IEC PAS 61076-2-114

Edition 1.0 2016-05

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Connectors for electronic equipment – Product requirements – Part 2-114: Circular connectors – Detail specification for data and power connectors with M8 screw-locking

IEC PAS 61076-2-114:2016-05(en)

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CONNECTORS FOR ELECTRONIC EQUIPMENT – PRODUCT REQUIREMENTS –

Part 2-114: Circular connectors – Detail specification for data and power connectors with M8 screw-locking

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IEC PAS 61076-2-114 has been processed by subcommittee 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

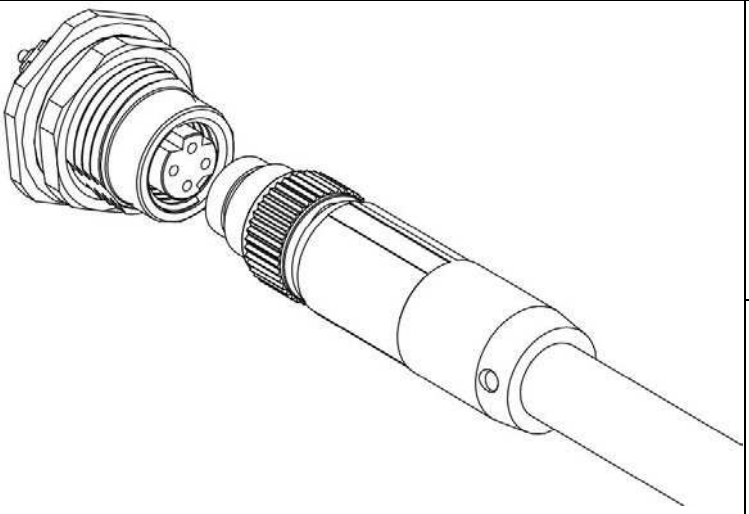
The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
48B/2459/PAS	48B/2476/RVC

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

IEC SC 48B – Connectors Specification available from: IEC General secretariat or from the addresses shown on the inside cover.	IEC 61076-2-114
ELECTRONIC COMPONENTS DETAIL SPECIFICATION in accordance with IEC 61076-1	
	Circular connectors M8 for data and power applications with screw-locking and 4 ways Male and female connectors Male and female contacts Rewireable – Non-rewireable
	Free cable connectors Straight and right angle connectors Fixed connectors Flange mounting Single hole mounting

CONNECTORS FOR ELECTRONIC EQUIPMENT – PRODUCT REQUIREMENTS –

Part 2-114: Circular connectors – Detail specification for data and power connectors with M8 screw-locking

1 Scope

This part of IEC 61076 describes circular connectors with M8 screw-locking typically used for data transmissions in industrial applications. These connectors consist of fixed and free connectors either rewireable or non-rewireable, with M8 screw-locking. Male connectors have round contacts ∅0,8 mm.

The coding provided by this PAS prevents the mating of accordingly coded male or female connectors to any other similarly sized interfaces covered by other standards.

NOTE M8 is the dimension of the thread of the screw-locking mechanism of these circular connectors.

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 60050-581, *International Electrotechnical Vocabulary – Part 581: Electromechanical components for electronic equipment*

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

IEC 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*

IEC 60352 (all parts), *Solderless connectors*

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 60512-29-100, *Connectors for electronic equipment – Tests and measurements – Part 29-100: Signal integrity tests up to 500 MHz on M12 style connectors – Tests 29a to 29g*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*

IEC 60603-7:2008, *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

IEC 60603-7-1, *Connectors for electronic equipment – Part 7-1: Detail specification for 8-way, shielded, free and fixed connectors*

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

IEC 60998-2-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units*

IEC 60999 (all parts), *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units*

IEC 61076-1:2006, *Connectors for electronic equipment – Product requirements – Part 1: Generic specification*

IEC 62197-1, *Connectors for electronic equipment – Quality assessment requirements – Part 1: Generic specification*

IEC 62430, *Environmentally conscious design for electrical and electronic products*

IEC GUIDE 109, *Environmental aspects – Inclusion in electrotechnical product standards*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581 as well as the following apply.

3.1
mounting orientation
circular mounting position of the connector in relation to the polarization of the mating interface

Note 1 to entry: Where the free connector has an angled cable entry (as opposed to a straight cable entry), the angle between the cable entry direction and the polarization keyway should be specified.

4 Technical information

4.1 Systems of levels

4.1.1 Performance levels

Not applicable.

4.1.2 Compatibility levels, according to IEC 61076-1:2006

D-coding 4 contacts

4.2 Classification into climatic categories (Table 1)

Table 1 – Climatic category

Climatic category	Category temperature		Damp heat steady state		Days
	Lower °C	Upper °C	Temperature °C	Rel. humidity %	
25/85/21	–25	+85	40	93	21

4.3 Creepage and clearance distances

See 7.3.

4.4 Current-carrying capacity

Conditions: IEC 60512, test 5b
All contacts
Values at 40 °C
D-coding = 2 A

4.5 Marking

The marking of the connector and the package shall be in accordance with 2.7 of IEC 61076-1:2006.

5 Dimensional information

5.1 General

Throughout this PAS, dimensions are in mm. Drawings are shown in the first angle projection. The shape of the connectors may deviate from those given in the following drawings as long as the specified dimensions are not influenced.

Missing dimensions shall be chosen according to common characteristics and intended use.

5.2 Isometric view and common features

5.2.1 General

For all connector styles with cables, the length L of the cable shall be agreed between manufacturer and user. For interface dimensions see 5.3.

5.2.2 Common features

Not applicable.

5.2.3 Reference system

Not applicable.

5.3 Engagement (mating) information

5.3.1 Engaging (mating) direction

Arrows in Figure 1 indicates the mating direction.

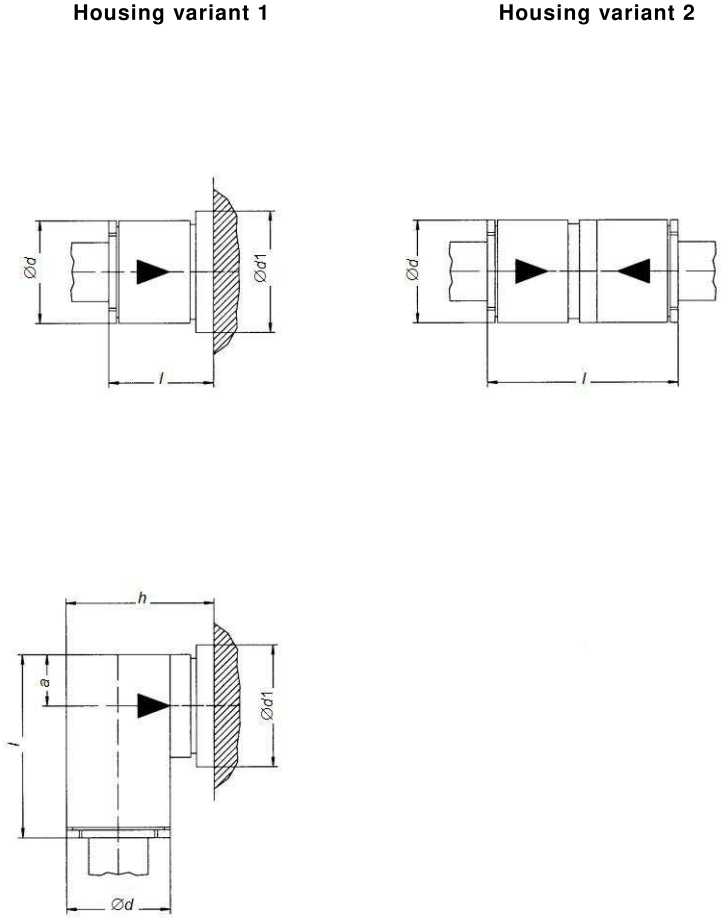


Figure 1 – Engagement (mating) information

5.3.2 Contact levels and sequencing

The contact and disconnection sequence during the connection process is not defined.

5.3.3 Perpendicular to the engaging (mating) direction

The maximum allowable displacement in each perpendicular direction is 0,1 mm.

5.3.4 Inclination

The maximum allowable inclination in the longitudinal and transverse axes is 5° in the positive and negative direction.

5.4 Fixed connectors

5.4.1 Dimensions

5.4.1.1 General

Table 2 shows styles of fixed connectors.

Table 2 – Styles of fixed connectors

Style	Description
BM	Tube insert, male contacts dip solder mounting, long version
CM	Tube insert, male contacts dip solder mounting, short version
EM	Fixed connector with wire ends, male contacts, single hole mounting
EF	Fixed connector with wire ends, female contacts, single hole mounting

5.4.1.2 Style BM

Figure 2 shows style BM.

