

# 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

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## PRE-STANDARD

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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**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### 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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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

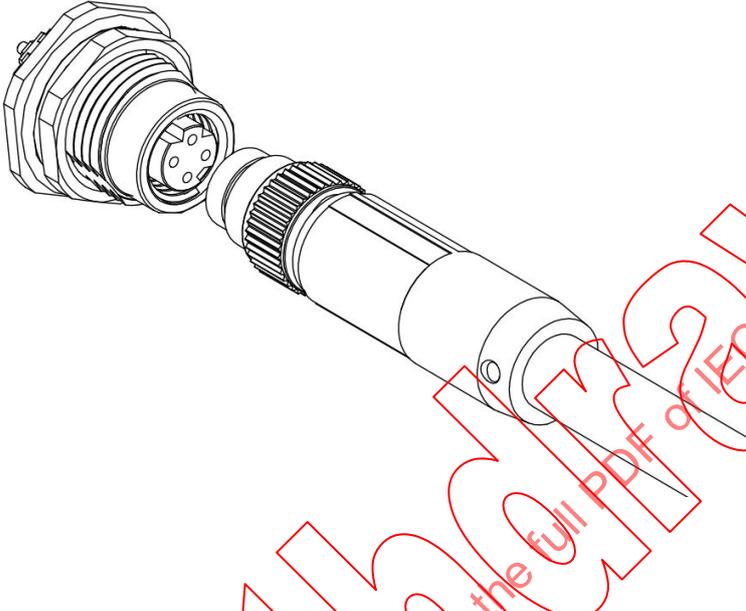
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INTRODUCTION

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

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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

#### 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 rewirable or non-rewirable, with M8 screw-locking. Male connectors have round contacts  $\varnothing 0,8$  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.

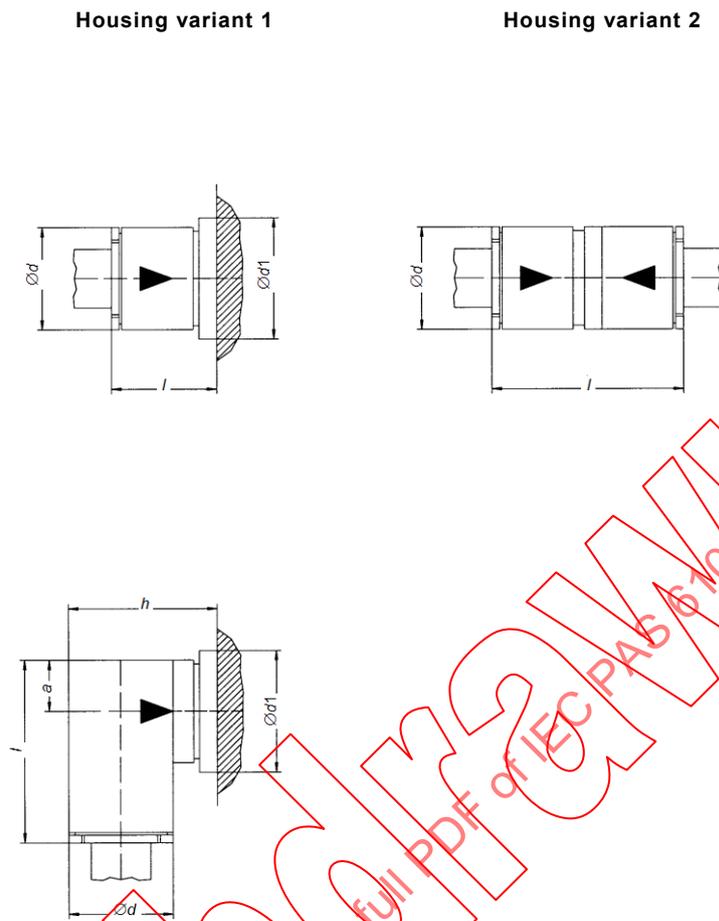
#### 5.2.3 Reference system

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**

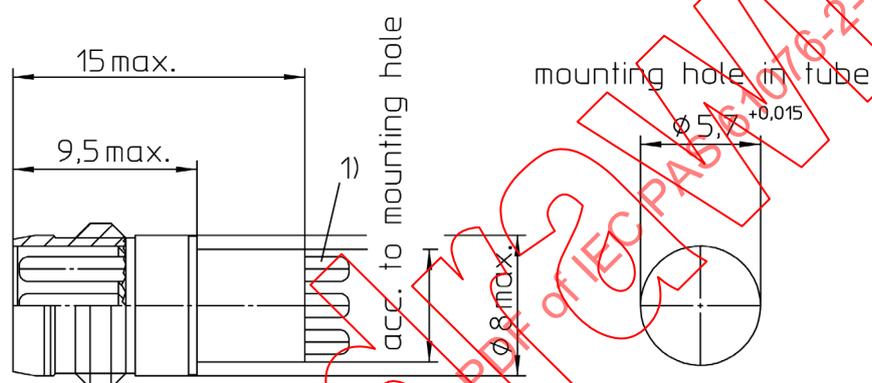
Table 2 shows styles of fixed connectors.

