

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Connectors for electronic equipment –
Part 7-3: Detail specification for 8-way, shielded, free and fixed connectors, for
data transmissions with frequencies up to 100 MHz**

**Connecteurs pour équipements électroniques –
Partie 7-3: Spécification particulière pour les fiches et les embases blindées à
8 voies pour la transmission de données à des fréquences jusqu'à 100 MHz**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONNECTORS FOR ELECTRONIC EQUIPMENT –

Part 7-3: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 100 MHz

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International Standard IEC 60603-7-3 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

This standard cancels and replaces IEC/PAS 60603-7-3 published in 2004. This first edition constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
48B/1816/FDIS	48B/1835/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60603-7 series, under the general title *Connectors for electronic equipment*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

Withdrawn

INTRODUCTION

Applications have emerged which require the use of the interface described in IEC 60603-7: 1996, with certain performance specifications at higher frequencies. The parameters for this performance include insertion loss, near end crosstalk (NEXT), far end crosstalk (FEXT), and return loss. Based on application requirements, the specifications for these parameters always apply to a mated connection of a free (plug) and fixed (outlet) connector. Details for testing of connectors and test plugs are given in Annex C.

Withdrawn

CONNECTORS FOR ELECTRONIC EQUIPMENT –

Part 7-3: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 100 MHz

1 General

1.1 Scope

This part of IEC 60603 covers 8-way shielded free and fixed connectors and specifies mechanical and environmental requirements and electrical transmission requirements for frequencies up to 100 MHz. These connectors are typically used as category 5 connectors in class D cabling systems specified in ISO/IEC 11801:2002.

These connectors are intermateable, interoperable, and backward compatible with other IEC 60603-7 series connectors. While the definition of interoperable is being discussed within the IEC, “interoperable” in this standard means the following: the fixed and the free connector are capable of interconnecting with any IEC 60603-7 series connector, and when it is interconnected, it fully meets all requirements of the lower frequency IEC 60603-7 series standard.

NOTE Transmission performance categories: in this IEC standard, the term “category”, when used in reference to transmission performance, refers to those categories defined in ISO/IEC 11801:2002.

1.2 Normative references

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

IEC 60050-581, *International Electrotechnical Vocabulary (IEV) – Chapter 581: Electro-mechanical components for electronic equipment*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-38, *Environmental testing – Part 2: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60169-16, *Radio-frequency connectors – Part 16: RF coaxial connectors with inner diameter of outer conductor 7 mm (0,276 in) with screw coupling – Characteristic impedance 50 ohms (75 ohms) (Type N)*

IEC 60352 (all parts), *Solderless connections*

IEC 60352-2, *Solderless connections – Part 2: Solderless crimped connections – General requirements, test methods and practical guidance*

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

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

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

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

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

IEC 60512 (all parts), *Connectors for electronic equipment – Tests and measurements*

IEC 60512-1-100, *Connectors for electronic equipment – Tests and measurements – Part 1-100: General – Applicable publications*

IEC 60603-7 (all parts), *Connectors for electronic equipment*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61076-1:2006, *Connectors with assessed quality, for use in d.c., low-frequency analogue and in digital high speed data applications – Part 1: Generic specification*

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61156-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC 61156-2, *Multicore and symmetrical pair/quad cables for digital communications – Part 2: Horizontal floor wiring – Sectional specification*

IEC 61156-3, *Multicore and symmetrical pair/quad cables for digital communications – Part 3: Work area wiring – Sectional specification*

IEC 61156-4, *Multicore and symmetrical pair/quad cables for digital communications – Part 4: Riser cables – Sectional specification*

IEC 61156-5, *Multicore and symmetrical pair/quad cables for digital communications – Part 5: Symmetrical pair/quad cables with transmission characteristics up to 600 MHz – Horizontal floor wiring – Sectional specification*

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

ISO 1302, *Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation*

ITU-T Recommendation G.117, *Transmission aspects of unbalance about earth*

ITU-T Recommendation K.20:2000¹, *Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents*

ITU-T Recommendation K.44:2000², *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation*

ITU-T Recommendation O.9, *Measuring arrangements to assess the degree of unbalance about earth*

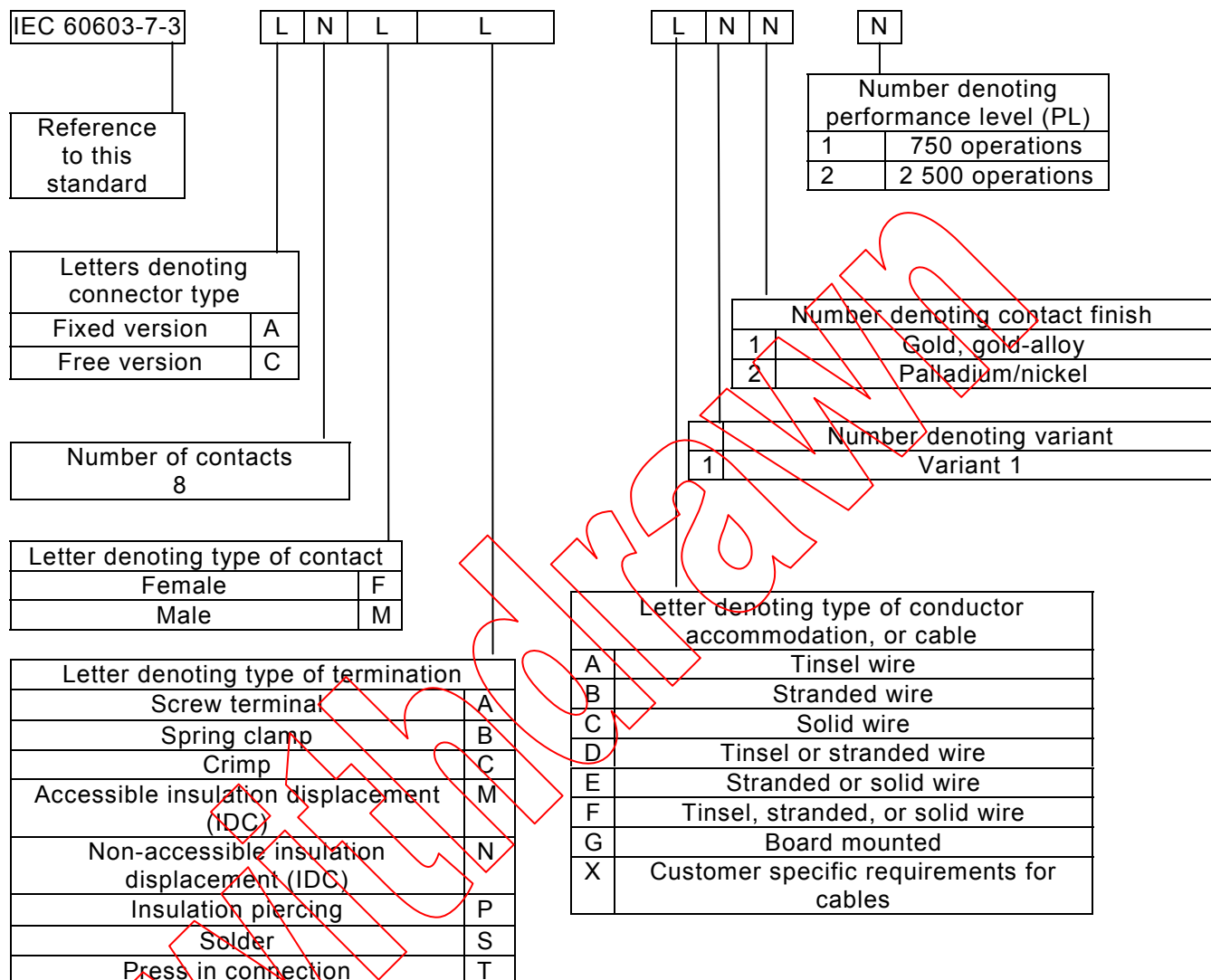
EN 50289-1-14, *Communication cables – Specification for test methods – Part 1-14: Electrical test methods – Coupling attenuation or screening attenuation of connecting hardware*

¹ This has been replaced by a new edition (2003), but for the purposes of this part of IEC 60603-7, the 2000 edition is cited.

² This has been replaced by a new edition (2003), but for the purposes of this part of IEC 60603-7, the 2000 edition is cited.

2 IEC type designation

Connectors, connector bodies and connectors with pre-inserted contacts according to this standard shall be designated by the following system.



"L" stands for letter

"N" stands for number

EXAMPLE:

IEC 60603-7-3 A8FM-E11-1: Fixed connector having 8 female contacts with IDC termination for stranded and solid wire, gold plated, meeting performance level 1.

2.1 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60050(581), IEC 61076-1, IEC 60512-1, as well as the following, apply.

2.1.1

interchangeability level

Level at which these connectors are intermateable, interoperable and backward compatible with IEC 60603-7 series connectors

2.1.2

intermateability

Intermateability is ensured by application of the “GO” and “NO-GO” gauge requirements herein, and adherence to the dimensional requirements within

2.1.3

backward compatibility

Plug or jack which is in compliance with this detail specification, mated with a jack or plug in compliance with any lower frequency IEC 60603-7 series standard, fully complying with the requirements of the lower frequency IEC 60603-7 series standard

