (AWG 18)	0,32 mm^2 (AWG 22)	0,13 mm^2 (AWG 26)	1,25 mm^2 (AWG 16)
Maximum d.c. resistance (loop)	44 Ω/km	112 Ω/km	264 Ω/km	40 Ω/km
Characteristic impedance at 31,25 kHz	100 Ω ±20 %	100 Ω ±30 %	[a]	[a]
Maximum attenuation at 39 kHz	3 dB/km	5 dB/km	8 dB/km	8 dB/km
Maximum capacitive unbalance	2 nF/km	2 nF/km	[a]	[a]
Group delay distortion (7,9 to 39 kHz)	1,7 μs/km [b]	[a]	[a]	[a]
Surface covered by shield	90 %	[a]	–	–
Extent of network including spur cables	1 900 m	1 200 m	400 m	200 m
For maximum d.c. resistance (loop), the cross sectional area shall be the minimum value. All cable shall be annealed copper, tin coated.				
[a] Not specified. [b] Using currently available insulation material allows the cable to meet the requirements.				

The reference cable (that means type A) shall be used for the conformance tests.

When new systems are installed, cables that meet the minimum requirements of types A and B shall be used. When multi-pair cables (that means type B) are used, several fieldbuses (31,25 kbit/s) can be operated in one cable.

Installation of other electric circuits in the same cable should be avoided. Type C and D cables should only be used for so called retrofit applications (that means use of already installed cables) for substantially reduced networks. In such cases the interference susceptibility of the transmission frequently does not meet the requirements.

A.4.4.1.3 Cables for wireless installation

A.4.4.1.4 Optical fibre cables

Not applicable.

A.4.4.1.5 Special purpose balanced and optical fibre cables

Not applicable.

A.4.4.1.6 Specific requirements for CPs

Not applicable.

A.4.4.1.7 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.2 Connecting hardware selection

A.4.4.2.1 Common description

A.4.4.2.2 Connecting hardware for balanced cabling CPs based on Ethernet

Not applicable.

A.4.4.2.3 Connecting hardware for copper cabling CPs not based on Ethernet

Replacement:

Table A.6 provides values based on the template given in IEC 61918:2013, Table 8.

Table A.6 – Connectors for copper cabling CPs not based on Ethernet

	IEC 60807-2 or IEC 60807-3	IEC 61076-2-101			IEC 61169-8	ANSI/(NFPA) T3.5.29 R1-2007		Others		
	Sub-D	M12-5 with A-coding	M12-5 with B-coding	M12-n with X-coding	Coaxial (BNC)	M 18	7/8-16 UN-2B THD	Open style	Terminal block	Others
CP 1/1	9 pin	Yes	No	No	No	No	Yes	No	No	No
NOTE For M12-5 connectors, there are many applications using these connectors that are not compatible and when mixed can cause damage to the applications.										

A.4.4.2.4 Connecting hardware for wireless installation

A.4.4.2.5 Connecting hardware for optical fibre cabling

Not applicable.

A.4.4.2.6 Specific requirements for CPs

Not applicable.

A.4.4.2.7 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.3 Connections within a channel/permanent link

A.4.4.3.1 Common description

A.4.4.3.2 Balanced cabling connections and splices for CPs based on Ethernet

Not applicable.

A.4.4.3.3 Copper cabling connections and splices for CPs not based on Ethernet

A.4.4.3.3.1 Common description

Addition:

Refer to the manufacturer's data sheet regarding the number of allowed connections.

A.4.4.3.3.2 Connections minimum distance

A.4.4.3.3.3 Copper cabling splices

A.4.4.3.3.4 Copper cabling bulkhead connections

A.4.4.3.3.5 Copper cabling J-J adaptors

A.4.4.3.4 Optical fibre cabling connections and splices for CPs based on Ethernet

Not applicable.

A.4.4.3.5 Optical fibre cabling connections and splices for CPs not based on Ethernet

Not applicable.

A.4.4.3.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.4 Terminators

A.4.4.4.1 Common description

A.4.4.4.2 Specific requirements for CPs

Addition:

For CP 1/1 networks terminators shall be used.

Line termination shall consist of a series circuit of one capacitor and one resistor on both ends of the main fieldbus line.

