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National Standard of the People's Republic of China

GB/T 26846-202×
Replaces GB/T 26846-2011

Lead-out wire and connector of motor and controller used for electric bicycles

电动自行车用电动机和控制器的引出线及接插件

(English Translation)

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Content

Foreword

SAC/TC 155 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This standard is drafted in accordance with the rules given in GB/T 1.1-2020, *Directives for standardization—Part 1: Rules for the structure and drafting of standardizing documents.*

This standard replaces the GB/T 26846-2011, (*Lead-out wires and connectors for motors and controllers for electric bicycles*). In addition to a number of editorial changes, the following technical deviations have been made with respect to the GB/T 26846-2011:

a) change standard name
b) change the structure of the lead-out line (see Chapter 4, 4.2 of the 2011 edition);
c) remove structural checks have been removed (see 5.3 in the 2011 version);
d) add general rules for lead-out wires and connectors have been added (see 5.1);
e) change requirements and test methods for contact resistance (see 5.2.1, 6.2.1, 4.8, 5.9 of the 2011 edition);
f) add requirements and test methods for voltage drop (see 5.2.2, 6.2.2);
g) change requirements and test methods for insulation resistance (see 5.2.3, 6.2.3, 4.7, 5.8 of the 2011 edition);
h) change requirements and test methods for withstand voltage (see 5.2.4, 6.2.4, 4.7, 5.8 of the 2011 edition);
i) change requirements and test methods for pull-out force (see 5.3.1, 6.3.1, 4.3, 5.4 of the 2011 edition);
j) change requirements and test methods for crimp pull-off force (see 5.3.2, 6.3.2, 4.4, 5.5 of the 2011 edition);
k) add requirements and test methods for weld retention force (see 5.3.3, 6.3.3);
l) add requirements and test methods for reliability of terminal surface coatings (see 5.3.4, 6.3.4);
m) add requirements and test methods for polarity anti-staggering (see 5.3.5, 6.3.5);
n) add requirements and test methods for retention force of lead-out wires and connectors (see 5.3.6, 6.3.6);
o) add requirements and test methods for vibration (see 5.3.7, 6.3.7);
p) add requirements and test methods for mechanical shock (see 5.3.8, 6.3.8);
q) add requirements and test methods for drops (see 5.3.9 , 6.3.9);
r) add requirements and test methods for high temperatures (see 5.4.1, 6.4.1);
s) add requirements and test methods for low temperatures (see 5.4.2, 6.4.2).
t) add requirements and test methods for temperature shock (see 5.4.3, 6.4.3);
u) change requirements and test methods for temperature and humidity cycling (see 5.4.3, 6.4.3, 4.10, 5.11 of the 2011 edition);

v) add requirements and test methods for waterproofing (see 5.4.4, 6.4.4);
w) delete requirements and test methods for bending tests (see 4.9, 5.10 of the 2011 edition);
x) add general provisions for test methods (see 6.1);
y) change the chapter on "Rules for testing" (see chapter 7, chapter 6 of the 2011 edition);
z) add a chapter on "Marking, packaging, transportation and storage" (see chapter 8).
aa) add definitions of lead-out wire colors for motors and controllers (see Annex A).
bb) Change the requirements for cross sections at the terminal-conductor crimp and at the crimp point (see Annex B, Annex A of the 2011 edition);
cc) delete connector specification numbers (see Annex B of the 2011 edition);

Please note that some of the contents of this document may be patented. The issuer of this document assumes no responsibility for identifying patents.

This standard is proposed by the China National Light Industry Council.

This standard was prepared by SAC/TC 155 (National Technical Committee for Bicycle Standardization).

The previous editions of this standard are as follow:
--The first edition was issued in 2011 as GB/T 26846-2011;
--This is the first revision.

Lead-out wires and connectors of motors and controllers used for electric bicycles

1 Scope

This document specifies the requirements for lead-out wires and connectors of motors and controllers for electric bicycles, describes the testing equipment and apparatus and the corresponding test methods, specifies the inspection rules, marking, packaging, transportation and storage, and gives the definition of terms to facilitate the technical provisions of the definition and product structure.

This document is applicable to the design, production, inspection and sale of lead-out wires and connectors for electric motors and controllers for electric vehicles included in power-assisted bicycles as defined in QB/T 1714.

2 Normative References

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

GB/T 191 *Graphic symbols for packaging, storage and transportation*

GB/T 2423.5 *Environmental test Part 2: Test methods Test Ea and guidelines: Shock*

GB/T 2423.17 *Environmental test for electrical and electronic products Part 2: Test method Test Ka: Salt spray*

GB/T 2829 *Cyclic test counting sampling procedures and tables (applicable to the test of process stability)*
GB/T 4208 *Enclosure protection level (IP code)*

GB/T 5169.16 *Fire hazard test for electrical and electronic products Part 16 Test flame 50W Horizontal and vertical flame test method*

GB/T 12742 *Technical conditions for bicycle testing equipment and apparatus*

GB/T 26846-20XX

GB/T 26125 *Determination of six restricted substances in electrical and electronic products*

GB 42295-2022 *Electrical safety requirements for electric bicycles*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

Lead-out wire

Cables connect motors and controllers to connectors for electric bicycles.

3.2

Connector

A combination of terminals, sheaths, and accessories used to make electrical connections.

3.3

Plug

A connector consists of a connector housing and terminals that can be plugged into a socket for electrical connection.

3.4

Socket

A connector consists of a connector housing and terminals that can accept plugs for electrical connection.

3.5

Terminal

A metal part is used to realize an electrical connection.

3.6

Connector housing

An insulator is used for mounting terminals.

3.7

Main circuit

A circuit transmits power electrical energy from the output of a battery system to drive a motor.

3.8

Control circuit

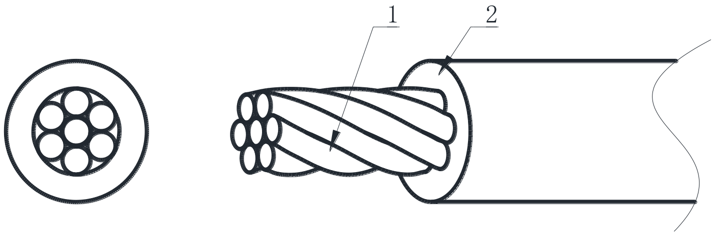
A circuit consists of signal lines from the motor and controller.

4 Product Structure

4.1 Lead-out wire structure

4.1.1 Single-core cable

The structure of single-core cables is shown in Figure 1, it shall comply with the dimensional specifications in Table 1.



Description:

1 - Copper conductor; 2 - Insulator.

Figure 1 Schematic diagram of single-core cable structure

Table 1 Cable size specifications

Conductor Specifications mm^2	Conductor O.D. mm	Thick-walled mm			Thin-walled mm			Ultra-thin wall mm		
		Insulation thickness	Cable outer diameter		Insulation thickness	Cable outer diameter		Insulation thickness	Cable outer diameter	
	Max[a]	Min[b]	Max[a]	Min[c]	Min[b]	Max[a]	Min[c]	Min[b]	Max[a]	Min[c]
0.13	0.55				0.20	1.05	0.95	0.16	0.95	0.85
0.22	0.77	-	-	-	0.20	1.20	1.10	0.16	1.05	0.95
0.35	0.90				0.20	1.40	1.20	0.16	1.20	1.10
0.50	1.10	0.48	2.30	2.00	0.22	1.60	1.40	0.16	1.40	1.30
0.75	1.30	0.48	2.50	2.20	0.24	1.90	1.70	0.16	1.60	1.45
1.00	1.50	0.48	2.70	2.40	0.24	2.10	1.90	0.16	1.75	1.55
1.50	1.80	0.48	3.00	2.70	0.24	2.40	2.20	0.16	2.10	1.90
2.50	2.20	0.56	3.60	3.30	0.28	3.00	2.70	0.20	2.70	2.50
4.00	2.80	0.64	4.40	4.00	0.32	3.70	3.40			
6.00	3.40	0.64	5.00	4.60	0.32	4.30	4.00	-		
10.00	4.50	0.80	6.50	5.90	0.48	6.00	5.30			
Note: "-" indicates that the cable type does not exist										

[a] The maximum conductor outside diameters listed in the table are specified for bundle stranded conductors. By agreement between the supplier and the buyer, a different maximum conductor outside diameter is permitted for re-stranding and other stranding methods. This difference may affect the cable O.D. dimensions in the table.

[b] The nominal insulation thickness W_{nom} is calculated according to the following formula:

$W_{nom} = 1.25 \times W_{min}$ or $W_{nom} = W_{min} = \frac{W_{min}}{0.8}$

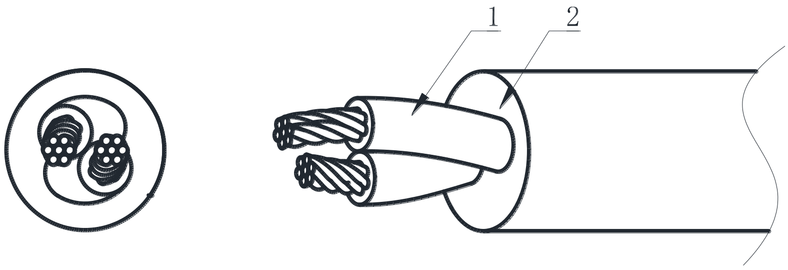
Where: W_{min} ----- Minimum insulation thickness in millimeters (mm);

W_{nom} ----- Nominal insulation thickness in millimeters (mm).

[c] For compressed conductors, the minimum cable outside diameter is not assessed.

4.1.2 Composite cable

The structure of the composite cable is shown in Figure 2, the composite cable formed by stranding one or more groups of single-core cables. The specifications for the cross-sectional area of the core conductors are shown in Table 1 shall comply with dimensions specification in Table 1.