**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**

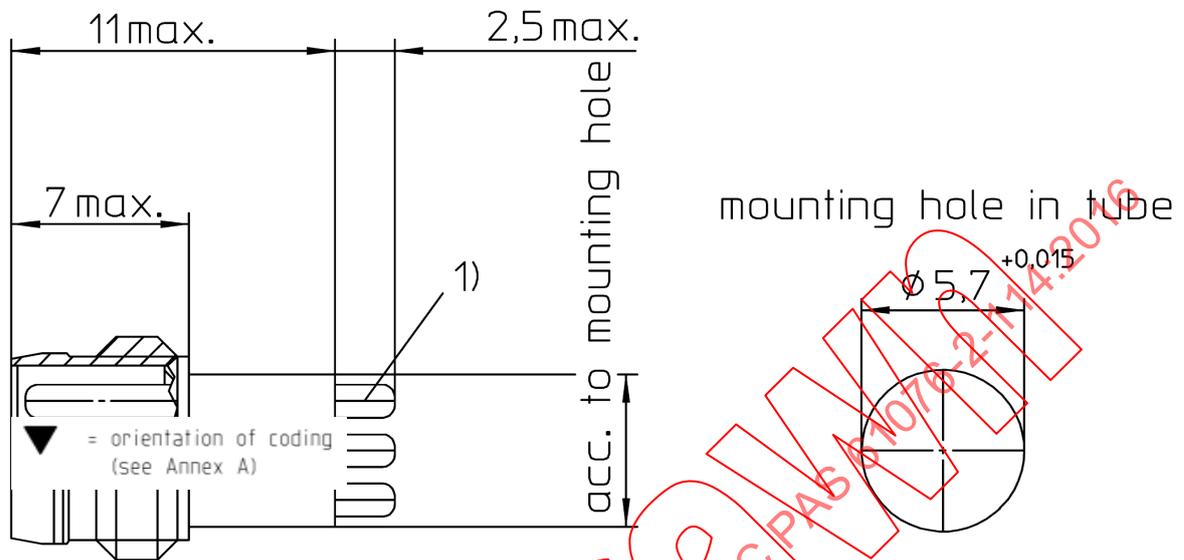
Figure 2 shows style BM.



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

**5.4.1.3 Style CM**

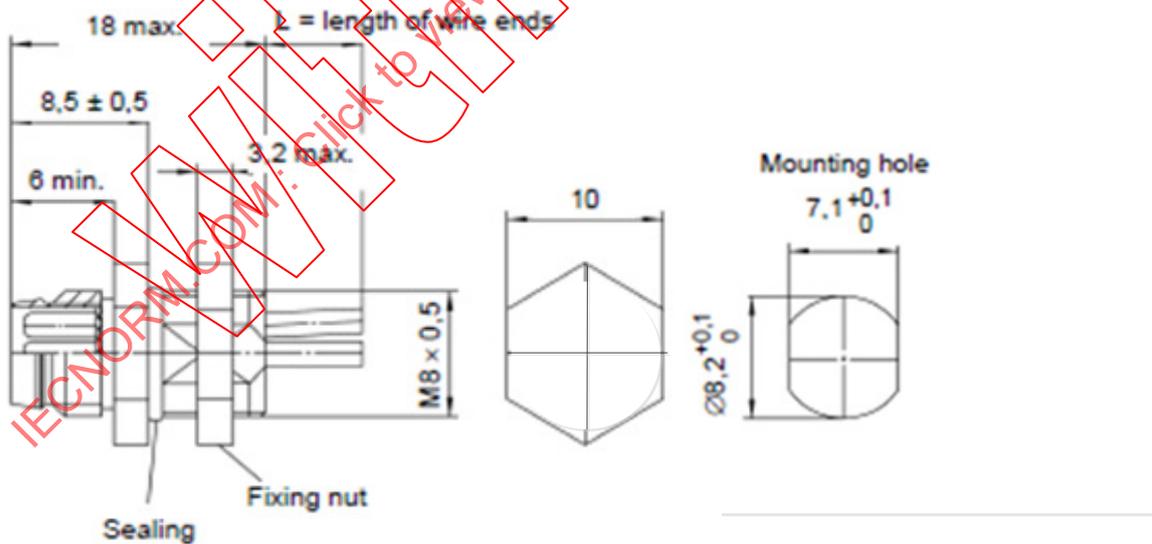
Figure 3 shows style CM.