Allowed values:

R = 100 Ω ± 2 %

C = 1 μF ± 20 %

A.4.4.4.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.5 Device location and connection

A.4.4.5.1 Common description

A.4.4.5.2 Specific requirements for CPs

Not applicable.

A.4.4.5.3 Specific requirements for wireless installation

Not applicable.

A.4.4.5.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.6 Coding and labelling

A.4.4.6.1 Common description

A.4.4.6.2 Additional requirements for CPs

A.4.4.6.3 Specific requirements for CPs

Not applicable.

A.4.4.6.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.7 Earthing and bonding of equipment and devices and shielded cabling

A.4.4.7.1 Common description

A.4.4.7.1.1 Basic requirements

A.4.4.7.1.2 Planner tasks

A.4.4.7.1.3 Methods for controlling potential differences in the earth system

A.4.4.7.1.4 Selection of the earthing and bonding systems

A.4.4.7.2 Bonding and earthing of enclosures and pathways

A.4.4.7.2.1 Equalisation and earthing conductor sizing and length

A.4.4.7.2.2 Bonding straps and sizing

A.4.4.7.2.3 Surface preparation and methods

A.4.4.7.2.4 Bonding and earthing

A.4.4.7.3 Earthing methods

A.4.4.7.3.1 Equipotential

A.4.4.7.3.2 Star

A.4.4.7.3.3 Earthing of equipment (devices)

A.4.4.7.3.4 Copper bus bars

A.4.4.7.4 Shield earthing

A.4.4.7.4.1 Non-earthing or parallel RC

A.4.4.7.4.2 Direct

A.4.4.7.4.3 Derivatives of direct and parallel RC

A.4.4.7.5 Specific requirements for CPs

Addition:

For CP 1/1 four options are available to the planner for shield termination.

Single-point shield earthing (Class A) requires that the shield be connected to earth at only one location on a network as provided in 4.1.2 of IEC 61918:2013. IEC 61158-2 recommends single-point shielding installation. The cable shield is usually connected to the common system referencing earth through the fieldbus power supply.

The advantage of this type of installation lies in its protection against interference frequencies up to a few megahertz. Ripple frequencies in the 50 Hz or 60 Hz range and multiples thereof (harmonic) are particularly well suppressed. These frequencies can come from power cables routed parallel to the fieldbus cable.

Single-point shield earthing also offers protection against lightning. By separating the cable shield and plant earthing, equalizing currents cannot flow over the cable shield. Thus, if lightning strikes the plant, it cannot run through to the control system and cause damage.

Further EMC protection involves laying the fieldbus cable in a steel pipe (conduit) or armored cable.

Multi-point shield earthing (Class B), or direct shield earthing as provided in 5.7.4.3, provides the greatest degree of protection against electromagnetic interference, similar to conduit or armored cable, in the upper frequency range even for interferences that are above several megahertz. All the instrument and cable shields of the bus cable are connected to earth locally which, in turn, has to be connected to earth in the safe area for installations in hazardous areas. Multi-point shield earthing provides optimal protection from a single noise source at any location.

In accordance with IEC 60079-13:2010, 12.2.2.3, this method can be used if the installation is performed in such a way that provides a high degree of safety with regard to potential matching. Under these conditions, this version meets the requirements of hazardous area installation rules.

The disadvantage of multi-point shield earthing is seen in the event of poor equipotential bonding system. If good potential matching is not possible between the earthing points of the shield, the shield will become a current carrying conductor and induce noise into the network.

Multi-point shield earthing provides direct connection for lightning surges back to the control room through the signal and shield wires and may require special attention.

Combined Topologies (Class C) uses a mixture of topologies from Class A (single-point) and Class B (multi-point) with signal isolation located in the field junction box. The mixed topology breaks up paths for ground circulation currents and surges that may exist in the Class B topology. In this concept, the shield of the trunk segment from the control room to the field junction boxes is connected to earth at a single location, typically at the fieldbus power supply. At the junction box, the trunk shield should be continuous if multiple isolated device couplers are used, but the trunk shield should not be connected to earth at the junction box.

On the field side, the shield is connected both at the instrument and at the isolated device coupler. This topology is common in hazardous areas that involve a mixture of increased safety and intrinsic safety and moves the barrier into the junction box to provide a maximum number of devices for the segment. The trunk side maintains all of the benefits associated with Class A while the field side provides enhanced electromagnetic noise immunity offered by Class B.

