

TEST REPORT

Product description: Photovoltaic Connector)

Model/ type Ref: MC4/1000V; MC4/1500V; Y3; Y4; Y5; T3; T4; T5; T6; T7

Trade mark (if any): N/A

Description: Photovoltaic Connector

Name and address of the applicant:

Yueqing Baoman Electric Appliance Co., Ltd

Hu Heng Xi Ao Village, Liu Shi Town, Yueqing City, Wenzhou City, Zhejiang Province, China

Name and address of the manufacturer:

Yueqing Baoman Electric Appliance Co., Ltd

Hu Heng Xi Ao Village, Liu Shi Town, Yueqing City, Wenzhou City, Zhejiang Province, China

Test report No.: TR23062501

Sample (s)of the product were tested and found to be in conformity with standard (s)

EN IEC 62852:2015+A1:2020

Test result:	PASS
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2023-06-25

Tested by: Jime

Approved By: Kenny



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Standard: <u>EN IEC 62852:2015+A1:2020</u>	
Procedure deviation:	NONE
Non -standard test method:	NONE
General remarks This report shall not be reproduced except in full without the written approval of the testing laboratory The test results presented in this report relate only to the item(s)tested "(see Annex#)" refers to an annex appended to the report Throughout this report a comma is used as the decimal separator	



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Test Summary

Test Item	Requirement & Test Method	Result	Verdict
5	Constructional requirements and performance		P
5.1	<p>General</p> <p>This standard does not define electrical rating values for voltage and current. These values are assigned by the manufacturer.</p> <p>Connectors shall be suitable for durable outdoor use in an ambient temperature area from -40 °C to +85 °C.</p> <p>Multi-way connectors shall be designed so that these requirements for earth-faulted and short-circuit-proofed installation complies with IEC 62548 or IEC 60364-7-71 2.</p>		P
5.2	Marking and identification		P
5.2.1	<p>Identification</p> <p>Connectors shall be identified and characterised by the following:</p> <ul style="list-style-type: none"> a) manufacturer's name, trademark or mark of origin; b) type reference (for example, the catalogue number); c) rated current in amperes (A); d) rated voltages or rated insulation voltages between line to earth and line to line in volts (V); e) rated impulse voltage in kilovolts (kV), if specified; f) pollution degree; g) degree of protection by enclosure according to IEC 60529; h) specified temperatures: ULT, LLT, maximum ambient temperature (minimum +85 °C); i) type of terminals; j) connectable conductors; <p>NOTE For current capacity of cables and wires, see IEC 60364-5-52.</p> <ul style="list-style-type: none"> k) reference to this standard or to the Detail Specification (DS), if applicable; l) symbols „Do not disconnect under load“, as given in Annex A; alternatively an adequate warning notice can be found in particular national language; m) polarity of connector, if applicable; n) RTE/RTI or TI (mechanical and electrical) of all polymeric insulating materials used in the connector. 		P



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Test Item	Requirement & Test Method	Result	Verdict
5.2.2	<p>Marking The marking shall be indelible and easily legible. The minimum marking on the connector shall be that of item a), l) and m) in 5.2.1 . Symbol or warning notice listed in l) of 5.2.1 shall be imprinted or labelled close to connector. A notice to attach the label shall be given in technical documentation. Markings a) and b) of 5.2.1 shall be applied on the smallest package unit.</p>		P
5.2.3	<p>Technical documentation Identification items of 5.2.1 not marked on the connector according to 5.2.2 and the following information shall be given in the technical documentation of the manufacturer:</p> <ul style="list-style-type: none"> a) information regarding the type of cable suitable for termination, if applicable; b) information regarding mounting, if applicable; c) assembly information such as required tooling (part number) by manufacturer, if applicable. 		P
5.3	<p>Provision against incorrect mating (non-intermateable) A multi-way connector shall be so designed that contact between live contacts of different polarity is not possible by engagement.</p>		P
5.4	Protection against electric shock		P
5.4.1	A connector shall be so designed that, after mounting, its live parts are not accessible by the IEC test finger in accordance with IEC 60529.		P
5.4.2	Protection against electric shock shall be ensured also during insertion and withdrawal. Compliance shall be tested by the IEC test probe 1 1 in accordance with IEC 61032.		P
5.5	<p>This standard applies to the following terminations and connection methods:</p> <ul style="list-style-type: none"> a) crimped connections according to IEC 60352-2 b) insulation displacement connections according to IEC 60352-3 (accessible IDC) or IEC 60998-2-3 		P