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

**5.4.1.4 Style EM**

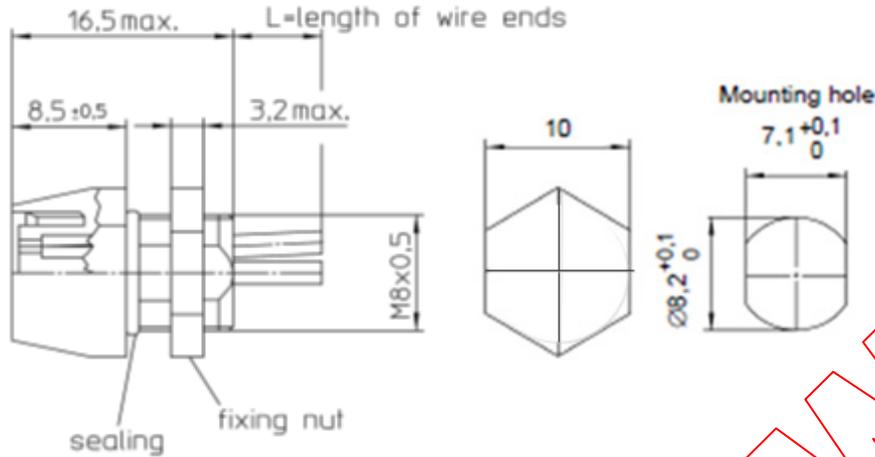
Figure 4 shows style EM.



**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.

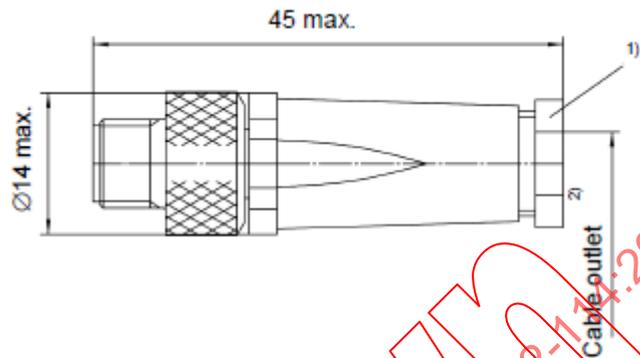
**Table 3 – Styles of free connectors**

Style	Description
JM	Rewireable connector, male contacts, straight version, with locking nut <sup>a</sup>
KM	Rewireable connector, male contacts, right angled version, with locking nut <sup>a</sup>
LM	Non-rewireable connector, male contacts, straight version, with locking nut <sup>a</sup>
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

<sup>a</sup> Knurled ring or hexagonal ring upon agreement.

### 5.5.1.2 Style JM

Figure 6 shows style JM.



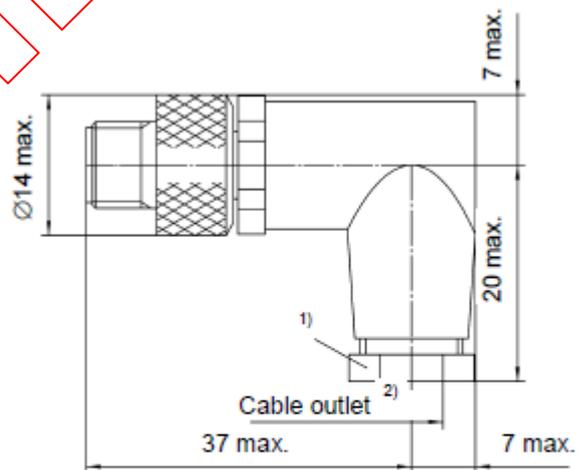
#### Key

- 1) Cable outlet alternatively outside.
- 2) Cable outlet diameter-range upon agreement.

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

### 5.5.1.3 Style KM

Figure 7 shows style KM.



#### Key

- 1) Cable outlet alternatively outside.
- 2) Cable outlet diameter-range upon agreement.

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

#### 5.5.1.4 Style LM

Figure 8 shows style LM.

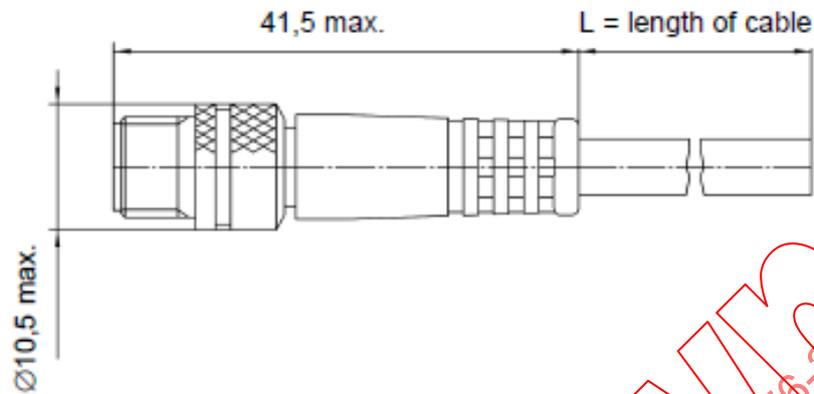


Figure 8 – Non-rewireable connector, male contacts, straight version, with locking nut

#### 5.5.1.5 Style MM

Figure 9 shows style MM.