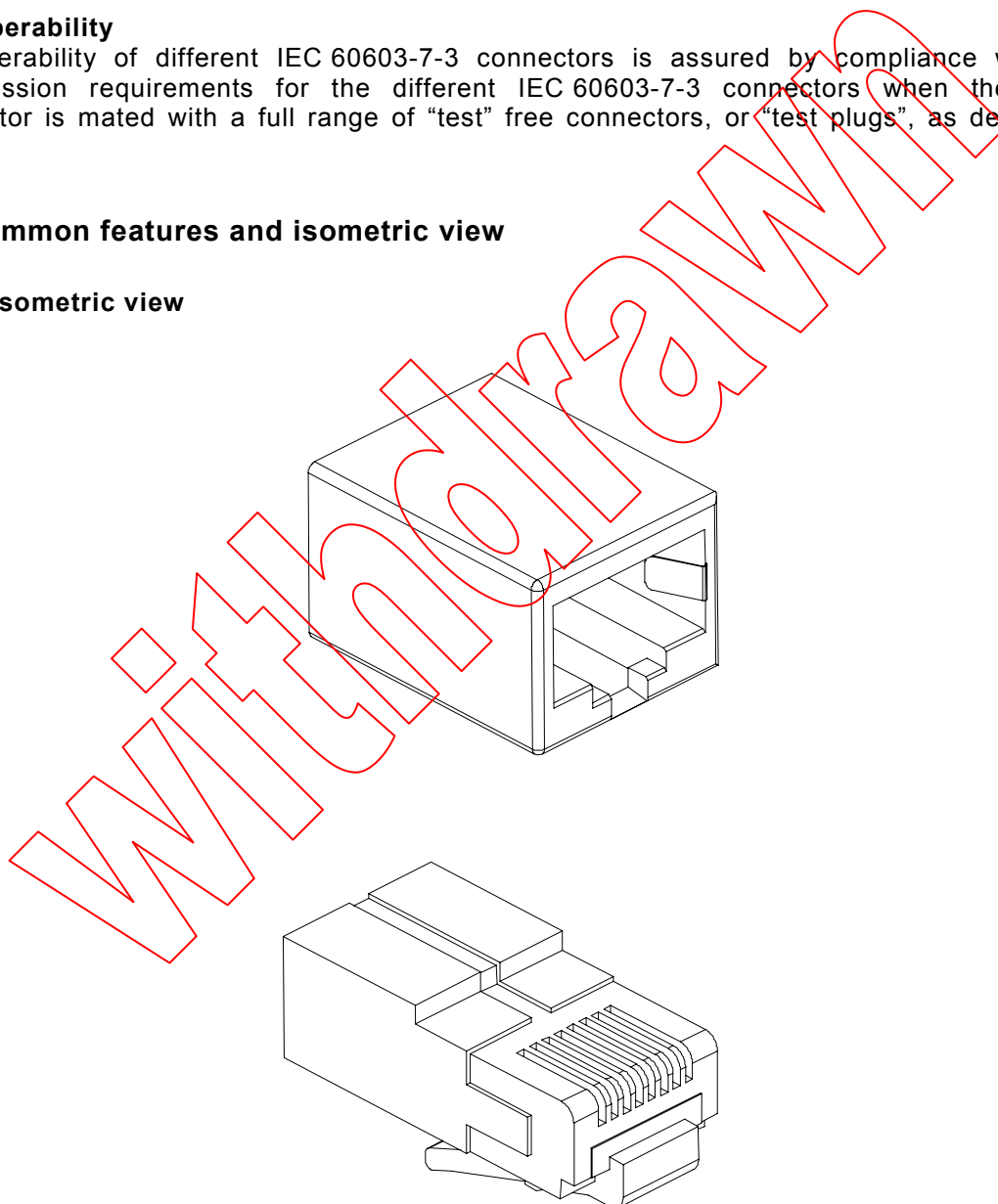
2.1.4

interoperability

Interoperability of different IEC 60603-7-3 connectors is assured by compliance with all transmission requirements for the different IEC 60603-7-3 connectors when the fixed connector is mated with a full range of “test” free connectors, or “test plugs”, as described herein

3 Common features and isometric view

3.1 Isometric view



IEC 086/05

Figure 1 – Isometric view

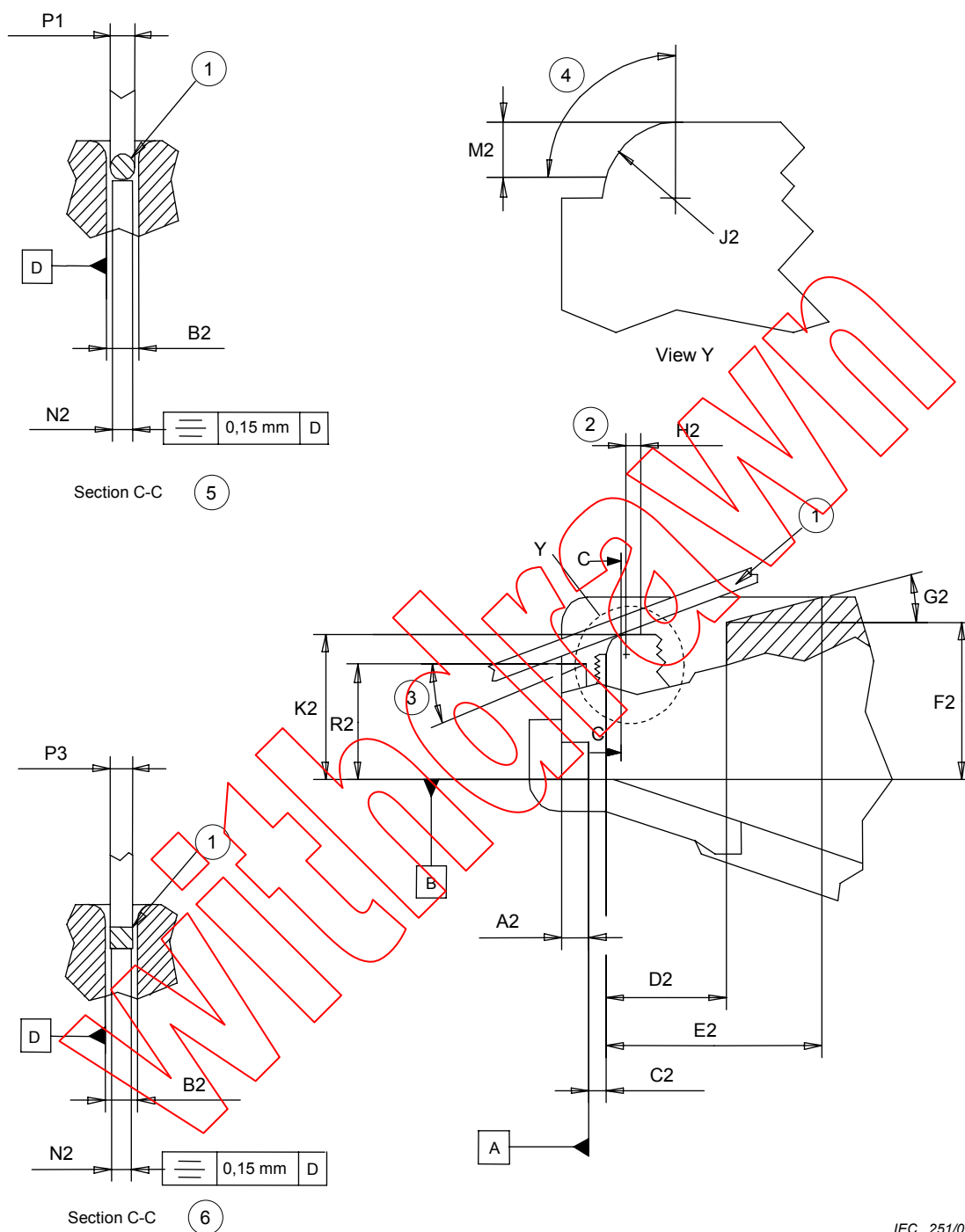
3.2 Mating information

3.2.1 General

Dimensions are given in millimetres. Drawings are shown in third-angle projections. The shape of connectors may deviate from those shapes given in Figures 1 to 4 as long as the dimensions specified are not influenced.

Withdrawn

3.2.2 Contacts – mating conditions



IEC 251/07

Figure 2 – Contact interface dimensions with terminated free connector

Table 1 – Dimensions for Figure 2

Letter	Maximum mm	Minimum mm
A2	1,45	0,89
B2	0,61	0,51
C2	0,46	0,03
D2		2,79
E2		4,11
F2	6,22	
H2		0,38
J2	0,64	0,38
K2	6,15	5,89
M2		0,30
N2		0,28
P1	0,50	0,45
P3	0,50	0,36
R2	4,83	

Letter	Maximum
G2	10°
Care shall be taken that the jack contacts avoid interference with the plastic of the free connector.	

3.2.3 Fixed connector

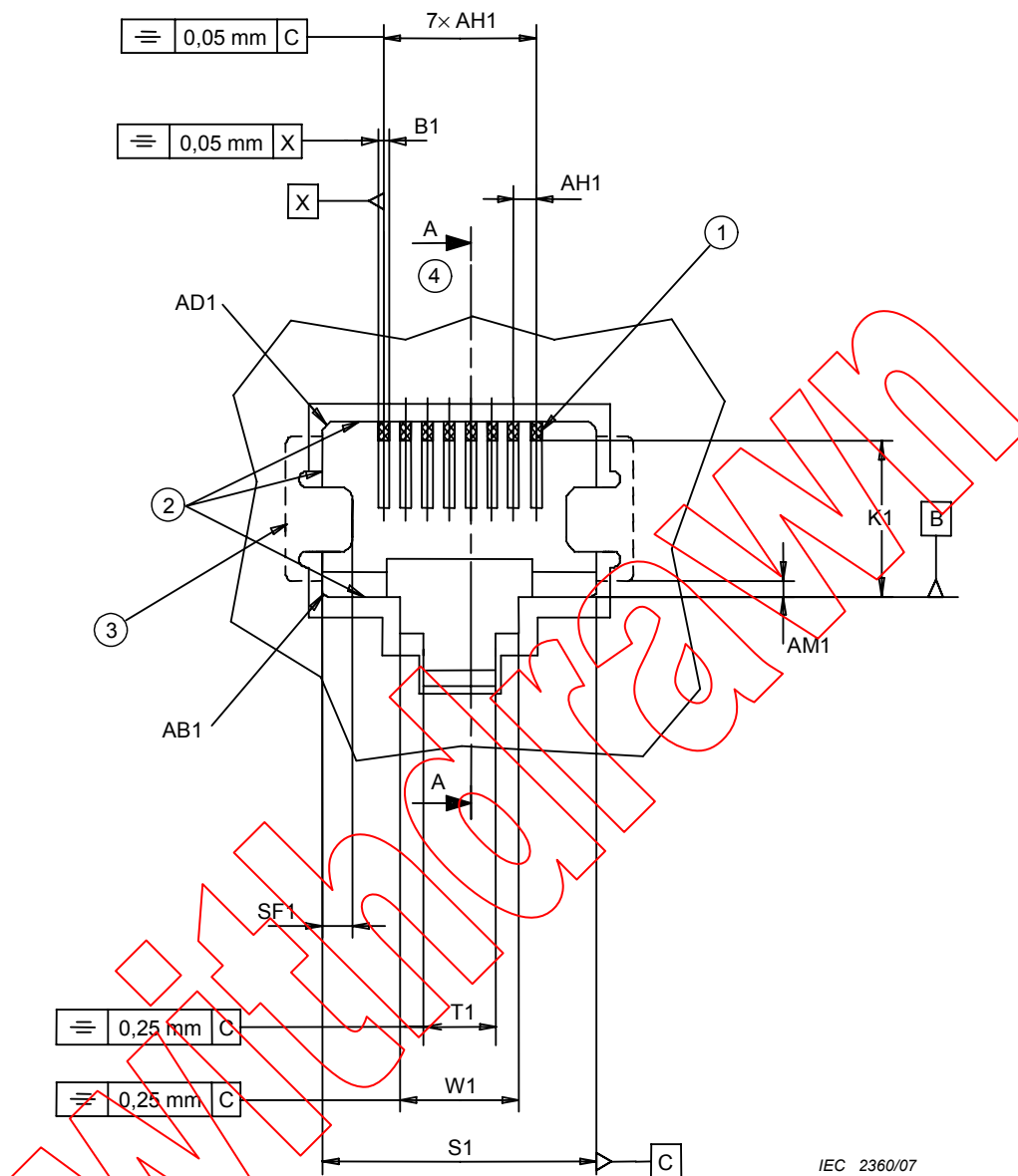
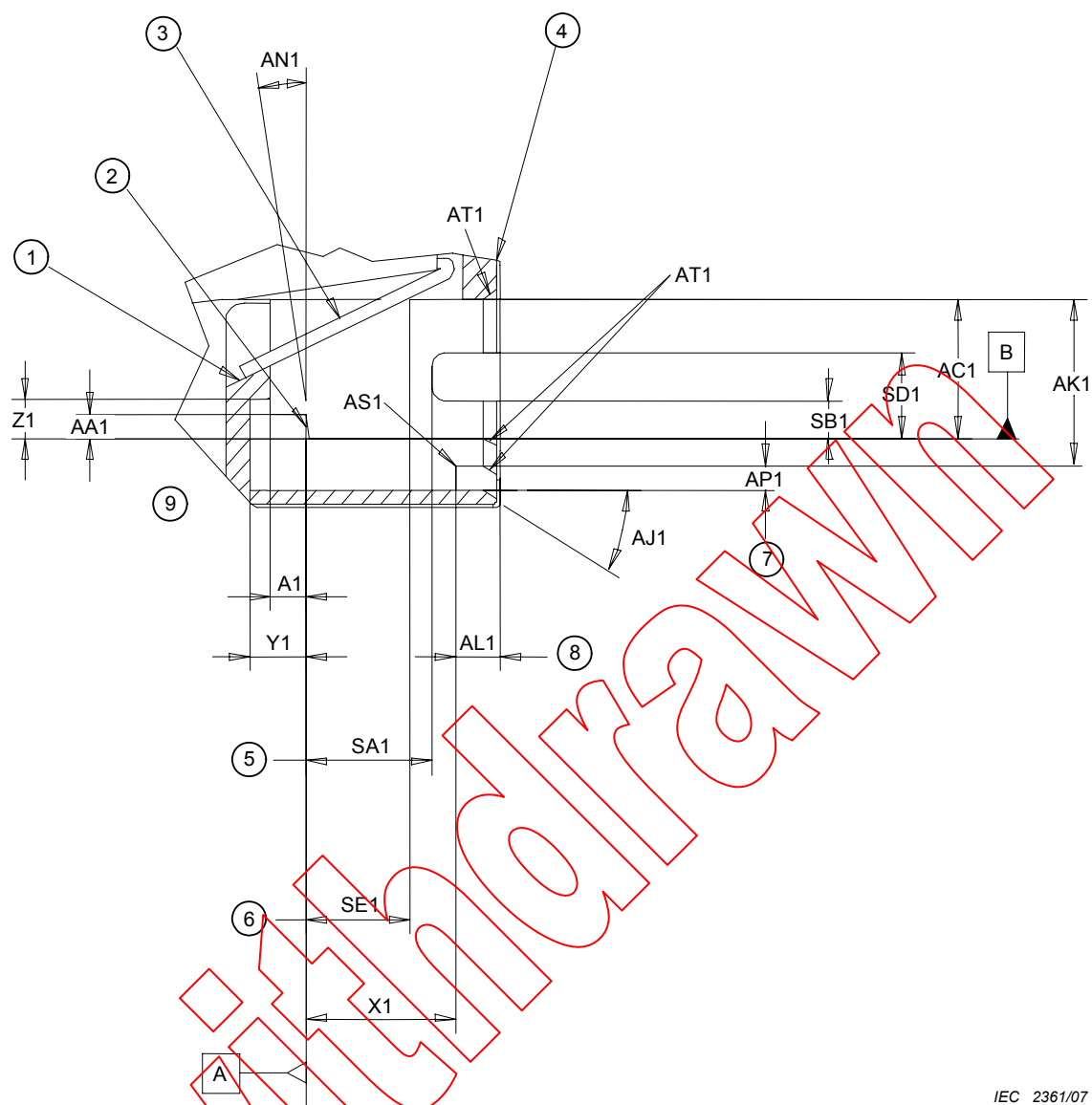