Test	Requirement & Test Method	Result	Verdict
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Item			
	<p>c) insulation displacement connections according to IEC 60352-4 (non-accessible IDC) or IEC 60998-2-3</p> <p>d) press-in connections according to IEC 60352-5</p> <p>e) insulation piercing connections according to IEC 60352-6 or IEC 60998-2-3</p> <p>f) screwless-type clamping units according to IEC 60999-1 or IEC 60999-2 or IEC 60352-7</p> <p>g) screw-type clamping units according to IEC 60999-1 or IEC 60999-2</p> <p>h) flat, quick-connect terminations according to IEC 61210</p> <p>As a minimum the applicable tests according to 6.3.1 5 shall be performed for all terminations and connection methods intended to be used.</p> <p>Other terminations and connection methods shall be tested in accordance with the relevant standards.</p> <p>Soldering and welding connections are also permitted.</p> <p>Termination and connection methods shall provide sufficient means for retaining the conductor in position.</p> <p>Electrical connections shall be so designed that the contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics not less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any shrinkage or yielding of the insulating material (see IEC 60309-1 :1 999, 25.3 or IEC 60999-1:1999, Clause 7 or IEC 60999-2). Insulation piercing terminations and insulation displacement connections are excluded from this requirement because of the tests performed according to IEC 60352-6 or IEC 60998-2-3.</p> <p>Precautions shall be taken to ensure that adequate contact pressure is maintained during connector lifetime.</p> <p>To compensate for changes during use, (e.g. loosening at screw-type clamping units caused by thermal cycles) the use of a lock washer, spring washer or similar could be sufficient.</p> <p>All terminations and connection methods shall be protected from mechanical and excessive thermal stress which could cause increased contact resistance.</p>		P



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Test Item	Requirement & Test Method	Result	Verdict
5.6	Resistance to deterioration If deterioration of specific parts might impair safety, the resistance of those parts to expected stresses shall be verified by the execution of the test program in Clause 6.		P
5.7	General design		P
5.7.1	Mechanisms which are used for mounting the connector and/or termination of conductors shall not be used to fix live parts in the connector housing, if it may impair the proper function of the mechanism or reduce the clearance and creepage distances below the requirements according to 5.1.8.		P
5.7.2	Connectors shall be so designed that connection of conductors of the type and cross-sectional areas as described in 5.7.3 and as specified by the manufacturer is possible. Besides the termination of the conductor, care shall be taken that no damage of the insulation is possible, e.g. by avoiding sharp edges.		P
5.7.3	Cables connected to the connector shall be suitable for use in photovoltaic systems and shall comply with the requirements of IEC 62930. The values of the rated current and the rated voltage shall have at least the rated values of the connector.		P
	The class of the conductor shall be Class 5 in accordance with IEC 60228, Class 2 conductors are allowed for cables intended for fixed installation.		P
5.7.4	Non-rewirable connectors shall be so designed that: - the flexible cable cannot be separated from the connector without making it permanently useless, - the connector cannot be disassembled or parts of it cannot be removed by hand or by using a general purpose tool, for example a screwdriver, as intended, - means are provided to prevent live parts, e.g. free strands of a conductor, from reducing the minimum insulation distance between such live parts and all accessible external surfaces of the connector, with the exception of the engagement face of the male connector, - a connector becomes useless for further use when for the re-mounting, other parts than the original ones are necessary, - connectors with non-rewirable terminations are also considered as rewirable, if they are reconstituted with original parts and with tools of the manufacturer, if applicable.		P



Test Item	Requirement & Test Method	Result	Verdict
5.8	<p>Design of a free connector In a free connector, the wires shall be protected against shear and tensile stress at the termination and be secured to prevent twisting. This requirement does not apply to a) free connectors for termination to cables in fixed mountings (plug connection in the sense of a detachable connection), b) free connectors in which the termination is protected against pull and twisting mounting provisions in the end-use product.</p>		P
5.9	<p>Degree of protection (IP Code) A connector shall have a degree of protection at least of IP55, according to IEC 60529. Depending on the installation a higher degree of protection may be required.</p>		P
5.10	<p>Dielectric strength A connector shall withstand the specified test voltage. Compliance is determined by the tests according to 6.3.8.</p>		P
5.11	Mechanical and electrical durability		P
5.11.1	A connector shall meet the mechanical operations without load of 50 operating cycles.		P
5.11.2	A non-rewirable connector shall withstand number of bends as described in 6.3.6.		P
5.12	<p>Range of ambient temperature A connector shall withstand the upper and lower values of temperature range as given in 5.2.1 or as specified by the manufacturer, if lower than the minimum value or higher than the maximum value as defined in 5.2.1 .</p>		P
5.13	<p>Temperature rise The sum of the ambient temperature and the temperature rise of a connector shall not exceed the upper limiting temperature (ULT).</p>		P
5.14	Cable anchorage		P
5.14.1	<p>Connectors intended to be used with cables specified by the manufacturer For connectors intended to be used with cables specified by the manufacturer, the tests shall be performed with cables as stated by the manufacturer. The unloaded cable shall be marked so that any displacement relative to the gland can be easily detected.</p>		