Description:

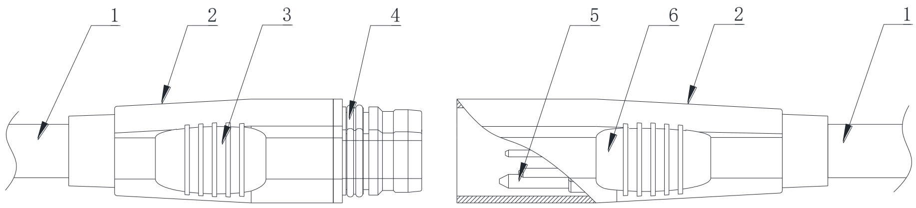
1 – Single wire; 2 - Sheath.

Figure 2 Schematic diagram of composite cable structure

4.2 Connector structure

4.2.1 Waterproof motor connectors

The structure of the waterproof motor connector is schematically shown in Figure 3.



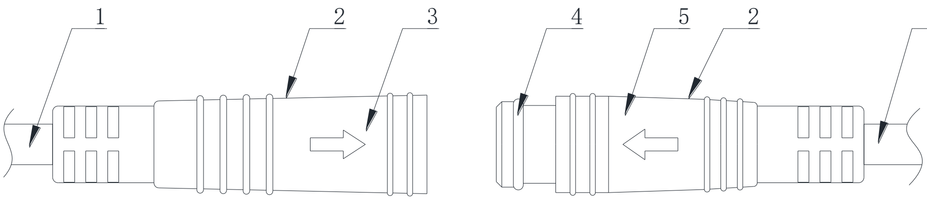
Description:

1 – Lead-out wire; 2 - Connector housing; 3 - Socket; 4 – Sealing ring; 5 - Terminal; 6 -- Plug.

Figure 3 Waterproof motor connector

4.2.2 Waterproof controller connectors

A schematic diagram of the waterproof controller connector structure is shown in Figure 4.



Description:

1 – Lead-out wire; 2 - Connector housing; 3 - Socket; 4 – Sealing ring; 5 - Plug.

Figure 4 Waterproof controller connector

4.2.3 Non-waterproof integrated connector

The structure of the non-waterproof integrated connector is shown in Figure 5.

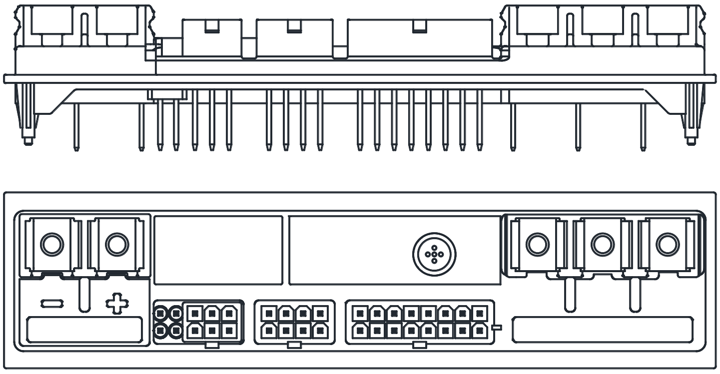
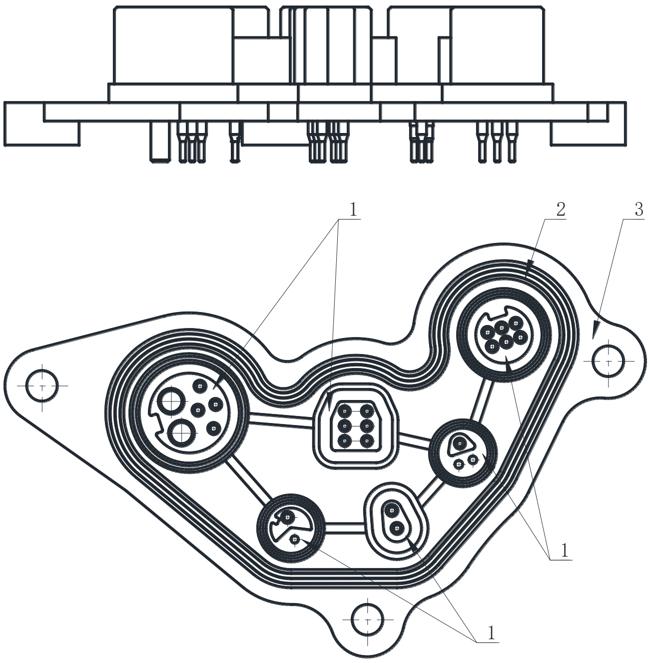


Figure 5 Non-waterproof integrated connector

4.2.3 Waterproof integrated connector

The structure of the waterproof integrated connector is shown in Figure 6.



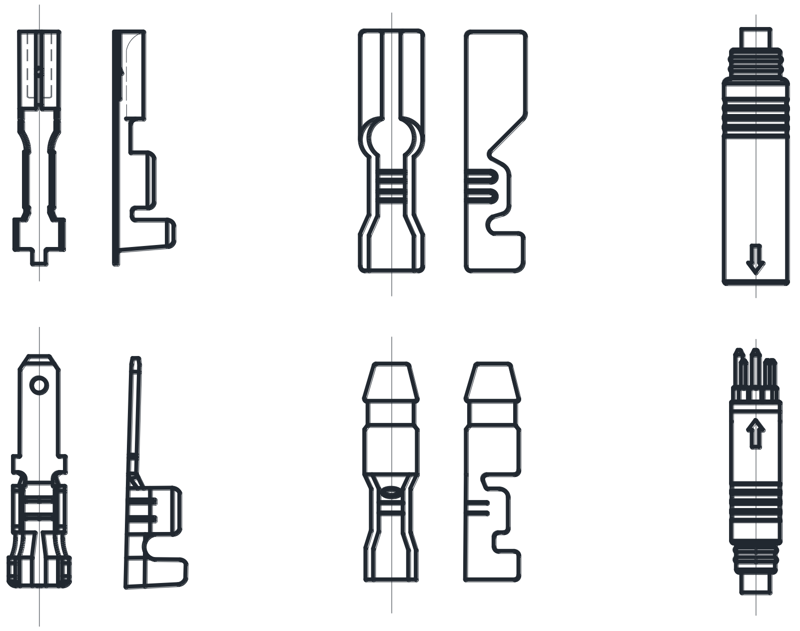
Description:

1 – Socket; 2 – Sealing ring; 3 – Plastic base.

Figure 6 Waterproof integrated connector

4.2.3 Terminals

The terminal structure of the connector is shown schematically in Figure 7.



a) Monolithic b) Monolithic column c) Multilinear

Figure 7 Terminal structure of the connector

5 Requirements

5.1 General

5.1.1 The lead-out wires of the motor and the lead-out wires of the main circuit of the controller should be selected as cables with a temperature resistance of more than 200 ℃, and the lead-out wires of other control circuits should be selected as cables with a temperature resistance of more than 90 ℃. Flame retardant properties of the lead-out wire should be able to pass the V-0 test given in GB/T 5169.16. The physical properties of the lead-out wires should be in line with the relevant national or industry standards for cables.

5.1.2 The shell of the connector should be selected to withstand temperature greater than 120 ℃, and the flame retardant grade should be able to pass the V-0 test given in GB/T 5169.16. The material of terminals should be copper alloy.

5.1.3 The colors of motor and controller lead-out wires can be specified in Annex A.

5.1.4 The lead-out wires and connectors shall comply with the requirements in Table 2 Test Temperature and Table 3 Waterproof Rating according to their operating ambient temperature and application scenarios, respectively.

5.1.5 The content of hazardous substances in the lead-out wires and connectors shall comply with the provisions of GB/T 26125.

5.1.6 The appearance of lead-out wires and connectors shall meet the following requirements:

a) No rust, burrs, breaks or cracks on the surface of the terminals;

b) Conductor surfaces are smooth, free of oil and grease, and free of burrs, sharp edges, and bumps or breaks that damage insulation;

c) The connector shell and its auxiliary parts are free of cracks and deformations affecting performance;

d) The lead-out wires are free of color difference, deformation and breakage;

e) No displacement or loosening of parts connected by threads.

Table 2 Temperature level

Operating temperature ℃	Test temperature ℃
-40 to +70	+85±2
-40 to +85	+100±2
-40 to +100	+125±2
-40 to +125	+155±2

Table 3 Waterproof level

Waterproof level	Application scenario
IPX0	No waterproofing requirements
IPX5	Applied to internal parts, may be exposed to rain
IPX6	For occasional rain
IPX7	For frequent usage rain or wading

5.2 Electrical performance

5.2.1 Contact resistance

Test according to the method described in 6.2.1, the contact resistance value of the connector shall meet the requirements of 4.3.4 in GB 42295-2022.

5.2.2 Voltage drop

Test in accordance with the method given in 6.2.2, the test current and measured voltage drop of the crimped terminals shall comply with in Table 4.

Table 4 Conductor nominal cross-sectional area versus voltage drop and test current

Nominal cross-sectional area of conductor mm^2	Test current A	Voltage drop mV	Nominal cross-sectional area of conductor mm^2	Test current A	Voltage drop mV
0.13	1	2	1.50	20	11
0.22	1	2	2.50	30	16

Nominal cross-sectional area of conductor mm^2	Test current A	Voltage drop mV	Nominal cross-sectional area of conductor mm^2	Test current A	Voltage drop mV
0.35	2	2.5	4.00	35	18
0.50	5	3	6.00	40	20
0.75	10	6	10.00	50	25
1.00	15	8	-	-	-
Note: Conductors with nominal cross-sectional area not listed in the table may have their test current and voltage drop determined by linear interpolation.					

5.2.3 Insulation resistance

Test according to the method given in 6.2.3, the insulation resistance value of the connectors of the main circuit or control circuit shall comply with the provisions in Table 5.