Multi-point shielding using capacitive coupling (Class D) is a variation of multi-point shielding (Class B) except that an adequate equipotential bonding system does not exist throughout the plant site. Similar to Class B, this topology requires the shield to be connected to earth at several points, including the instruments and field junction boxes. However, at the control center area, the shield is connected to earth through a coupling capacitor. The coupling capacitor is used to block DC ground loop currents that would result from a poor equipotential bonding system.

Similar to Class B, this topology offers better EMC susceptibility at high frequencies and blocks low frequency currents that would be carried by the shield in a multi-point shielding.

However, a fault condition, such as a lightning strike, could result in a high voltage being present at the host system side. Class A, B or C is preferred topology over Class D.

A.4.4.7.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.8 Storage and transportation of cables

A.4.4.8.1 Common description

A.4.4.8.2 Specific requirements for CPs

Not applicable.

A.4.4.8.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.9 Routing of cables

A.4.4.10 Separation of circuit

A.4.4.11 Mechanical protection of cabling components

A.4.4.11.1 Common description

A.4.4.11.2 Specific requirements for CPs

Not applicable.

A.4.4.11.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.4.12 Installation in special areas

A.4.4.12.1 Common description

A.4.4.12.2 Specific requirements for CPs

Not applicable.

A.4.4.12.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.4.5 Cabling planning documentation

A.4.5.1 Common description

A.4.5.2 Cabling planning documentation for CPs

Not applicable.

A.4.5.3 Network certification documentation

A.4.5.4 Cabling planning documentation for generic cabling in accordance with ISO/IEC 24702

A.4.6 Verification of cabling planning specification

A.5 Installation implementation

A.5.1 General requirements

A.5.2 Cable installation

A.5.2.1 General requirements for all cabling types

A.5.2.1.1 Storage and installation

A.5.2.1.2 Protecting communication cables against potential mechanical damage

Table A.7 provides values based on the template given in IEC 61918:2013, Table 18.

Table A.7 – Parameters for balanced cables

Characteristic		Value
Mechanical force	Minimum bending radius, single bending (mm)	a
	Bending radius, multiple bending (mm)	a
	Pull forces (N)	a
	Permanent tensile forces (N)	a
	Maximum lateral forces (N/cm)	a
	Temperature range during installation (°C)	a
[a] Depending on cable type; see manufacturer's data sheet.		

A.5.2.1.3 Avoid forming loops

A.5.2.1.4 Torsion (twisting)

A.5.2.1.5 Tensile strength (on installed cables)

A.5.2.1.6 Bending radius

A.5.2.1.7 Pull force

A.5.2.1.8 Fitting strain relief

A.5.2.1.9 Installing cables in cabinet and enclosures

A.5.2.1.10 Installation on moving parts

A.5.2.1.11 Cable crush

A.5.2.1.12 Installation of continuous flexing cables

A.5.2.1.13 Additional instructions for the installation of optical fibre cables

A.5.2.2 Installation and routing

A.5.2.3 Specific cable installation requirements for CPs

Not applicable.

A.5.2.4 Specific requirements for wireless installation

A.5.2.5 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.5.3 Connector installation

A.5.3.1 Common description

A.5.3.2 Shielded connectors

A.5.3.3 Unshielded connectors

A.5.3.4 Specific requirements for CPs

Not applicable.

A.5.3.5 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.5.4 Terminator installation

A.5.5 Device installation

A.5.6 Coding and labelling

A.5.7 Earthing and bonding of equipment and devices and shield cabling

A.5.7.1 Common description

A.5.7.2 Bonding and earthing of enclosures and pathways

A.5.7.2.1 Equalisation and earthing conductor sizing and length

A.5.7.2.2 Bonding straps and sizing

A.5.7.2.3 Surface preparation and methods

A.5.7.3 Earthing methods

A.5.7.4 Shield earthing methods

A.5.7.4.1 General

A.5.7.4.2 Parallel RC

A.5.7.4.3 Direct

A.5.7.4.4 Derivatives of direct and parallel RC

A.5.7.5 Specific requirements for CPs

Not applicable.

A.5.7.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.5.8 As-implemented cabling documentation

A.6 Installation verification and installation acceptance test

A.6.1 General

A.6.2 Installation verification

A.6.3 Installation acceptance test

A.6.3.1 General

A.6.3.2 Acceptance test of Ethernet-based cabling

Not applicable.