Test Item	Requirement & Test Method	Result	Verdict
	<p>The cable is pulled for a duration of 1 s, 50 times, without jerks in the direction of the axis with the relevant force as specified in Table 13.</p> <p>At the end of this period, the displacement shall not exceed 2 mm. This measurement shall be carried out after unloading the force from the cable.</p> <p>Afterwards the specimen shall be mounted in the test apparatus for torque test. The unloaded cable shall be marked so that any torsion relative to the gland can be easily detected, and then a torque as specified in Table 14 shall be applied for 1 min.</p> <p>During test, the torsion shall not exceed 45°.</p>		P
5.14.2	<p>Connectors intended to be used with generic cables A test mandrel equivalent to the minimum value of the anchorage range of the cable gland as specified by the manufacturer or supplier, with a sheath thickness as specified in Table 13 shall be fixed to the sample.</p> <p>The unloaded test mandrel shall be marked so that any displacement relative to the gland can be easily detected.</p> <p>The test mandrel shall be pulled for a duration of 1 s, 50 times, without jerks in the direction of the axis with the relevant force as specified in Table 13.</p> <p>At the end of this period, the displacement shall not exceed 2 mm. This measurement is to be carried out after unloading the force from the test mandrel.</p>		P
	<p>Unless otherwise specified, test mandrels shall consist of a metallic rod with an elastomeric sheath having a hardness of 70 Shore D \pm 10 points in accordance with ISO 868 and a sheath thickness as specified in Table 13 or Table 14. The complete test mandrel shall have a tolerance of \pm 0,2 mm for mandrels up to and including 1,6 mm diameter and \pm 0,3 mm for mandrels larger than 1,6 mm diameter. The shape shall be circular or a profile simulating the outer dimension of the cable as specified by the manufacturer or supplier.</p>		P



Test Item	Requirement & Test Method	Result	Verdict																														
	<p style="text-align: center;">Table 13 – Pull forces for cord anchorage</p> <table border="1"> <thead> <tr> <th>Cable diameter mm</th><th>Pull force N</th><th>Minimum sheath thickness of test mandrel mm</th></tr> </thead> <tbody> <tr><td>Up to 4</td><td>-</td><td>1*</td></tr> <tr><td>>4 to 8</td><td>30</td><td>1</td></tr> <tr><td>>8 to 11</td><td>42</td><td>2</td></tr> <tr><td>>11 to 16</td><td>65</td><td>2</td></tr> <tr><td>>16 to 23</td><td>70</td><td>2</td></tr> <tr><td>>23 to 31</td><td>80</td><td>2</td></tr> <tr><td>>31 to 43</td><td>90</td><td>2</td></tr> <tr><td>>43 to 55</td><td>100</td><td>2</td></tr> <tr><td>>55</td><td>115</td><td>2</td></tr> </tbody> </table> <p>* For cable diameters up to 4 mm, a suitable non-metallic mandrel may be used.</p> <p>Afterwards the specimen shall be mounted in the test apparatus for torque test. The unloaded mandrel shall be marked so that any torsion relative to the gland can be easily detected, and then a torque specified in Table 14 is applied for 1 min.</p>	Cable diameter mm	Pull force N	Minimum sheath thickness of test mandrel mm	Up to 4	-	1*	>4 to 8	30	1	>8 to 11	42	2	>11 to 16	65	2	>16 to 23	70	2	>23 to 31	80	2	>31 to 43	90	2	>43 to 55	100	2	>55	115	2		P
Cable diameter mm	Pull force N	Minimum sheath thickness of test mandrel mm																															
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	<p>During test, the torsion shall not exceed 45°. The torsion test shall be performed by using a test mandrel equivalent to the maximum value of the anchorage range of the cable gland as specified by the manufacturer or supplier, with a torque for the appropriate maximum cable diameter as specified in Table 14.</p> <p style="text-align: center;">Table 14 – Values for torsion test</p> <table border="1"> <thead> <tr> <th>Cable diameter mm</th><th>Torque Nm</th><th>Minimum sheath thickness of test mandrel mm</th></tr> </thead> <tbody> <tr><td>>4 to 8</td><td>0.10</td><td>1</td></tr> <tr><td>>8 to 11</td><td>0.15</td><td>2</td></tr> <tr><td>>11 to 16</td><td>0.35</td><td>2</td></tr> <tr><td>>16 to 23</td><td>0.60</td><td>2</td></tr> <tr><td>>23 to 31</td><td>0.80</td><td>2</td></tr> <tr><td>>31 to 43</td><td>0.90</td><td>2</td></tr> <tr><td>>43 to 55</td><td>1.00</td><td>2</td></tr> <tr><td>>55</td><td>1.20</td><td>2</td></tr> </tbody> </table>	Cable diameter mm	Torque Nm	Minimum sheath thickness of test mandrel mm	>4 to 8	0.10	1	>8 to 11	0.15	2	>11 to 16	0.35	2	>16 to 23	0.60	2	>23 to 31	0.80	2	>31 to 43	0.90	2	>43 to 55	1.00	2	>55	1.20	2		P			
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>55	1.20	2																															
5.15	Mechanical strength		P																														
5.15.1	A connector including its internal insulation shall show no damage likely to impair safety after exposure to mechanical stress according to Table 6.		P																														
5.15.2	In a connector assembled for final use, the contacts shall be securely retained in the contact insert.		P																														
5.16	Connector without locking device Connectors without locking device or without snap-in device shall withstand a withdrawal force of at least 50 N.		P																														
5.17	Connector with locking device Connectors with locking device or with snap-in device shall withstand a load of at least 80 N.		P																														