Table 5 Insulation resistance values of connectors for main or control circuits

Unit: megaohms

Test position	Insulation resistance value					
	Normal	High temperature	Low temperature	Thermal cycling	Temperature and humidity cycle	Waterproof
Betwenn main and control circuits	＞150	＞50	＞150	＞150	＞50	＞20
Between cables inside the main circuit						
Between main circuit and housing						
Between control circuits and housings						

5.2.4 Withstanding voltage

Test in accordance with the method given in 6.2.4, the connector shall have no breakdown or flying arc, and the current leakage shall not be greater than 5 mA.

5.3 Mechanical properties

5.3.1 Insertion and extraction forces

Test according to the method given in 6.3.1, the single-wire piece insertion and extraction force shall comply with the provisions in Table 6, the single-wire column insertion and extraction force shall comply with the provisions in Table 7, and the multi-wire insertion and extraction force shall comply with the provisions in Table 8.

Note: When the overall insertion and extraction force of the connector is greater than 75 N, it is recommended that the connector be inserted and extracted using an integrated or separate auxiliary tool.

Table 6 Insertion and extraction forces for single wire tab type connectors

Connector type	Terminal width mm	1st maximum insertion force N	1st maximum pull-out force N	10th minimum pull-out force N
With locking device	2.8	27	27	4
	4.8	30	30	7
	6.3	45	45	9
	8.0	59	59	12
	9.5	67	67	15
No locking device	2.8	53	53	6
	4.8	67	67	15
	6.3	80	80	18
	8.0	90	90	24
	9.5	100	100	30

Table 7 Insertion and extraction forces for single-wire post connectors

Connector Type	Gauge mm	1st maximum insertion force N	1st maximum pull-out force N	10th minimum pull-out force N
With locking device	Φ2.1	25	25	4
	Φ2.3	30	30	5
No locking device	Φ3.5	35	35	12
	Φ4.0	45	45	15

Table 8 Insertion and extraction forces for multi-wire connectors

Units: newton

Plug type	Plug-in applications	Insertion force (initial state)		Insertion and extraction force after environmental test
		Insertion force	Pull-out force	
No locking device	Main circuit conductor connectors	<100	>50	≥50% of initial state
	Control circuit conductor connectors	<80	>20	≥50% of initial state
With locking device	Main circuit conductor connectors	<100	-	≥50% of initial state
	Control circuit conductor connectors	<80	-	≥50% of initial state

5.3.2 Crimp pull-off force

The cross section at the crimp of the terminal to the conductor of the lead-out wire and at the point of crimp shall comply with Annex B. Test method is given in 6.3.2, the pull-off force between the terminal and the lead-out wire shall comply with specification in Table 9.

Table 9 Terminal pull-off force

Nominal cross-sectional area of conductor mm^2	Minimum pull-off force N	Nominal cross-sectional area of conductor mm^2	Minimum pull-off force N
0.13	15	1.50	150
0.22	28	2.50	230
0.35	50	4.00	310
0.50	60	6.00	450
0.75	85	10.00	500
1.00	108	-	-
Note: 1. For terminal and lead-out wire connection, the tension value of the pull-off force test includes insulation layer crimping; 2. When two or more lead-out wires are connected to a contact or a terminal at the same time, take the lead-out wire with smaller cross-section for pull-off force test; 3. For conductors with nominal cross-sectional areas not listed in the table, the pull-off force may be determined by linear interpolation.			

5.3.3 Welding retention forces

When soldering methods are used for welded joints, corrosive soldering should not be used. Welded joints shall be smooth and shall not contain defects such as leakage, under-welding, or flux entrapment. Test according to the method given in 6.3.3, the welding retention force shall comply with the provisions in Table 10.

Table 10 Welding retention force

Nominal cross-sectional area of conductor mm^2	Minimum retention force N	Nominal cross-sectional area of conductor mm^2	Minimum retention force N
0.13	3	1.50	45
0.22	5	2.50	70
0.35	12	4.00	100
0.5	15	6.00	130
0.75	23	10.00	150
1.00	35	-	-
Note: 1. Retention force test is performed on the lead-out wire conductor with small cross-section located on the surface of the welded joint in the width direction of the welded joint; 2. Conductors with no nominal cross-sectional area listed may be used to determine the retention force value by linear interpolation.			

5.3.4 Reliability of terminal surface coatings

Test by the method given in 6.3.4, the test specimen shall meet the following requirements:

a) The terminal surface plating has no metal terminal substrate exposed;

b) The insertion and withdrawal forces meet the requirements of 5.3.1;

c) The contact resistance meets the requirements of 5.2.1;

d) The withstand voltage meets the requirements of 5.2.4;

Terminal surface plating material and the corresponding number of insertion and removal shall comply with the provisions in Table 11.

Table 11 Terminal surface coating materials and corresponding number of insertions and withdrawals

Terminal surface plating material	Sn	Ag	Au
Number of insertions and removals	20	50	100

5.3.5 Polarity Mis-insertion Prevention

Test as given in 6.3.5, the contacts shall be free of functional cosmetic damage to any plug terminals and the plug shall be free of contact with the socket terminals.

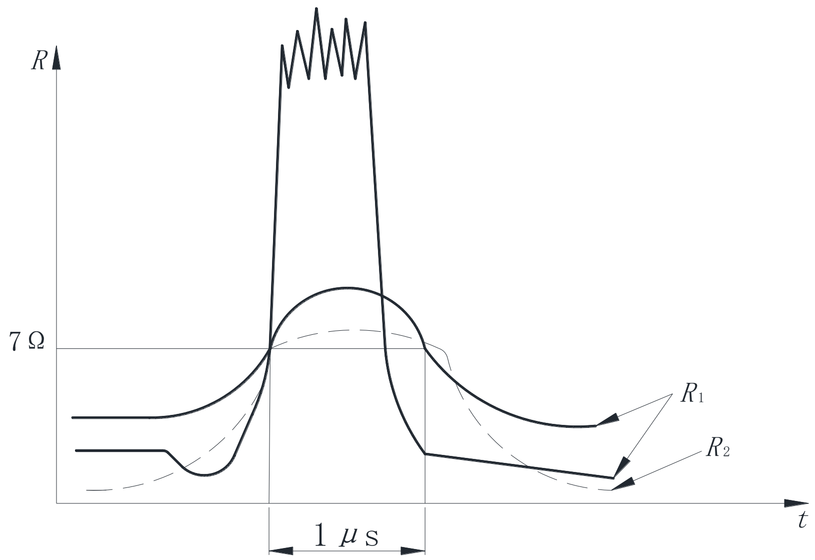
5.3.6 Retention force of lead-out wires and connectors

Test as given in 6.3.6, there shall be no separation of the connector from the lead-out wires.

Note: This test item is not applicable to the construction of products in which the connector terminals and the housing can be disassembled and reassembled.

5.3.7 Vibration

Test according to the method given in 6.3.7, during which the resistance value of the connecting circuit of the connector terminals should not be greater than 7 Ω continuously for a period of time greater than 1 μs, and the instantaneous disconnect monitoring diagram is shown in Figure 8. After the test, the connector should be free from damage and loosening of parts, and there should be no cracks and deformations affecting the performance of the connector shell and its auxiliary parts, and the contact resistance of the terminals should satisfy the requirements given in 5.2.1.



Description:

R – Contact resistance; R_1 – Comply with requirement; R_2 – Not comply with requirement; t – time.

Figure 8 Instantaneous disconnect monitoring diagram

5.3.8 Impact

Test in accordance with the method given in 6.3.8, during which the resistance value of the connecting circuit of the connector terminals shall not be greater than 7 Ω continuously for a period of time greater than 1 μs, and the diagram is shown in Figure 8. After the test, the connector shall be free from damage, and there shall be no loosening of the parts, and the contact resistance of the terminals shall satisfy the requirements given in 5.2.1.

5.3.9 Drop

Test in accordance with the method given in 6.3.9, the connector shall be free of disconnect and free of fragments affecting the functional appearance, and the contact resistance shall meet the requirements given in 5.2.1.

5.4 Environmental performance

5.4.1 High temperature storage

After the testing according to the method given in 6.4.1, the contact resistance, insulation resistance, insertion and extraction force and waterproofing of the test specimen shall meet the requirements given in 5.2.1, 5.2.3, 5.3.1 and 5.4.5 respectively, and the lead-out wires shall be free of color difference, deformation and breakage; and the shells of connectors and their auxiliary parts shall be free of cracks and deformations affecting performance.

5.4.2 Low temperature storage

After the testing in accordance with the method given in 6.4.2, the contact resistance, insulation resistance, insertion and extraction force and waterproofing of the test specimen shall meet the requirements given in 5.2.1, 5.2.3, 5.3.1 and 5.4.5 respectively, and the lead-out wires shall be free from color difference, deformation and breakage; and the shells of connectors and their auxiliary parts shall be free from cracks and deformations affecting performance.

5.4.3 Thermal cycling

After the testing in accordance with the method given in 6.5.3, the contact resistance, insulation resistance, insertion and extraction force and waterproofing of the test specimen shall meet the requirements given in 5.2.1, 5.2.3, 5.3.1 and 5.4.5 respectively, and the lead-out wires shall be free from color difference, deformation and breakage; and the shells of connectors and their auxiliary parts shall be free from cracks and deformations affecting performance.

5.4.4 Temperature and humidity cycling

After the testing according to the method given in 6.5.4, the contact resistance, insulation resistance, insertion and extraction force and waterproofing of the test specimen shall meet the requirements given in 5.2.1, 5.2.3, 5.3.1 and 5.4.5 respectively, and the lead-out wires shall be free from color difference, deformation and breakage; and the shells of connectors and their auxiliary parts shall be free from cracks and deformations affecting performance.

5.4.5 Waterproof

After the testing in accordance with the method given in 6.4.5, the protection level of the test specimen shall comply with requirements in Table 3, there shall be no water damage in the enclosed area isolated by the waterproof structure, and the insulation resistance value shall meet the requirements given in 5.2.3.