Figure 3a) – View of contact zone

IEC 2360/07



IEC 2361/07

View of contact zone section A-A**Key**

- 1 Optional contact rest.
- 2 Preferred free connector stop.
- 3 Contacts shown at rest. Contacts shall always be contained inside guide slots. Contacts shall move freely within their guide slots.
- 4 This surface need not be planar or coincident with the surface below the locking device as long as insertion, latching and unlatching of free connectors is not inhibited.
- 5 Dimension to point of shield mating contact.
- 6 Maximum forward extension of contacts below surface AC1 to avoid contact with shields of free connectors. Applies in the mated state.
- 7 Flat surface.
- 8 Projections beyond AL1 dimension shall not prevent finger access to the free connector locking device.
- 9 All internal corners in the connector cavity shall be 0,38 mm radius maximum unless otherwise specified.

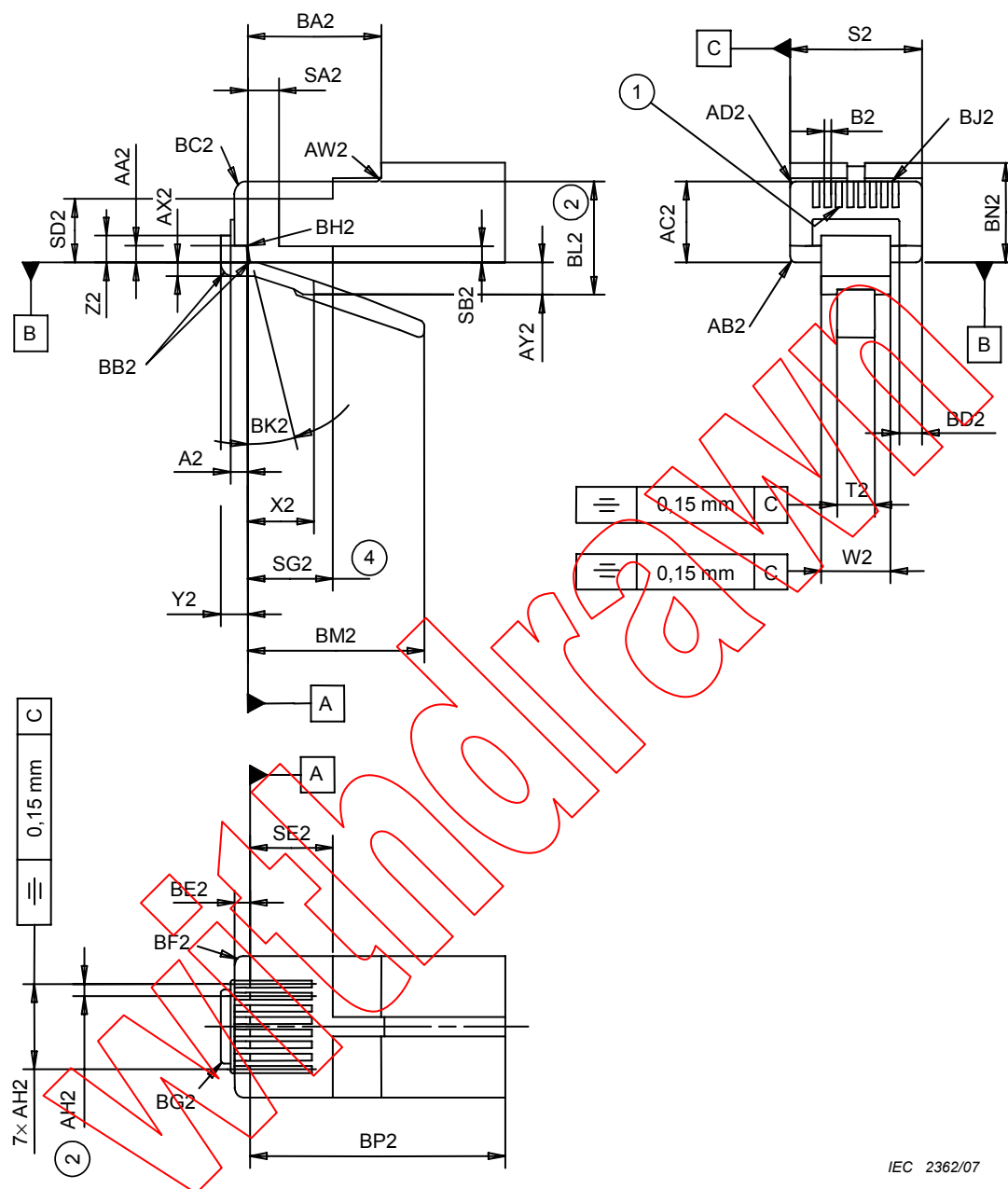
Figure 3b) – Section A-A**Figure 3 – Fixed connector details**

Table 2 – Dimensions for Figure 3

Letter	Maximum mm	Minimum mm	Nominal (ref) mm
A1		1,47	
B1	0,71		
K1	5,84		
S1	12,04	11,84	11,94
T1	4,19	3,94	
W1	6,38	6,22	
X1	6,86	6,68	
Y1		2,40	
Z1		2,08	
AA1	1,24		
AB1	0,38		
AC1	6,96	6,76	6,86
AD1	0,13		
AH1			1,02 TP ^a
AK1	8,66	8,38	
AL1		1,40	
AM1		1,52	
AP1		1,27	
AS1	0,08		
AT1			0,76
SA1		5,31	
SB1		2,16	
SD1	4,90		
SE1	5,80		
SF1		b	
^a TP indicates true position. ^b Care shall be taken that all screen contacts of the fixed connector always make contact with the screen contacts of the free connector in worst case condition to ensure reliable performance.			

Letter	Maximum	Suggested minimum
AJ1		15°
AN1	3°30'	

3.2.4 Free connector



IEC 2362/07

Key

- 1 Full radius permitted on all slots.
- 2 These dimensions apply to the locations of the contact slots.
- 3 Applies with locking device depressed.
- 4 SG2 refers to foremost extension of the screen at the bottom of the plug.

Figure 4 – Free connector view

Table 3 – Dimensions for Figure 4

Letter	Maximum mm	Minimum mm	Nominal (ref) mm
A2 a)	a)	a)	1,17
B2 a)	a)	a)	0,56
S2	11,79	11,58	11,68
T2	3,38	3,12	
W2	6,17	6,02	
X2	6,02	5,77	
Y2	2,34		
Z2	2,06		
AA2		1,24	
AB2	0,64	0,38	
AC2	6,71	6,50	6,60
AD2	0,64	0,13	
AH2			1,02
AW2	0,51		
AX2	1,32		
AY2	2,87	2,67	
BA2		12,32	
BB2	1,14	0,38	
BC2	1,02	0,51	
BD2		0,51	
BE2	1,09		
BF2	0,64		
BG2	0,64	0,38	
BH2			0,13
BL2	8,36		
BM2	15,88	14,61	
BN2	8,00		
SA2	4,22		
SB2	1,66		
SD2		4,95	
SE2		6,85	
SG2		1,50 ^b	

a) See Table 1.

b) When this dimension is less than 6,85 mm (for further study), and the free connector is mated with a IEC 60603-7-7 fixed connector, utilising switch option 1, there is a possibility that signal conductors 3,4,5,6 of the fixed connector may make contact with the screen of this free connector.

Letter	Maximum	Nominal (ref)
BJ2		Full radius
BK2	3°30'	

4 Cable terminations and internal connections – fixed and free connectors

4.1 General

A connector may include multiple terminations between the cable termination and the separable contact interface. These may include press-in connections of jack springs into PCBs, for example. All terminations shall meet the relevant termination requirements given in this standard.

If a type of solderless termination which is not covered by any IEC specification is used, the supplier shall assure its reliability by performing similar tests, and demonstrating a similar level of performance, to those in the IEC 60352 series.

Free connectors are intended to be terminated to cable to provide connector and cable assemblies. The connector type designation provides basic terminations concerning the type of conductor (tinsel, stranded, solid) to which the conductor may be applied, and the type of connection used (solder, insulation displacement, etc.). Specific details concerning wire gauge size, type and thickness of conductor insulation, size and shape of cordage or cable jacket, etc., are not intended to be part of this detail specification. Minor variations in a free connector's interior details to accommodate differing wire gauge sizes, outer jackets, etc., do not require the generation of new free connector specifications.