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5.18	Clearances and creepage distances		P																																																																																						
5.18.1	<p>General</p> <p>Clearances and creepage distances shall be dimensioned according to the following specifications.</p> <p>For connectors the requirements for double insulation shall be met between energized and accessible parts in the engaged position.</p> <p>For multi-way connectors the requirements for double or reinforced insulation shall be met between energized and accessible parts with different electrical potential in engaged and unengaged positions.</p>		P																																																																																						
5.18.2	<p>Clearances</p> <p>Clearances through slots and openings in enclosures of insulating material shall be dimensioned according to Table 2.</p> <p>Table 2 – Rated impulse voltages and minimum clearances</p> <table border="1"> <thead> <tr> <th rowspan="2">Rated DC voltage V</th> <th colspan="2">Basic insulation</th> <th colspan="2">Reinforced insulation</th> </tr> <tr> <th>Rated impulse voltage kV (1,2/50 µs)</th> <th>Clearance mm</th> <th>Rated impulse voltage kV (1,2/50 µs)</th> <th>Clearance mm</th> </tr> </thead> <tbody> <tr> <td>100</td> <td>1,5</td> <td>0,5</td> <td>2,5</td> <td>1,5</td> </tr> <tr> <td>150</td> <td>2,5</td> <td>1,5</td> <td>4,0</td> <td>3,0</td> </tr> <tr> <td>300</td> <td>4,0</td> <td>3,0</td> <td>6,0</td> <td>5,5</td> </tr> <tr> <td>600</td> <td>6,0</td> <td>5,5</td> <td>8,0</td> <td>8,0</td> </tr> <tr> <td>1 000</td> <td>8,0</td> <td>8,0</td> <td>12</td> <td>14</td> </tr> <tr> <td>1 600</td> <td>10</td> <td>11</td> <td>16</td> <td>19</td> </tr> </tbody> </table> <p>Minimum values for pollution degree 2 is 0,2 mm and for pollution degree 3 is 0,8 mm.</p> <p>NOTE Values are derived from IEC 60664-1:2007 for overvoltage category III and IEC TR 60664-2-1.</p>	Rated DC voltage V	Basic insulation		Reinforced insulation		Rated impulse voltage kV (1,2/50 µs)	Clearance mm	Rated impulse voltage kV (1,2/50 µs)	Clearance mm	100	1,5	0,5	2,5	1,5	150	2,5	1,5	4,0	3,0	300	4,0	3,0	6,0	5,5	600	6,0	5,5	8,0	8,0	1 000	8,0	8,0	12	14	1 600	10	11	16	19		P																																															
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5.18.3	Creepage distances		P																																																																																						
5.18.3.1	<p>General</p> <p>Creepage distances between live parts and accessible surfaces shall be dimensioned for reinforced or double insulation according to Table 3 related to the rated voltage considering the pollution degree as specified in 5.18.3.2.</p> <p>Table 3 – Creepage distances for basic insulation</p> <table border="1"> <thead> <tr> <th rowspan="2">Voltage (DC) V</th> <th rowspan="2">Pollution degree 1 All material groups mm</th> <th colspan="3">Pollution degree 2</th> <th colspan="3">Pollution degree 3</th> </tr> <tr> <th>Material group I mm</th> <th>Material group II mm</th> <th>Material group III mm</th> <th>Material group I mm</th> <th>Material group II mm</th> <th>Material group III mm</th> </tr> </thead> <tbody> <tr> <td>25</td> <td>0,125</td> <td>0,5</td> <td>0,5</td> <td>0,5</td> <td>1,3</td> <td>1,3</td> <td>1,3</td> </tr> <tr> <td>50</td> <td>0,18</td> <td>0,6</td> <td>0,9</td> <td>1,2</td> <td>1,5</td> <td>1,7</td> <td>1,9</td> </tr> <tr> <td>100</td> <td>0,25</td> <td>0,71</td> <td>1,0</td> <td>1,4</td> <td>1,8</td> <td>2,0</td> <td>2,2</td> </tr> <tr> <td>150</td> <td>0,31</td> <td>0,8</td> <td>1,1</td> <td>1,6</td> <td>2,0</td> <td>2,2</td> <td>2,5</td> </tr> <tr> <td>200</td> <td>0,42</td> <td>1,0</td> <td>1,4</td> <td>2,0</td> <td>2,5</td> <td>2,8</td> <td>3,2</td> </tr> <tr> <td>300</td> <td>0,70</td> <td>1,6</td> <td>2,1</td> <td>3,0</td> <td>3,8</td> <td>4,2</td> <td>4,7</td> </tr> <tr> <td>600</td> <td>1,7</td> <td>3,0</td> <td>4,3</td> <td>6,0</td> <td>7,0</td> <td>8,6</td> <td>9,5</td> </tr> <tr> <td>1 000</td> <td>3,2</td> <td>6,0</td> <td>7,1</td> <td>10,0</td> <td>12,5</td> <td>14,0</td> <td>16,0</td> </tr> <tr> <td>1 500</td> <td>5,2</td> <td>7,6</td> <td>10,4</td> <td>15</td> <td>18,0</td> <td>20,9</td> <td>23,6</td> </tr> </tbody> </table> <p>Linear interpolation is allowed.</p> <p>Values for reinforced or double insulation are twice the values for basic insulation.</p> <p>NOTE Values are derived from IEC 60664 for overvoltage category III, some values are rounded.</p>	Voltage (DC) V	Pollution degree 1 All material groups mm	Pollution degree 2			Pollution degree 3			Material group I mm	Material group II mm	Material group III mm	Material group I mm	Material group II mm	Material group III mm	25	0,125	0,5	0,5	0,5	1,3	1,3	1,3	50	0,18	0,6	0,9	1,2	1,5	1,7	1,9	100	0,25	0,71	1,0	1,4	1,8	2,0	2,2	150	0,31	0,8	1,1	1,6	2,0	2,2	2,5	200	0,42	1,0	1,4	2,0	2,5	2,8	3,2	300	0,70	1,6	2,1	3,0	3,8	4,2	4,7	600	1,7	3,0	4,3	6,0	7,0	8,6	9,5	1 000	3,2	6,0	7,1	10,0	12,5	14,0	16,0	1 500	5,2	7,6	10,4	15	18,0	20,9	23,6		P
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200	0,42	1,0	1,4	2,0	2,5	2,8	3,2																																																																																		
300	0,70	1,6	2,1	3,0	3,8	4,2	4,7																																																																																		
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5.18.3.2	<p>Pollution degree</p> <p>Creepage distances and clearances between hazardous live parts and accessible surfaces outside the enclosure shall be dimensioned according to pollution degree 3. Distances inside the enclosure shall be at least dimensioned for pollution degree 2.</p>		P
5.18.3.3	<p>Comparative tracking index (CTI)</p> <p>Insulation materials are classified into four groups corresponding to their comparative tracking index (CTI), when tested in accordance with IEC 60112:</p> <ul style="list-style-type: none"> Material Group I CTI ≥ 600 Material Group II $400 \leq \text{CTI} < 600$ Material Group IIIa 1 $75 \leq \text{CTI} < 400$ Material Group IIIb 1 $00 \leq \text{CTI} < 175$ <p>A material may be included in one of these four groups on the basis that the PTI, verified by the method of IEC 60112 using solution A, is not less than the lower value specified for the group.</p>		P
	5.19 Insulation parts		P
5.19.1	<p>General</p> <p>Insulating parts shall be so designed that they withstand the expected thermal requirements.</p>		P
5.19.2	<p>Outer accessible parts</p> <p>Outer accessible parts consisting of isolating material whose deterioration could impair the safety of the connector shall meet following requirements:</p> <ul style="list-style-type: none"> a) Flammability Class minimum HB, or V-2 according to IEC 60695-11-10. This shall be proved by a data sheet of the material supplier or by a test of the end product. Flammability V-1 or V-0 according to IEC 60695-11-10 are also acceptable. b) Weather resistance according to ISO 4892-2, method A or ISO 4892-3 with a total duration of 500 h. Dielectric strength according to 6.3.8 b) shall be fulfilled after the test. c) Glow wire test with 650 °C according to IEC 60695-2-1 1 . d) approval of relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) in accordance with IEC 60216-5 or IEC 60216-1 . Values shall be listed in technical information. 		P