5.4.6 Salt spray

Test in accordance with the method given in 6.4.6, the metal terminal plating area of the test specimen shall be free of corrosion and the contact resistance value shall meet the requirements given in 5.2.1.

6 Test Methods

6.1 General

6.1.1 The following basic guidelines are observed for all tests:

Prior to the start of the test, the test specimens were kept at room temperature (23±5) ℃ and relative humidity of 45% to 75% for 24 h. The test specimens were kept at room temperature (23±5) ℃ and relative humidity of 45% to 75% for 24 h;

The test methods and test specimens do not affect each other; test specimens in the test chamber to maintain a certain distance, avoid stacking or mutual contact.

Throughout the test, no lubricants or other additives are applied to the surface of the plugs and sockets, with the exception of lubricants left over from the manufacturing process;

6.1.2 Unless otherwise specified, the test environment satisfies the following conditions:
Temperature: (23±5) ℃;
Relative humidity: 45% to 75%;
Air pressure: 86 kPa to 106 kPa.

6.1.3 The error in accuracy of all control values (actual values) relative to the specified values during the measurement is:
Voltage: ±1%;
Current: ±1%;
Temperature: ±2 ℃;
Time: ± 0.1%;

Note: Measurement accuracy errors include measurement instrument accuracy errors.

6.1.4 The test adopts the testing equipment and apparatus given in GB/T 12742.

6.2 Electrical performance test

6.2.1 Contact resistance

As shown in Figure 9, plug the terminals in place, use a DC low resistance tester to measure the resistance value R_e between T_1 and T_2, b section resistance value R_b, d section resistance value R_d, and then calculate the contact resistance value R_c according to the formula (1). The measured value does not include the resistance of the conductor.

If the lead-out wire of the test sample is soldered to the measuring point, its connection to the influencing connector is excluded.

Terminal contact resistance is calculated according to formula (1):

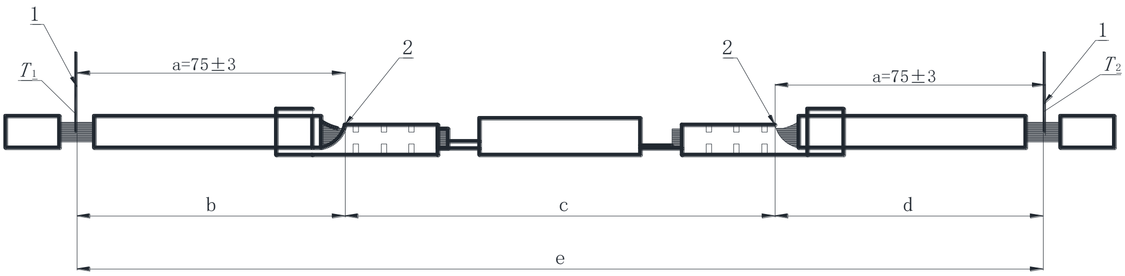
$$R_c = R_e - R_b - R_d \quad \text{..............................} \quad (1);$$

where:

R_c - Resistance value of the c-connection segment in milliohms (mΩ);
R_e - Measures the resistance of the wire segment in milliohms (mΩ);
R_b - b-segment wire resistance value in milliohms (mΩ);
R_d - d-segment wire resistance value in milliohms (mΩ).

When the measured contact resistance value is in dispute, measure it according to the method described in 5.3.4 of GB 42295-2022.

Unit:mm



Description:

1 - Test wire; 2 - Reference point; T_1 - Test point 1; T_2 - Test point 2; a - Recommended distance; b - Conductor resistance R_b of b; c - Connection resistance R_c of c; d - Conductor resistance R_d of d; e - Measurement resistance R_e of e.

Figure 9 Schematic diagram of contact resistance measurement

6.2.2 Voltage drop

Take the test sample with cable length greater than 160 mm, connect the circuit according to Figure 10, and use the voltage drop tester to load the test current as shown in Table 4 in the AC section and CD section, respectively, and read and record the voltage drop U_{AC} and U_{CD} on the voltage drop tester after reaching thermal equilibrium.

The voltage drop in the conductor crimping zone is calculated according to equation (2):

$$U_{AB} = U_{AC} - U_{CD} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2);$$

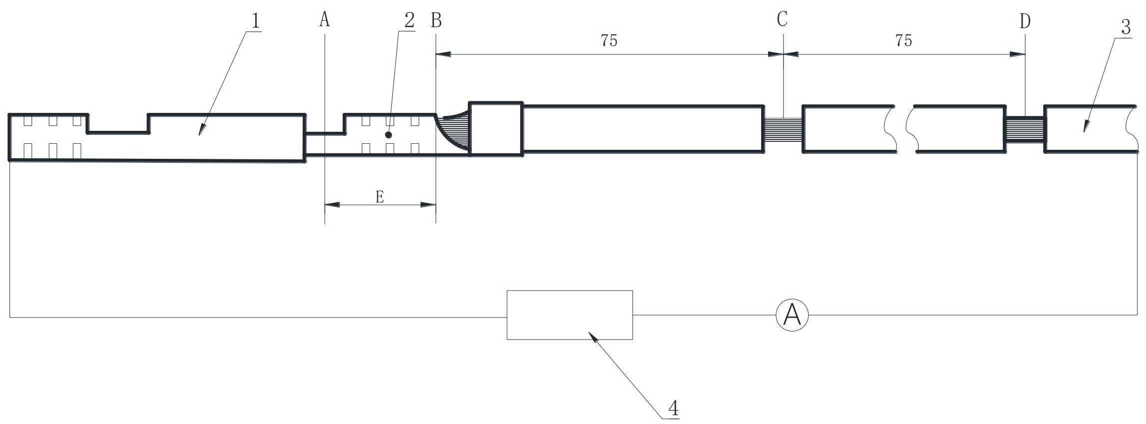
where:

U_{AB} - Conductor crimp zone voltage drop in millivolts (mV);

U_{AC} - Voltage drop between measurement points A and C in millivolts (mV);

U_{CD} - Voltage drop between measurement points C and D in millivolts (mV).

Unit:mm



Description:

1 - Terminal; 2 - Temperature test point; 3 - Cable; 4 - Constant current power supplies; A -Test point A; B - Test point B; C -Test point C; D - Test point D; E - Conductor crimp zone;

Figure 10 Schematic diagram of voltage drop test

6.2.3 Insulation resistance

Measure the insulation resistance value between all adjacent but not connected terminals in the connector (as shown in Figure 11), between the terminals and the electrodes, and between the terminals and the metal foil of the cladding shell with a DC voltage of 500 V insulation resistance meter for a duration of 60 s. Record the insulation resistance value.

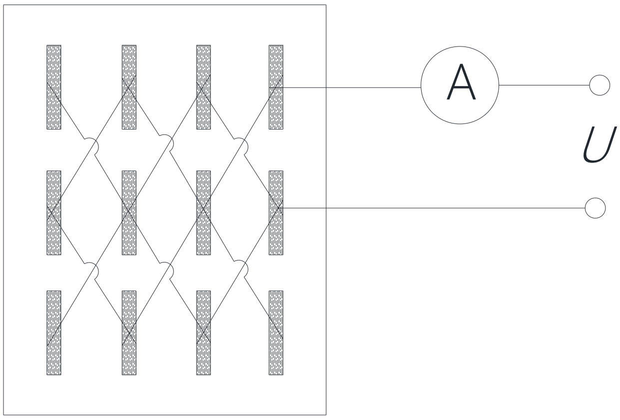


Figure 9 Method of connecting wires in the insulation resistance test

6.2.4 Withstanding voltage

6.2.4.1 Withstand voltage test between adjacent conductors

The procedure for testing voltage withstand between adjacent conductors is as follows:

a) Connect the withstand voltage tester to the end of an adjacent conductor with adjacent terminals having opposite polarity;

b) Test voltage loading, test time, and trip current are shown in Table 12, record current leakage results, and visually inspect connector appearance.

6.2.4.2 Withstand voltage test between conductor and enclosure

The procedure for testing the withstand voltage between the conductor and the enclosure is as follows:

a) The connector housing is wrapped in metal foil, which must not touch any of the terminals and conductors. Connect the negative terminal of the high-voltage test set to the metal foil and the positive terminal to the end of the conductor;

b) Test voltage loading, test time, and trip current are shown in Table 12, record current leakage results, and visually inspect connector appearance.

Table 12 Withstand Voltage Test Parameter List

Test site	Test Voltage (DC) V	Testing time min	Tripping current mA
Between main circuits, between main circuits and control circuits, between main circuits and enclosures	1000	1	5
Between control circuits and between control circuits and enclosures	500	1	5

6.3 Mechanical performance tests

6.3.1 Insertion and extraction forces

Mount the test specimen on a suitable insertion and extraction test device and perform insertion and extraction at a constant speed of (60±5) mm/min. When the insertion and removal force test is performed by the terminal only, ensure that the insertion and removal force is applied along the centerline of the terminal. Record the maximum value of first applied insertion and extraction force and the minimum value of 10th applied extraction force.

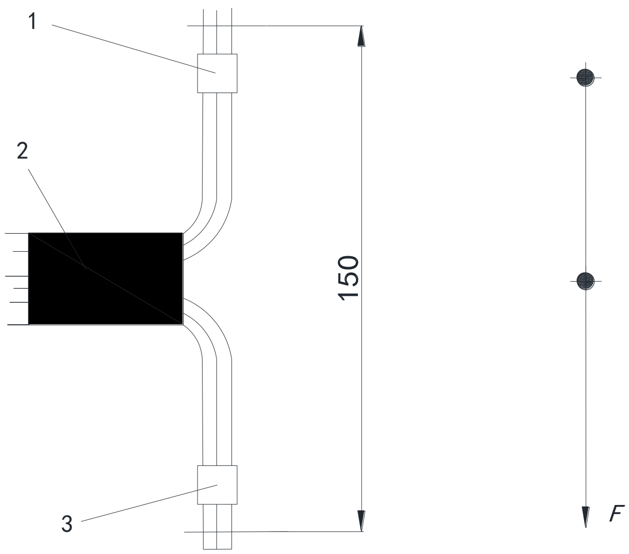
6.3.2 Crimp pull-off force

Measure the nominal cross-sectional area of the conductor of the lead-out wire. Apply a tension force at a constant rate of (60±5) mm/min along the axial direction of the test specimen, using a suitable tension test device. If the terminal has an insulator for an electrical conductor, it is mechanically ineffective. When multiple lead-out wire conductors are crimped to a single terminal, apply a separate tensile force to each lead-out wire conductor until the terminal is completely disengaged. Record the minimum value of the pull-off force.

