REMTEK
CABLE ACCESSORIES

CERTIFICATE OF COMPLIANCE

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Test Standards:

IEC 61238-1:2003. AS/NZS 4325.1:1995

Product:

Cable Lugs

Model No.:

1.5-5 / 70-10 / 95-6 / 630-16

Test Conclusion: PASS

The test sample as described in the report (Report No.: YW161009-47) were complied with the requirement of IEC 61238-1:2003 and AS/NZS 4325.1:1995 those test conducted.

The products above have been tested with the listed standard IEC 61238-1:2003 and AS/NZS 4325.1:1995.

中国科学院广州化学研究所分析测试中心
Analyzing and Testing Center of Guangzhou Institute of Chemistry, Chinese Academy of Sciences
广州中科检测技术服务有限公司
Guangzhou CAS Test Technical Services Co., Ltd.

TEST REPORT

The following merchandise was (were) submitted and identified by the client as:

Name of Sample :	Cable Lugs
Test Type :	Requested by the applicant
Analysis No. :	A160728-39/42
Sample Quantity :	4
Batch No. /Brand/Model :	1.5-5 / 70-10 / 95-6 / 630-16
Sample Received :	2016/07/28
Test Period :	2016/07/28 – 2016/10/09
Test Standard:	IEC 61238-1:2003 & AS/NZS 4325.1:1995
Test Result :	Please refer to next page(s).
Test Part Description :	Power Cable/Crimped Connections
Issue Date	2016/10/10

Edited by: _____ **Approved by:** _____

Checked by: _____ **Official Seal:** _____

广州中科检测技术服务有限公司 检验检测专用章

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TEST REPORT

Report No. : YW161009-47 **Date : 2016/10/09** **Page No. : 2 of 18**

Summary of Test:

1. The tests that carried out were as follows:

Clause	Tests
6	Electrical tests
7	Mechanical tests

Note : 1) Pass : Complied with the requirement.
2) N/A : Not applicable.
3) N/C: Not conducted
4) Fail : Failed.
5) All the tests were carried out at ambient temperature of 25℃ ± 5℃, unless otherwise specified.

Summary of Result(s):

The test samples as described in this report complied with the requirement of IEC 61238-1:2003 and AS/NZS 4325.1:1995 those test conducted.

******** To be continued ********

TEST REPORT

Report No. : YW161009-47 **Date : 2016/10/09** **Page No. : 3 of 18**

Sample details

Model	Size	Photo
1.5-5	-	
70-10	-	

********* continue ********

TEST REPORT

Report No. : YW161009-47 **Date : 2016/10/09** **Page No. :** 4 of 18

Model	Size	Photo
95-6	-	
630-16	-	

********* continue ********

Clause No.	Test Requirements	Results	Verdict
6	**Electrical tests**		
6.1	**Installation**		Pass
	All conductors of the same cross-sectional area in the test loop shall be taken from the same continuous core.		Pass
	For each series of tests, six connectors shall be fitted in accordance with the manufacturer's instructions, on a bare conductor or on a conductor that has had the insulation removed before assembly, to form a test loop together with the corresponding reference conductor.		Pass
	For stranded conductors, potential between the strands at measuring points can cause errors in measuring electrical resistance. Equalizers (see Annex A) shall be used to overcome this problem and to ensure uniform current distribution in the reference conductor and between connectors at the equalizer points.	Soldered equalizers	Pass
	In the case of insulation piercing connectors, the insulation shall be retained on the conductor under the connector and for a distance of at least 100 mm outside the connector. Reference conductor(s) with the insulation retained shall also be included in the test loop. If the connector is to be tested according to Class B, there is no need for bare reference conductors.		N/A
	The test loop shall be installed in a location where the air is calm. The ambient temperature of the test location shall be between 15 °C and 30 °C.		Pass
	For assembly of the IPC, the temperature shall be (23 ± 3) °C.		N/A
	In the case of solid conductors, the potential measuring points shall be as close as possible to the connector in order to reduce l_a and l_b close to zero.		Pass
	The test loop may be of any shape provided that it is arranged in such a way that there is no adverse affect from the floor, walls and ceiling.		Pass