Test Item	Requirement & Test Method	Result	Verdict																								
5.19.3	<p>Inner parts</p> <p>Inner parts consisting of isolating material retaining current carrying parts in position shall meet following requirements:</p> <p>a) Flammability Class minimum HB, or V-2 according to IEC 60695-1 1 -1 0. This shall be proved by a data sheet of the material supplier or a test of the end product.</p> <p>Flammability V-1 or V-0 according to IEC 60695-1 1 -1 0 are also acceptable.</p> <p>b) Isolating material shall have a CTI-value complying with the rated values of this standard according to IEC 60664-1 .</p> <p>c) Glow wire test with 750 °C according to IEC 60695-2-1 1 .</p> <p>d) approval of relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) in accordance with IEC 6021 6-5 or IEC 6021 6-1 . Values shall be listed in technical information.</p>		P																								
5.20	Current carrying parts and resistance against corrosion		P																								
5.20.1	<p>Metal parts shall be so designed that corrosion shall not impair safety with regard to electrical and mechanical characteristics. Compliance is checked by 6.3.9.</p> <p>All current carrying parts shall consist of base metal and plating, such that under normal operation a sufficient mechanical strength, electrical conductivity and corrosion resistance as described in this standard are given.</p>		P																								
5.20.2	Under wet ambient conditions all metal parts which have a difference of their electrochemical potentials more than 350 mV according to IEC/TR 60943 shall not be in contact with each other.		P																								
6	Tests		P																								
6.1	General		P																								
6.1.1	The tests shall be carried out in the sequence specified for each test group using the number of specimens as given in Table 4. For each test group a separate set of new specimens shall be used.		P																								
Table 4 – Plan of specimens required for tests <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Reference table</th> <th>Test group</th> <th>Number of specimens</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>Group A: mechanical</td> <td>One per test</td> </tr> <tr> <td>7</td> <td>Group B: service life</td> <td>3</td> </tr> <tr> <td>8</td> <td>Group C: service life</td> <td>3</td> </tr> <tr> <td>9</td> <td>Group D: thermal</td> <td>3</td> </tr> <tr> <td>10</td> <td>Group E: climatic</td> <td>3</td> </tr> <tr> <td>11</td> <td>Group F: degree of protection</td> <td>2</td> </tr> <tr> <td>12</td> <td>Group G: isolating material</td> <td>3</td> </tr> </tbody> </table> <p>NOTE For a connector family of the same design and comparable size, tests may be only for that member of a family which represents the worst case for that test.</p>				Reference table	Test group	Number of specimens	6	Group A: mechanical	One per test	7	Group B: service life	3	8	Group C: service life	3	9	Group D: thermal	3	10	Group E: climatic	3	11	Group F: degree of protection	2	12	Group G: isolating material	3
Reference table	Test group	Number of specimens																									
6	Group A: mechanical	One per test																									
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8	Group C: service life	3																									
9	Group D: thermal	3																									
10	Group E: climatic	3																									
11	Group F: degree of protection	2																									
12	Group G: isolating material	3																									