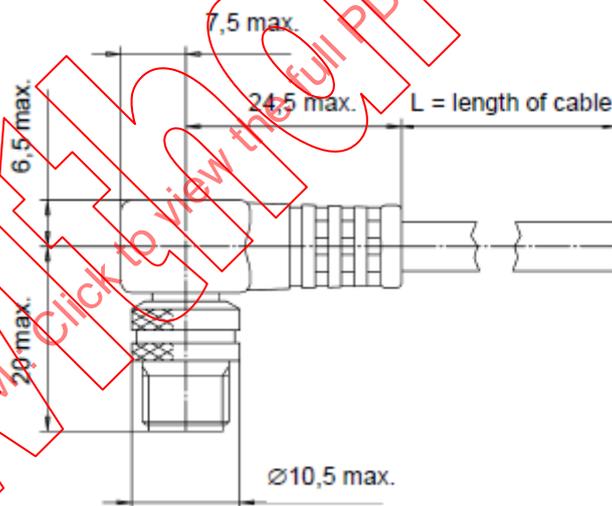
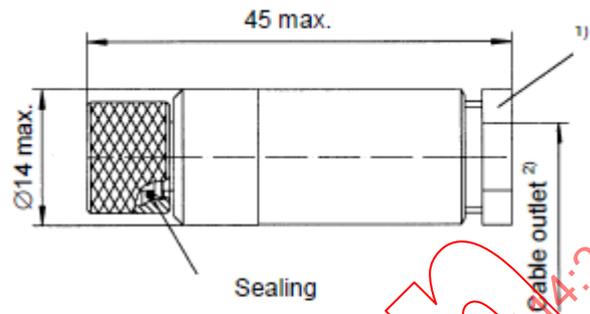


Figure 9 – Non-rewireable connector, male contacts, right angled version, with locking nut

### 5.5.1.6 Style JF

Figure 10 shows style JF.



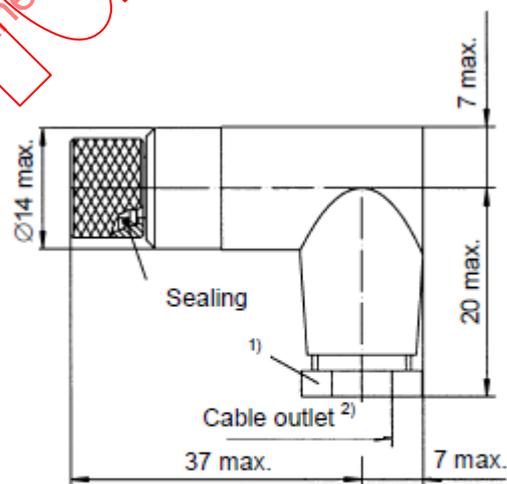
**Key**

- 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.

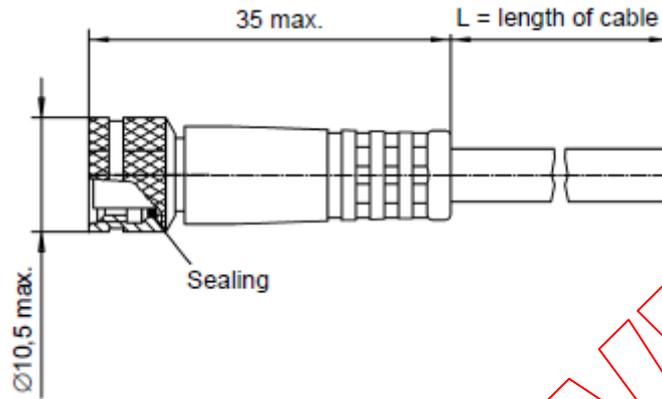


Figure 12 – Non-rewireable connector, female contacts, straight version, with locking nut

### 5.5.1.9 Style MF

Figure 13 shows style MF.

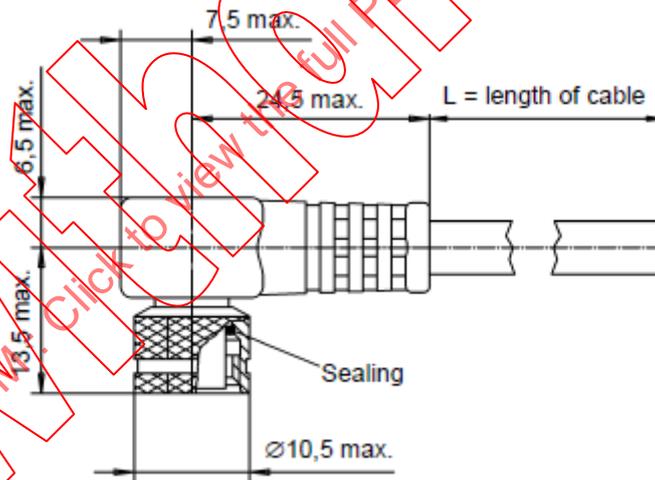


Figure 13 – Non-rewireable connector, female contacts, right angled version, with locking nut