Clause No.	Test Requirements	Results	Verdict
	To permit the short-circuit tests (Class A connectors only) to be made easily, the loop can be made dismantleable. In this case, the technology of the sectioning connections shall be such that they do not influence the measurements, particularly from the point of view of temperature.		Pass
	Retightening of bolts or screws of the connectors under test is not permitted.		Pass
6.1.1	**Through connectors and terminal lugs**		Pass
	The test loop is shown in Figure 1, which indicates the dimensions that shall be used.		Pass
	Where terminal lugs are to be tested, the palms shall be bolted to linking bars in accordance with the manufacturer's instructions. These linking bars shall, at the point of connection, be of the same dimensions and thickness as the palm, and also of the same material.		Pass
	It may be necessary to adjust the thermal characteristics of the linking bar outside the point of connection, to achieve the temperatures specified in 6.3. As an alternative to linking bars, tests can be made on terminal lugs with palm connected direct to palm. In case of disagreement, the method with linking bars shall be used.	Linking bars	Pass
	If however it is requested that the terminal lug test includes an evaluation of the performance of the bolted palm when connected to a plant terminal, then linking bar ends, or an intermediate piece, shall be used of a material, size and surface coating agreed between the parties.		N/A
6.1.2	**Branch connectors**		N/A
	When the branch connector is intended for a branch cross-sectional area equal to the main, or a cross-sectional area immediately above or below the main, it is treated as a through connector between the main and the branch, and the test method for through connectors is applicable. In other cases, the test loop shall be as shown in Figure 2. Where a type of connector makes it necessary for the		N/A

Clause No.	Test Requirements	Results	Verdict
	main conductor to be cut, that part of the connector which acts as a through connector, shall also be tested as for through connectors.		
6.2	**Measurements**		Pass
6.2.1	**Electrical resistance measurements**		Pass
	Measurements of electrical resistance shall be made at stages throughout the test as specified in 6.3.		Pass
	These measurements of resistance shall be made under steady temperature conditions of both the test loop and test location. The ambient temperature shall be between 15 °C and 30 °C.		Pass
	The recommended method is to pass a direct current of up to 10 % of the heat cycling current, through the connectors and the reference conductor, without increasing the temperature and to measure the potential difference between specific potential points. The ratio of potential difference and direct current is the resistance between those points. *NOTE To improve the accuracy of the resistance measurement, it is recommended that the same direct current is used throughout the test programme.*		Pass
	For branch conductors assembled in accordance with Figure 2, the whole of the measuring current shall flow through that part of the connector whose potential difference is being measured. Switches or disconnect points may be provided for this purpose.		Pass
	Thermoelectric voltages may affect the accuracy of low resistance measurements (of the order of 10 μΩ). If this is suspected, two resistance measurements shall be taken with the direct measuring current reversed between readings. The mean of the two readings is then the actual resistance of the sample.		Pass
	The potential points shall be as indicated in Figure 3, and Annex B, and the various lengths shown shall also be measured to enable the actual connector		Pass

Clause No.	Test Requirements	Results	Verdict
	resistances to be determined. The temperature of connector and reference conductor shall be recorded when resistance measurements are made. For direct comparison, the resistance values shall be corrected to 20 °C. Information on the recommended method is also given in Annex B. Temperature measurements at these locations shall be made during the heat cycling test.		
	Indirect resistance readings: - voltage measurements shall have an accuracy within ±0,5 % or ±10 μV, whichever is the greater; - current measurements shall have an accuracy within ±0,5 % or ±0,1 A, whichever is the greater.		Pass
	Direct resistance readings: Resistance measurements shall have an accuracy within ±1 % or ±0,5 μΩ, whichever is the greater when the instrument is calibrated against a certified standard resistance.		Pass
6.2.2	**Temperature measurements**		Pass
	The temperature measurements shall be made at stages throughout the test, as specified in 6.3.		Pass
	Temperatures of both connectors and reference conductors shall be measured at the points indicated in Figure 3. The recommended method of temperature measurement is to use thermocouples. Temperature readings shall have an accuracy within ±2 K.		Pass
6.3	**Heat cycle test**		Pass
	The heat cycling test shall be made with alternating current.		Pass
6.3.1	**First heat cycle**		Pass
	The object of the first heat cycle is to determine the reference conductor temperature to be used for subsequent cycles and also to identify the median		Pass