6.3.3 Welding retention forces

Measure the nominal cross-sectional area of the lead-out wire conductor. As shown in Figure 12, using a suitable fixture, apply a tensile force at a constant rate of (60±5) mm/min along the axial direction of the lead-out wire until the solder joint is completely detached. Record the minimum value of the retention force.

Unit:mm



Description:

1 – Fixed clamp of tensile test machine; 2 – Solder contact; 3 – Moving clamp of tensile test machine;

Figure 12 Schematic diagram of retention force test

6.3.4 Plugging and unplugging number of times

The test specimen is inserted and removed under no load conditions at a constant rate of (60±5) mm/min in the direction of the centerline of the connector. The number of insertion and extraction is given in Table 11.

At the end of the insertion and extraction test, the outer surface of the test specimen is visually inspected and the insertion and extraction force, contact resistance, and voltage withstand are performed in accordance with the methods given in 6.2.1, 6.2.4 and 6.3.1, respectively.

6.3.5 Polarity Mis-insertion Prevention

The test specimen is tested for insertion force in accordance with 6.3.1 and the maximum insertion force F is recorded.

The test sample of the plug and socket in a staggered plug with the way were fixed in the upper and lower ends of the force gauge, to (60±5) mm/min constant rate of coupling force applied, when the coupling force reaches the set value to stop the test, visual inspection of the test sample of the appearance of the condition of the plug and socket terminals in contact with the situation.

The coupling force setting is related to the insertion force *F*. When 1.5*F* is not greater than 20 N, the coupling force value is set to 20 N; when 1.5*F* is greater than 20 N, the coupling force value is set to 1.5*F*.

6.3.6 Holding force of lead-out wires and connectors

As shown in Figure 13, place the test specimen in the hole of the rigid support plate, apply a tensile force along the axial direction of the lead-out wire, hold it for 1 min, and visually check the separation of the lead-out wire from the connector.

The applied pulling force is related to the total cross-sectional area of the lead-out wires, with a total cross-sectional area greater than or equal to 1.0 mm^2 applying a pulling force of 133 N and a total cross-sectional area of less than 1.0 mm^2 applying a pulling force of 89 N. The total cross-sectional area of the lead-out wires is equal to or greater than 1.0 mm.

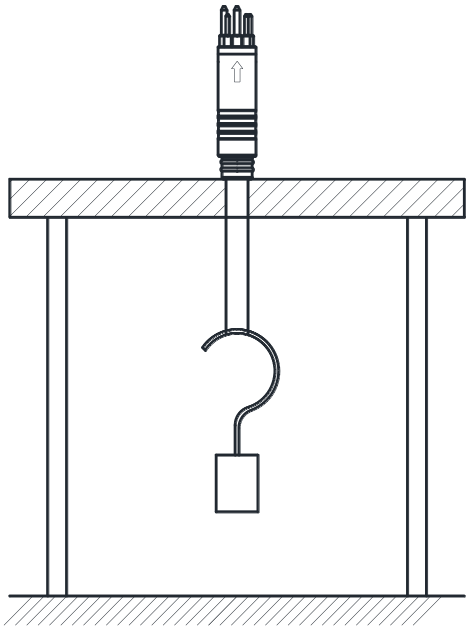


Figure 13 Schematic diagram of lead-out wire and connector retention force test

6.3.7 Vibration

6.3.7.1 Installation

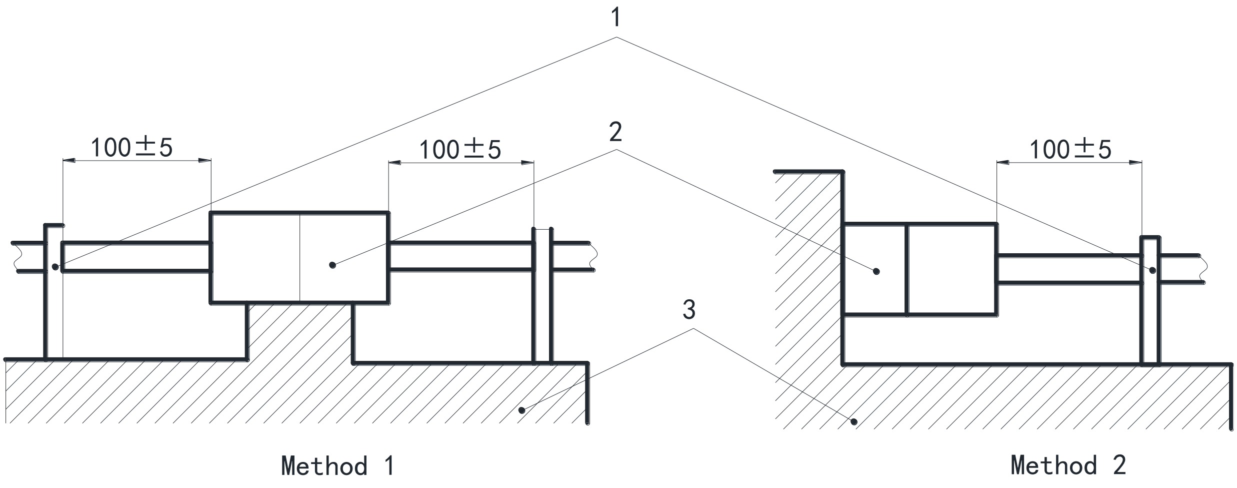
Mount the test specimen on the vibration test stand for vibration testing as shown in Figure 14. And remark the mounting method in the report.

As shown in Figure 15, the terminals of the test specimen were connected to the resistance value measurement circuit, and a current of 100 mA was applied for the change in resistance value of the terminal connection circuit of the test specimen during the vibration test.

6.3.7.2 Preprocessing

The test specimen is pre-inserted and uninserted 5 times to allow the interface to fully achieve surface degradation.

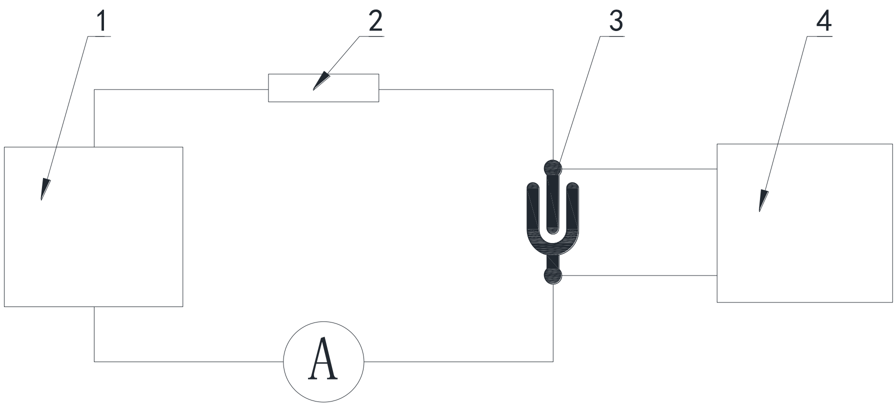
Unit: mm



Description:

1 –Fixed bracket; 2 – Test sample; 3 – Vibration test platform;

Figure 14 Shaker Wiring Schematic



Description:

1 - Power supply; 2 – Variable resistor; 3 - Test sample; 4 - Monitoring equipment;

Figure 15 Schematic diagram of measurement of resistance value of connection circuit of connector terminals

6.3.7.3 Test methods

The frequency sweep is performed at 1 octave per minute (1 oct/min), and 16 h of sweep cycles were applied in each of the three mutually perpendicular directions, for a total test time of 48 h. The time at which the resistance value of the terminal connecting circuit is continuously greater than 7 Ω during the test is recorded. The vibration test parameters are shown in Table 15.

At the end of the test, visually check the appearance of the test specimen, hand check the looseness of each part of the test specimen, and measure the terminal contact resistance value according to the method given in 6.2.1.

Table 15 Vibration test parameters

Vibration level[a]	Low frequency/amplitude	High frequency/acceleration
A	10 Hz～4 1Hz/±0.75 mm	>41 Hz～500 Hz/5 g[b]
B	10 Hz to 58 Hz/±0.75 mm	>58 Hz～500 Hz/10 g
C	10 Hz to 71 Hz/±0.75 mm	>71 Hz～500 Hz/15 g

[a] Class A, connectors mounted on the support part of the body and not connected to the motor system; Class B, connectors mounted on the part connected to the motor system but not connected to the part subject to severe vibration; Class C, connectors mounted under severe vibration environment.

[b] g is 9.80665 m/s.^{2}

6.3.8 Mechanical impact

The test specimens were connected according to Figure 15, and a current of 100 mA was applied for detecting the change in contact resistance of the test specimens during the mechanical impact test. Perform half-sine impact on the test specimen according to the method given in GB/T 2423.5. Apply an acceleration of 25 g and last for 15 ms, 10 times impact in the direction of each of the three mutually perpendicular axes (a total of 30 times impact), and record the time when the resistance value of the terminal connection circuit of the test specimen is continuously greater than 7 Ω during the test. At the end of the test, visually check the appearance of the test specimen, hand check the looseness of the test specimen parts, and measure the terminal contact resistance value according to the method given in 6.2.1.