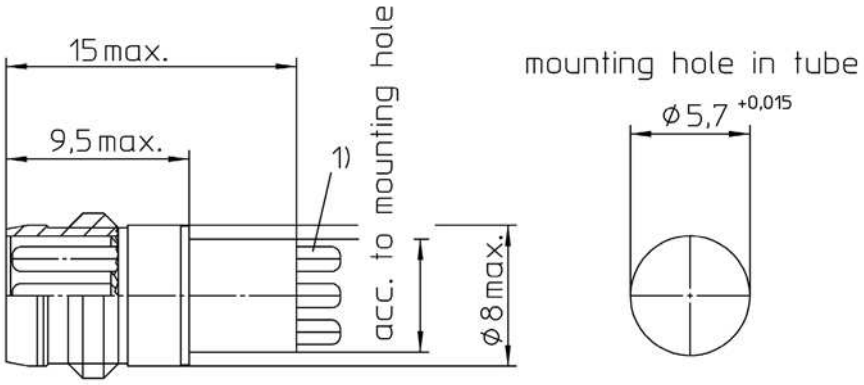


Figure 2 – Tube insert, male contacts dip solder mounting, long version

5.4.1.3 Style CM

Figure 3 shows style CM.

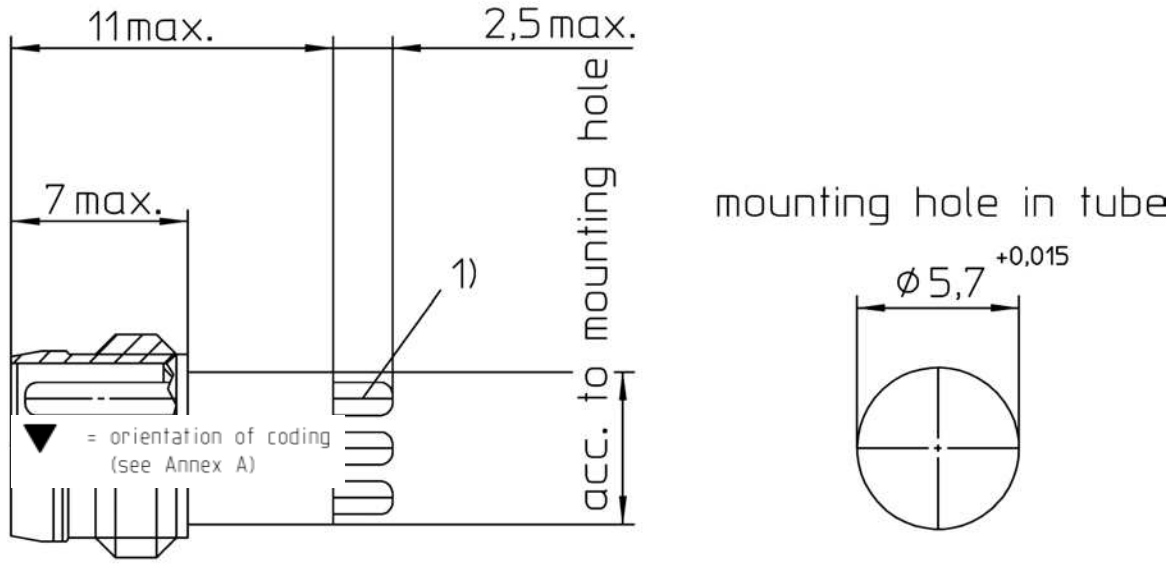


Figure 3 – Tube insert, male contacts dip solder mounting, short version

5.4.1.4 Style EM

Figure 4 shows style EM.

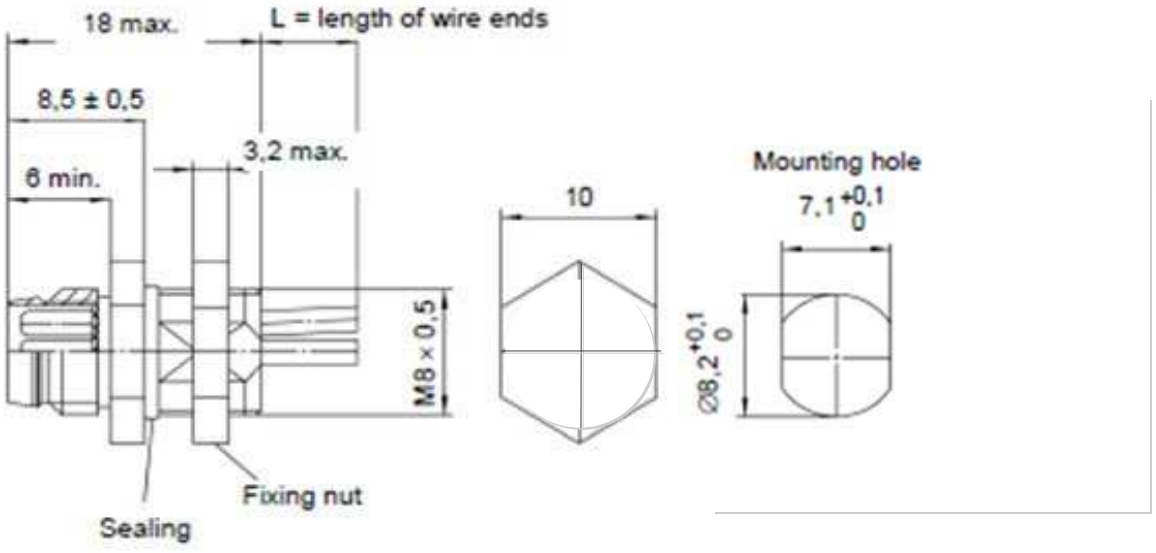


Figure 4 – Fixed connector with wire ends, style EM

5.4.1.5 Style EF

Figure 5 shows style EF.

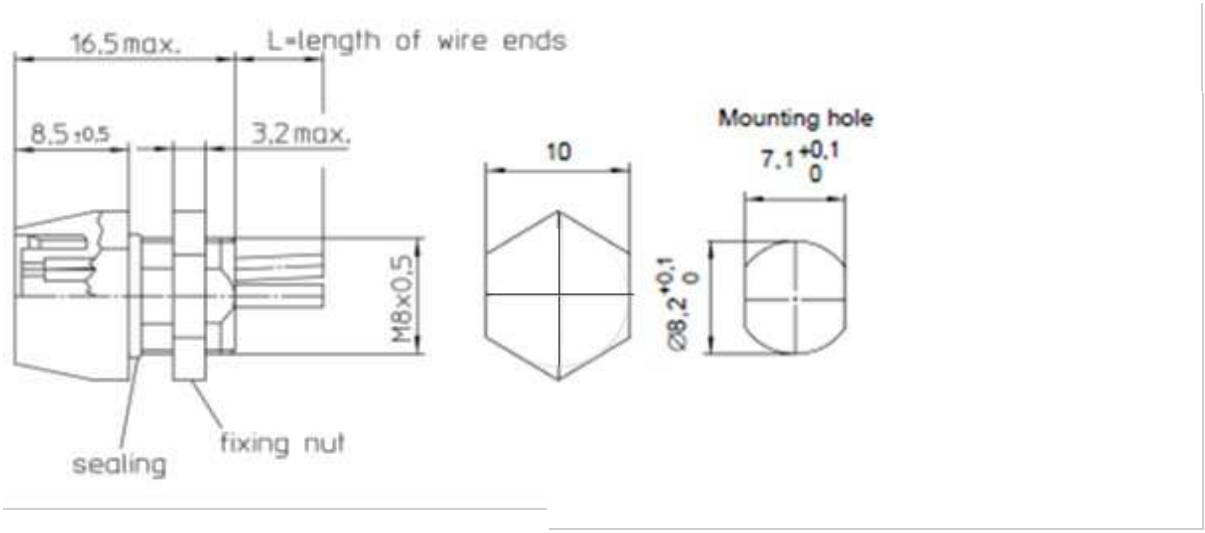


Figure 5 – Fixed connector with wire ends, style EF

5.4.2 Terminations

The contact terminations shall be of the following types: screw, crimp, piercing, insulation displacement, press-in or solder.

Solderless terminations shall be in accordance with the relevant standard from the IEC 60352 series.

Screw type terminations shall be in accordance with the IEC 60999 series.

5.5 Free connectors

5.5.1 Dimensions

5.5.1.1 General

Table 3 shows styles of free connectors.