Clause No.	Test Requirements	Results	Verdict
	connector.		
	a) Non-IPC through connectors and terminal lugs		Pass
	Current is circulated in the test loop, bringing the reference conductor to 120 °C at equilibrium.		Pass
	Equilibrium is defined as the moment when the reference conductor and the connectors do not vary in temperature by more than ±2 K for 15 min.		Pass
	If the temperature of the median connector (see 3.11) is equal to or greater than 100 °C, the reference conductor temperature for subsequent heat cycles shall be deemed to be 120 °C. If not, then the current shall be increased until the median connector temperature reaches 100 °C at equilibrium, subject to the reference conductor temperature not exceeding 140 °C. If the temperature of the median connector does not reach 100 °C, even with a reference conductor temperature of 140 °C, the test shall be continued at that temperature. The measured reference conductor temperature θ_R shall then be used for subsequent heat cycles (120 ° C $\leqslant \theta_R \leqslant$ 140 ° C). The current I_N at equilibrium temperature shall be recorded in the test report. *NOTE 1 Where linking bars are used for terminal lugs, the temperature at the midpoint of the bar linking the palms should also be measured. This temperature should be equal to the temperature of the reference conductor θ_R, with a tolerance of ±5 K.*		Pass
	b) Non-IPC branch connectors		N/A
	Where it is necessary to use the circuit shown in Figure 2, current shall be circulated in the test loop, bringing the main reference conductor and the three branch reference conductors to 120 °C at equilibrium. To achieve this, the currents in the three branches shall be adjusted by current injection or impedance control. If the median connector temperature (see 3.11) is then equal to or greater than 100 °C, the reference conductor temperature for		N/A

Clause No.	Test Requirements	Results	Verdict
	subsequent heat cycles shall be deemed to be 120 °C. If not, then the current shall be increased in the loop until the median connector temperature reaches 100 °C at equilibrium, provided the reference conductors do not exceed 140 °C. It may be necessary at this stage, and also at intervals throughout the test, to adjust the current in an individual branch so as to ensure that each branch reference temperature is the same as the main reference temperature. The measured reference conductor temperature θ_R on the main and branch conductors, shall then be used for subsequent heat cycles (120 ° C $\leqslant$ θ_R $\leqslant$ 140 ° C). The current(s) I_N at equilibrium temperature in the main and branch conductors shall be recorded in the test report.		
	c) IPC		N/A
	For tests of IPCs, the same test loop as in Figure 1 or 2 shall be used except that the insulated reference conductor(s) is (are) added in the circuit. During cycling, the temperature on the median connector shall be modified to be 10 K higher than the maximum conductor temperature in normal operation for which these type of connectors are intended. However, the circulated current shall be limited so that the temperature of the insulated reference conductor at equilibrium is not more than 10 K to 15 K above the maximum conductor temperature in normal operation. In the case of branch connectors, it may be necessary at intervals throughout the test, to adjust the current in an individual branch so as to ensure that each branch reference temperature is the same as the main reference temperature. The current(s) I_N at equilibrium temperature in the main and possible branch conductors shall be recorded in the test report. *NOTE 2 If a connector is used in an application where considerably higher temperatures are reached than the maximum conductor temperature in normal operation, additional tests at higher temperature of the test loop may be made, after agreement between manufacturer and user. The additional increase in temperature of the test loop should be achieved by the*		N/A