### 5.5.1.10 Interface dimensions – Fixed connectors

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

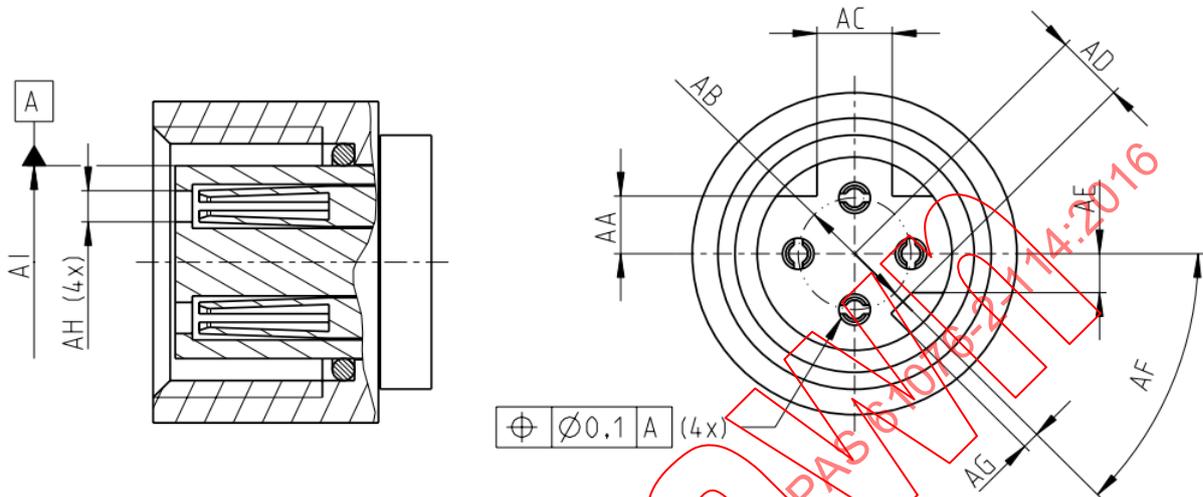


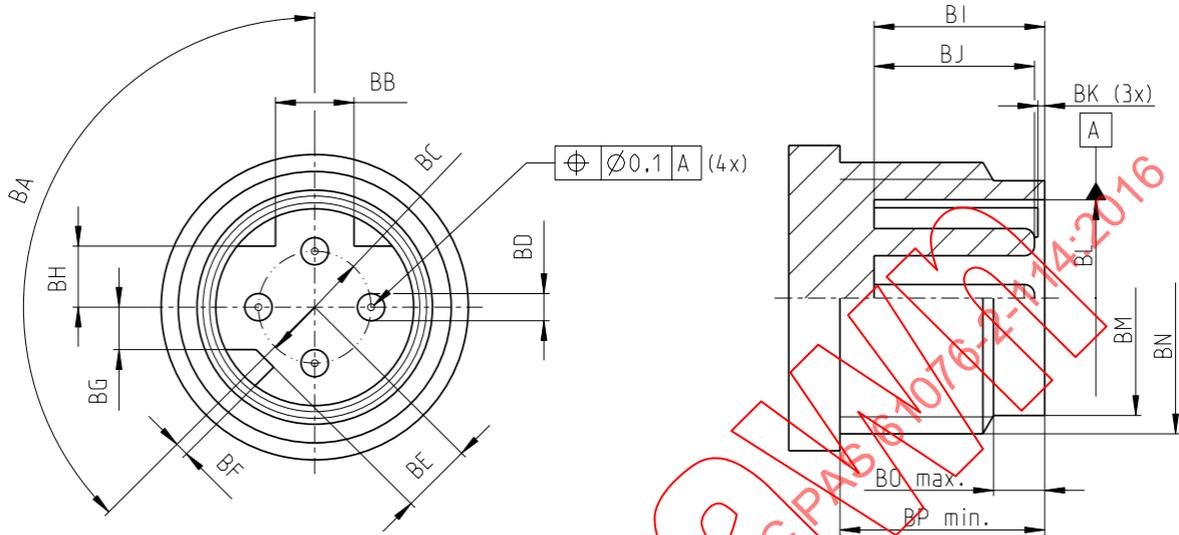
Figure 14 – Fixed connector

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	∅ 0,92		
AI	∅ 5,7	∅ 5,6	∅ 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	∅ 0,83	∅ 0,77	∅ 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	∅ 5,8	∅ 5,75	∅ 5,8
BM	∅ 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.

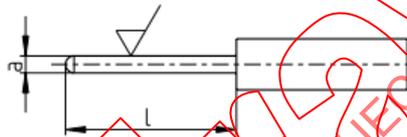


Figure 16 – Gauge dimensions

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 panel 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	Rated current
			a.c. or d.c.	A
D-coding	4 way	4	60	4

Insulation resistance : 10<sup>8</sup> 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<sup>8</sup> 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	<sup>a</sup>
<sup>a</sup> 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<sup>2</sup>

Duration: 10 cycles each axis

Cable with maximum wire size or overmolded cable.