Table 3 – Styles of free connectors

Style	Description
JM	Rewireable connector, male contacts, straight version, with locking nut [a]
KM	Rewireable connector, male contacts, right angled version, with locking nut [a]
LM	Non-rewireable connector, male contacts, straight version, with locking nut [a]
MM	Non-rewireable connector, male contacts, right angled version, with locking nut
JF	Rewireable connector, female contacts, straight version, with locking nut
KF	Rewireable connector, female contacts, right angled version, with locking nut
LF	Non-rewireable connector, female contacts, straight version, with locking nut
MF	Non-rewireable connector, female contacts, right angled version, with locking nut
[a] Knurled ring or hexagonal ring upon agreement.	

5.5.1.2 Style JM

Figure 6 shows style JM.

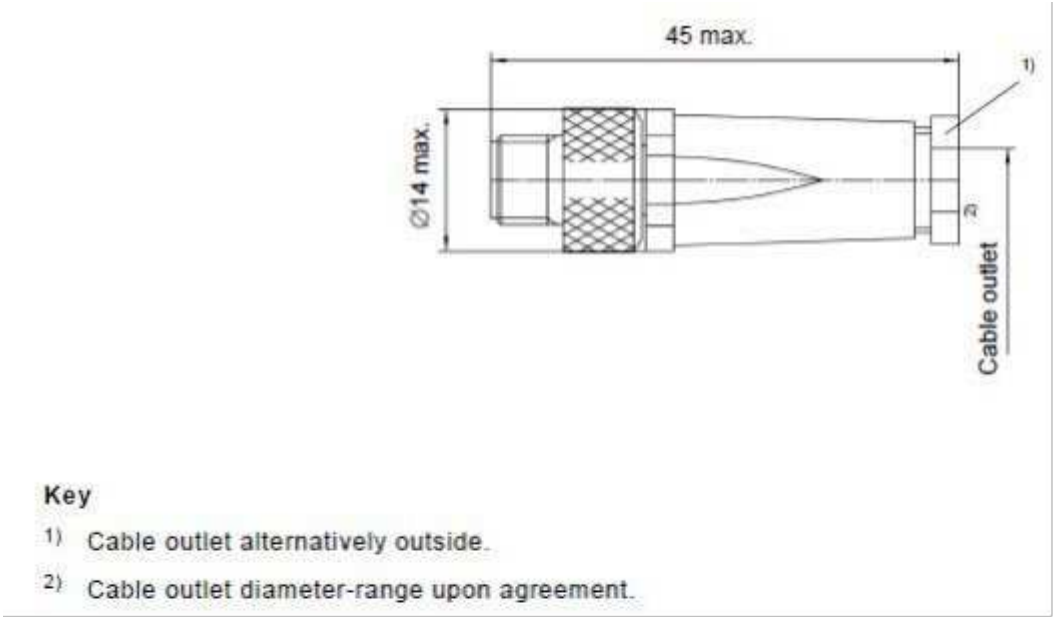


Figure 6 – Rewireable connector, male contacts, straight version, with locking nut

5.5.1.3 Style KM

Figure 7 shows style KM.

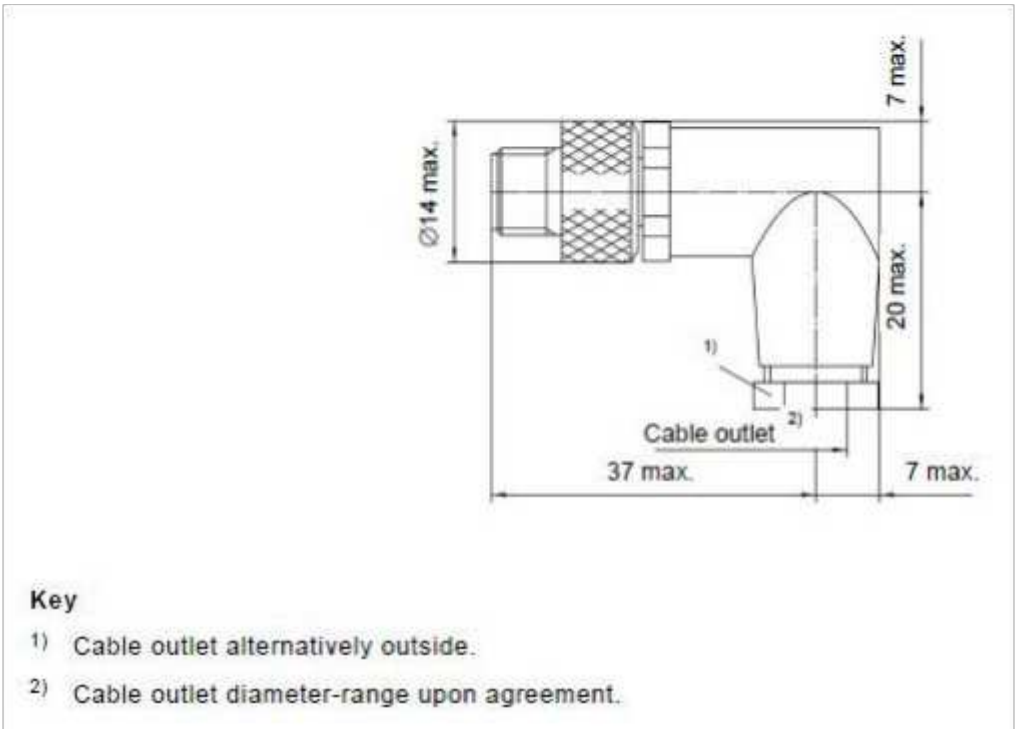


Figure 7 – Rewireable connector, male contacts, right angled version, with locking nut

5.5.1.4 Style LM

Figure 8 shows style LM.

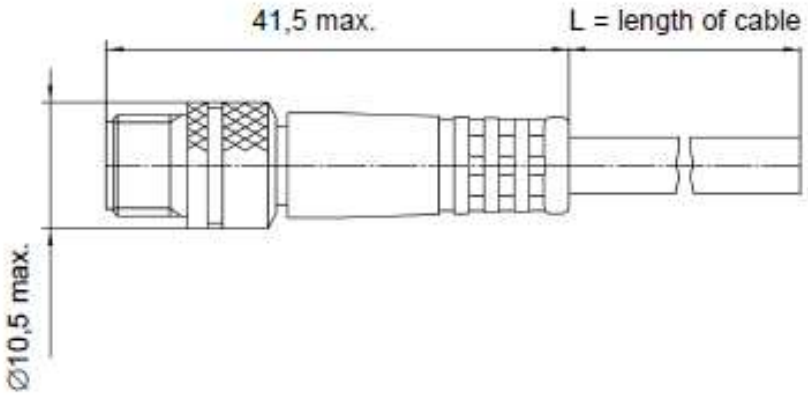


Figure 8 – Non-rewireable connector, male contacts, straight version, with locking nut

5.5.1.5 Style MM

Figure 9 shows style MM.

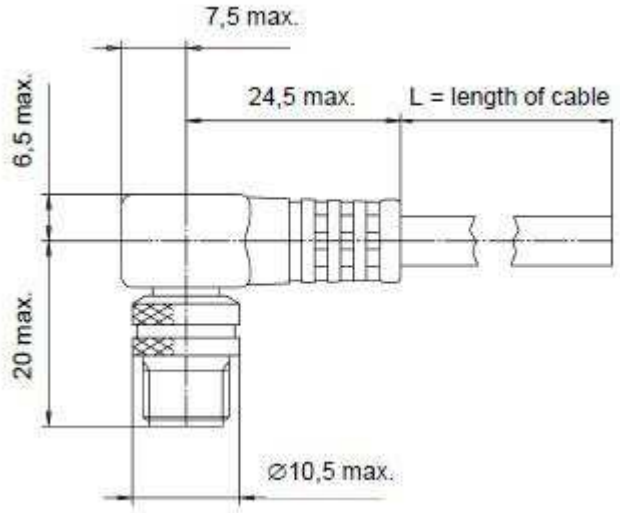
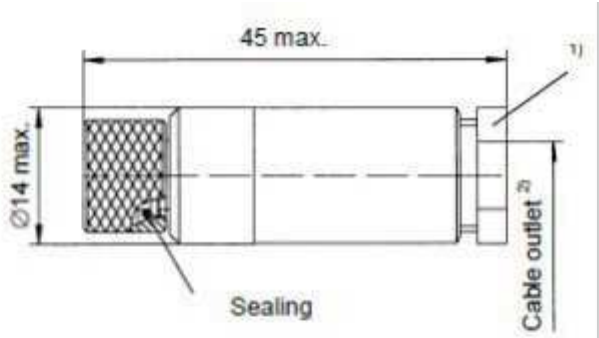


Figure 9 – Non-rewireable connector, male contacts, right angled version, with locking nut

5.5.1.6 Style JF

Figure 10 shows style JF.



