

# PUBLICLY AVAILABLE SPECIFICATION

## PRE-STANDARD

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**Connectors for electronic equipment – Product requirements –  
Part 2-110: Circular connectors – Detail specification for circular connectors  
M 12 × 1 with screw-locking, for high speed Ethernet and high speed data  
communication with frequencies up to 500 MHz and 10 gigabits/s**

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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland  
Email: [inmail@iec.ch](mailto:inmail@iec.ch)  
Web: [www.iec.ch](http://www.iec.ch)

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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**CONNECTORS FOR ELECTRONIC EQUIPMENT –  
PRODUCT REQUIREMENTS****Part 2-110: Circular connectors –  
Detail specification for circular connectors****M 12 × 1 with screw-locking, for high speed Ethernet and high speed  
data communication with frequencies up to 500 MHz and 10 gigabits/s**

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The text of this PAS is based on the following document:

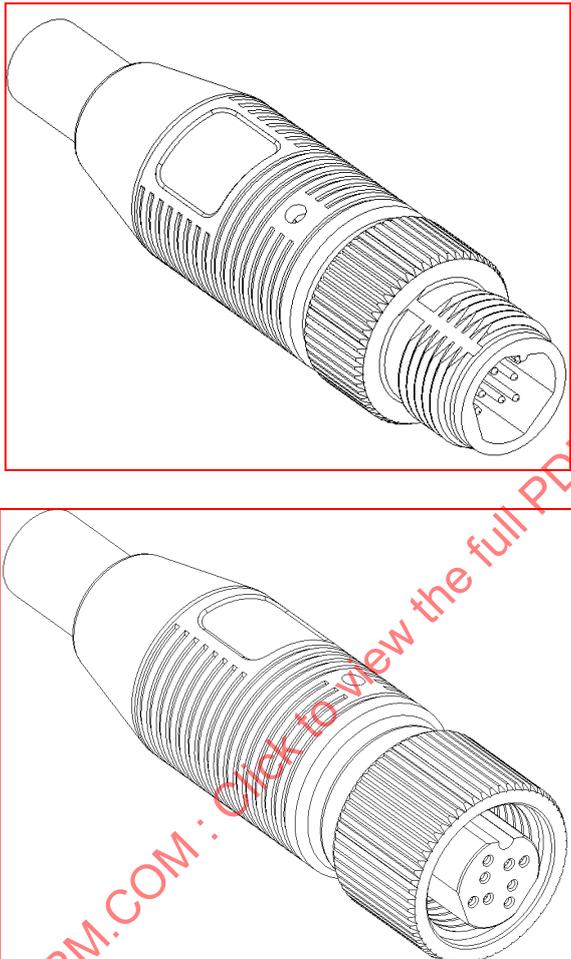
This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

<b>Draft PAS</b>	<b>Report on voting</b>
48B/2096/PAS	48B/2148/RVD

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INTERNATIONAL ELECTROTECHNICAL COMMISSION	IEC 61076-2-110
ELECTRONIC COMPONENTS in accordance with IEC 61076-1	
	<p>Circular connectors M12 × 1 mm 8 poles, for data communication with frequencies up to 500 MHz</p> <p>Pin and socket connector Rewireable - Non-rewireable</p> <p>Free cable connectors Straight and right angle connectors</p> <p>Fixed connectors</p> <p>Flange mounting Rear mounting Single hole mounting</p>

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## CONNECTORS FOR ELECTRONIC EQUIPMENT – PRODUCT REQUIREMENTS –

### Part 2-110: Circular connectors – Detail specification for circular connectors M 12 × 1 with screw-locking, for high speed Ethernet and high speed data communication with frequencies up to 500 MHz and 10 gigabits/s

#### 1 General information

Throughout this detail specification dimensions are in mm.

##### 1.1 Scope

This Publicly Available Specification (PAS) describes M12 circular connectors for use in industrial environments for high speed Ethernet and high speed data transfer. Applications include, but are not limited to, vision systems and data acquisition. Screw locking M12 connectors consist of fixed and free connectors.

Male connectors have round contacts  $\varnothing$  0,6mm.

##### 1.2 Recommended method of termination

The contact terminations shall be of the following types: screw, crimp, insulation piercing, and insulation displacement.