A.6.3.3 Acceptance test of non-Ethernet-based cabling

A.6.3.3.1 Copper cabling for non-Ethernet-based CPs

A.6.3.3.2 Optical fibre cabling for non-Ethernet-based CPs

Not applicable.

A.6.3.3.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

A.6.3.4 Specific requirements for wireless installation

A.6.3.5 Acceptance test report

A.7 Installation administration

A.7.1 General

A.7.2 Fields covered by the administration

A.7.3 Basic principles for the administration system

A.7.4 Working procedures

A.7.5 Device location labelling

A.7.6 Component cabling labelling

A.7.7 Documentation

A.7.8 Specific requirements for administration

Not applicable.

A.8 Installation maintenance and installation troubleshooting

A.8.1 General

A.8.2 Maintenance

A.8.3 Troubleshooting

A.8.4 Specific requirements for maintenance and troubleshooting

Not applicable.

Annex B
(normative)

CP 1/2 (FOUNDATION™ HSE) specific installation profile

B.1 Installation profile scope

Addition:

This standard specifies the installation profile for Communication Profile CP 1/2 (FOUNDATION™ HSE). The CP 1/2 is specified in IEC 61784-1.

B.2 Normative references

B.3 Installation profile terms, definitions, and abbreviated terms

B.3.1 Terms and definitions

B.3.2 Abbreviated terms

B.3.3 Conventions for installation profiles

Not applicable.

B.4 Installation planning

B.4.1 General

B.4.2 Planning requirements

B.4.3 Network capabilities

B.4.3.1 Network topology

B.4.3.1.1 Common description

B.4.3.1.2 Basic physical topologies for passive networks

Not applicable.

B.4.3.1.3 Basic physical topologies for active networks

B.4.3.1.4 Combination of basic topologies

Not applicable.

B.4.3.1.5 Specific requirements for CPs

B.4.3.1.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.3.2 Network characteristics

B.4.3.2.1 General

B.4.3.2.2 Network characteristics for balanced cabling not based on Ethernet

Not applicable.

B.4.3.2.3 Network characteristics for balanced cabling based on Ethernet

Replacement:

Table B.1 provides values based on the template given in IEC 61918:2013, Table 2.

Table B.1 – Network characteristics for balanced cabling based on Ethernet

Characteristic	CP 1/2
Supported data rates (Mbit/s)	100
Supported channel length (m) [b]	100
Number of connections in the channel (max.) [a,b]	4
Patch cord length (m) [a]	100
Channel class per ISO/IEC 24702 (min.) [b]	D
Cable category per ISO/IEC 24702 (min.) [c]	5
Connecting HW category per ISO/IEC 24702 (min.)	5
Cable types	–
[a] See B.4.4.3.2. [b] For the purpose of this table the channel definitions of ISO/IEC 24702 are applicable. [c] Additional information is available in IEC 61156 series.	

B.4.3.2.4 Network characteristics for optical fibre cabling

Not applicable.

B.4.3.2.5 Specific network characteristics

B.4.3.2.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.4 Selection and use of cabling components

B.4.4.1 Cable selection

B.4.4.1.1 Common description

B.4.4.1.2 Copper cables

B.4.4.1.2.1 Balanced cables for Ethernet-based CPs

Replacement:

Table B.2 provides values based on the template given in IEC 61918:2013, Table 4.

Table B.2 – Information relevant to copper cable: fixed cables

Characteristic	CP 1/2
Nominal impedance of cable (tolerance)	100 Ω ± 15 Ω (IEC 61156-5)
DCR of conductors	–
DCR of shield	–
Number of conductors	8
Shielding	–
Colour code for conductor	YE, WH, OG, BU
Jacket colour requirements	–
Jacket material	MICE classification dependent
Resistance to harsh environment (e.g. UV, oil resist, LS0H)	MICE classification dependent
Agency ratings	–

Replacement:

Table B.3 provides values based on the template given in IEC 61918:2013, Table 5.