Key

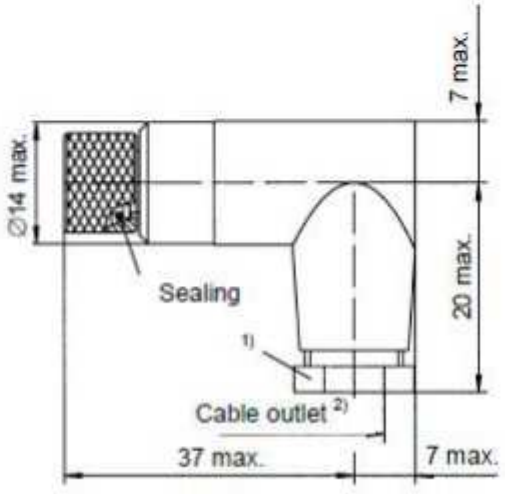
1) Cable outlet alternatively outside.

2) Cable outlet diameter range upon agreement.

Figure 10 – Rewireable connector, female contacts, straight version, with locking nut

5.5.1.7 Style KF

Figure 11 shows style KF.



Key

1) Cable outlet alternatively outside.

2) Cable outlet diameter range upon agreement.

Figure 11 – Rewireable connector, female contacts, right angled version, with locking nut

5.5.1.8 Style LF

Figure 12 shows style LF.

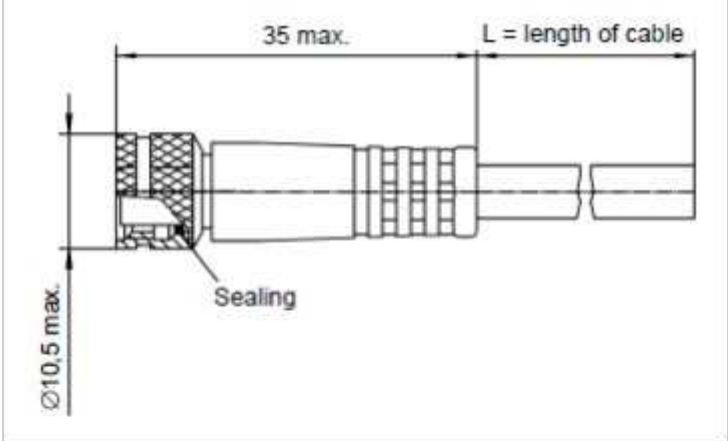


Figure 12 – Non-rewireable connector, female contacts, straight version, with locking nut

5.5.1.9 Style MF

Figure 13 shows style MF.

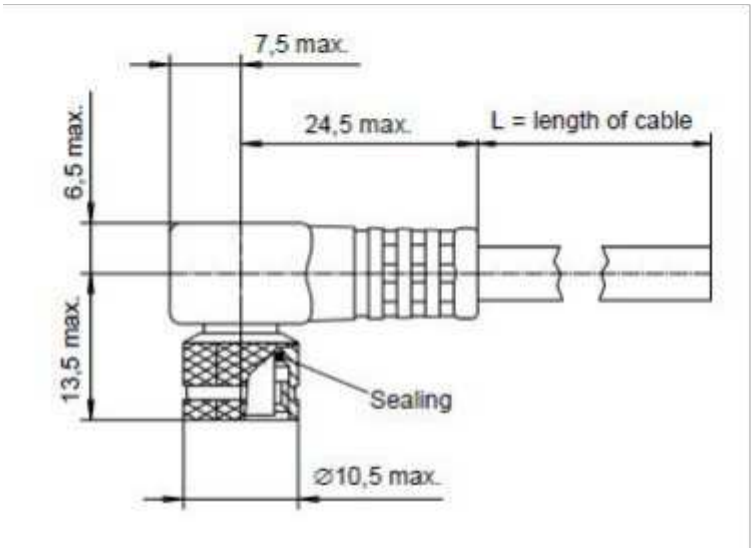


Figure 13 – Non-rewireable connector, female contacts, right angled version, with locking nut

5.5.1.10 Interface dimensions – Fixed connectors

Figure 14 shows a fixed connector with female contacts and Table 4 shows the related dimensions.

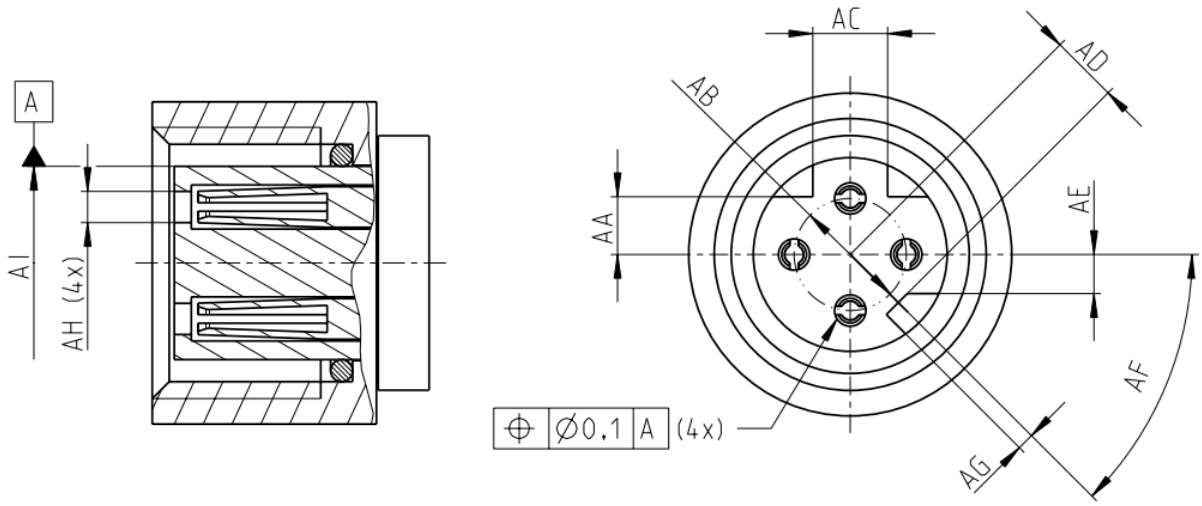


Figure 14 – Fixed connector

Table 4 – Dimensions of fixed connector

Letter	Maximum mm	Minimum mm	Nominal mm
AA	1,75	1,65	1,7
AB			3,3
AC	2,25	2,15	2,2
AD	2	1,9	1,95
AE	1,15	1,05	1,1
AF	46°	44°	45°
AG	0,6	0,5	0,55
AH	ø 0,92		
AI	ø 5,7	ø 5,6	ø 5,65

5.5.1.11 Interface dimensions – Free connector

Figure 15 shows a free connector with male contacts and Table 5 shows the related dimensions.