##### 1.2.1 Number of contacts or contact cavities

Connector type H	M12	2 to 8 contacts
------------------	-----	-----------------

##### 1.3 Ratings and characteristics

Rated voltage: 48 V, see 4.2.1, Table 3

Current rating: 0,5 A, see 4.2.3

Insulation resistance:  $10^8 \Omega$ , see 4.2.5

Climatic category:  $-25 \text{ }^\circ\text{C} / +85 \text{ }^\circ\text{C} / 21$  days see 4.1, Table 2

Contact spacing: see Clause 3

##### 1.4 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 – Electromechanical components for electronic equipment*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*  
Amendment 1 (1992)

IEC 60352-2, *Solderless connections – Part 2: Crimped 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 60529:1989, *Degrees of protection provided by enclosures (IP code)*

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

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

IEC 61076-2, *Connectors for use in d.c., low-frequency analogue and digital high speed data applications – Part 2: Circular connectors with assessed quality – Sectional specification*

IEC 61076-2-101:2008, *Connectors for electronic equipment – Product requirements – Part 2-101: Circular connectors – Detail specification for M12 connectors with screw-locking*

IEC 61984, *Connectors – Safety requirements and tests*

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

## **1.5 Marking**

The marking of the connector and the package shall be in accordance with 2.6 of IEC 61076-2.

## **1.6 Safety aspects**

For safety aspects IEC 61984 shall be considered unless otherwise specified.

## **2 Technical information**

### **2.1 Definitions**

For the purposes of this PAS, the terms and definitions given in IEC 60050-581 apply.

### **2.2 Survey of styles and variants**

Subclause 2.2 of IEC 61076-2-101:2008 applies.

## **3 Dimensions**

### **3.1 General**

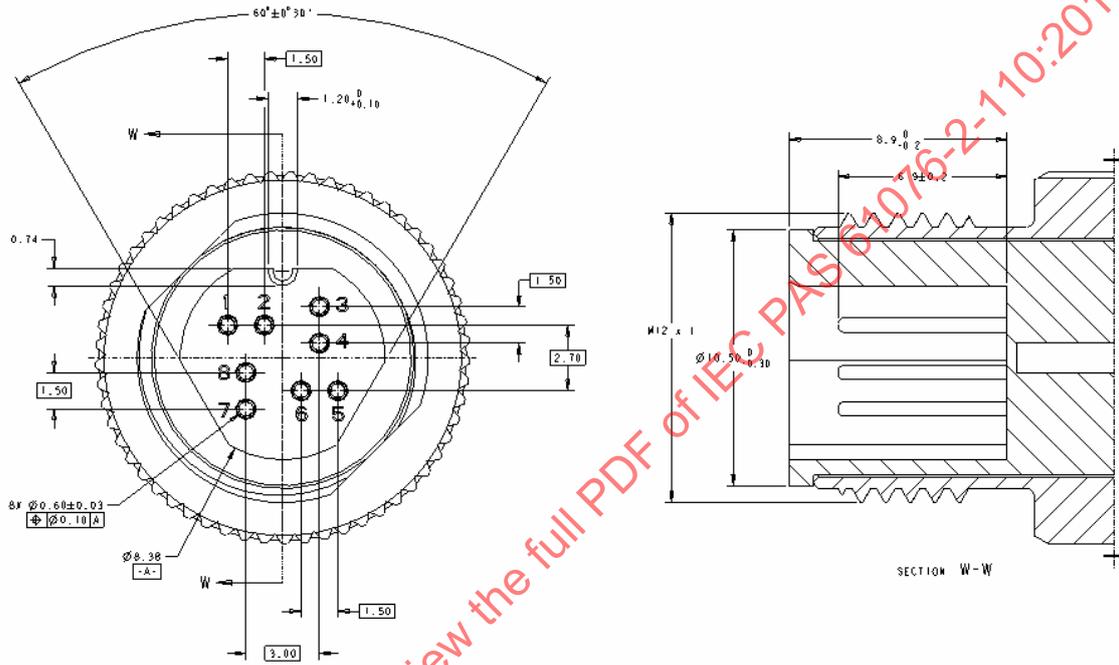
All dimensions in this document are in mm. Drawings are shown in the first angle projection. The shapes of the connectors may deviate from those given in the following drawings as long as the specified dimensions are not influenced.