6.3.9 Drop test

Suspend the test specimen at a height of (1000±10) mm from the nearest point of the test specimen and the drop surface, and drop the test specimen freely along the three mutually perpendicular axes, and perform two drop tests in each direction. At the end of the test, visually inspect the appearance and fragmentation of the test specimen, and measure the contact resistance value according to the method given in 6.2.1.

Note: The drop surface should be a flat, hard, rigid concrete or iron plate (minimum cable length 100mm).

6.4 Environmental performance tests

6.4.1 High temperature storage

Place the inter-mated complete connectors in a high-temperature environment for 168 h.

After the test, remove the test specimen and start measuring the contact resistance and insulation resistance within 2 min according to the methods given in 6.2.1 and 6.2.3, and after placing them in a room-temperature environment for 2 h, perform the insertion and extraction force and waterproofing tests according to the methods given in 6.3.1 and 6.4.5, and check the test specimen's appearance visually.

The high temperature test temperature is selected according to the working environment temperature of the test specimen, see Table 2.

6.4.2 Low temperature storage

Place the inter-mated complete connectors in a low-temperature environment at (-40±2) ℃ for 48 h. At the end of the test, remove the test specimen, place it at room temperature for 2 h, and then conduct contact resistance and insulation resistance measurements, insertion and extraction force and waterproofing tests according to the methods given in 6.2.1, 6.2.3, 6.3.1, and 6.4.5 respectively, and check the test specimen's appearance visually.

6.4.3 Thermal cycling

The inter-mated complete connectors are placed in a low temperature environment at (-40±2) ℃, kept for 30 min, over to a high temperature environment within 30 s, kept for 30 min, and over to a low temperature environment within 30 s. This is a cyclic test.

After 32 cycle tests the test specimen is removed and placed in a room temperature environment for 2 h. The contact resistance, insulation resistance, insertion and extraction force and waterproofing tests are carried out in accordance with the methods given in 6.2.1, 6.2.3 6.3.1 and 6.4.5 respectively, and the appearance of the test specimen is visually inspected.

The high temperature test temperature is selected according to the working environment temperature of the test specimen, see Table 2.

6.4.4 Temperature and humidity cycles

Place the test specimen in the constant temperature and humidity test chamber and conduct the test according to the following test procedure.

The test chamber was kept at a temperature of (23±5) ℃ and a relative humidity of 45 % to 75 % for 4 h. The temperature was kept at a temperature of (23±5) ℃ and a relative humidity of 45 % to 75 %;

Within 0.5 h, the temperature inside the test chamber was increased to (55±2) ℃ and the relative humidity was maintained at 95 % to 99 % for 10 h. The temperature was increased to (55±2) ℃ and the relative humidity was maintained at 95 % to 99 %;

Within 2.5 h, reduce the temperature inside the test chamber to (-40±2) ℃ ambient condition and keep it for 2 h;

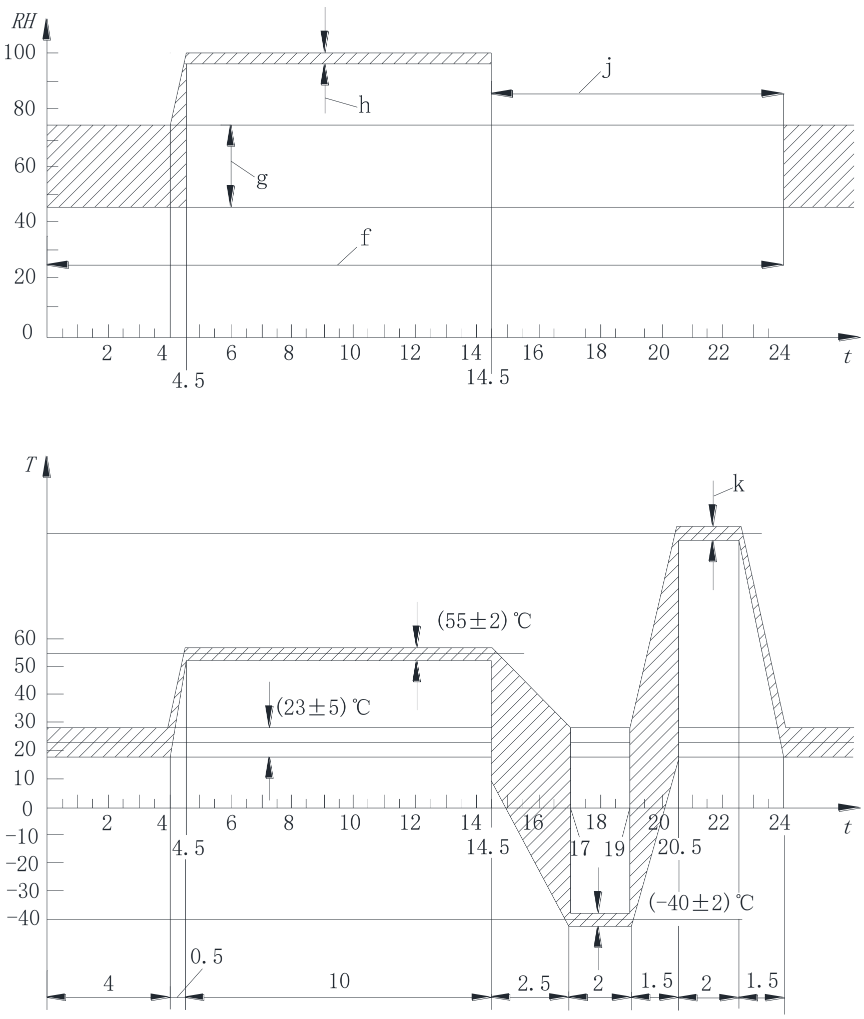
Within 1.5 h, the temperature in the test chamber was raised to the corresponding high test temperature (see Table 2) and held for 2 h. The temperature in the test chamber was raised to the corresponding high test temperature (see Table 2);

The temperature in the test chamber was reduced to room temperature (23±5) ℃ within 1.5 h. The temperature was reduced to the normal temperature (23±5) ℃ within 1.5 h.

The above is one test cycle, and a total of 10 cycle tests are performed.

At the end of the test, remove the test specimen and place it in a room temperature environment for 2 h. After that, conduct contact resistance and insulation resistance measurements, insertion and extraction force and waterproofing tests, and visually inspect the appearance of the test specimen in accordance with the methods given in 6.2.1, 6.2.3, 6.3.1 and 6.4.5, respectively.

A schematic of the temperature and humidity cycle is shown in Figure 16.



Description:

T - temperature (℃);*RH* - relative humidity in laboratory(%); f - 1 cycle; g - 45% to 75%; c - 95% to 99%; j - uncontrolled humidity; k - test temperature level (see Table 2); *t* - time (h).

Note: Shaded areas indicate temperature and humidity tolerances.

Figure 16 Temperature and humidity cycle test cycle diagram

6.4.5 Waterproof

The test specimen shall be tested for waterproofing according to the method given in GB/T 4208. After the test, visually check the water damage in the closed area of the test specimen, and measure the insulation resistance value according to the method given in 6.2.3.

6.4.6 Salt spray

The test specimen shall be subjected to 48 h salt spray test according to the method given in GB/T 2423.17. After the test, visually check the appearance of the test specimen and measure the contact resistance value according to the method given in 6.3.1.

7 Inspection Rules

7.1 General principles

The products should be inspected and qualified by the quality inspection department of the manufacturing enterprise, and accompanied by a certificate of conformity before leaving the factory.
Product inspection is divided into factory inspection, cycle inspection and type inspection.

7.2 Test matrix

The cluster test items are shown in Table 16.

Table 16 Cluster test matrix

Test name	Requirement	Test method	Test group								
			A	B	C	D	E	F	G	H	I
Contact resistance	5.2.1	6.2.1	–	3	2, 4	2	2	2	2	2	4
Voltage drop	5.2.2	6.2.2	1	–	–	–	–	–	–	–	–
Electrical insulation resistance	5.2.3	6.2.3	–	–	–	3, 6	3, 6	3. 6	3. 6	–	–
Withstand voltage	5.2.4	6.2.4	–	4	–	–	–	–	–	–	–
Insertion and extraction force	5.3.1	6.3.1	–	2	–	4	4	4	4	–	–
Crimp pull-off force	5.3.2	6.3.2	2	–	–	–	–	–	–	–	–
Welding retention force	5.3.3	6.3.3	2[a]	–	–	–	–	–	–	–	–
Reliability of terminal surface coatings	5.3.4	6.3.4	–	1	–	–	–	–	–	–	–
Polarity mis-insertion	5.3.5	6.3.5	–	–	–	–	–	–	–	–	1

Lead-out wire and connector retention force	5.3.6	6.3.6	–	–	–	–	–	–	–	–	2
Vibration	5.3.7	6.3.7	–	–	1	–	–	–	–	–	–
Mechanical impact	5.3.8	6.3.8	–	–	3	–	–	–	–	–	–
Drop	5.3.9	6.3.9	–	–	–	–	–	–	–	–	3
High temperature	5.4.1	6.4.1	–	–	–	1	–	–	–	–	–
Low temperature	5.4.2	6.4.2	–	–	–	–	1	–	–	–	–
Thermal cycling	5.4.3	6.4.3	–	–	–	–	–	1	–	–	–
Temperature and humidity cycling	5.4.4	6.4.4	–	–	–	–	–	–	1	–	–
Waterproof[b]	5.4.5	6.4.5	–	–	–	5	5	5	5	–	–
Salt spray	5.4.6	6.4.6	–	–	–	–	–	–	–	1	–
Number of test samples	–	–	5 sets	5 sets	5 sets	5 sets	5 sets	5 sets	5 sets	5 sets	5 sets
Note: Test group A B C D E F G H I, total 9 sets, 5 sets of each test sample,											
[a] 5 sets of test specimens for each of the parallel test sets. [b] Non-waterproof connectors may not be tested for waterproofing.											