If the connector is able to be used with multiple cable types, the manufacturer shall assure that all terminations comply with the relevant IEC standards with each of the cable types.

4.2 Termination types

4.2.1 Solder terminations

Solder terminations are not covered by the IEC 60352 series and are allowed.

4.2.2 Insulation displacement terminations

Insulation displacement terminations shall conform to IEC 60352-3 or IEC 60352-4.

4.2.3 Crimp terminations

Crimp terminations shall conform to IEC 60352-2.

4.2.4 Insulation piercing terminations

Insulation piercing terminations shall conform to IEC 60352-6.

4.2.5 Press-in terminations (compliant pin)

The press-in pin terminations shall conform to IEC 60352-5.

4.2.6 Spring clamp terminations

Spring clamp terminations shall conform to IEC 60352-7.

4.2.7 Other types

In the case where a type of solderless termination is used which is not covered by any IEC specification and the supplier cannot demonstrate a similar level of performance or there is no applicable IEC 60352 standard to be used as a reference, the supplier shall show conformance with the full test schedule in 7.7 for all possible variations of terminations, for

example each cable construction type (screen construction types, wire construction (solid, flexible)) the connector is intended to be used for.

5 Gauges

5.1 Fixed connectors

Gauges shall be made according to the following requirements:

Material: tool steel, hardened.

✓ = Surface roughness, according to ISO 1302.

Ra = 0,25 µm maximum.

A 0,01 mm wear tolerance shall be applied.

Clearance shall be provided for connector contacts.

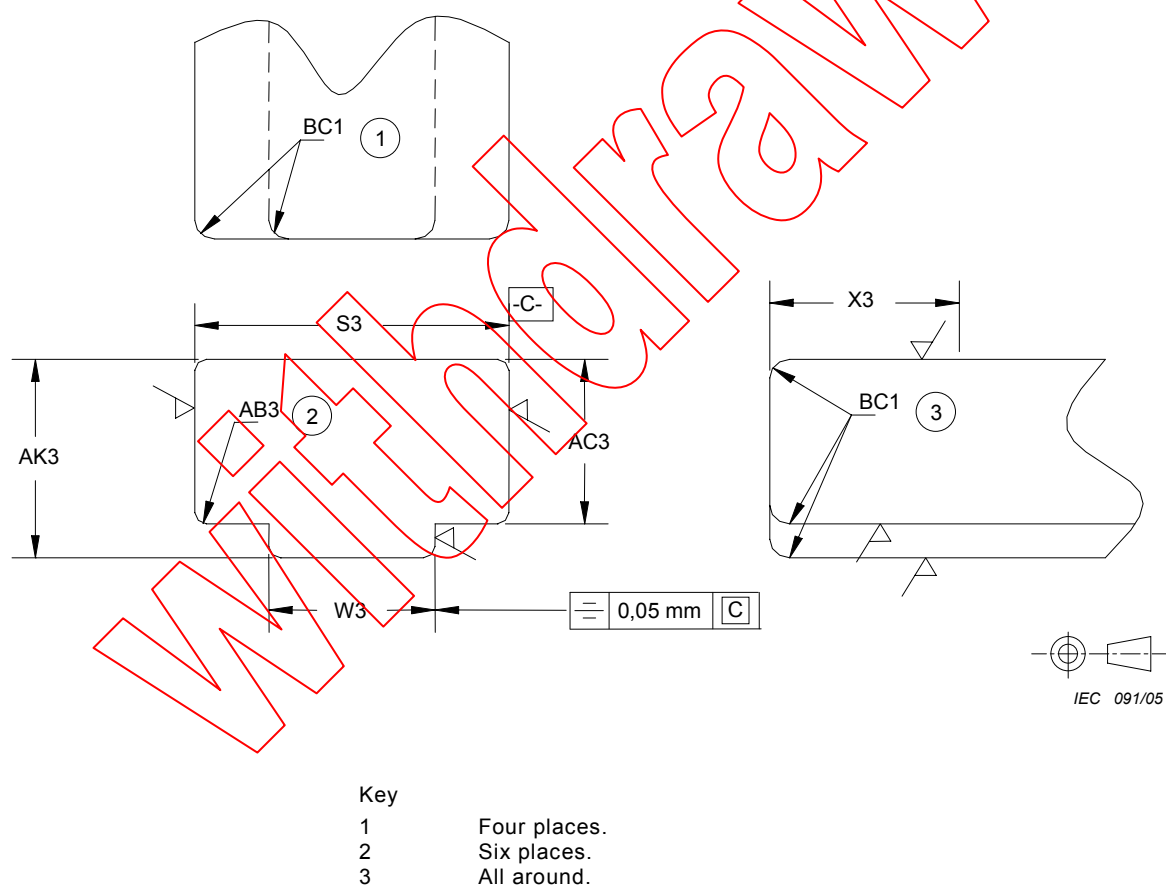


Figure 5 – “Go” gauge

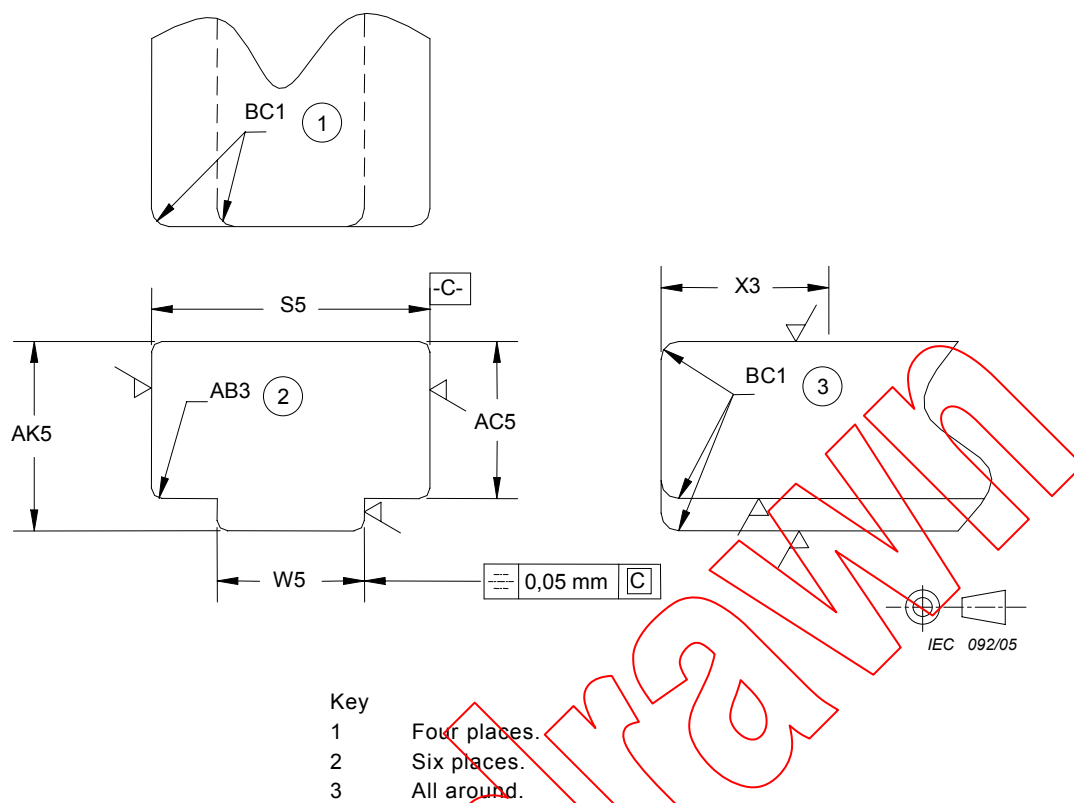


Figure 6a) – “No-go” gauge width

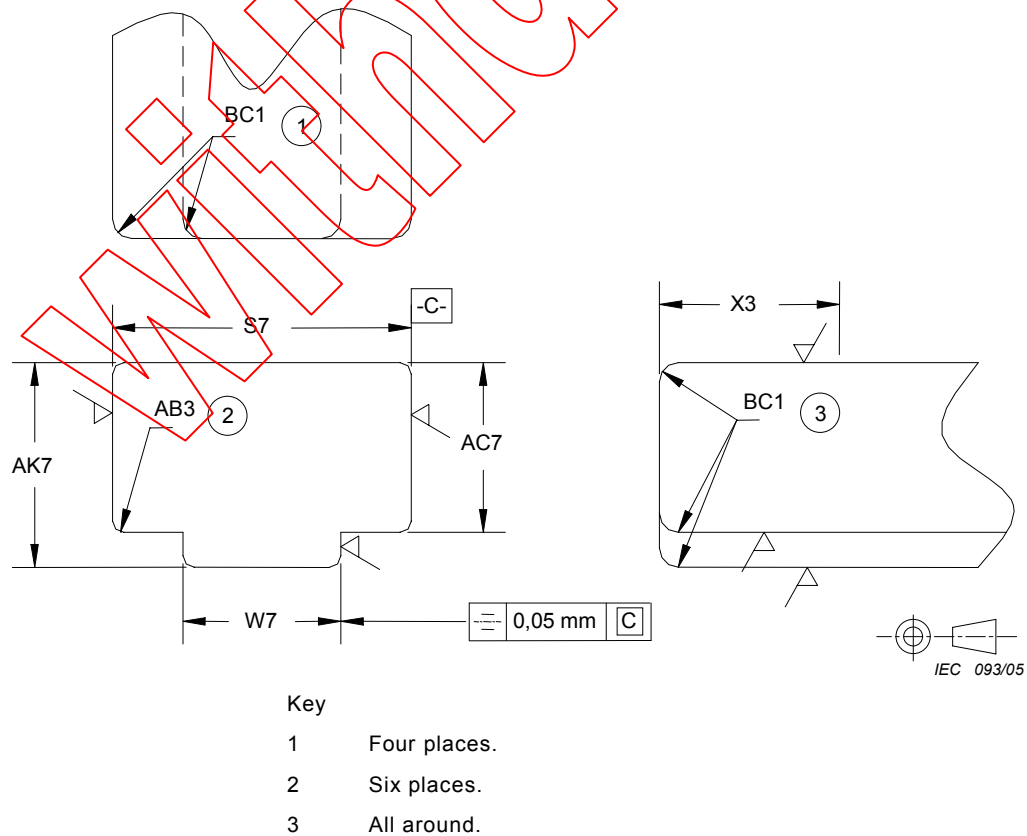


Figure 6b) – “No-go” gauge height

Figure 6 – “No-go” gauges

Table 4 – Dimensions for Figures 5 and 6

Letter	Maximum mm	Minimum mm	Nominal (ref) mm
S3	11,796	11,786	
S5	12,050	12,040	
S7	11,68	11,58	
X3		10,16	
AB3	0,51	0,389	0,450
AC3	6,716	6,706	
AC5	6,45	6,35	
AC7	6,970	6,96	
BC1	0,89	0,64	0,76
W3	6,12	6,109	
W5	6,38	6,365	
W7	5,97	5,89	
AK3	8,357	8,346	
AK5	8,13	8,05	
AK7	8,672	8,66	

Withd

5.2 Free connectors

Material: tool steel, hardened.