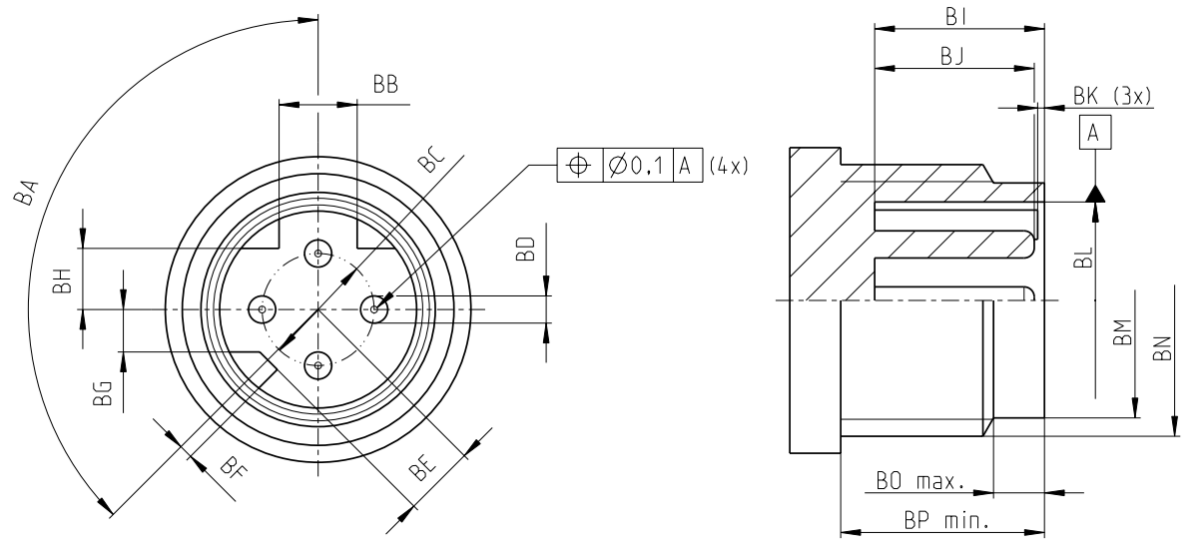


Figure 15 – Free connector

Table 5 – Dimensions of free connector

Letter	Maximum mm	Minimum mm	Nominal mm
BA	136°	134°	135°
BB	2,4	2,3	2,35
BC			D 3,3
BD	ø 0,83	ø 0,77	ø 0,8
BE	2,2	2,1	2,15
BF	0,4	0,3	0,35
BG	1,35	1,25	1,3
BH	1,9	1,8	1,85
BI	5,05	4,95	5
BJ	4,7	4,5	4,6
BK	0,2	0	0,1
BL	ø 5,8	ø 5,75	ø 5,8
BM	ø 6,92		
BN			M8x1
BO	3		
BP		6	

5.6 Accessories

Not applicable.

5.7 Mounting information for connectors

5.7.1 Mounting on panels

Not applicable.

5.8 Gauges

5.8.1 Sizing gauges and retention force gauges

Material: tool steel, hardened

= Surface (clean and free of grease)
roughness according to ISO 1302: Ra = 0,25 μm max
0,15 μm min

Figure 16 shows gauge dimensions.

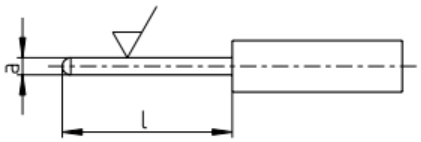


Figure 16 – Gauge dimensions

Table 6 shows gauges.

Table 6 – Gauges

Gauge	Mass g	Application	Ø *a* mm	*l* min mm	Nom pin Ø
P	-	Sizing	0,83 ±3 μm	10	0,8
P	20	Retention force	0,77 ±3 μm	10	

5.8.2 Mechanical function, engaging/separating/insertion/withdrawal force gauges

Not applicable.

5.8.3 Probes

Not applicable.

5.8.4 Contact resistance gauge

Not applicable.

5.8.5 Test panel (for voltage proof test)

For all styles of fixed connectors, the panal cutout shall be designed according to the drawings in 5.4 with cutout dimensions 2 μm larger than the maximum tolerance of the fixed connector. The test panel shall have the maximum thickness according to the style.

For free connectors, the connectors shall be wrapped into a foil of aluminum. The foil shall be connected to PE.

5.8.6 Test panel (for EMC/ crosstalk, etc.)

Not applicable.

6 Characteristics

6.1 General

For the ratings, see Table 7.

Table 7 – Ratings of connectors

Coding	Style	Contacts	Rated voltage a.c. or d.c. V	Rated current A
D-coding	4 way	4	60	4

Insulation resistance : 10^8 Ω min.
Climatic category : see Table 8
Contact spacing : see Clause 6

The Detail Quality Specification according to IEC 62197-2-1 is not applicable.

6.2 Pin assignment and other definitions

See Annex A.

6.3 Classification into climatic categories

Conditions: IEC 60068-1

Table 8 shows climatic category.

Table 8 – Performance levels

Performance level	Climatic category	Category temperature		Damp heat steady state		Days
		Lower °C	Upper °C	Temperature °C	Rel. humidity %	
P21, P22, P23	25/85/21	–25	+85	40	93	21

6.4 Electrical characteristics

6.4.1 Creepage and clearance distances

See 7.3.

6.4.2 Voltage proof

The connector shall be tested according to the ratings in 6.1 and shall be mounted to the test panel specified in 5.8.5.

Conditions: IEC 60512, Test 4a
Standard atmospheric conditions
Mated connectors

6.4.3 Current-carrying capacity

Table 9 – Current-carrying capacity

Coding	Nominal current	Current at RTI
D-coding	4 A	0 A
NOTE Current-carrying capacity up to 40 °C.		

6.4.4 Contact and shield resistance

Conditions: IEC 60512, Test 2a
Standard atmospheric conditions
Measuring points, see Figure 22
Mated connectors

The maximum allowable contact and shield resistance is 10 mΩ.

6.4.5 Insulation resistance

Conditions: IEC 60512, Test 3a, Method A
Standard atmospheric conditions
Test voltage 500 V ± 15 V d.c.

The minimum allowable insulation resistance is 10^8 Ω.

6.4.6 Impedance

100 Ohms.

6.5 Mechanical characteristics

6.5.1 Mechanical operation

Conditions: IEC 60512, Test 9a
Standard atmospheric conditions
Max. speed of operations = 10 mm/s
Rest: 30 s, unmated

Table 10 shows the number of mechanical operations.

Table 10 – Number of mechanical operations

Performance level	Mechanical operations
P21	100
P22	50
P23	20
other types	[a]
[a] Other mating cycles are upon agreement between manufacturer and user.	

6.5.2 Effectiveness of connector coupling device

Conditions: IEC 60512, Test 8a or IEC 60512, Test 15f
Standard atmospheric conditions

The minimum allowable force is 100 N.

6.5.3 Engaging and separating forces (or insertion and withdrawal forces)

Conditions: IEC 60512, Test 13b
Max. speed = 10 mm/s

Table 11 shows insertion and withdrawal forces.

Table 11 – Insertion and withdrawal forces

Number of poles	Total insertion force N	Total withdrawal force N
4	Max. 20	Max. 20

6.5.4 Contact retention in insert

Not applicable.

6.5.5 Polarization and coding method

Conditions: IEC 60512, Test 13e
Standard atmospheric conditions

See Table 12.

Table 12 – Insertion force

Number of poles	Total insertion force N
4	Min. 20

6.6 Other characteristics

6.6.1 Shock and vibration (method either random or sine)

Conditions: IEC 60512, Test 6d
Standard atmospheric conditions
Connectors in mated and locked position
The fixed and free connector shall be rigidly installed in a suitable fixture as specified in Figure 17.
Vibration severity: 10 Hz to 500 Hz with 0,35 mm or 50 m/s^2

Duration: 10 cycles each axis

Cable with maximum wire size or overmolded cable.

Figure 17 shows a dynamic stress test arrangement.