7.3 Factory inspection

7.3.1 Inspection program

In accordance with the requirements of the normative provisions of this standard, the factory inspection items stipulated in the technical standards and Table 17 of the enterprise, the factory products are inspected one by one and should be qualified in all cases.

When the factory inspection is used for the acceptance of delivery by the supplying and demanding parties, the requirements specified in 7.3 of this standard may be agreed upon separately in the contract.

Table 17 Factory Inspection Items

Test name	Requirement	Test method
Electrical insulation resistance	5.2.3	6.3.3
Withstand voltage	5.2.4	6.3.4

7.3.2 Unit products

Unit products in the lot: set.

7.4 Periodicity test

7.4.1 Inspection program

In accordance with the provisions of GB/T 2829, a sampling program is used. All inspection items in this standard are inspected by taking samples from the factory inspection of qualified products. Inspection items, test group, discrimination level (DL), unqualified classification, unqualified quality level (RQL), sample size (*n*), judgment array, etc. are shown in Table 18. The test sequence should comply with Table 16

Table 18 Cyclic test program

Test name	Requirement	Test method	Test group	DL	Failure classification	RQL	*n*	Judgment array
Contact resistance	5.2.1	6.2.1	B C D E G H I	II	B	65	n=5	A_c =1; R_e =2
Withstand voltage	5.2.4	6.3.4	B				n=5	A_c =1; R_e =2
Voltage drop	5.2.2	6.3.2	A				n=5	A_c =1; R_e =2
Insulation resistance	5.2.3	6.3.3	D E F G				n=5	A_c =1; R_e =2
Insertion and extraction force	5.3.1	6.3.1	B D E F G				n=5	A_c =1; R_e =2
Crimp pull-off force	5.3.2	6.4.2	A				n=5	A_c =1; R_e =2
Welding retention force	5.3.3	6.4.3	A				n=5	A_c =1; R_e =2
Reliability of terminal surface coatings	5.3.4	6.3.4	B				n=5	A_c =1; R_e =2
Polarity mis-insertion	5.3.5	6.3.5	I				n=5	A_c =1; R_e =2
Lead-out wire and connector retention force	5.3.6	6.3.6	I				n=5	A_c =1; R_e =2
Vibration	5.3.7	6.3.7	C				n=5	A_c =1; R_e =2
Mechanical impact	5.3.8	6.3.8	C				n=5	A_c =1; R_e =2
Drop	5.3.9	6.4.9	I				n=5	A_c =1; R_e =2
High temperature	5.4.1	6.4.1	D				n=5	A_c =1; R_e =2
Low temperature	5.4.2	6.4.2	E				n=5	A_c =1; R_e =2
Thermal cycling	5.4.3	6.4.3	F				n=5	A_c =1; R_e =2
Temperature and humidity cycling	5.4.4	6.4.4	G				n=5	A_c =1; R_e =2
Waterproof	5.4.5	6.4.5	D E F G				n=5	A_c =1; R_e =2
Salt spray	5.4.6	6.4.6	H				n=5	A_c =1; R_e =2

7.4.2 Unit products

Unit products in the lot: set.

7.4.3 Batch quality

The level of quality of the submitted inspection lot, expressed as a percentage of nonconformities.

7.4.4 Inspection cycle

The periodicity of the cycle test is 6 months, or different test periods may be specified in the ordering contract for different test groups.

7.5 Type examination

7.5.1 Test samples

In the absence of special requirements, the type inspection of the product should be from the factory inspection of qualified products in accordance with the number of samples required for the cycle test randomly selected.

7.5.2 Inspection procedures

All the samples taken first according to the factory inspection program for inspection qualified and then according to the cycle of inspection of the test group, test items and test sequence for inspection.

7.5.3 Inspection cycle

The periodicity of the type inspection is 12 months. The type examination is carried out when one of the following conditions occurs.

a) Identification of new products or product modification, design, structure, process, materials have a large change in the production of stereotypes after the inspection;

b) When a product is discontinued for more than six months and then resumed production or mass production inspection of off-site production;

c) When requested by the user in a contractual environment.

7.5.4 Determination of conformity

The product type test items are all qualified.

8 Marking, Packaging, Transportation and Storage

8.1 Marking

8.1.1 Product mark

The product shall be clearly and permanently marked in a conspicuous place with a traceable characteristic symbolic marking, such as manufacturer's name or trademark, model specification, date of manufacture or code. The contract environment can be marked according to the requirements of the demand side.

8.1.2 Packaging mark

The following markings should be on the outside of the product box, and special cases can be marked according to the requirements of the agreement between the supply and demand sides.

a) Name of the manufacturing plant;

b) Product name;

c) Trademarks;

d) Product model (type, specification);

e) Standard code, number, name (can also be marked on the product or instruction)

f) Dimension (L×W×H) and volume of the box;

g) Quantity;

h) Net and gross weight;

i) Graphic signs for storage and transportation, such as "Handle with care" and "Fear of moisture";

j) Date of manufacture and production lot number.

The symbols of the product packaging, storage and transportation symbols should be consistent with the requirements of GB/T 191.

8.2 Packaging

Factory products should be accompanied by product specifications, packing list, certificate of conformity.

Each product should be packaged in a single small package, with outer carton or other materials, firmly bundled. Special cases can be packaged according to the requirements of the supply and demand sides (agreement).

8.3 Transportation

Boxes containing products should be loaded, unloaded and transported in accordance with the storage and transportation pictorial markings. They should be handled gently and should not be thrown. It should not be exposed to sunlight and rain during transportation, and should not be mixed with flammable products and active chemicals.

8.4 Storage

8.4.1 The product should be stored in a dry, ventilated room that is protected from rain and snow. It should not be stored with corrosive items such as acids, alkalis or dusty items.

8.4.2 The product shall be free from corrosion and deterioration for 48 months from the date of shipment under normal transportation and storage conditions.

Annex A
(Informational)
Motor and controller lead-out wire color definitions

The colors of the motor and brake lead-out wires are shown in Table A.1, and the electrical connections of the controller are shown in Figure A.1.

Table A.1 Motor and controller lead-out wire color definitions

Part	Functional symbol	Functional description	Color
Display (i.e. measuring instrument)	P+	display power positive	red
	KEY	display lock	blue
	GND	ground	black
	COM1	communication signal 1	yellow
	COM2	communication signal 2	green
Left brake handle /right brake handle	Sensor	brake signal	yellow
	VCC	brake power positive	red
	GND	ground	black
Electric motor	HA	motor hall signal A	yellow
	HB	motor hall signal B	green
	HC	motor hall signal C	blue
	VCC	motor hall power positive	red
	A/U	motor phase A/U	yellow
	B/V	motor phase B/V	green
	C/W	motor phase C/W	blue
	GND	ground	black
	Reserve 1	extensional reservation 1	white
	Reserve 2	extensional reservation 2	orange
	Reserve 3	expansion reservation 3	brown
	Reserve 4	extensional reservation 4	purple
Throttle	Sensor	throttle signal	blue
	VCC	throttle power positive	red
	GND	ground	black

Table A.1 Motor and controller lead-out wire color definitions (continued)

Part	Functional symbol	Functional description	Color
Front light /rear Light	+	light power positive	red
	GND	ground	black
Battery	P+	battery positive	red
	P-	battery negative	black
	COM1	battery communication signal 1	green
	COM2	battery communication signal 2	blue
	Reserve 1	extensional reservation 1	white
	Reserve 2	extensional reservation 2	orange
	Reserve 3	extensional reservation 3	brown
	Reserve 4	extensional reservation 4	purple
Boost sensor	Sensor	boost sensor signal	white
	VCC	boost sensor power positive	red
	GND	ground	black
	Reserve 1	extensional reservation 1	green
	Reserve 2	extensional reservation 2	blue
	Reserve 3	extensional reservation 3	purple
	Reserve 4	extensional reservation 4	brown
Vehicle speed sensor	Sensor	vehicle speed sensor signal	white
	GND	ground	black
	Reserve Positive	VCC	red
	Reserve 1	extensional reservation 1	blue