▽ = Surface roughness, according to ISO 1302.

Ra = 0,25 µm maximum.

A 0,01 mm wear tolerance shall be applied.

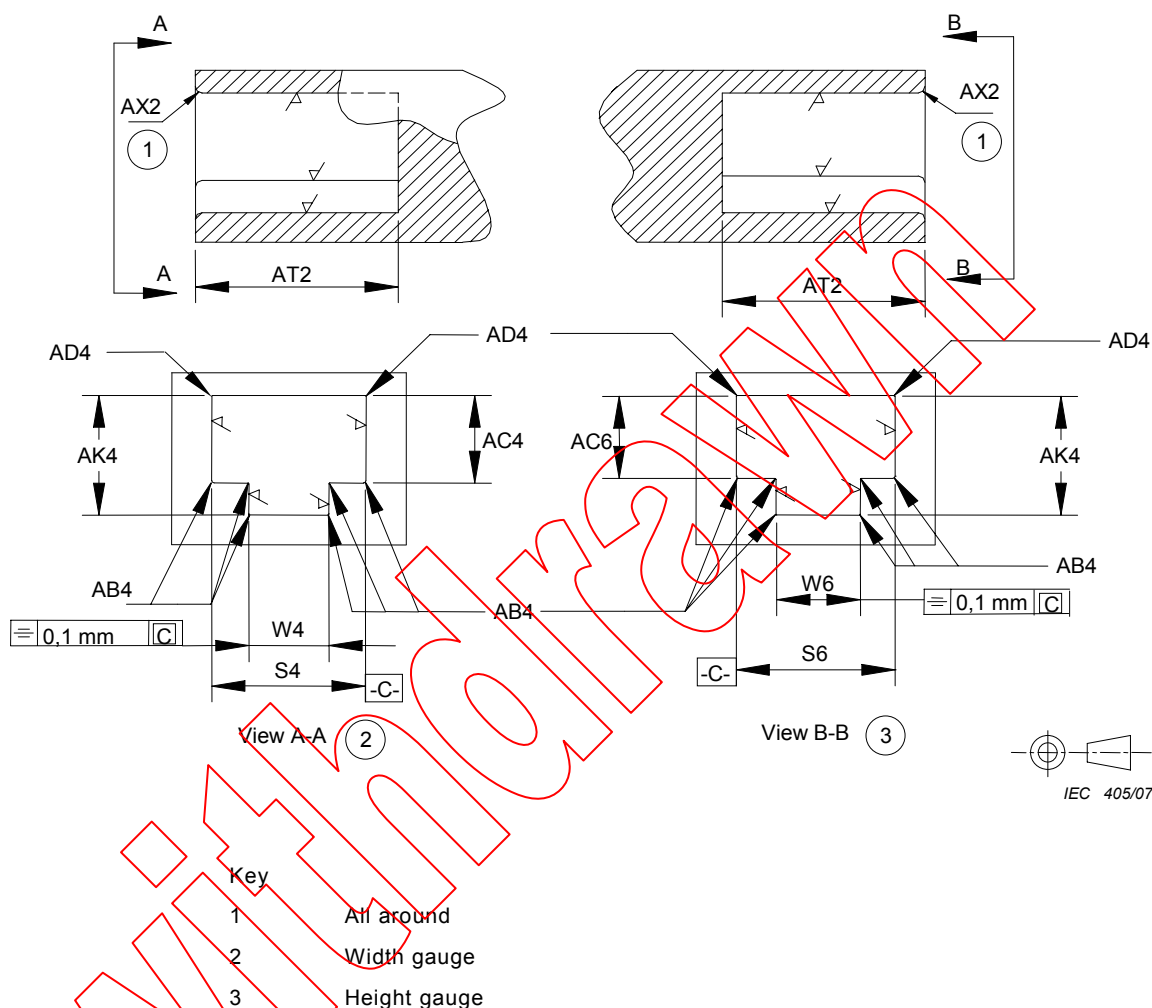
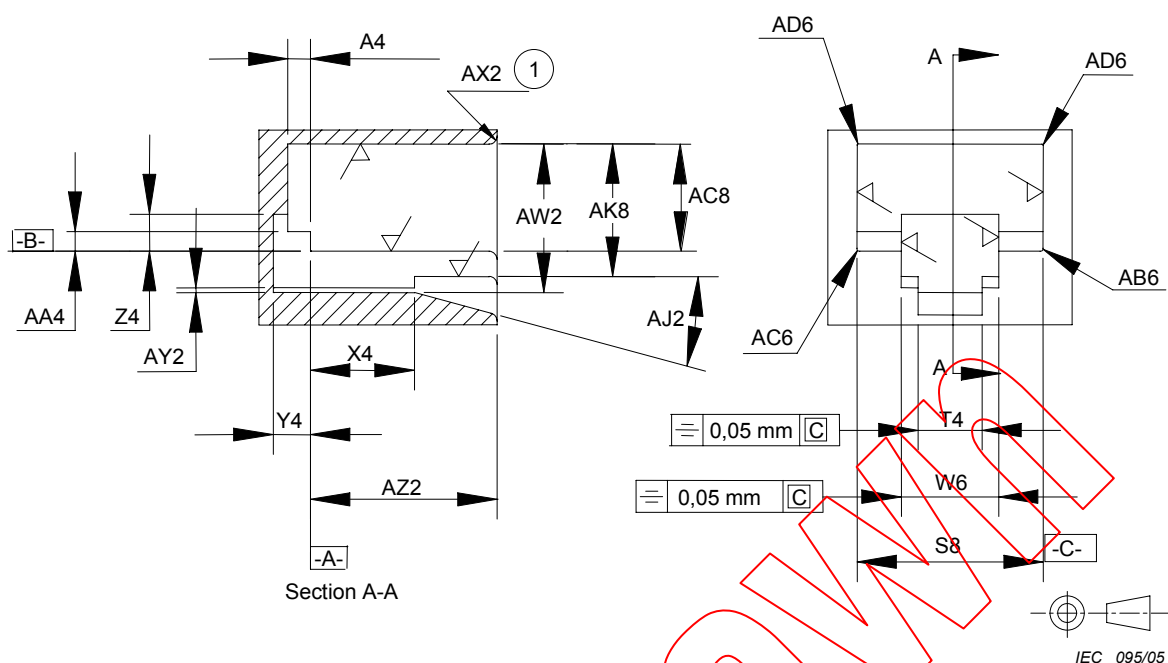


Figure 7 – “No-go” gauges

Table 5 – Dimensions for Figure 7

Letter	Maximum mm	Minimum mm
S4	11,593	11,582
S6	11,989	11,887
W4	6,02	6,010
W6	6,40	6,30
AB4	0,38	0,0
AC4	6,91	6,81
AC6	6,512	6,502
AD4	0,127	0,0
AK4	9,42	9,32
AT2	15,29	15,19
AX2	0,635	0,38



Key
1 All around
Figure 8 – “Go” gauge

Table 6 – Dimensions for Figure 8

Letter	Maximum mm	Minimum mm
A4	1,448	1,438
S8	11,847	11,836
T4	4,115	4,013
W6	6,198	6,187
X4	6,604	6,594
Y4	2,39	2,34
Z4	2,39	2,29
AA4	1,255	1,245
AB6	0,38	0,0
AC8	6,767	6,756
AD6	0,13	0,0
AK8	8,357	8,346
AW2	9,42	9,32
AX2	0,64	0,38
AY2	0,305	0,295
AZ2	11,91	11,81

Letter	Maximum	Minimum
AJ2	16°	14°

6 Characteristics

6.1 General

Compliance to the test schedules is intended to ensure the reliability of all performance parameters, including transmission parameters, over the range of operating climatic conditions. Stable and compliant contact resistance is a good indication of the stability of transmission performance.

6.2 Pin and pair grouping assignment

For those specifications for which pin and pair groupings are relevant, unless otherwise specified, the pin and pair grouping assignments shall be as shown in Figure 9.

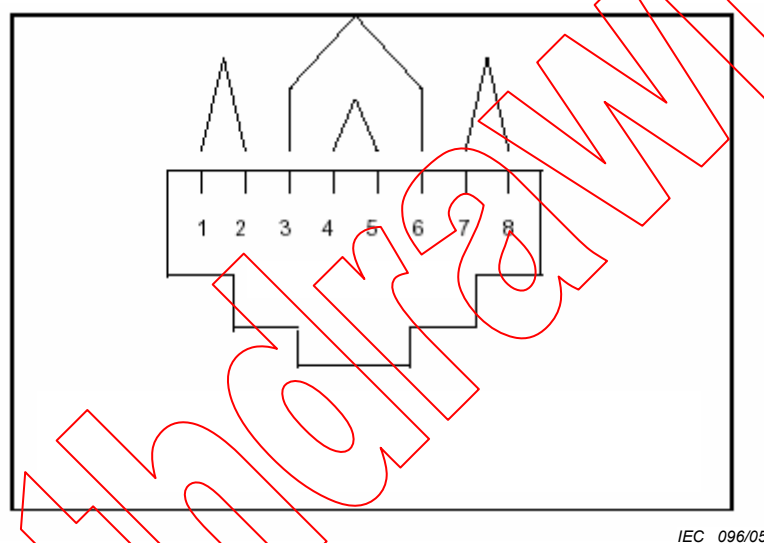


**Figure 9 – Fixed connector pin and pair grouping assignment
(front view of connector)**

6.3 Classification into climatic category

The lowest and highest temperatures and the duration of the damp-heat steady-state test should be selected from the preferred values stated in 2.3 of IEC 61076-1:2006. The connectors are classified into climatic categories in accordance with the general rules given in IEC 60068-1. The preferred temperature range and severity of the damp heat, steady state test has been selected to comply with the IEC 61156 series.

Table 7 – Climatic categories – Selected values

Climatic category	Lower temperature °C	Upper temperature °C	Damp heat, steady state days
40/070/21	–40	70	21

6.4 Electrical characteristics

6.4.1 Creepage and clearance distances

The permissible operating voltages depend on the application and on the applicable or specified safety requirements.

Insulation coordination is not required for this connector; therefore, the creepage and clearance distances in IEC 60664-1 are reduced and covered by overall performance requirements.

Therefore, the creepage and clearance distances are given as operating characteristics of mated connectors.

In practice, reductions in creepage or clearance distances may occur due to the conductive pattern of the printed board or the wiring used, and shall duly be taken into account.

See table 8.