For connector dimensions, see 2.2.

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

The missing interface dimensions of the female styles shall be chosen according to the common characteristics of the male styles.

**3.2 Interface dimensions**



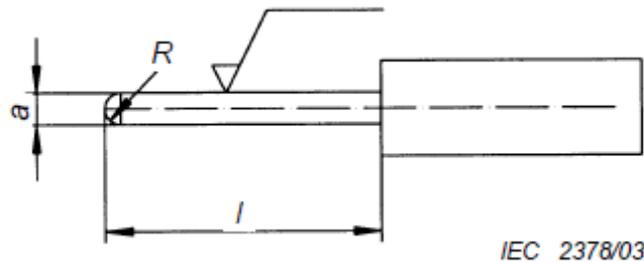
**Figure 1 – Interface dimensions free connector**

**3.3 Gauges**

**3.3.1 Sizing gauges and retention force gauges**

Material: tool steel, hardened

✓ = Surface roughness according to ISO 1302: Ra = 0,25 µm max.  
0,15 µm min.



IEC 2378/03

**Figure 2 – Gauge dimensions**

**Table 1 – Gauges**

Gauge	Mass g	Application	Ø a mm	L min mm
P31	-	Sizing	0,63	10
P32	20	Retention force	0,57	10

## 4 Characteristics

### 4.1 Climatic category

Conditions: IEC 60068-1

**Table 2 – Climatic category**

Climatic category	Category of temperature		Damp heat steady-state		Days
	Lower °C	Upper °C	Temperature °C	Relative humidity %	
25/85/21	-25	+85	40	93	21

### 4.2 Electrical

#### 4.2.1 Rated voltage – Rated impulse voltage – Pollution degree

Conditions: IEC 60664-1

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

**Table 3 – Rated voltage - Impulse voltage – Pollution degree**

Contact arrangement according to Clause 3	Rated voltage V	Rated impulse voltage kV	IP 65/67 variants Pollution degree b)
8 poles	48	1,5	3
a) In mated condition.			
b) The rated voltage and impulse voltage are based on pollution degree 2. This results from application of the rules of IEC 60664-1.			

#### 4.2.2 Voltage proof

Conditions: IEC 60512-4-1, Test 4a  
Standard atmospheric conditions  
Mated connectors

**Table 4 – Voltage proof connectors**

Contact arrangement according to 3.2	Between contacts Impulse withstand voltage (kV)		Between contacts and metal housing Impulse withstand voltage (kV)	
	Fixed connectors	Free connectors	Fixed connectors	Free connectors
	0,5	0,5	0,5	0,5

### 4.2.3 Current-carrying capacity

Conditions: IEC 60512, Test 5a  
 All contacts  
 Values at 40 °C ambient temperature  
 8 pole (0,25mm<sup>2</sup> wire gauge) = 0,5 A (single contact 1 A)

### 4.2.4 Contact resistance

Conditions: IEC 60512, Test 2a  
 Standard atmospheric conditions  
 Connecting points, see 5.1.1  
 Contact resistance < 5mΩ

### 4.2.5 Insulation resistance

Conditions: IEC 60512, Test 3a, Method A  
 Standard atmospheric conditions  
 Insulation resistance ≥ 10<sup>8</sup> Ω

## 4.3 Mechanical

### 4.3.1 IP degree of protection

IP65 / IP67 according to IEC 60529 connectors in mated and locked position. IP68 as agreed between manufacturer and user.

### 4.3.2 Mechanical operation

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

**Table 5 – Number of mechanical operations**

Contact finish	Mechanical operations
Gold	100
Other types	a)
a) Other mating cycles are permissible when agreed between manufacturer and user.	

### 4.3.3 Insertion and withdrawal forces

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

**Table 6 – Insertion and withdrawal forces**

Total insertion force	Total withdrawal force
N	N
23 max	30 max

#### 4.3.4 Contact retention in insert

Not applicable

#### 4.3.5 Polarizing method

Conditions: IEC 60512, Test 13e  
Insertion force 35 N min

#### 4.3.6 Vibration (sinusoidal)

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 5.1.2  
Vibration Severity: 10 Hz to 500 Hz and 0,35 mm or 5 g

#### 4.3.7 Shock

Conditions: IEC 60512 Test 6c  
Connectors in mated and locked position  
The fixed and free connector shall be rigidly installed in a suitable fixture as specified in 5.1.2  
Half sine shock acceleration  $490\text{m/s}^2$  (50g)  
Duration of impact: 11ms

### 5 Test schedule

#### 5.1 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 set of connector styles is called a specimen.

When the initial tests have been completed, all the specimens are divided in the 4 test groups AP, BP, CP and DP. In addition 20 single contacts are used for EP and 20 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 1.