Figure 17 shows a dynamic stress test arrangement.

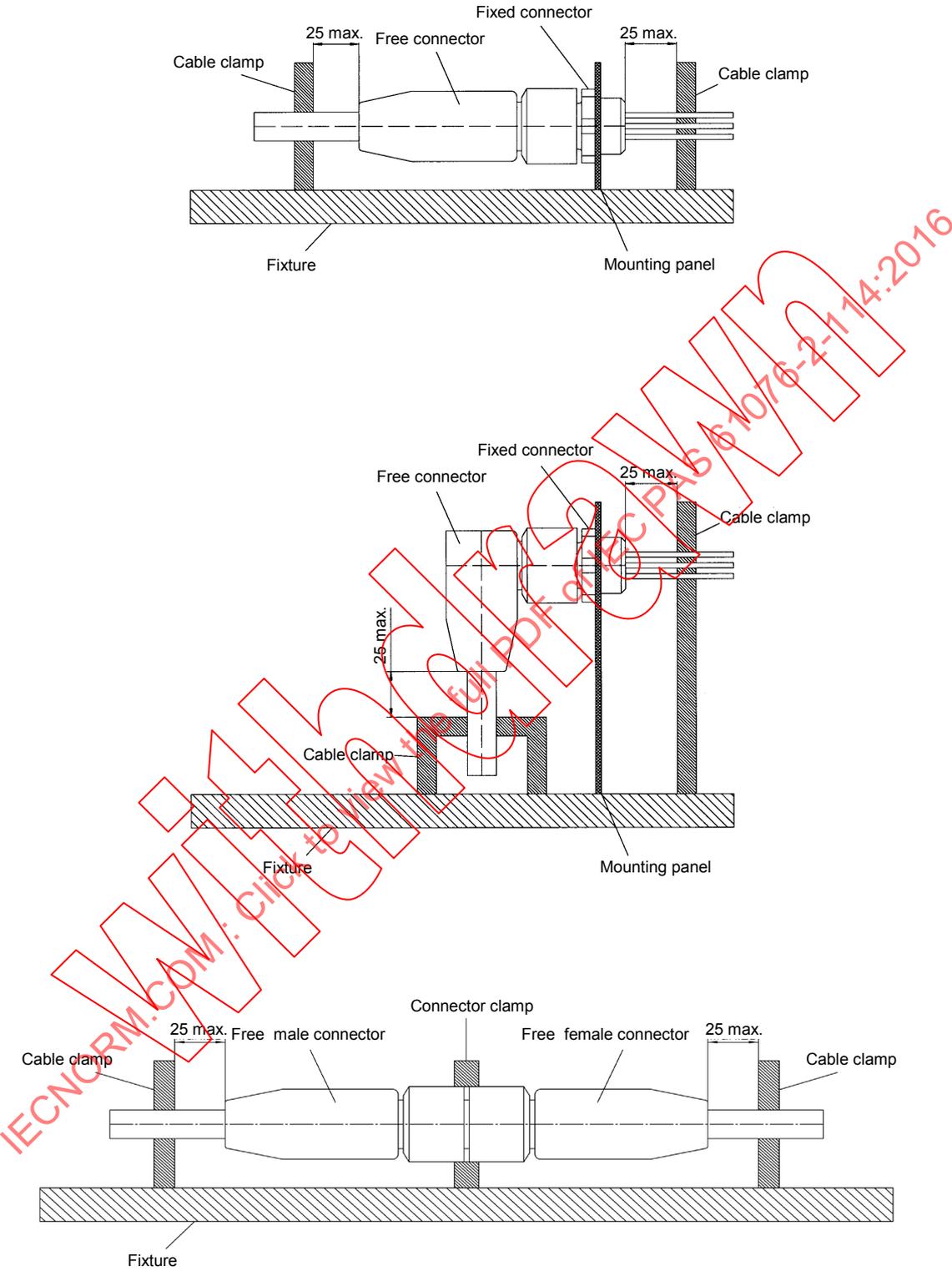


Figure 17 – Dynamic stress test arrangement

### 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 <sup>a</sup>
<sup>a</sup> 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.