Test Item	Requirement & Test Method	Result	Verdict
6.1.2	A pair of connectors (male and female) or free contacts are defined as a specimen. Unless otherwise specified in the test program the unmated pair of connectors shall be tested		P
6.1.3	The tests shall be made under the standard atmospheric conditions of IEC 60068-1,unless otherwise specified in the test schedule.		P
6.1.4	The specimen is deemed not to comply with this standard if the specimen fails in more than one of the tests of any test group. If the specimen fails in one of the tests, this test and the preceding tests which may have affected its results shall be repeated on a new set of specimen. This new specimen shall pass the repeated tests, otherwise the product is deemed not to comply.		P
6.1.5	All visual examination tests shall be performed with the naked eye, unless otherwise specified.		P
6.2	Preparation of specimens		P
6.2.1	Specimens shall be pre-conditioned under standard conditions for testing, for a period of 24 h, in accordance with IEC 6051 2-1 .		P
6.2.2	The tests shall be carried out with copper conductors unless otherwise specified by the manufacturer and with the type of conductor specified for the connector. If terminations are provided for all types of conductors, solid, stranded and flexible, the tests shall be carried out only with flexible conductors according to IEC 60228, Class 5.		P
6.2.3	Screw-type clamping units shall be tightened with the value of the torque stipulated in Table 5 according to IEC 60999-1 and IEC 60999-2 unless otherwise specified by the manufacturer.		P

Table 5 – Values of torque for screw-type clamping units

Nominal diameter of thread mm	Table 5 – Values of torque for screw-type clamping units				
	I Nm	II Nm	III Nm	IV Nm	V Nm
≤ 1.6			0.1	0.1	
> 1.6 up to 2.0			0.2	0.2	
> 2.0 up to 2.5	0.2		0.4	0.4	
> 2.5 up to 3.0	0.25		0.5	0.5	
> 3.0 up to 3.2	0.3		0.6	0.6	
> 3.2 up to 3.6	0.4		0.8	0.8	
> 3.6 up to 4.1	0.7	1.2	1.2	1.2	1.2
> 4.1 up to 4.7	0.8	1.3	1.6	1.8	1.8
> 4.7 up to 5.5	0.8	1.4	2.0	2.0	2.0
> 5.5 up to 6.0	1.2	1.8	2.5	3.0	3.0
> 6.0 up to 8.0	2.5	2.5	3.5	4.0	4.0
> 8.0 up to 10.0			4.0	10.0	6.0
> 10.0 up to 12.0		4.0		14.0	8.0
> 12.0 up to 15		5.0		19.0	10.0



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Test Item	Requirement & Test Method	Result	Verdict
6.2.4	Unless otherwise specified in the test schedule, all tests shall be made on the specimen completely assembled according to the manufacturer's instructions.		P
6.3	Performance of tests		P
6.3.1	General In accordance with the test schedule given in 6.5, the general test methods specified in Tables 6 to 12, columns 3 and 7, shall be applied according to IEC 60512. Other tests are indicated in column 4.		P
6.3.2	Durability of marking The test is made by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked in petroleum spirit. Petroleum spirit is defined as the aliphatic solvent hexane with a content of aromatics of maximum 0,1 % volume, a kauri-butanol value of 29, initial boiling point of 65 °C, a dry point of 69 °C and a specific gravity of approximately 0,68 kg/l. After this test, the marking shall be legible to normal or corrected vision without additional magnification. This test shall be also carried out on an additional label with specified warning indication listed under I) from 5.2.1, if applicable. Markings made by impression, moulding, pressing, or engraving or the like are not subjected to this test.		P
6.3.3	Protection against electric shock		P
6.3.3.1	Connectors shall be tested by the test probe 11 according to IEC 61 032 using a test force of 10 N. For the test all covers and housing parts which are detachable without a tool shall be removed.		
6.3.3.2	The tests for the given IP code according to IEC 60529 shall be applied in the mated position. Subsequently the dielectric strength test according to 6.3.8 shall be performed within 1 h of second IP numeral (water) test.		
6.3.4	Temperature rise The object of this test is to assess the ability of a connector to continuously carry the rated current without exceeding the upper limiting temperature.		P