Table 8 – Creepage and clearance distances

Minimum distance between contacts and shield or chassis		Minimum distance between adjacent contacts	
Creepage mm	Clearance mm	Creepage mm	Clearance mm
1,40	0,51	0,36	0,36

6.4.2 Voltage proof

Conditions:

IEC 60512, Test 4a, Method A

Standard atmospheric conditions

Mated connectors

All variants: 1 000 V d.c. or a.c. peak, contact to contact

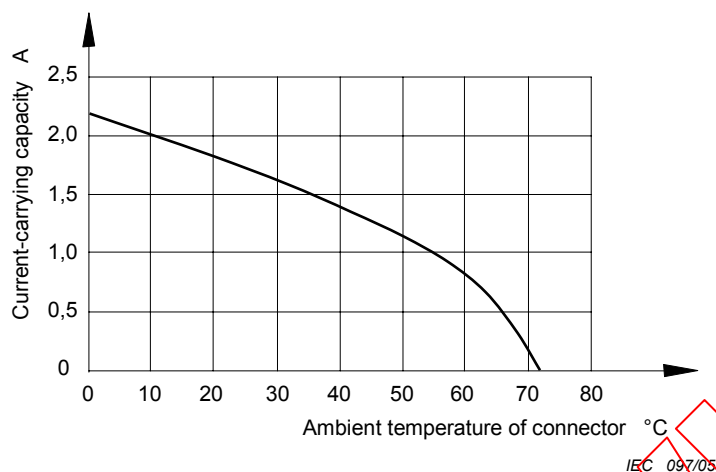
1 500 V d.c. or a.c. peak, contact to shield and test panel

6.4.3 Current-carrying capacity

Conditions: IEC 60512, Test 5b

All contacts, connected in series

The permanent current carrying capacity of each signal contact when connected in series in accordance with the requirements of 2.5 of IEC 61076-1:2006 shall comply with the derating curve given in Figure 10.



The maximum temperature rise is 30 °C when applying 0,75 A at ambient 60 °C.

Figure 10 – Connector de-rating curve

6.4.4 Initial contact resistance – interface only (between separable fixed and free connectors)

Conditions: IEC 60512, Test 2a
 Arrange according to 7.2
 Mated connectors
 Connection points: as specified in Figure 11
 Signal contacts: 20 mΩ maximum
 Shield contact: 20 mΩ maximum

6.4.5 Input to output d.c. resistance

Conditions: IEC 60512, Test 2a
 Mated connectors
 Connection points: Cable termination to cable termination
 Signal contacts: 200 mΩ maximum
 Shield: 100 mΩ maximum

6.4.6 Input-to-output d.c. resistance unbalance

Conditions: IEC 60512, Test 2a
 Mated connectors
 Connection points: Cable termination to cable termination
 Among all signal conductors, maximum difference between maximum and minimum
 50 mΩ maximum

6.4.7 Initial insulation resistance

Conditions: IEC 60512, Test 3a
 Method A
 Mated connectors
 Test voltage: 100 V d.c.
 Between each signal contact and shield: 500 MΩ minimum

6.4.8 Transfer impedance

Conditions: Annex I, Transfer Impedance

Mated connectors, terminated with each cable construction intended to be allowed for these connectors

All types: $\leq 0,1f^{0,3} \Omega$ from 1 MHz to 10 MHz

$\leq 0,02f \Omega$ from 10 MHz to 80 MHz

where f is the frequency in MHz

6.5 Transmission characteristics

6.5.1 General

Category 5 performance level, respective to transmission characteristics, is determined according to the specific test methods described in test group EP. Category 5 transmission performance, interoperability and backward compatibility shall be demonstrated by testing the fixed connectors with the full range of free connectors or test plugs described in Annex C. Interoperability and backward compatibility of free connectors shall be demonstrated by testing them against the limits in Annex C.

All transmission performance requirements apply between the reference planes specified in Clause D.8.

6.5.2 Insertion loss

Conditions: Annex E, Insertion loss

Mated connectors

All types: $\leq 0,04 \sqrt{f}$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

Whenever the formula results in a value less than 0,1 dB, the requirement shall revert to 0,1 dB

6.5.3 Return loss

Conditions: Annex F, Return loss

Mated connectors

All types: $\geq 60 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

Whenever the formula results in a value greater than 30 dB, the requirement shall revert to 30 dB

6.5.4 Propagation delay

All types: $\leq 2,5$ ns

The propagation delay test does not need to be performed, since it is assumed that connectors comply by design

6.5.5 Delay skew

All types: $\leq 1,25$ ns.

The delay skew test does not need to be performed, since it is assumed that connectors comply by design

6.5.6 NEXT loss

Conditions: Annex G, NEXT loss, pair to pair (PP)

Mated connectors, between all combinations of 2 pairs of contacts

All types: $\geq 83 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

Whenever the formula results in a value greater than 80 dB, the requirement shall revert to 80 dB

6.5.7 Power sum NEXT loss (for information only)

Conditions: Mated connectors, between each pair and all other pairs combined

All types: $\geq 80 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

NOTE This characteristic is achieved by compliance to PP NEXT (6.5.6), and there is no necessity to test it.

6.5.8 FEXT loss

Conditions: Annex H, FEXT pair to pair

Mated connectors, between all combinations of 2 pairs of contacts

All types: $\geq 75,1 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

Whenever the formula results in a value greater than 75 dB, the requirement shall revert to 75 dB

6.5.9 Power sum FEXT loss (for information only)

Conditions: Mated connectors, between each pair and all other pairs combined

All types: $\geq 72,1 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

NOTE This characteristic is achieved by compliance to PP FEXT (6.5.8), and there is no necessity to test it.

6.5.10 Transverse conversion loss

Conditions: Annex J, Transverse conversion loss

Mated connectors

All types: $\geq 68 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

Whenever the formula results in a value greater than 40 dB, the requirement shall revert to 40 dB

6.5.11 Transverse conversion transfer loss

Conditions: Annex J, transverse conversion transfer loss

Mated connectors

All types: $\geq 68 - 20 \log(f)$ dB ($1 \text{ MHz} \leq f \leq 100 \text{ MHz}$) where f is the frequency in MHz

Whenever the formula results in a value greater than 40 dB, the requirement shall revert to 40 dB.

6.5.12 Coupling attenuation

Conditions: According to EN 50289-1-14

Mated connectors

All types: ≥ 35 dB from 30 MHz to 100 MHz

$\geq 75 - 20 \log(f)$ dB from 100 MHz to 1 000 MHz

where f is the frequency in MHz

NOTE Coupling attenuation is assumed to be fulfilled when transverse conversion loss and transverse conversion transfer loss are met on the full bandwidth.

6.6 Mechanical

6.6.1 Mechanical operation

Conditions: IEC 60512, Test 9a
Speed: 10 mm/s maximum
Rest: 1 s minimum (mated and unmated)
PL 1: 750 operations
PL 2: 2 500 operations

NOTE PL1 and PL2 are defined in Clause 2.

6.6.2 Effectiveness of connector coupling devices

Conditions: IEC 60512, Test 15f
All types: 50 N for 60 s $\pm$ 5 s

6.6.3 Insertion and withdrawal forces

Conditions: IEC 60512, Test 13b
Speed: 10 mm/s maximum
All types, insertion and withdrawal: 30 N maximum

7 Tests and test schedule

7.1 General

See Clause 5 of IEC 61076-1:2006.

This document states the test sequence (in accordance with this standard) and the number of specimens for each test sequence.

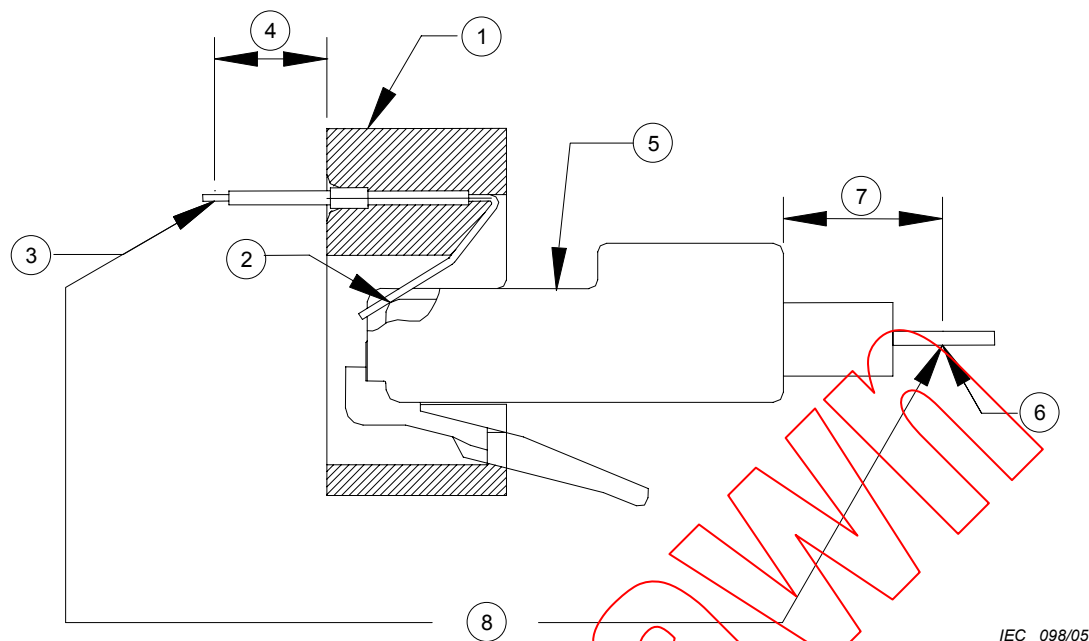
Individual variants may be submitted to type tests for approval of those particular variants.

It is permissible to limit the number of variants tested to a selection representative of the whole range for which approval is required (which may be less than the range covered by the detail specification), but each feature and characteristic shall be proved.

The connectors shall have been processed in a careful and workmanlike manner, in accordance with good current practice.

Unless otherwise specified, mated sets of connectors shall be tested. For contact resistance measurements, care shall be taken to keep a particular combination of connectors together during the complete test sequence; that is, when un-mating is necessary for a certain test, the same connectors shall be mated for subsequent tests.

7.2 Arrangement for contact resistance test



Key

- 1 Fixed connector.
- 2 Point B.
- 3 Point A.
- 4 As short as practical (except for vibration test CP2, see 7.3).
- 5 Free connector.
- 6 Point C.
- 7 As short as practical (except for vibration test CP2, see 7.3).
- 8 Contact resistance measurement points.

Figure 11 – Arrangement for contact resistance test

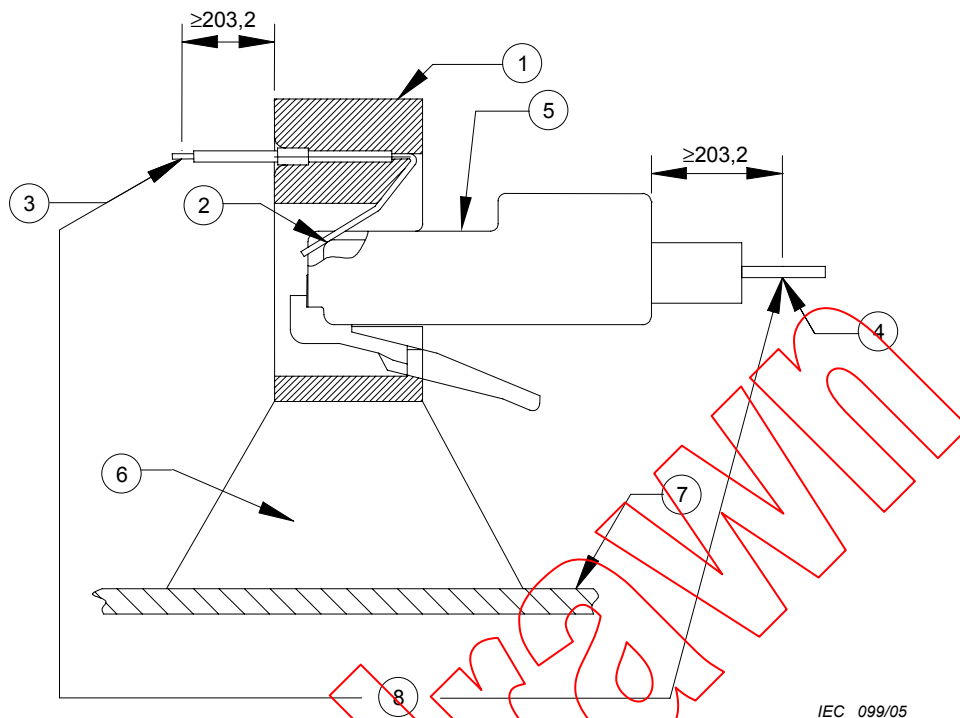
The test procedure is as follows.