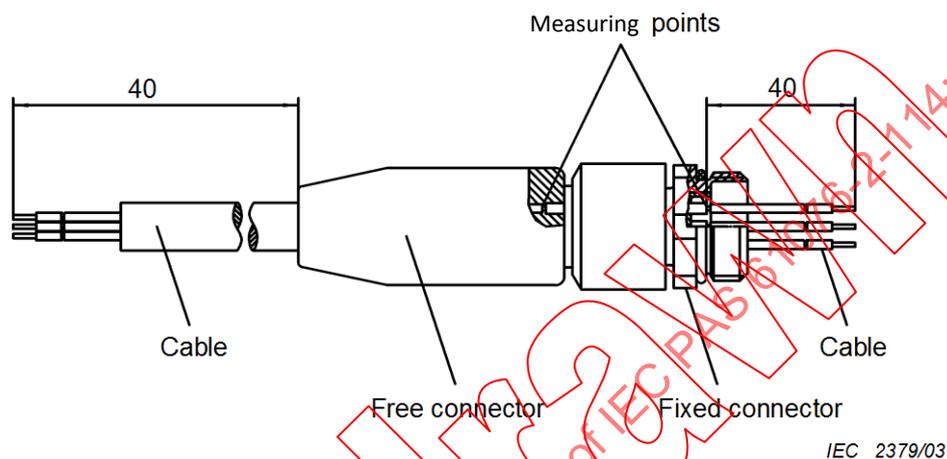


Figure 18 – Contact resistance arrangement

#### 7.5 Arrangement for dynamic stress tests

Conditions: IEC 60512, Test 6d

Figure 19 shows a dynamic stress test arrangement.