Test Item	Requirement & Test Method	Result	Verdict
	<p>The test shall be carried out according to test 5a of IEC 6051 2, under the following test conditions.</p> <p>Test conditions:</p> <ul style="list-style-type: none"> - maximum permissible conductor cross-section according to manufacturer's specification. <p>In case of a declared cross-section area with same rated current, the test will be applied to the most unfavourable cross-section;</p> <ul style="list-style-type: none"> - length of test cables = 500 mm \pm 50 mm for cross-section $\leq 10 \text{ mm}^2$; - length of test cables = 1 000 mm \pm 100 mm for cross-section $> 10 \text{ mm}^2$; - the test shall be carried out with rated current as specified by the manufacturer at an ambient temperature of 85 °C or the maximum ambient temperature specified by manufacturer, if higher; - the test shall be continued until a constant temperature is obtained. 		P
6.3.5	<p>Mechanical operation</p> <p>The object of this test is to assess the mechanical operational endurance of a connector in the normal operational mode without electrical load. The test shall be carried out according to test 9a of IEC 6051 2, under the following conditions.</p> <p>Test conditions:</p> <ul style="list-style-type: none"> - the specimens shall be engaged and disengaged by means of a device simulating normal operating conditions for a number of cycles specified by the manufacturer. The preparation and mounting of the specimen shall be as in normal use; - the type and cross-section of the cable/wire bundle to be used shall be specified by the manufacturer; - the speed of insertion and withdrawal shall be approximately 0,01 m/s with a rest in the unmated position of approximately 30 s. 		P
6.3.6	<p>Bending (flexing) test (see IEC 60309-1:1 999, 24.4)</p> <p>Non-rewirable connectors shall be subjected to a bending test in an apparatus similar to that shown in Figure 1 .</p> <p>The specimen is fixed to the oscillating member of the apparatus so that, when this is at the midpoint of its travel, the axis of the flexible cable, where it enters the specimen, is vertical and passes through the axis of oscillation.</p>		P



Test Item	Requirement & Test Method	Result	Verdict
	<p>The oscillating member is so positioned that the flexible cable makes a minimum lateral movement when the oscillating member of the test apparatus is moved over its full travel. The cable is loaded with a weight such that the force applied is</p> <ul style="list-style-type: none"> • 20 N for non-rewirable connectors with a conductor cross-section $> 0,75 \text{ mm}^2$, • 10 N for non-rewirable connectors with a conductor cross-section $\leq 0,75 \text{ mm}^2$. <p>A current equal to the rated current of the connector is passed through the conductors.</p>		P
	<p>The oscillating member is moved backwards and forwards through an angle of 90° (45° on either side of the vertical). The rate of bends shall be 60 per minute. One bending is one movement, either backwards or forwards. The number of bends is 100.</p> <p>Specimens with cables of circular cross-section shall be rotated approximately 90° around the vertical axis within the oscillating part after 50 % of flexings; specimens with flat flexible cables are only bent in a direction perpendicular to the plane containing the axis of the conductor.</p> <p>During this test, there shall be no interruption of the test current.</p> <p>After the test there shall be no damage; the cable support sleeve shall not be loosened from the body and the insulation shall show no signs of abrasion or of wear and tear. Broken strands shall not pierce the insulation, during the high voltage test according to 6.3.8.b) there shall be no breakdown of the test voltage.</p>		P
6.3.7	<p>Measurement of clearances and creepage distances</p> <p>Clearances and creepage distances shall be measured according to Annex B with the following additional requirements.</p> <p>For connectors without breaking capacity, clearances and creepage distances to the accessible surface shall be measured only in the mated position.</p> <p>For multi-way connectors the requirements for double or reinforced isolation between active parts with different potential shall be determined in mated and unmated condition.</p>		P



Test Item	Requirement & Test Method	Result	Verdict
	The surface of an unenclosed connector to be incorporated into an equipment or a device shall not be regarded as accessible, unless otherwise claimed by the manufacturer.		P
6.3.8	<p>Dielectric strength</p> <p>The test voltage has to be applied between the short circuited output terminals and a metal foil which is wrapped around the specimen after relevant conditioning. During dielectric strength test no breakdown of test voltage shall occur. The insulation shall be tested according to the following tests:</p> <p>a) Impulse withstand test</p> <p>The impulse withstand test shall be carried out with a voltage having a 1 ,2/50 µs waveform according to IEC 60060-1 with three impulses of each polarity and an interval of at least 1 s between impulses. The output impedance of the impulse generator should not be higher than 500 Ω. The test voltage shall comply with the rated impulse voltage according to table 2.</p> <p>b) Voltage proof (IEC 6051 2-4-1 , test 4a)</p> <p>The voltage proof shall be performed by applying a r.m.s. withstand voltage (50 Hz/60 Hz) with a r.m.s. value of 2 000 V + 4 times rated voltage. The test duration shall be 1 min.</p> <p>Voltage proof can also be performed with DC voltage. For this the value of test voltage shall be equal to the amplitude value of AC voltage.</p>		P
6.3.9	<p>Corrosion test</p> <p>For testing the protection of contacts against the influence of a corrosive atmosphere, one of the two alternative tests shall be selected. In both cases, the specimens shall be mated.</p> <p>Test 1 : Flowing mixed gas corrosion according to test 1 1 g of IEC 6051 2, with a choice of method 1 or method 4 (see IEC 6051 2-1 1 -7:2003, Table 1)</p> <p>The test duration shall be four days.</p> <p>Test 2: Sulphur dioxide test with general condensation of moisture according to ISO 6988.</p> <p>The test duration shall be 24 h (1 test cycle).</p>		P
6.3.10	<p>Mechanical strength at lower temperatures</p> <p>The specimens and the test apparatus shall be stored for 5 h at a temperature of -40 °C or the minimum ambient temperature specified by the manufacturer, if lower, on a steel plate of 20 mm thickness. The test shall be carried out immediately after the storage duration in the cold chamber.</p>		P