- a) Determine the bulk resistance of the fixed connector between points A and B of Figure 11 by calculation or by measurement. This resistance is noted R_{AB} .
- b) Determine the bulk resistance of the free connector between points B and C of Figure 11 by calculation or by measurement. This resistance is noted R_{BC} .
- c) Measure the total mated connector resistance between points A and C, following the requirements and procedures of IEC 60512, Test 2a. This resistance is noted R_{AC} .
- d) Calculate the contact resistance by subtracting the sum of the bulk resistance of the fixed and free connectors from the total mated connector resistance.

$$\text{Contact resistance} = R_{AC} - (R_{ABl} + R_{BCl})$$

where l indicates initial value.

7.3 Arrangement for vibration test (test phase CP1)



Key

- 1 Fixed connector vibration feature.
- 2 Contact point.
- 3 Point A: secure to the non-vibrating member.
- 4 Point C: secure to the non-vibrating member.
- 5 Free connector.
- 6 Fixed connector rigidly fixed to the mounting plate.
- 7 Mounting plate.
- 8 Contact resistance measurement point.

Figure 12 – Arrangement for vibration test

7.4 Test procedures and measuring methods

The test methods specified and given in the relevant standards are the preferred methods but not necessarily the only ones that can be used. In case of dispute, however, the specified method shall be used as the reference method.

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1.

Where approval procedures are involved and alternative methods are employed, it is the responsibility of the manufacturer to satisfy the authority granting approval that any alternative methods which he may use give results equivalent to those obtained by the methods specified.

7.5 Preconditioning

Before the tests are made, the connectors shall be preconditioned under standard atmospheric conditions for testing as specified in IEC 60068-1 for a period of 24 h, unless otherwise specified by the detail specification.

7.6 Wiring and mounting of specimens

7.6.1 Wiring

The wiring of these connectors shall take into account the wire diameter of the cables defined in IEC 61156-2, IEC 61156-3, IEC 61156-4 and IEC 61156-5 as applicable. Where wiring of test specimens is required, this detail specification contains information suitable to comply with the selected methods of test.

7.6.2 Mounting

When mounting is required in a test, unless otherwise specified, the connectors shall be rigidly mounted on a metal plate or to specified accessories, whichever is applicable, using the specified connection methods, fixing devices and panel cut-outs as laid down in this detail specification.

7.7 Test schedules

The test parameters required shall not be less than those listed in Clause 6.

7.7.1 Basic (minimum) test schedule

Not applicable

7.7.2 Full test schedule

7.7.2.1 General

The following tests specify the characteristics to be checked and the requirements to be fulfilled.

For a complete test sequence, a minimum of $52+N$ specimens are needed. This equals 5 groups of 10 for test AP, BP, CP, DP and FP. One group of 2 shall be for transmission testing, group EP. The N groups of 1 shall be for the “screen performance” testing, group GP. The N stands for each cable screen construction type the connectors are intended to be used for.

Test group GP shall be performed N times with the specimens terminated with the different cable construction types the connectors are intended to be used for.

Where not otherwise stated, contact resistance tests, including screen contacts, apply only to the interface between plug and jack (see 7.2).

7.7.2.2 Test group P – preliminary

All specimens shall be subjected to the following tests. All the test group specimens shall be subjected to the preliminary group P tests in the following sequence; see Table 9.

The specimens shall then be divided into the appropriate number of groups. All connectors in each group shall undergo the following tests as described in the sequence given, required alteration of the sequence of tests or adding of new tests to verify additional connector characteristics.

Table 9 – Test group P

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
P1	General examination			Visual examination	1a	There shall be no defects that would impair normal operation
				Examination of dimensions and mass	1b	The dimensions shall comply with those specified in the detail specification
P2	Polarization		Not applicable			
P3	Contact resistance		Measurement points as in Figure 11 All signal contacts and shield / specimens	Millivolt level method	2a	Contact resistance = 20 mΩ maximum
P4			100 V d.c. Method A Mated connectors	Insulation resistance	3a	500 MΩ minimum
P5			Signal contact to signal contact Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All signal contacts to shield and test panel Method A Mated connectors			1 500 V d.c. or a.c. peak

7.7.2.3 Test group AP

Table 10 – Test group AP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
AP1	Insertion and withdrawal forces	13b	Connector locking device depressed			Insertion force 30 N maximum Withdrawal force 30 N maximum
AP2	Effectiveness of connector coupling device	15f	Rate of load application 44,5 N/s maximum			50 N for 60 s ± 5 s
AP3	Rapid change of temperature	11d	–40 °C to 70 °C Mated connectors 25 cycles t = 30 min Recovery time 2 h			

Table 10 (continued)

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
AP4			100 V d.c. Method A Mated connectors	Insulation resistance	3a	500 M Ω minimum
AP5			Measurement points as in Figure 11 All signal contacts and shield / specimens	Contact resistance	2a	20 m Ω maximum change from initial
AP6			Signal contact to signal contact: Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All signal contacts to shield and test panel: Method A Mated connectors			500 V d.c. or a.c. peak
AP7			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation
AP8	Cyclic damp heat	See IEC 60068-2-38	21 cycles; low temperature 25 °C; high temperature 65 °C; cold subcycle –10 °C; humidity 93 % Half of the samples in mated state Half of the samples in unmated state			
AP9			Measurement points as in Figure 11 All signal contacts and shield / specimens	Contact resistance	2a	20 m Ω maximum change from initial for signal contacts Input to output resistance 100 m Ω maximum for shield
AP10	Insertion and withdrawal forces	13b	Connector locking device depressed			Insertion force 30 N maximum Withdrawal force 30 N maximum
AP11	Effectiveness of connector coupling device	15f	Rate of load application 44,5 N/s maximum			50 N for 60 s $\pm$ 5 s
AP12			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation
AP13	Solderability		As applicable			
AP14	Resistance to soldering heat		As applicable			

Table 10 (continued)

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
AP15 a)			Signal contact to signal contact: Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All signal contacts to shield and test panel: Method A Mated connectors			1 500 V d.c. or a.c. peak

a) Step AP15 shall not be performed if solderability and resistance to soldering heat were not performed.

7.7.2.4 Test group BP

Table 11 – Test group BP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
BP1	Locking-device mechanical operations		2 <i>N</i> operations (see mechanical operations)			See Annex B
BP2	Mechanical operations	9a	<i>N</i> /2 operations (see mechanical operations). Speed 10 mm/s. Rest 1 s (when mated and unmated). Locking device inoperative			PL1: <i>N</i> = 750 PL2: <i>N</i> = 2 500
BP3	Flowing mixed gas corrosion	11g	4 days Half of the samples in mated state Half of the samples in unmated state		11g	
BP4			Measurement points as in Figure 11 All signal contacts and shield / specimens	Contact resistance	2a	20 mΩ maximum change from initial for signal contacts Input to output resistance 100 mΩ maximum for shield
BP5	Mechanical operations	9a	<i>N</i> /2 operations (see mechanical operations) Speed 10 mm/s. Rest 5 s (when unmated). Locking device inoperative			

Table 11 (continued)

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
BP6			Measurement points as in Figure 11 All signal contacts and shield per specimen	Contact resistance	2a	20 mΩ maximum change from initial for signal contacts Input to output resistance 100 mΩ maximum for shield
BP7			100 V d.c. Method A Mated connectors	Insulation resistance	3a	500 MΩ minimum
BP8			Signal contact to signal contact: Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All signal contacts to shield and test panel: Method A Mated connectors			1 500 V d.c. or a.c. peak
BP9				Visual examination	1a	There shall be no defects that would impair normal operation

7.7.2.5 Test group CP**Table 12 – Test group CP**

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
CP1	Vibration	6d	$f = (10 \text{ to } 500) \text{ Hz}$, Amplitude = 0,35 mm Acceleration = 50 m/s ² 10 sweeps/axis Measurement points as in Figure 12	Contact disturbance	2e	10 μs maximum
CP2			Measurement points as in Figure 11 All signal contacts and shield / specimens	Contact resistance	2a	No disturbance of plug and jack between vibration test and measurement 20 mΩ maximum change from initial for signal contacts Input to output resistance 100 mΩ maximum for shield

Table 12 (continued)

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
CP3			100 V d.c. Method A Mated connectors	Insulation resistance	3a	500 MΩ minimum
CP4			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation

7.7.2.6 Test group DP

Table 13 – Test group DP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
DP1	Electrical load and temperature	9b	500 h 70 °C Recovery period 2 h			0.5 A 5 specimens No current 5 specimens
DP2			100 V d.c. Method A Mated connectors	Insulation resistance	3a	500 MΩ minimum
DP3			Signal contact to signal contact Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All signal contacts to shield and test panel: Method A Mated connectors			1 500 V d.c. or a.c. peak
DP4			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation
DP5			Measurement points as in Figure 11 All signal contacts and shield / specimens	Contact resistance	2a	20 mΩ maximum change from initial for signal contacts Input to output resistance 100 mΩ maximum for shield
DP6	Gauging	Annex L	Both, free and fixed connector			All samples tested shall pass all gauges and forces
DP7	Gauging continuity	Annex A	All signal contacts and shield / specimens	Contact disturbance	2e	10 μs maximum

7.7.2.7 Test group EP

Table 14 – Test group EP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
EP1			All pairs	Insertion loss	Test 25b and Annex E of this part of IEC 60603-7	Per Clause 6
EP2			All pair combinations, both directions	NEXT loss	Test 25a and Annex G of this part of IEC 60603-7	Per Clause 6
EP3			All pairs, both directions	Return loss	Test 25e and Annex F of this part of IEC 60603-7	Per Clause 6
EP4			All pair combinations, both directions	FEXT loss	Test 25a and Annex H of this part of IEC 60603-7	Per Clause 6
EP5			All pairs	Transverse conversion loss	Annex J of this part of IEC 60603-7	Per Clause 6
EP6				Transverse conversion transfer loss	Annex J of this part of IEC 60603-7	Per Clause 6
EP7	Input to output d.c. resistance		Measurement points as defined in 6.4.5 All signal contacts and shield	Millivolt level method	2a	Per Clause 6
EP8	Input to output d.c. resistance unbalance		Measurement points as defined in 6.4.6 All signal contacts	Millivolt level method	2a	Per Clause 6
All measurements shall be performed on mated connectors.						