<table>
<tr><th>Clause No.</th><th>Test Requirements</th><th>Results</th><th>Verdict</th></tr>
<tr><td></td><td>application of thermal insulation.</td><td></td><td></td></tr>
<tr><td>6.3.2</td><td>Second heat cycle</td><td></td><td>Pass</td></tr>
<tr><td></td><td>The object of this second heat cycle is to determine the heat cycle duration and temperature profile which will be used on the test loop for all subsequent heat cycles. Current is circulated in the loop until the main reference conductor temperature reaches the value θ_R determined in 6.3.1, with a tolerance of $^{+6}_{0}$ K and the median connector temperature is stable within a band of 2 K over a 10 min period.</td><td></td><td>Pass</td></tr>
<tr><td></td><td>An elevated current may be used to reduce the heating period. The duration of this elevated current is given in Table 1. The current shall thereafter be decreased or regulated to a mean value of the current close to I_N to ensure stable conditions during the median-connector control period. It may be necessary to use more than one cycle to determine the second heat cycle.</td><td></td><td>Pass</td></tr>
<tr><td></td><td>The reference conductor temperature shall be the control parameter, in order to keep the temperature profile during the heat cycle test. In this way, the fluctuation of the ambient temperature will not affect the temperature profile of the reference conductor.
Table 1 – Minimum elevated current heating time
<table>
<tr><td>Nominal conductor cross-sectional area, A mm²</td><td>Al
Cu</td><td>$16 \le A \le 50$
$10 \le A \le 35$</td><td>$50 < A \le 150$
$35 < A \le 95$</td><td>$150 < A \le 630$
$95 < A \le 400$</td><td>$A > 630$
$A > 400$</td></tr>
<tr><td>Time min</td><td></td><td>5</td><td>10</td><td>15</td><td>20</td></tr>
</table></td><td></td><td>Pass</td></tr>
<tr><td></td><td>The reference temperature time (t_1) heating profile, see Figure 4, determined in this way shall be recorded and used for all subsequent cycles.</td><td></td><td>Pass</td></tr>
<tr><td></td><td>After the period t_1, follows a period t_2 of cooling to bring the temperature of all connectors and the reference conductor to a value $\leqslant 35$ ° C.</td><td></td><td>Pass</td></tr>
<tr><td></td><td>It may be necessary in subsequent heat cycles to adjust t_2 to ensure that the temperature conditions are reached.</td><td></td><td>Pass</td></tr>
</table>

Clause No.	Test Requirements	Results	Verdict
	If accelerated cooling is used, it shall act on the whole of the loop, and use air within ambient temperature limits.		Pass
	The total period $t_1 + t_2$ constitutes a heat cycle (see Figure 4).		Pass
6.3.3	**Subsequent heat cycles**		Pass
	A total of 1 000 heat cycles (as defined in 6.3.2) shall be made. After the cooling period of the cycles indicated below, the resistance and temperature of each connector and each reference conductor shall be recorded as indicated in 6.2. The maximum temperature of each connector during the cycle just prior to or following the resistance measurements shall also be recorded.		Pass
	Measurements shall be made at the following cycles: *Class A* 0 (before the first heat cycle, see 6.3.1) 200, before short-circuit 200, after short-circuit 250 Then every 75 cycles (in total 14 measurements) *Class B* 0 (before the first heat cycle, see 6.3.1) 250 then every 75 cycles (in total 12 measurements) A tolerance of ±10 cycles may be used.		Pass
6.3.4	**Short-circuit tests (for Class A connectors only)**		Pass
	Six short-circuits are applied after the 200th heat cycle.		Pass
	The short-circuit current level shall be such that it raises the bare reference conductors from a temperature of ≤35 ° C to a temperature between 250 ° C and 270 ° C. However, for IPC connectors the short-circuit current shall be limited so that the temperature of the insulated reference conductor does not exceed the maximum permissible temperature of the insulation. *NOTE 1 The short-circuit current may be calculated according to Clause 3 of IEC 60949 and*		Pass

Clause No.	Test Requirements	Results	Verdict
	may be determined in accordance with Annex D of this standard as a method for selecting the current needed for a certain temperature rise, providing the actual conductor cross-sectional area is verified.		
	The maximum temperature, time and approximate current, or the actual current and time, used for the short-circuit test, shall be recorded and stated in the test report.		Pass
	The duration of the short-circuit current shall be $(1^{+0,5}_{-0,1})$ s with a maximum current of 25 kA. If the required short-circuit current exceeds this value a longer duration ≤5 s with a current between 25 kA and 45 kA shall be used.		Pass
	After each short-circuit, the test loop shall be cooled to a temperature ≤35 °C. *NOTE 2 For large cross-sectional areas, pre-heating up to 90 °C may be used. However, for cross-sectional areas exceeding 630 mm² copper or 1 000 mm² aluminium, the above parameters (45 kA and 5 s) are insufficient to reach 250 °C.*		Pass
	As stated in 6.1, the test loop may be dismantled for these tests. Since the short-circuit test is intended to reproduce the thermal effects of high currents only, the recommended method is to use a concentric return conductor in order to reduce the electro-dynamic forces. The test arrangements shall be recorded. *NOTE 3 It should be noted that bending or vibrations during assembly, transport and handling may give rise to mechanical forces which affect the contact resistance of the test objects and should thus be avoided. Where tests are required to reproduce, e.g. forces that occur on terminal lugs bolted to a terminal plant, then the mechanical arrangement of the test loop should be agreed between the parties concerned.* *NOTE 4 For special applications, other short-circuit conditions may be adopted.* *NOTE 5 For branch connectors, the reference conductor is that associated with the branch.*		Pass
6.4	**Assessment of results**		Pass