Test Item	Requirement & Test Method	Result	Verdict
	<p>Test shall be carried according to the following procedure: Four impacts on the specimen, an energy of 1 J with an appropriate impact test apparatus according to IEC 60068-2-75 shall be carried out at four uniformly distributed positions on the circumference. The test is passed successfully if no damage appeared which may impair the function of the connector and the dielectric strength test of 6.3.8 b) has been passed.</p>		P
6.3.11	<p>Change of temperature (IEC 60068-2-1 4 test Na) The test shall be carried in climatic chamber without any pre-treatment of the specimens as follows:</p> <ul style="list-style-type: none"> - 30 min at upper specified ambient temperature, minimum +85 °C ± 2 °C; - 30 min at lower specified ambient temperature, maximum -40 °C ± 2 °C; - transfer duration $t_2 \leq 3$ min; - number of test cycles: 200. <p>During thermal cycle test the rated current shall be applied such that it is conducted through the current-carrying contacts.</p>		P
6.3.12	<p>Damp heat test The test shall be carried out according to IEC 60068-2-78 with the following test conditions: Severity according to IEC 6121 5-2:2016, 4.1 3:</p> <ul style="list-style-type: none"> - test temperature: upper specified ambient temperature, minimum +85 °C ± 2 °C - relative humidity: +85 % ± 5 % - test duration: 1 000 h 		P
6.3.13	<p>Insertion and withdrawal force The test shall be carried out with the relevant counterpart according to IEC 6051 2, test 1 3b. The actuation speed shall be 50 mm/min. The measured withdrawal force shall not be less than 50 N.</p>		P
6.3.14	<p>Effectiveness of connector coupling device The test shall be carried out according to IEC 6051 2, test 15f. The specified force of 80 N shall be applied in the direction of the separation of the mated pair with the rate of 1 0 N/s. It shall not be possible to disengage the connector.</p>		P

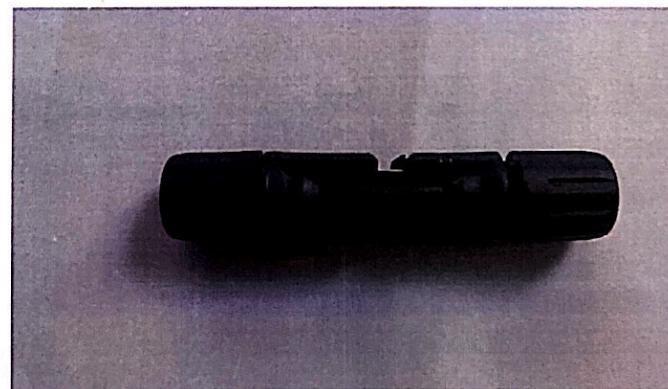


Test Item	Requirement & Test Method	Result	Verdict
6.3.15	<p>Terminations and connecting methods</p> <p>The following applicable tests shall be conducted:</p> <ul style="list-style-type: none"> a) for crimped connections, visual tests on the crimp barrel and tensile strength test of the crimp connection as specified in IEC 60352-2. If deviations to IEC 60352-2 exist, the tensile strength according to IEC 60352-2 and the dimensions according to the manufacturers specifications are tested to fulfil IEC 61984; b) and c) for insulation displacement connections, visual examination is carried out on new parts for insulation displacement terminals according to IEC 60352-3:1 993, 1 2.1 and for solderless non-accessible displacement terminals according to IEC 60352-4:1994, 1 2.2.4. The electrical and thermal tests are carried out according to IEC 61984; d) for press-in connections, visual and dimensional tests on the press-in post and test of the push-out force as specified in IEC 60352-5; e) insulation piercing connections according to IEC 60352-6 or IEC 60998-2-3; f) for the screwless-type clamping unit, mechanical tests on the conductor connection as specified in IEC 60999-1 or IEC 60999-2 or IEC 60352-7; g) for the screw-type clamping unit, mechanical tests on the conductor connection as specified in IEC 60999-1 or IEC 60999-2. For prepared conductors the manufacturers instructions for the preparation applies; h) for flat, quick-connect terminations, dimensional tests and safety tests as specified in IEC 61210 as far as applicable. 		P
6.4	<p>Test schedule (routine test) for non-rewirable free connectors</p> <p>For non-rewirable free connectors, it shall be ensured that live parts, e.g. loose strands, cannot become accessible. If this cannot be ensured by design or by the manufacturing process, each manufactured connector shall be subjected to the following test.</p>		P



Test Item	Requirement & Test Method	Result	Verdict
	<p>The accessible outer surface of the connector, with the exception of the engagement face of the male connector, shall be scanned by plane electrodes with a force of 20 N and each time the specified impulse withstand voltage of the connector shall be applied between all live parts and these electrodes according to 6.3.8. Alternatively, the specified r.m.s. withstand voltage according to 6.3.8 shall be applied for a minimum of three full cycles (60 ms). No breakdown or flashover shall occur.</p>		P

Photos of Product:



The end of report



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