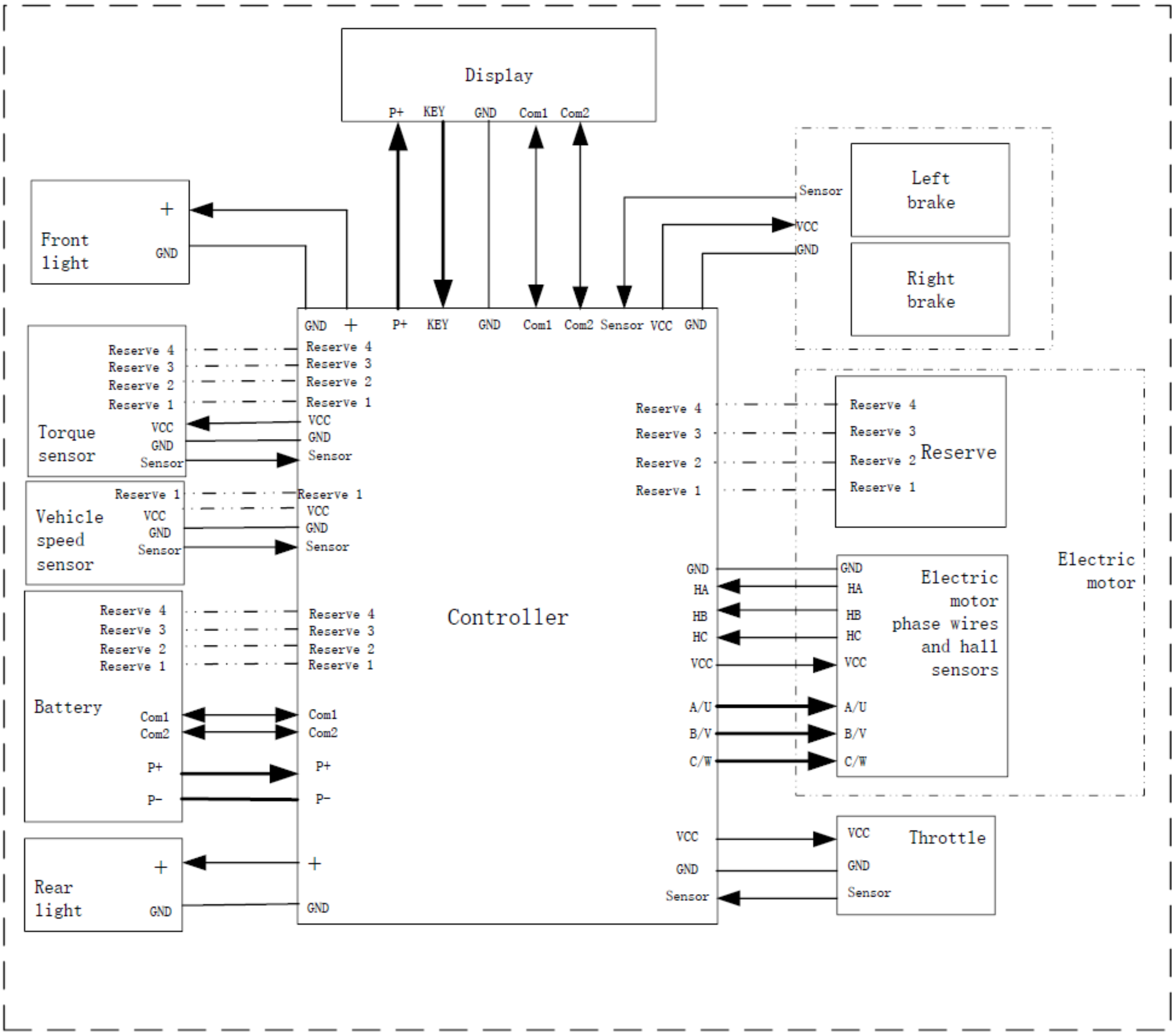
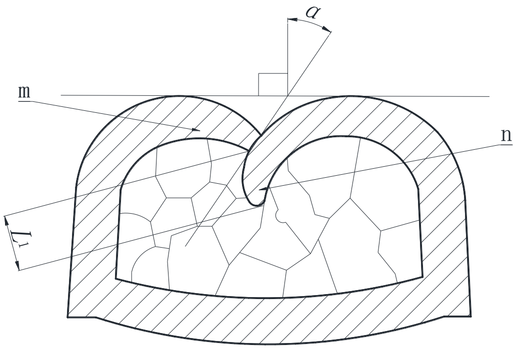


Figure A.1 Schematic diagram of controller electrical connections

Annex B
(Normative)
Requirements for cross-section at terminal-conductor crimp and at crimp point

B.1 See Figure B.1, all single wires in the conductor shall have irregular polygonal sections (no rounded strands), there shall be no visible gaps between the parts where the conductor meets the terminal and between the single wires and between the single wires, and the crimped part of the terminal shall encompass the entire conductor. The crimped part of the terminal crimp a, b should meet and be symmetrical. Where symmetry is ideal for conductor crimping, it is acceptable to overlap the crimp wing foot.



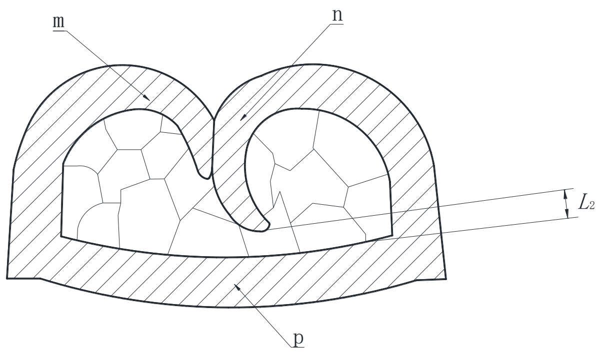
Description:

m – crimped portion m of the terminal crimp; n – crimped portion n of the terminal crimp; L_1 – distance between the ends of crimped portions m and n of the terminal crimp; α – support angle.

Figure B.1 Schematic diagram of terminal cross section type A

B.2 See Figure B.2. The distance *d between the* ends of the crimped portion a and b of the terminal crimp and the bottom c is not less than 0.1× *δ*.

Note: δ is the terminal material thickness.

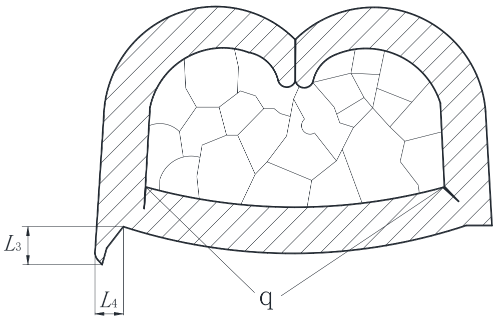


Description:

m – crimped portion m of the terminal crimp; n – crimped portion n of the terminal crimp; p – terminal crimp bottom p; L_1 – distance between the ends of crimped portions m and n of the terminal crimp;

Figure B.2 Schematic diagram of terminal cross section type B

B.3 See Figure B.3. The burr height e on both sides of the bottom of the section should not exceed *δ* and the burr width *f* should not exceed 0.5× *δ*.



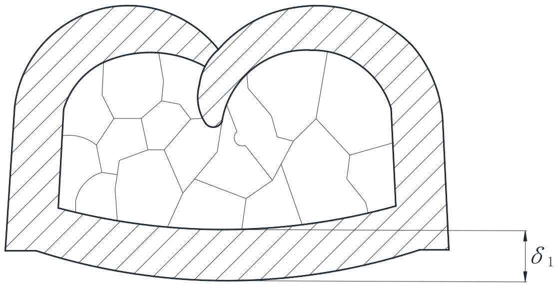
Description:

L_3 - burr length; L_4- burr width; q - crack.

Figure B.3 Schematic diagram of terminal cross section type C

B.4 See Figure B.3. Cracks shall not appear in the crimped portion of the terminals in the cross-section *h*. For conductors crimped to internally knurled or reticulated terminals, the marks shown in the cross-section shall not be judged to be cracks appearing in the crimp.

B.5 See Figures B.4 and B.5. The thickness *g* of the base plate after terminal crimping should not be less than 0.75× δ, and the value of δ should be determined as in B.2.



Description:

δ_1--Thickness of base plate after terminal crimping.

Figure B.4 Schematic diagram of terminal cross section type D

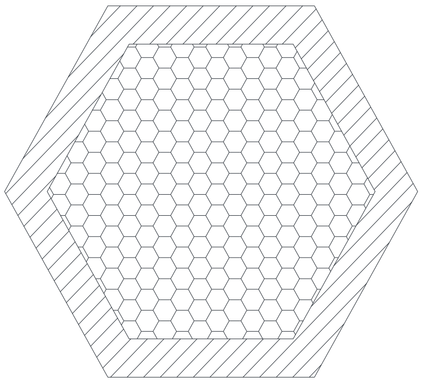


Figure B.5 Schematic diagram of terminal hexagonal crimping cross section

B.6 The crimping parameters are developed in the following steps:

a) Section analysis equipment to determine, according to the formula (3) to calculate the compression rate, the compression rate is appropriate to control in (10~30) %.

$$\text{Compression rate} = (1-S_1/S_0) \times 100\ \% \quad \text{.................. (3)}$$

where:

S_1 - after crimping, closed crimping in the cross-sectional area of the conductor, including strand filament gap area, the unit around the beating square millimeter (mm^2);

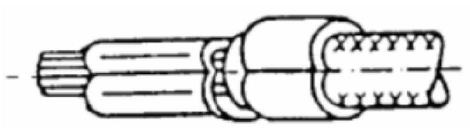
S_0 - not crimped nominal conductor cross-sectional area, unit of square millimeters (mm^2).

b) Based on the cross-sectional area of the cable, standardized values and tolerances are established, see Table B.1.

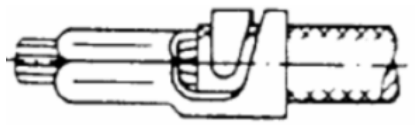
Table B.1 Corresponding table of cable cross-sectional area and crimp height tolerance

Cross-sectional area mm^2	Crimp height tolerance mm	Hexagonal crimp height tolerance mm
<0.35	±0.03 or less (on request)	-
= 0.35	±0.03	-
>0.35 and <8.0	±0.05 to 0.1	±0.10
≥8.0	±0.1 to 0.2	±0.20

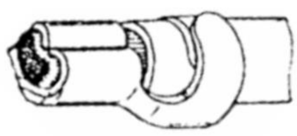
B.7 For crimping of cable insulation, symmetrical crimping, winding crimping or stacking crimping is appropriate, see Figure B.6.



a) Symmetrical



b) Winding type



c) Overlaying

Figure B.6 Crimping of cable insulation

B.8 The use of pre-insulated terminals is not suitable for crimp terminals for electric bicycles.

B.9 Parallel crimping, with the contacts shown in Figure B.7 shall comply with the following requirements:

a) The conductor shall be pressed all the way into the crimped portion of the terminal and the wire ends shall be visible on both sides of the terminal and extend no more than 3 mm.

b) The entrance curve R shall be visible on both sides of the conductor crimp area, and the wire insulation shall not be pressed into the terminal.

c) The tension values of the contacts shall comply with values in Table 9.

d) The contact voltage drop shall be no greater than that specified in Table 4.

a) Bilateral splitting of wires

b) Single-side splitting of wires

Description:

1 - Cable; 2 - Terminal; E - Conductor crimp area; y - Inlet curve.

Figure B.7 Schematic diagram of crimped joints

Biliography

[1] QB/T 1714 *Naming and Modeling Methods for Bicycles*