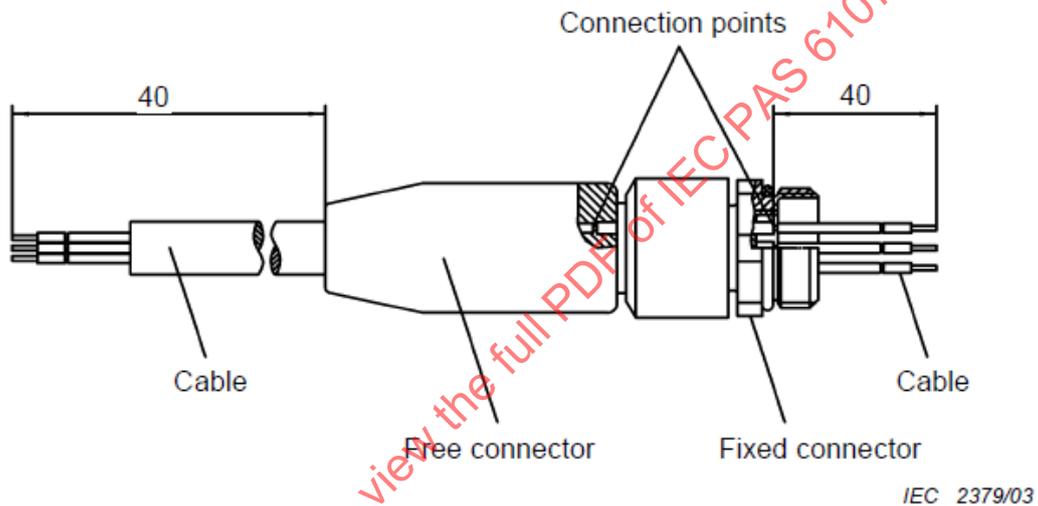
**Table 7 – Number of test specimens**

Number of specimen	Test group						
	P	AP	BP	CP	DP	EP	FP
	12	3	3	3	3	20 single contacts	20

**5.1.1 Arrangement for contact resistance measurements**

Conditions: see 4.2.4

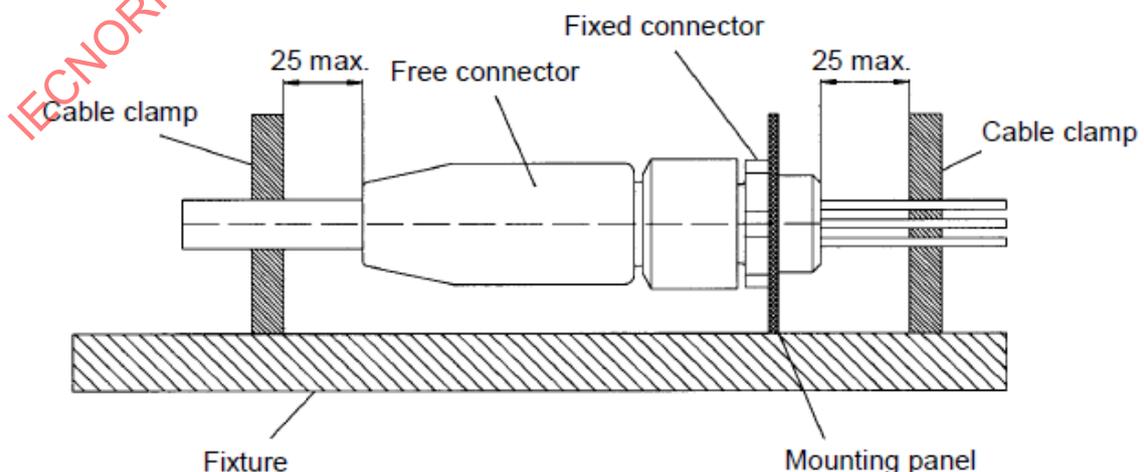
The measurement of contact resistance shall be carried out on the number of contacts specified. Any subsequent measurements of contact resistance shall be made on the same contacts.