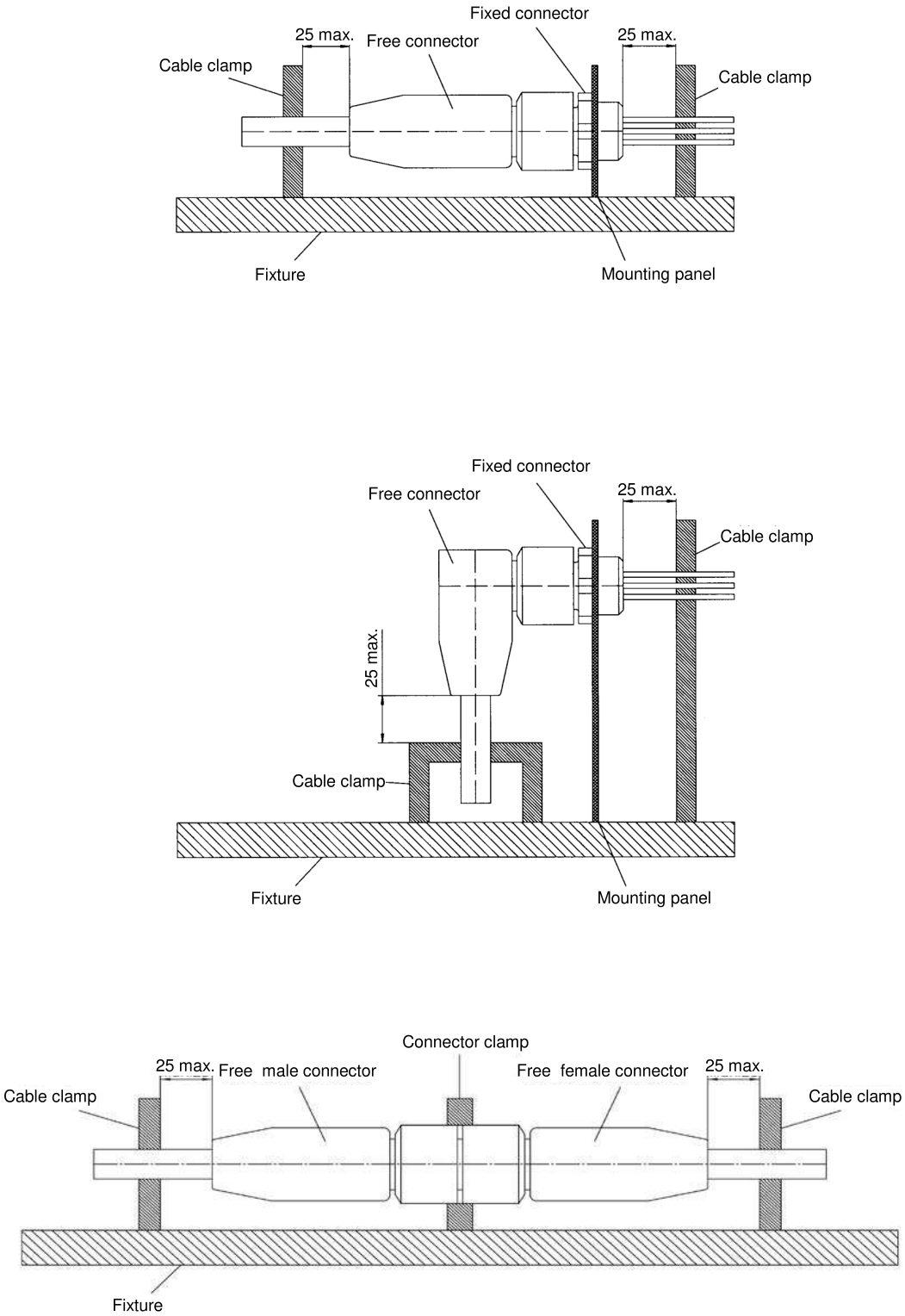


Figure 17 – Dynamic stress test arrangement

6.6.2 Degree of protection provided by enclosures (IP code)

Conditions: IEC 60529:1989, test 14.2.5 and test 14.2.7 (second numeral) and IEC 60529:1989,test 6, Table 7 (first numeral)

Either IP65 or IP67 according to IEC 60529
Connectors in mated and locked position.
IP68 as agreed between manufacturer and user.
Fixed connector to be mounted according to 5.8.5

6.6.3 Screen and shielding properties

Not applicable.

6.7 Environmental aspects

6.7.1 Marking of insulation material (plastics)

If applicable and possible, all plastic material should be marked according to ISO 11469 to ease recycling.

6.7.2 Design/ use of material

The design has to take into account the relevant IEC guides for designing products (IEC 62430) and the use of material (IEC Guide 109) with regard to the environment.

7 Test schedule

7.1 General

This test schedule shows the tests and the order in which they shall be carried out as well as the requirements to be met.

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1, as directed by the applicable part of IEC 60512.

Unless otherwise specified, mated and locked sets of connectors shall be tested. Care shall be taken to keep a particular combination of connectors together during the complete test sequence, i.e. when unmating is necessary for a certain test, the same connector styles as before shall be mated for the subsequent tests.

In the following, a mated and locked sets of connector styles is called a specimen.

When the initial tests P have been completed, the specimens are divided in the 4 test groups AP, BP, CP and DP. In addition, 20 single contacts are used for EP and 2 additional specimens for FP.

Before testing commences, the connectors shall be stored for at least 24 h in the non-engaged state under standard atmospheric conditions as per IEC 60068-1.

The necessary specimens are stated in Table 13.

Table 13 – Number of test specimens

	Test group					
	P	**AP**	**BP**	**CP**	**DP**	**GP**
No. of specimen	12	3	3	3	3	3

7.2 Climatic category

The climatic category and related performance levels are stated in Table 14.

Table 14 – Performance levels

Performance level	**Climatic category**	**Category temperature**		**Damp heat steady state**		**Days**
		Lower °C	**Upper** °C	**Temperature** °C	**Rel. humidity** %	
P21, P22, P23	25/85/21	–25	+85	40	93	21

7.3 Creepage and clearance distances

The coordination of creepage and clearance distances has to be performed according IEC 60664-1.

For voltage ratings see Table 15 and Table 16.

Application information: The permissible rated voltage depends on the application or specified safety requirements. Reductions in creepage or clearance distances may occur due to the printed board or wiring used, and shall duly be taken into account.

Table 15 shows rated voltage, rated impulse voltage and pollution degree.

Table 15 – Rated voltage – Rated impulse voltage – Pollution degree

No. of ways and coding		**PE contact**	**Rated voltage** V	**Rated impulse voltage** kV	**Pollution degree**
4	D-coding	without	60	1,5	3[a]
[a] Only in mated and locked condition.					

Table 16 shows voltage proof.

Table 16 – Voltage proof

kV r.m.s withstanding voltage

No. of ways and coding according to 3.2.2		**PE contact**	**Between contacts**		**Between contacts and metal-housing**	
			Fixed connectors	**Free connectors**	**Fixed connectors**	**Free connectors**
4	D	without	1,4	1,4	1,4	1,4
Only in mated and locked condition.						

7.4 Arrangement for contact resistance measurement

Conditions: IEC 60512, Test 2a
Standard atmospheric conditions
Measuring points see Figure 18

The measurement of contact resistance shall be carried out on the number of contacts specified. Any subsequent measurements of contact resistance shall be made on the same contacts. Figure 18 shows a contact resistance arrangement.

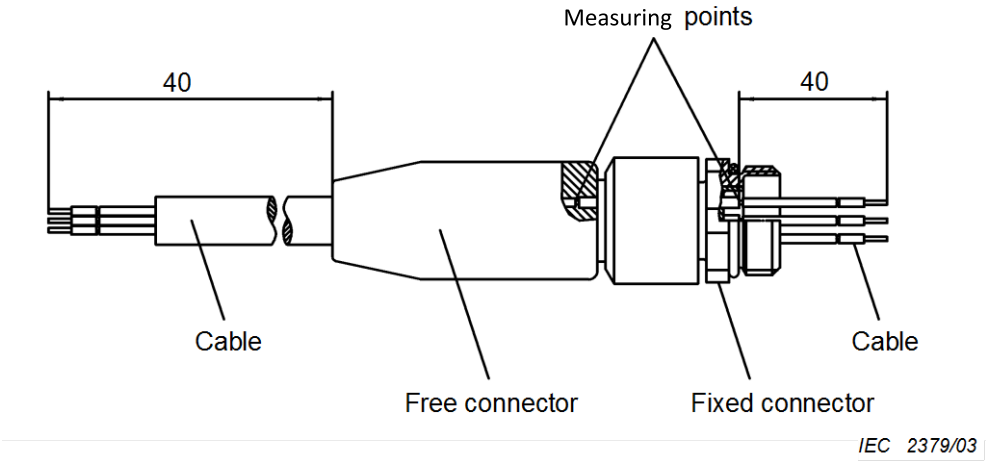


Figure 18 – Contact resistance arrangement

7.5 Arrangement for dynamic stress tests

Conditions: IEC 60512, Test 6d

Figure 19 shows a dynamic stress test arrangement.