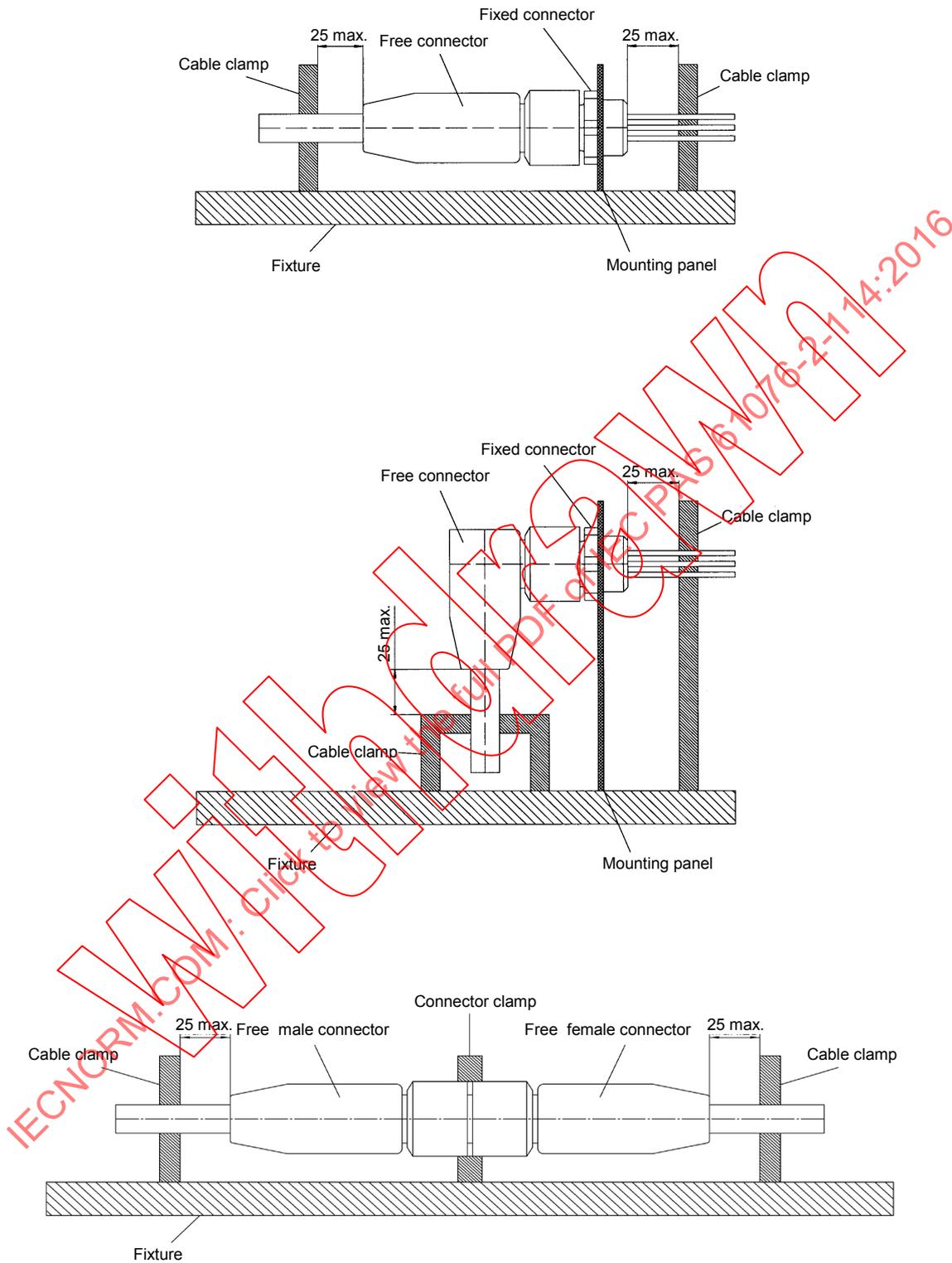


Figure 19 – Dynamic stress test arrangement

### 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 styles
P3	Restricted entry	16b					Product meets requirements
P5			Test voltage 500 V ± 15 V d.c. Method A	Insulation resistance <sup>a)</sup>	3a		10 <sup>8</sup> Ω min.
P6			Contact/ contact same measuring points as for P4	Voltage proof <sup>b)</sup>	4a		According to 7.3
P7	Sealing (gross air leakage)	14a	5 min in each direction				Test not to be performed, replaced by IP 65/67 test
P7.1	Sealing (fine air leakage)	14b					
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 effectiveness (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 <sup>2</sup> 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/s <sup>2</sup> (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 <sup>8</sup> 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 <sup>8</sup> 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 <sup>8</sup> 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 characteristic 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 characteristic numeral		Dust IP6X Test 6 Table 7, see IEC 60529	IEC 60529: 1989, Table 7		IP6X no deposit of dust on contacts <sup>a</sup>

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 <sup>8</sup> 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
<sup>a</sup> 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.

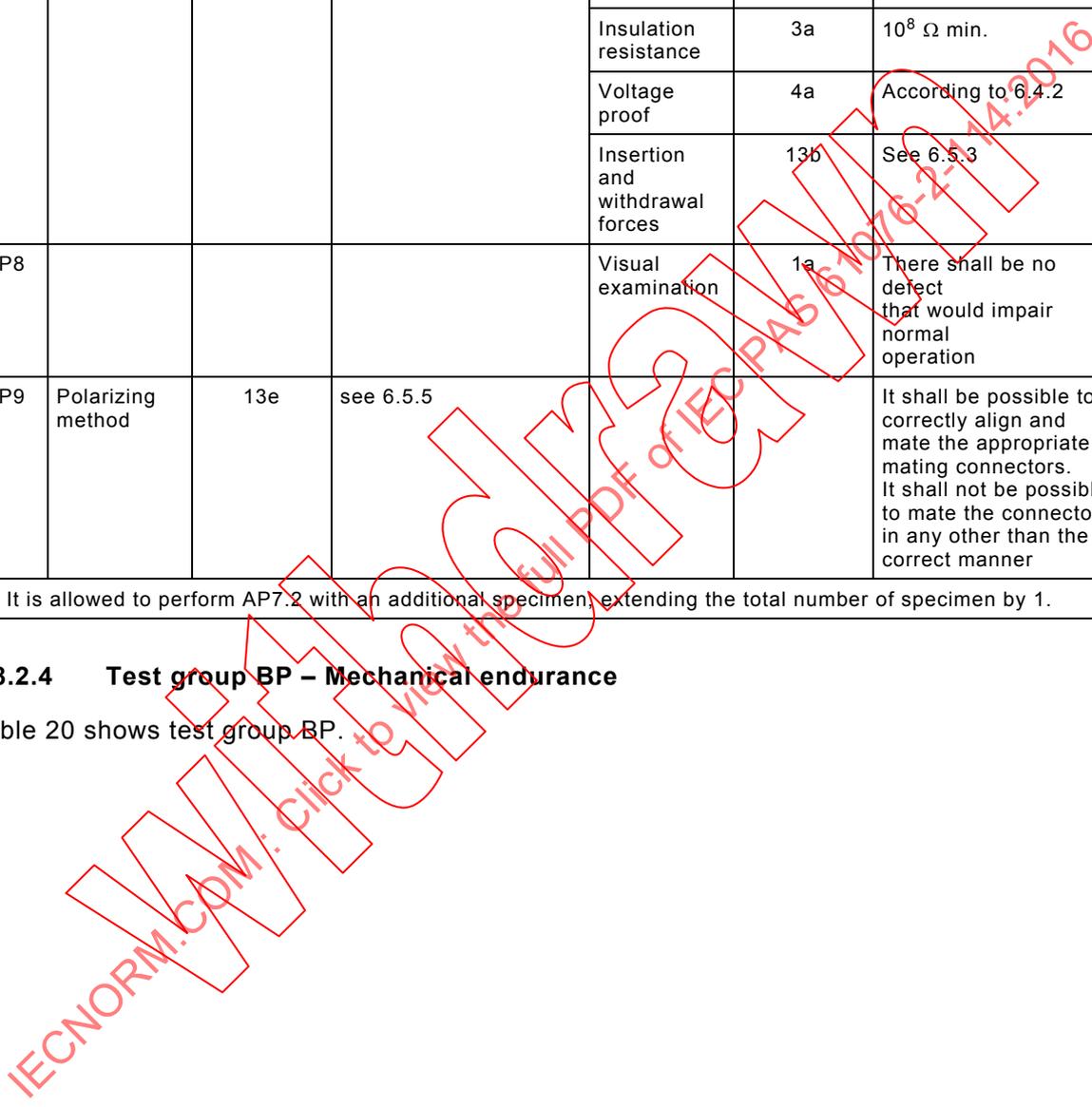


Table 20 – Test group BP (1 of 2)

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 <sup>8</sup> 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 characteristic 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 <sup>8</sup> 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

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