7.7.2.8 Test Group FP

Table 15 – Test group FP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
FP1	Surge test	ITU-T K.20:2000	Mated connectors Table 2a/2b Basic test level Tests 2.1.1a, 2.1.1b, 2.1.3, 2.2.1a, and 2.3.1a			Test 2.1 and 2.2: Acceptance criteria A per ITU-T K.44:2000, Clause 9 Test 2.3: Acceptance criteria B per ITU-T K.44:2000, Clause 9
FP2			100 V d.c. Method A Mated connectors	Insulation resistance	3a	500 MΩ minimum
FP3			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation

7.7.2.9 Test group GP

Table 16 – Test group GP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
GP1	High temperature	9b	500 h 70 °C Recovery period 2 h All samples in mated state			
GP2	Cyclic damp heat	See IEC 60068-2-38	21 cycles, Low temperature 25 °C, High temperature 65 °C, Cold subcycle –10 °C, Humidity 93 %, Half of the samples in mated state, Half of the samples in unmated state			
GP3			Additional tests for further study			
GP4				Transfer impedance	Annex I	Per Clause 6
GP5				Coupling attenuation	EN 50289-1-14	Per Clause 6

Annex A (normative)

Gauging continuity procedure

A.1 Object

The object of this test is to check whether, in worst-case conditions of the free connector, the electrical continuity for signal contacts and shield is guaranteed.

A.2 Preparation of the specimens

A gauge according to Figure A.1 should be applied to test the fixed connector specimen.

A.3 Test method

Apply to the test specimen and to the gauge a circuit according to IEC 60512, Test 2e. For each individual contact of the fixed connector and the shield, the test shall be repeated.

For the test of the signal contacts, the gauge shall be fully inserted and then be moved upwards until it stops against the plastic wall of the fixed connector (See Figure A.2).

For the test of the shield contact, the gauge shall be fully inserted and then be moved to both sides of the connector until it stops against the plastic wall of the fixed connectors. This movements shall be repeated 3 times.

During the movements, a forward force of 20 N minimum shall be applied as indicated by the arrow in Figure A.2.

A.4 Final measurements

The fixed connector specimen will meet the requirements if no discontinuity or a 10 μ s maximum discontinuity is monitored for each individual contact.

A.5 Description of the continuity gauge

The gauge shall be made according to the following specification (see Figure A.1):

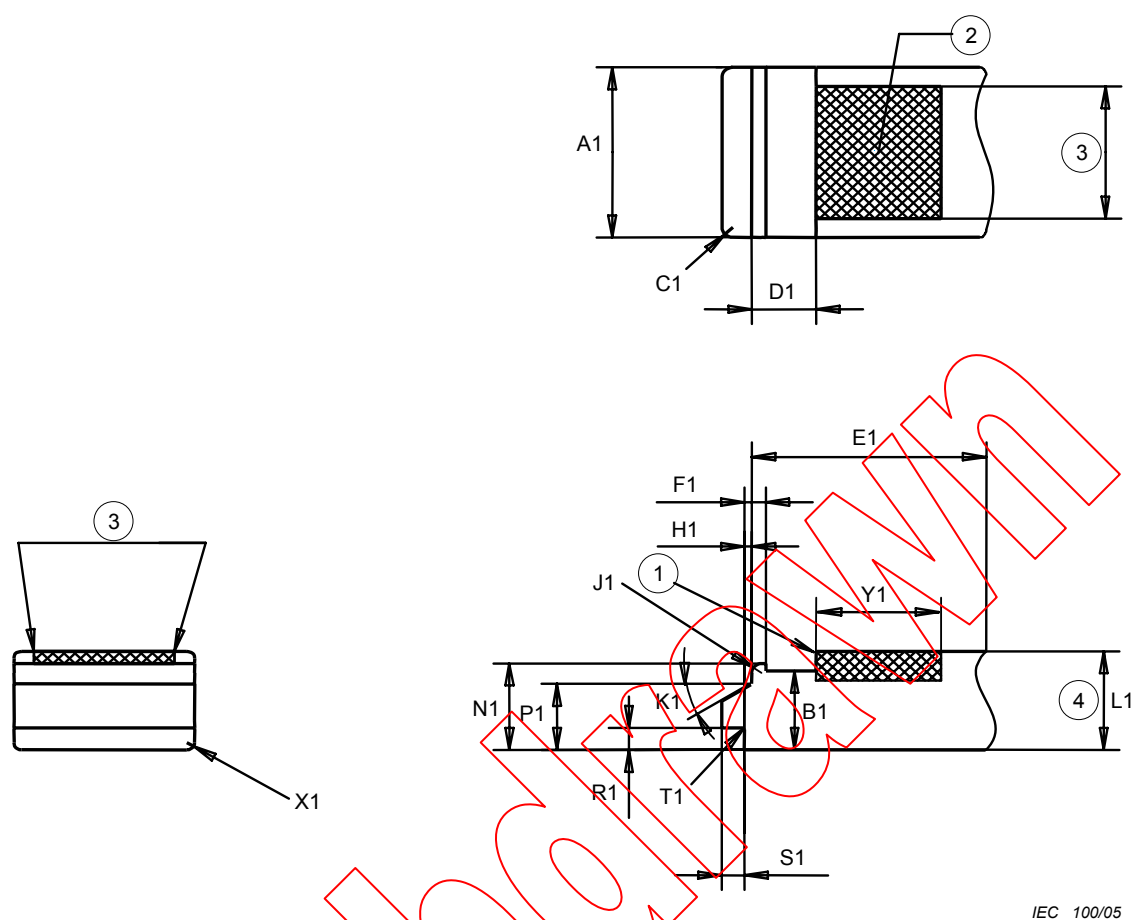
Material: tool steel, hardened with suitable plating finish.

Surface roughness: according to ISO 1302 Ra: 0,25 μ m maximum.

Table A.1 – Dimensions for Figure A.1

Letter	Maximum	Minimum
	mm	mm
A1	11,59	11,57
B1	4,90	
C1	0,8	0,6
D1	4,12	4,10
E1		15,0
F1	0,89	0,79
H1	0,47	0,45
J1	0,69	0,59
L1	6,72	6,70
N1	5,90	5,88
P1	4,7	4,3
R1	1,6	1,4
S1	1,46	1,44
T1	0,1	
X1	0,6	0,4
Y1		5,0

Letter	Maximum	Minimum
K1	30°	24°



IEC 100/05

Key

- 1 Sharp edge.
- 2 Insulation part.
- 3 Edge of insulation part may not extend beyond radius of steel part.
- 4 Dimension to edge of insulation part.

Figure A.1 – Gauge

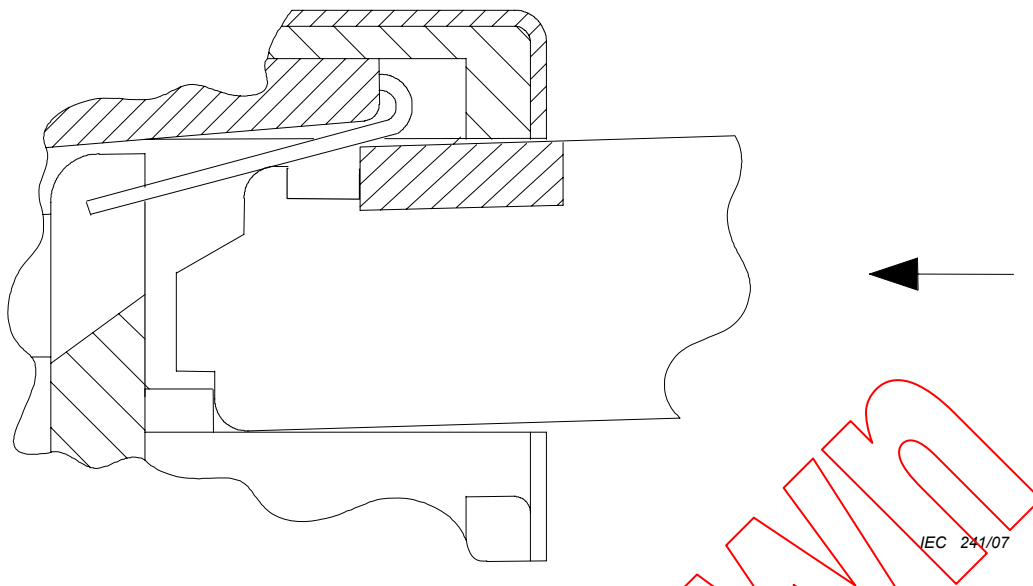


Figure A.2 – Gauge insertion

Withdrawn

Annex B (normative)

Locking-device mechanical operation

B.1 Object

The object of this mechanical endurance test is to assess the operational limits of the locking device on the free connectors.

B.2 Preparation of the specimens

The specimen shall be prepared and mounted so that the locking device is readily accessible for application of the test. No other movement of the free connector shall be allowed.

B.3 Test method

The specimen shall be subjected to mechanical operational endurance tests of the number of cycles, as specified in Table 11, group BP, test BP1.

The speed of the operation of the applied force to the locking device shall not exceed 20 cycles per minute.

The specimen shall be operated in the normal manner, and the locking device shall be depressed until it contacts the body of the free connector.

Mechanical aids which simulate normal operations may be used, provided that they do not introduce abnormal stresses.

B.4 Final measurements

After the specified number of operations, when visually examined in accordance with IEC 60512, Test 1a, the specimens shall show no visual indication of fatigue or stress cracking of the locking device.

Annex C (normative)

Test-plug requirements

C.1 General

In this Annex, unless otherwise specified, frequency is given in MHz.

Test plugs shall be measured according to the procedure in Clause C.8. They shall be measured mated to a reference jack as described in Clause C.5. For test-plug NEXT measurements, the NEXT of the reference jack shall be subtracted. Use the values in Table C.1 for the NEXT of the reference jack. Clauses C.2 to C.6 are for reference, and they specify how the NEXT of the reference jack was determined. However, C.5.2 shall be followed to select a reference jack. In addition, these clauses contain normative information to the extent that they are referenced by other clauses of this standard.

When NEXT measurements are made, the test leads shall be mounted in a pyramid, channel, or other device to manage both their common and differential mode impedance.

C.2 De-embedding reference NEXT plug construction

Take a pair from a cable that exhibits a return loss in excess of 35 dB from 1 MHz to 250 MHz. This value shall be measured on a cable with a length of approximately 150 mm. The return loss of the wire pair shall be verified under conditions of actual use. Cut four lengths of approximately 81 mm. Use of wire lengths of 81 mm will result in a plug length of approximately 75 mm, including the test leads. If the commonly available impedance management fixture is used, this will allow a small length of wire to be trimmed off to fit the plug on the fixture.

NOTE The port extension constants may be estimated by measuring the through delay of a 150 mm jumper; however, the data will have to be phase-corrected later, as specified in C.3.2.

Take a standard plug body that conforms to the dimensional requirements of IEC 60603-7 in which the 8 conductors are parallel and at the same height. Machine off the back end, where the strain relief is, so that the plug is 13 mm long from the nose where the contacts are to its back. Drill 8 conductor paths through the nose, so that the individual wires can be extended through the nose.

Untwist about 19 mm of one end of the four 81 mm long twisted pair wires. Strip off 1 mm to 2 mm of insulation from the untwisted end, so that 0603 package size resistors can be soldered there later. Place them in the plug, extending 6 mm beyond. The 3,6 pair will have to be split apart, but bend it back together as soon as practical after it exits from the nose. On the back end, insert pair 3,6 toward the locking tab from pair 4,5; later, we will bend it toward the locking tab and pair 4,5 away from the locking tab.

Set the plug blades into the wires.

Arrange the conductors according to Figure C.1.