**Figure 3 – Contact resistance arrangement**

**5.1.2 Arrangement for dynamic stress tests (vibration)**

Conditions: see 4.3.6



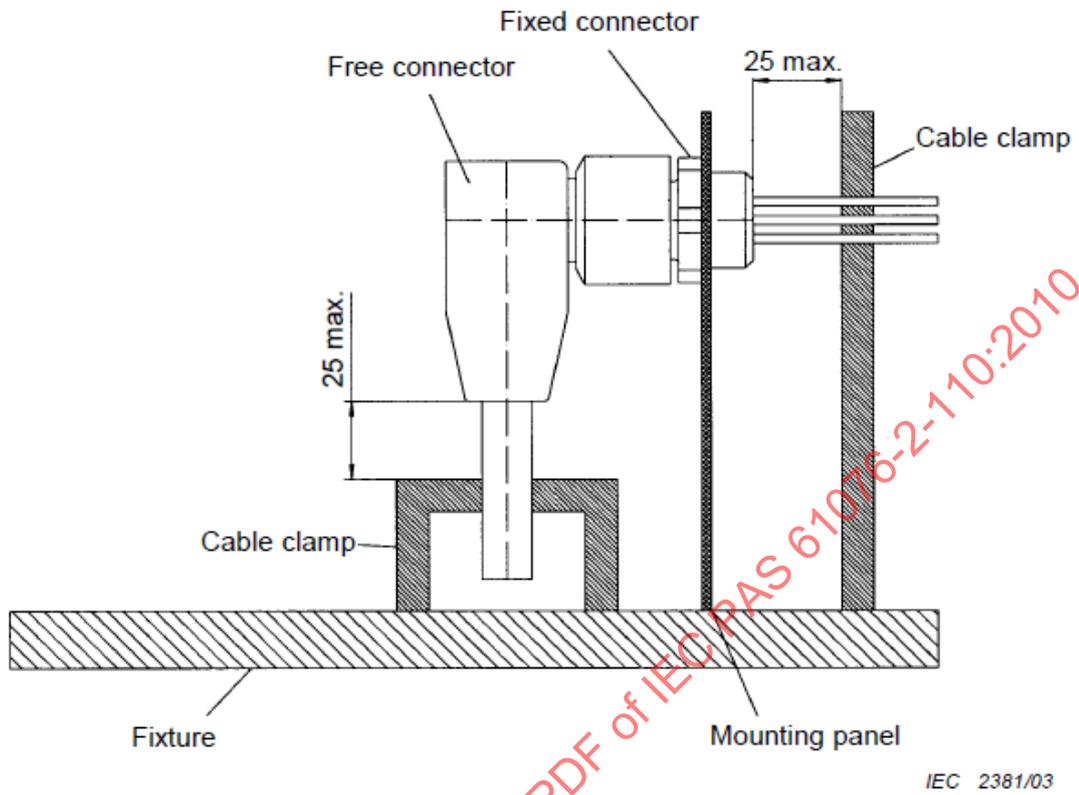


Figure 4 – Dynamic stress test arrangement

5.2 Test schedule

5.2.1 Test group P-Preliminary

All specimens shall be subjected to the following tests.

**Table 8 – 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.	All connector styles
P1	General examination	1	Unmated Connectors	Visual examination	1a	There shall be no defect that would impair normal operation
P2			Connection points according to 5.1.1 all contacts per specimens	Contact resistance – Millivolt level method	2a	Initial value acc.4.2.4
P3			Test voltage 500 V ± 15 V d.c. Method A	Insulation Resistance	3a	Initial Value acc.4.2.5
P4			Contact/contact same measuring points as for P3	Voltage proof	4a	According to 4.2.2

The specimen shall be divided into 4 groups. All connectors in each group shall undergo the tests specified for the relevant group