Table B.3 – Information relevant to copper cable: cords

Characteristic	CP 1/2
Nominal impedance of cable (tolerance)	100 Ω ± 15 Ω (IEC 61156-5)
DCR of conductors	—
DCR of shield	—
Number of conductors	8
Length	≤ 100 m
Shielding	—
Colour code for conductor	YE, WH, OG, BU
Jacket colour requirements	—
Jacket material	MICE classification dependent
Resistance to harsh environment (e.g. UV, oil resist, LS0H)	MICE classification dependent
Agency ratings	MICE classification dependent

B.4.4.1.2.2 Copper cables for non-Ethernet-based CPs

Not applicable.

B.4.4.1.3 Cables for wireless installation

B.4.4.1.4 Optical fibre cables

Not applicable.

B.4.4.1.5 Special purpose balanced and optical fibre cables

B.4.4.1.6 Specific requirements for CPs

Not applicable.

B.4.4.1.7 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.4.2 Connecting hardware selection

B.4.4.2.1 Common description

B.4.4.2.2 Connecting hardware for balanced cabling CPs based on Ethernet

Replacement:

Table B.4 provides values based on the template given in IEC 61918:2013, Table 7.

Table B.4 – Connectors for balanced cabling CPs based on Ethernet

	IEC 60603-7 series [a]		IEC 61076-3-106 [b]		IEC 61076-3-117[b]	IEC 61076-2-101	IEC 61076-2-109
	shielded	unshielded	Var. 1	Var. 6	Var. 14	M12-4 with D-coding	M12-8 with X-coding
CP 1/2	Yes	Yes	No	No	No	No	No

[a] For IEC 60603-7 series, the connector selection is based on the desired channel performance.

[b] Housings to protect connectors.

B.4.4.2.3 Connecting hardware for copper cabling CPs not based on Ethernet

Not applicable.

B.4.4.2.4 Connecting hardware for wireless installation

B.4.4.2.5 Connecting hardware for optical fibre cabling

Not applicable.

B.4.4.2.6 Specific requirements for CPs

Not applicable.

B.4.4.2.7 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.4.3 Connections within a channel/permanent link

B.4.4.4 Terminators

Not applicable.

B.4.4.5 Device location and connection

B.4.4.5.1 Common description

B.4.4.5.2 Specific requirements for CPs

Not applicable.

B.4.4.5.3 Specific requirements for wireless installation

B.4.4.5.4 Specific requirements for generic cabling in accordance with

ISO/IEC 24702

B.4.4.6 Coding and labelling

B.4.4.6.1 Common description

B.4.4.6.2 Additional requirements for CPs

B.4.4.6.3 Specific requirements for CPs

Not applicable.

B.4.4.6.4 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.4.7 Earthing and bonding of equipment and devices and shielded cabling

B.4.4.7.1 Common description

B.4.4.7.2 Bonding and earthing of enclosures and pathways

B.4.4.7.3 Earthing methods

B.4.4.7.4 Shield earthing

B.4.4.7.5 Specific requirements for CPs

Not applicable.

B.4.4.7.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.4.8 Storage and transportation of cables

B.4.4.9 Routing of cables

B.4.4.10 Separation of circuits

B.4.4.11 Mechanical protection of cabling components

B.4.4.11.1 Common description

B.4.4.11.2 Specific requirements for CPs

Not applicable.

B.4.4.11.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.4.12 Installation in special areas

B.4.4.12.1 Common description

B.4.4.12.2 Specific requirements for CPs

Not applicable.

B.4.4.12.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.4.5 Cabling planning documentation

B.4.6 Verification of cabling planning specification

B.5 Installation implementation

B.5.1 General requirements

B.5.2 Cable installation

B.5.2.1 General requirements for all cabling types

B.5.2.1.1 Storage and installation

B.5.2.1.2 Protecting communication cables against potential mechanical damage

Replacement:

Table B.5 provides values based on the template given in IEC 61918:2013, Table 18.

Table B.5 – Parameters for balanced cables

Characteristic		Value
Mechanical force	Minimum bending radius, single bending (mm)	a
	Bending radius, multiple bending (mm)	a
	Pull forces (N)	a
	Permanent tensile forces (N)	a
	Maximum lateral forces (N/cm)	a
	Temperature range during installation (°C)	a
[a] Depending on cable type; see manufacturer's data sheet.		