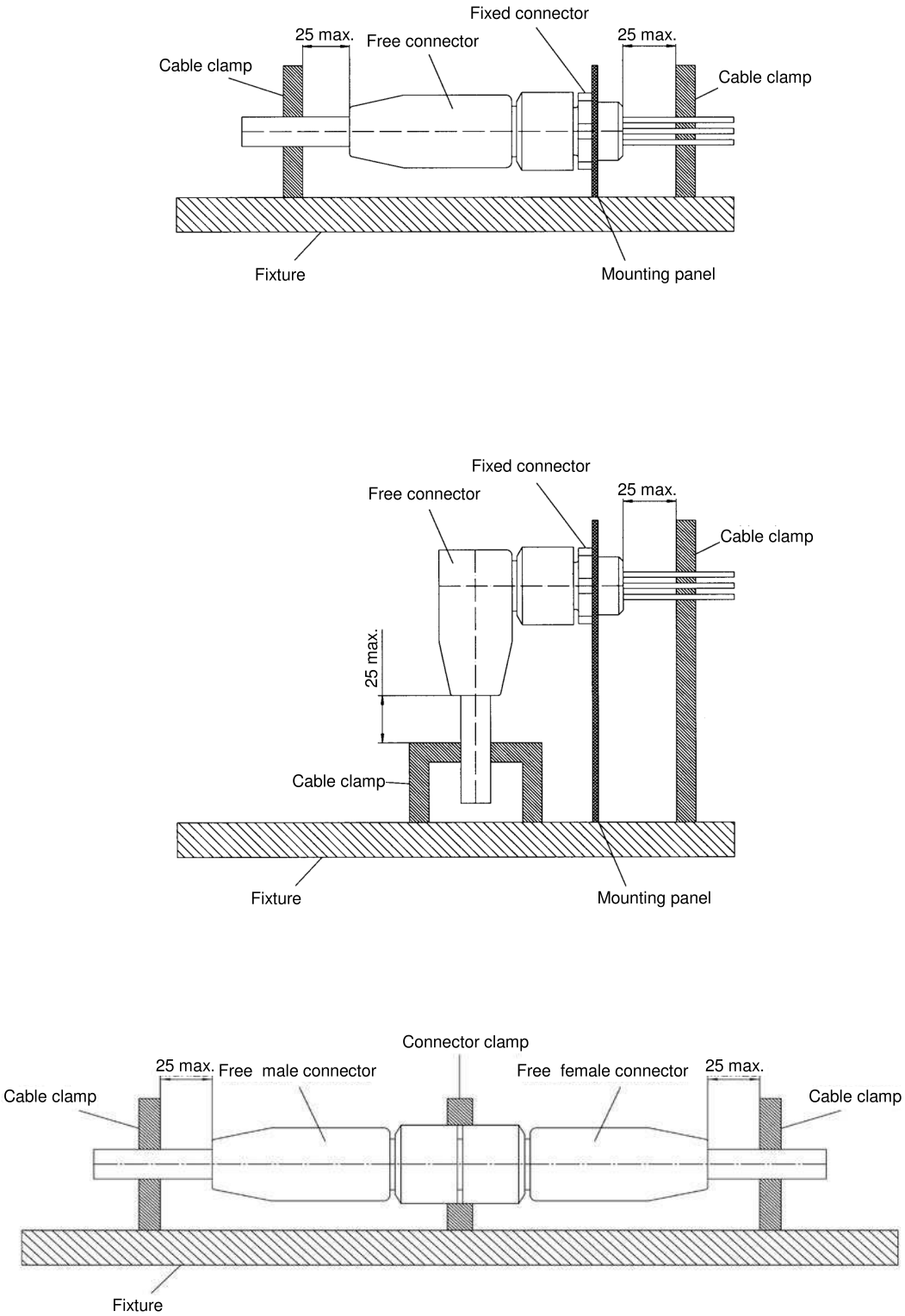


Figure 19 – Dynamic stress test arrangement

7.6 Arrangement for testing static load, axial

Conditions: IEC 60512, Test 8b

7.7 Wiring of specimens

The terminations shall be wired, in accordance with the relevant part of IEC 60352. For screw-type or screwless-type connection tests, also the relevant requirements of IEC 60999 should be duly taken into account.

7.8 Test schedules

NOTE In the following, a mated set of connectors is called a specimen.

7.8.1 Basic (minimum) test schedule

Not applicable.

7.8.2 Full test schedule

7.8.2.1 General (see Table 17)

Table 17 – Number of test specimens and contacts

Test group	AP	BP	CP	DP	GP	MP
Test specimens	3	3	3	3	3	3
Number of contacts	4	4	4	4	4	4

7.8.2.2 Test group P – Preliminary

All specimens shall be subject to the following tests (see Table 18), except for test P6.

The specimen shall be divided into five groups. All connectors in each group shall undergo the tests specified for the relevant group.

Table 18 – Test group P

Test phase	Test			Measurement to be performed		Requirements	
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	PL	All connector st yles
P3	Restricted entry	16b					Product meets requirements
P5			Test voltage 500 V ± 15 V d.c. Method A	Insulation resistance[a)]	3a		10^8 Ω min.
P6			Contact/ contact same measuring points as for P4	Voltage proof[b)]	4a		According to 7.3
P7 P7.1	Sealing (gross air leakage) Sealing (fine air leakage)	14a 14b	5 min in each direction				Test not to be performed, replaced by IP 65/67 test
P8	Electrical engagement length	1c					Test not to be performed, not specified
P9	Residual magnetism	24a					Test not to be performed, not specified
P10	Contact proof effective ness (scoop proof)	1d			1d		Test not to be performed, not specified
P11							Mating: PE and afterwards all other contacts in any order Unmating: All contacts in any order and PE at the

a) Only required on samples that have interim and final measurements performed after environmental testing. If specified in the detail product specification the insulation resistance shall also be measured between one termination and the housing having minimum spacing.

b) When applicable the detail product specification shall specify whether the connectors are to be mated or unmated for this test. The specimen shall be subjected to the test voltage between one termination and the housing having minimum spacing.

7.8.2.3 Test group AP – Dynamic/climatic

Table 19 shows the test group AP.

Table 19 – Test group AP *(1 of 3)*

Test phase	Test			Measurement to be performed		Requirements
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	All connector styles
AP1			See 6.5.3	Insertion and withdrawal forces	13b	Requirements see 6.5.3
AP2	Gauge retention force		Female contacts only 3 contacts/ specimen sizing and retention force gauge See 5.5	Engaging and separating forces	16e	See 5.5
AP3	Vibration	6d	10 Hz–500 Hz 0,35 mm or 50 m/s^2 3 axis 10 cycles each axis	Contact disturbance	2e	Duration of disturbance 1 μs max.
				Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Visual examination	1a	There shall be no defect that would impair normal operation
AP4	Shock	6c	Arrangement according to Figure 17 Half sine shock acceleration 490 m/s² (50 g) Duration of impact: 11 ms 6 shocks per axis 3 positive axis 3 negative axis	Contact disturbance	2e	Duration of disturbance 1 μs max.
				Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Visual examination	1a	There shall be no defect that would impair normal operation
AP5	Rapid change of temperature	11d	–25 °C to 85 °C, t = 30 min, 5 cycles	Contact resistance-Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
				Visual examination	1a	There shall be no defect that would impair normal operation

Table 19 *(2 of 3)*

Test phase	Test			Measurement to be performed		Requirements
	Title	**IEC 60512 Test No.**	**Severity or condition of test**	**Title**	**IEC 60512 Test No.**	
AP6	Climatic sequence	11a				
AP6.1	Dry heat	11i	Temp.: 85 °C Duration: 16 h	Insulation resistance at high temperature	3a	10^8 Ω min.
AP6.2	Damp heat, cyclic, first cycle	11m	Method Db Temp.: 40 °C Recovery time: 2 h	Visual examination	1a	There shall be no defect that would impair normal operation
AP6.3	Cold	11j	Temp.: –25 °C Duration: 2 h Recovery time: 2 h	Visual examination	1a	There shall be no defect that would impair normal operation
AP6.4	Damp heat, cyclic, remaining cycles	11m	Conditions according to AP6.2 5 cycles Recovery time: 2 h	Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
				Insertion and withdrawal forces	13b	See 6.5.3
				Visual examination	1a	There shall be no defect that would impair normal operation
AP7	Impacting water	14g				
AP7.1	IP code second characteris-tic numeral		See IEC 60529	IEC 60529: 1989, Test 14.2.5 and Test 14.2.7		No leakage on contacts
AP7.2	IP code first characteris-tic numeral		Dust IP6X Test 6 Table 7, see IEC 60529	IEC 60529: 1989, Table 7		IP6X no deposit of dust on contacts [a]

Table 19 *(3 of 3)*

Test phase	Test			Measurement to be performed		Requirements
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	
AP7.3				Contact resistance – Millivolt level	2a	Rise in relation to initial values 5 mΩ max.
					2b	
				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
				Insertion and withdrawal forces	13b	See 6.5.3
AP8				Visual examination	1a	There shall be no defect that would impair normal operation
AP9	Polarizing method	13e	see 6.5.5			It shall be possible to correctly align and mate the appropriate mating connectors. It shall not be possible to mate the connectors in any other than the correct manner
[a] It is allowed to perform AP7.2 with an additional specimen, extending the total number of specimen by 1.						

7.8.2.4 Test group BP – Mechanical endurance

Table 20 shows test group BP.