### 5.2.2 Test group AP – Dynamic/ Climatic

**Table 9 – Test group AP**

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 4.3.3	Insertion and withdrawal forces	13b	Requirements see 4.3.3
AP2	Gauge retention force		Female contacts only 3 contacts/ specimen sizing and retention gauge see 3.3.1	Engaging and separating forces	16e	See 3.3.1
AP3	Vibration	6d	Sweep cycles: 10 Full duration: 6 h See 4.3.6	Contact disturbance	2e	Duration of disturbance 1 µs max.
				Contact resistance – Millivolt level method	2a	Rise in relation to initial values ≤10 mΩ
				Visual examination	1a	There shall be no defect that would impair normal operation

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
AP4	Shock	6c	See 4.3.7	Contact disturbance	2e	Duration of disturbance 1 μs max.
				Contact resistance – Millivolt level method	2a	Rise in relation to initial values ≤10 mΩ
				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 ≤10 mΩ
				Insulation resistance	3a	Initial value acc.4.2.5
				Voltage Proof	4a	According to 4.2.2
				Visual examination	1a	There shall be no defect that would impair normal operation
AP6	Climatic sequence	11a				
AP6.1	Dry heat	11i	Temperature: 85 °C Duration: 16 h	Insulation resistance at high temperature	3a	Initial Value acc.4.2.5
AP6.2	Damp heat, cyclic, first cycle	11m	Method dB Temperature: 40 °C Recovery time: 2 h	Visual examination	1a	There shall be no defect that would impair normal operation
AP6.3	Cold	11j	Temperature: -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 ≤15 mΩ
				Insulation resistance	3a	Initial Value acc.4.2.5
				Voltage proof	4a	Acc. 4.2.2
				Insertion and withdrawal forces	13b	Requirements see 4.3.3
				Visual examination	1a	There shall be no defect that would impair normal operation
AP7	IP Protection degree	IEC 60529		Table 1 of IEC 60529		According to 4.3.1
AP8				Visual examination	1a	There shall be no defect that would impair normal operation

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
AP9	Polarizing method	13e	See 4.3.5			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. The insertion and withdrawal forces acc.AP1

### 5.2.3 Test group BP – Mechanical endurance

Table 10 – Test group BP

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
BP1			Female contacts only 3 contacts/ specimen sizing and retention force gauge see 3.3.1	Gauge retention force	16e	See 3.3.1
BP2	Mechanical operation (half of the specified number of operations)	9a	Speed 10 mm/s max. Rest 30 s (unmated). Operations see 4.3.2 Speed: 10 mm/s max. Rest time: 30 s (unmated)			
				Visual examination	1a	There shall be no defect that would impair normal operation
BP3	Climatic test					
BP3.1	Corrosion Industrial Atmosphere	11g	Flowing mixed gas corrosion - 4 days, test method 4 according IEC 60068-2-60	Contact resistance- Millivolt level method	2a	Rise in relation to initial values $\leq 10 \text{ m}\Omega$
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 $\leq 10 \text{ m}\Omega$
				Insulation resistance	3a	Initial value acc.4.2.5
				Voltage proof	4a	According 4.2.2
			Unmated connectors	Visual examination	1a	There shall be no defect that would impair normal operation

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
BP5				Insertion and withdrawal forces	13b	For requirements, see 4.3.3
BP6			Female contacts only 3 contacts/ specimen sizing and retention force gauge see 3.3.1	Gauge retention force	16e	See 3.3.1

**5.2.4 Test group CP – Electrical load**

**Table 11 – 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 r = 1 h 5 cycles	Contact resistance – Millivolt level method	2a	Rise in relation to initial values ≤10 mΩ
				Insulation Resistance	3a	Initial value according to 4.2.5
				Voltage Proof	4a	According to 4.2.2
CP2	Mechanical operation	9a	See BP2			
CP3	Electrical load and temperature	9b	Duration: 1000 h Amb.temp.: 40 °C Current load according to 4.2.3 Recovery time: 2  Temperature: sensor in center of specimen	Contact resistance – Millivolt level method		Rise in relation to initial values ≤10 mΩ
				Insulation Resistance	3a	Initial value acc.4.2.5
				Voltage Proof	4a	According to 4.2.2
CP4			Unmated connectors	Visual examination	1a	

**5.2.5 Test group DP – Chemical resistivity**

**Table 12 – Test group DP**

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
DP1	Resistance to fluids	19c	Upon agreement between manufacturer and user			Upon agreement between manufacturer and user