B.5.2.1.3 Avoid forming loops

B.5.2.1.4 Torsion (twisting)

B.5.2.1.5 Tensile strength (on installed cables)

B.5.2.1.6 Bending radius

B.5.2.1.7 Pull force

B.5.2.1.8 Fitting strain relief

B.5.2.1.9 Installing cables in cabinet and enclosures

B.5.2.1.10 Installation on moving parts

B.5.2.1.11 Cable crush

B.5.2.1.12 Installation of continuous flexing cables

B.5.2.1.13 Additional instructions for the installation of optical fibre cables

Not applicable.

B.5.2.2 Installation and routing

B.5.2.3 Specific cable installation requirements for CPs

Not applicable.

B.5.2.4 Specific requirements for wireless installation

Not applicable.

B.5.2.5 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.5.3 Connector installation

B.5.4 Terminator installation

Not applicable.

B.5.5 Device installation

B.5.5.1 Common description

B.5.5.2 Specific requirements for CPs

Not applicable.

B.5.6 Coding and labelling

B.5.6.1 Common description

B.5.6.2 Specific requirements for CPs

Not applicable.

B.5.7 Earthing and bonding of equipment and devices and shield cabling

B.5.7.1 Common description

B.5.7.2 Bonding and earthing of enclosures and pathways

B.5.7.3 Earthing methods

B.5.7.4 Shield earthing methods

B.5.7.5 Specific requirements for CPs

Not applicable.

B.5.7.6 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.5.8 As-implemented cabling documentation

B.6 Installation verification and installation acceptance test

B.6.1 General

B.6.2 Installation verification

B.6.2.1 General

B.6.2.2 Verification according to cabling planning documentation

B.6.2.3 Verification of earthing and bonding

B.6.2.3.1 General

B.6.2.3.2 Specific requirements for earthing and bonding

Not applicable.

B.6.2.4 Verification of shield earthing

B.6.2.5 Verification of cabling system

B.6.2.6 Cable selection verification

B.6.2.7 Connector verification

B.6.2.7.1 Common description

B.6.2.7.2 Specific requirements for CPs

Not applicable.

B.6.2.7.3 Specific requirements for wireless installation

Not applicable.

B.6.2.8 Connection verification

B.6.2.9 Terminators verification

Not applicable.

B.6.2.10 Coding and labelling verification

B.6.2.10.1 Common description

B.6.2.10.2 Specific coding and labelling verification requirements

Not applicable.

B.6.2.11 Verification report

B.6.3 Installation acceptance test

B.6.3.1 General

B.6.3.2 Acceptance test of Ethernet-based cabling

B.6.3.2.1 Validation of balanced cabling for CPs based on Ethernet

B.6.3.2.1.1 Common description

B.6.3.2.1.2 Transmission performance test parameters

B.6.3.2.1.3 Specific requirements for CPs based on Ethernet

Not applicable.

B.6.3.2.2 Validation of optical fibre cabling for CPs based on Ethernet

Not applicable

B.6.3.2.2.1 Common description

B.6.3.2.2.2 Specific requirements for optical fibre cabling CPs

B.6.3.2.3 Specific requirements for generic cabling in accordance with ISO/IEC 24702

B.6.3.3 Acceptance test of non-Ethernet-based cabling

Not applicable.

B.6.3.4 Specific requirements for wireless installation

B.6.3.5 Acceptance test report

B.7 Installation administration

B.7.1 General

B.7.2 Fields covered by the administration

B.7.3 Basic principles for the administration system

B.7.4 Working procedures

B.7.5 Device location labelling

B.7.6 Component cabling labelling

B.7.7 Documentation

B.7.8 Specific requirements for administration

Not applicable.

B.8 Installation maintenance and installation troubleshooting

B.8.1 General

B.8.2 Maintenance

B.8.3 Troubleshooting

B.8.4 Specific requirements for maintenance and troubleshooting

Not applicable.

Bibliography

Addition:

[27] FOUNDATION fieldbus System Engineering Guidelines, Version 3.1, March 2010, available at <http://www.fieldbus.org>

[28] FOUNDATION fieldbus Wiring and Installation 31.25 kbit/s, Voltage Mode, Wire Medium Application Guide, Version 1.0, 1996, available at <http://www.fieldbus.org>

[29] FOUNDATION fieldbus 31.25 kbit/s Intrinsically Safe Systems Application Guide, Version 2.0, 2004, available at <http://www.fieldbus.org>

_____

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™