Table 20 – Test group BP *(1 of 2)*

Test phase	Test			Measurement to be performed		Requirements
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	
BP1			Female contacts only 3 contacts/specimen sizing and retention force gauge see 5.5	Gauge retention force	16e	See 5.5
BP2	Mechanical operation (half of the specified number of operations)	9a	Speed 10 mm/s max. Rest 30 s (unmated) Operations see 5.3.2 Speed: 10 mm/s max. Rest time: 30 s (unmated)			
				Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Visual examination	1a	There shall be no defect that would impair normal operation
BP3	Climatic test		Standard atmospheric conditions			
BP3.1	Corrosion industrial atmosphere	11g	Flowing mixed gas corrosion – 4 days, test method 4 according IEC 60068-2-60 Half of the duration unmated with both connector parts exposed to the gas and mated for the remaining duration	Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
BP4	Mechanical operation (remaining half of specified number of operations)	9a	See BP2	Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
			Unmated connectors			
				Visual examination	1a	There shall be no defect that would impair normal operation
BP5.1	IP code second characteris-tic numeral		See IEC 60529	IEC 60529: 1989, Test 14.2.5 and Test 14.2.7		No leakage on contacts

Table 20 *(2 of 2)*

Test phase	Test			Measurement to be performed		Requirements
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	
BP5.2				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
BP6				Insertion and withdrawal forces	13b	Requirements see 6.5.3
BP7			Female contacts only 3 contacts/specimen sizing and retention force gauge see 5.5	Gauge retention force	16e	See 5.5

7.8.2.5 Test group CP – Moisture

Table 21 shows test group CP.

Table 21 – Test group CP

Test phase	Test			Measurement to be performed		Requirements
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	All connector styles
CP1	Rapid change of temperature	11d	–25 °C to 85 °C, t = 30 min, 5 cycles	Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
				Pressure Differential	Test 14b	Not required [a]
CP2	Mechanical operation	9a	See BP2			
CP3	Electrical load and temperature	9b	Duration: 1 000 h Amb.Temp.: 40 °C Current load acc. to 6.4.3 Recovery time: 2 h Temp. sensor in centre of specimen	Contact resistance – Millivolt level method	2a	Rise in relation to initial values 5 mΩ max.
				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
				Pressure Differential	Test 14b	Not applicable
CP4	Impacting dust and water	14g				
CP4.1	IP code second characteris-tic		See IEC 60529	IEC 60529: 1989, Test 14.2.5 and Test 14.2.7		No leakage on contacts
CP4.2				Insulation resistance	3a	10^8 Ω min.
				Voltage proof	4a	According to 6.4.2
CP5		1a	Unmated connectors	Visual examination	1a	There shall be no defect that would impair normal operation

[a] Test pressure differential applies only to connectors with glass to metal seal.

7.8.2.6 Test group DP – Endurance

Table 22 shows a test group DP.

Table 22 – Test group DP

Test phase	Test			Measurement to be performed		Requirement
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	All connector styles
DP1	Resistance to fluids	19c	5 cycles			The fluid used for testing is upon agreement between manufacturer and user.
DP2	Retreatment		Clearing of specimen by washing briefly in light petrol	Contact resistance Millivolt level	2a	Rise in relation to initial values 5 mΩ max.
DP3				Voltage proof	4a	According to 6.4.2
DP4			Unmated connectors	Visual examination	1a	There shall be no defect that would impair normal operation

7.8.2.7 Test group EP – Mould/Fire

Not applicable.

7.8.2.8 Test group FP – Fluids

Not applicable.

7.8.2.9 Test group GP – Connection method tests

Table 23 shows the test group GP.

Table 23 – Test group GP

Test phase	Test			Measurement to be performed		Requirement
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	All connector styles
GP1	Solderless connections: screw, crimp, insulation displacement, insulation piercing, press-in	IEC 60352	See relevant IEC 60352 standard, for screw-type terminations see relevant IEC 60998-2-1 or IEC 60999			

7.8.2.10 Test group HP – Accessories

Not applicable.

7.8.2.11 Test group KP – Climatic sequence

Not applicable.

7.8.2.12 Test group LP – Dynamic corrosion

Not applicable.

7.8.2.13 Test group MP – Electrical transmission requirements

These tests are applicable for connector for balanced pair cabling. The nominal impedance of the system is 100 Ω . The measurements shall be performed on each of four pairs using the pair/pin assignment as prescribed in Annex A. Different connections may result in reduced performance of the connection and should be avoided.

Further information may be available from the manufacturers of these connectors.

Cat 5 (according to ISO 11801) performance level, respective to transmission characteristics, is determined according to specific test methods described in test group MP, see Table 24. Cat 5 (according to ISO 11801) transmission performance interoperability shall be demonstrated by testing the M8 connectors with a Direct Fixture Jack (DFJ) or a Direct Fixture Plug (DFP) according IEC 60512-29-100. Transmission performance and backward compatibility shall be demonstrated by testing the female connectors with the full range of male connectors or “test plugs” described in IEC 60512-29-100.

All transmission performance requirements apply between the reference planes as specified in IEC 60512-29-100.

NOTE In the following Table 24 f is the frequency expressed in MHz.

Table 24 – Test group MP *(1 of 2)*

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test No.	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
MP 1			All pairs	Insertion loss	29a	Mated connectors All pairs: ≤ 0,04 √*f* dB from 1 MHz to 100 MHz Whenever the formula results in a value less than 0,1 dB, the requirement shall revert to 0,1 dB.
MP 2			All pairs, both directions, (pair to pair)	NEXT loss	29c	Mated connectors All pair combinations: ≥ 83-20log(f) dB from 1 MHz to 100 MHz Whenever the formula results in a value greater than 75 dB, the requirement shall revert to 75 dB.
MP 3			All pairs, both directions	Return loss	29b	Mated connectors All pairs: ≥ 60-20 log (*f*) dB from 1 MHz to 100 MHz Whenever the formula results in a value greater than 30 dB, the requirement shall revert to 30 dB.
MP 4			All pairs, both directions, (pair to pair)	FEXT loss	29d	Mated connectors All pair combinations: ≥ 75,1-20 log (*f*) dB from 1 MHz to 100 MHz Whenever the formula results in a value greater than 75 dB, the requirement shall revert to 75 dB.
MP 5			All pairs, both directions	TCL	29f	Mated connectors All pairs: ≥ 66-20log (*f*) dB from 1 MHz to 100 MHz Whenever the formula results in a value greater than 50 dB, the requirement shall revert to 50 dB.

Table 24 *(2 of 2)*

Test phase	Test			Measurement to be performed		
	Title	**IEC 60512 Test No.**	**Severity or condition of test**	**Title**	**IEC 60512 Test No.**	**Requirements**
MP 6			All pairs, both directions	TCTL	29g	Mated connectors All pairs: ≥ 66-20 log (*f*) dB from 1 MHz to 100 MHz Whenever the formula results in a value greater than 50 dB, the requirement shall revert to 50 dB.
MP 7	Input to output resistance		Measurement points as defined in 7.3 All input/output connector paths	Millivolt level method	2a	According to 6.4.5 of IEC 60603-7:2008 for signal conductors and IEC 60603-7-1 for shielding
MP 8	Resistance unbalance		Measurement points as defined in 7.3 All input/output connector path combinations	Millivolt level method	2a	According to 6.4.6 of IEC 60603-7:2008
MP 9			All pairs, both directions	PS NEXT	25i	Mated connectors All pairs: ≥ 80 – 20 log(*f*) dB from 1 MHz to 100 MHz
MP 10			All pairs, both directions	PS FEXT	25i	Mated connectors All pairs: ≥ 72,1 – 20 log(*f*) dB from 1 MHz to 100 MHz Whenever the formula results in a value greater than 62 dB, the requirement shall revert to 62 dB
NOTE All measurements to be performed on mated connectors. Although the mated free connector can be different according to the requirement of the test standards, the same fixed connectors shall be used for each of the tests.						

7.9 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 which can be used. In case of dispute, however, the specified method shall be used.

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

7.10 Pre-conditioning

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

7.11 Wiring and mounting of specimens

7.11.1 Wiring

Where wiring of test specimens is required, the detail product specification shall contain sufficient information to perform the tests.

7.11.2 Mounting

When mounting is required in a test, the connectors shall be rigidly mounted on a metal plate, a printed board or to specified accessories, whichever is applicable, using the normal mounting method, fixing devices and panel cut-out as laid down in the detail product specification.

Annex A
(informative)

Contact and pair designation for balanced cabling

A.1 Recommendation for cable connection

As described in 7.8.2.13 the electrical transmission properties depend on the pin and pair assignment. In installations according to TIA 568 B recommendations or in mixed configurations with connectors of the IEC 60603-7 series, the contact and pair designation according to Table A.1 and Figure A.1 is recommended.

Table A.1 – Example of contact and pair designation for balanced cabling (informative)

Pair	Contact	Colour
1	1	white-orange
	3	orange
2	2	white-green
	4	green

Figure A.1 – Example of contact arrangement for balanced cabling (informative)

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