Clause No.	Test Requirements	Results	Verdict
	An individual connector resistance factor k enables a common method of connector assessment to be made over the range of conductor cross-sectional areas applicable to this standard. The parameters listed below are calculated (see Annex E).		Pass
	a) The connector resistance factor k shall be calculated according to Clause E.2, for each of the six connectors at all the measurement intervals listed in 6.3.3.		Pass
	b) The initial scatter δ, between the six initial values of k, measured at heat cycle 0, shall be calculated according to Clause E.3.		Pass
	c) The mean scatter β, between the six values of k, averaged over the last 11 measurement intervals, shall be calculated according to Clause E.4.		Pass
	d) The change in resistance factor D for each of the six connectors shall be calculated according to Clause E.5. D is the change in the value of k taken over the last 11 measurement intervals, calculated as a fraction of the mean value of k in this interval.		Pass
	e) The resistance factor ratio λ shall be calculated according to Clause E.6.		Pass
	f) The maximum temperature θ_{max} on each connector shall be recorded according to Clause E.7.		Pass
6.5	**Requirements**		Pass
	The six connectors shall satisfy the requirements shown in Table 2. If one connector out of the six does not satisfy one or more of the requirements, a re-test may be carried out. In this event, all six new connectors shall satisfy the requirements.		Pass
	If more than one connector out of the six do not satisfy one or more of the requirements, no re-test is permitted and the type of connector shall be deemed as not conforming to this standard.		Pass

<table>
<tr><th>Clause No.</th><th>Test Requirements</th><th>Results</th><th>Verdict</th></tr>
<tr><td></td><td>Table 2 – Electrical test requirements
<table>
<tr><th>Parameter</th><th>Designation</th><th>Text reference</th><th>Maximum value</th></tr>
<tr><td>Initial scatter</td><td>δ</td><td>E.3</td><td>0,30</td></tr>
<tr><td>Mean scatter</td><td>β</td><td>E.4</td><td>0,30</td></tr>
<tr><td>Change in resistance factor</td><td>D</td><td>E.5</td><td>0,15</td></tr>
<tr><td>Resistance factor ratio</td><td>λ</td><td>E.6</td><td>2,0</td></tr>
<tr><td>Maximum temperature</td><td>θ_{max}</td><td>E.7</td><td>θ_{rel}</td></tr>
<tr><td colspan="4">NOTE Values given in this table are based on experience.</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>7</td><td>Mechanical tests</td><td></td><td>Pass</td></tr>
<tr><td></td><td>The purpose of these tests is to ensure an acceptable mechanical strength for the connections to the conductors of power cables.
NOTE The pull-out force does not give any reliable indication of the electrical quality of the connector.</td><td></td><td>Pass</td></tr>
<tr><td>7.1</td><td>Method</td><td></td><td>Pass</td></tr>
<tr><td></td><td>The test shall be made on three additional connectors identical to those used for the electrical test. The connectors are fitted as for the electrical test of 6.1. The conductor lengths, between connectors or between connector and tensile test machine jaws, shall be ⩾500 mm. The rate of application of the load shall not exceed 10 N per square millimetre of cross-sectional area and per second up to the value in Table 3, which is then maintained for 1 min.</td><td></td><td>Pass</td></tr>
<tr><td></td><td>If the connector is tested electrically for conductors with a different cross-sectional area, the different connectors shall be tested individually, in accordance with Table 3.
Table 3 – Tensile force for mechanical tests
<table>
<tr><th>Conductor material</th><th>Tensile force
N</th></tr>
<tr><td>Aluminium
Copper</td><td>40 × A [a]; maximum 20000
60 × A [a]; maximum 20000</td></tr>
<tr><td colspan="2">[a] A = nominal cross-sectional area (mm²).</td></tr>
</table></td><td></td><td>Pass</td></tr>
<tr><td>7.2</td><td>Requirements</td><td></td><td>Pass</td></tr>
<tr><td></td><td>No slipping shall occur during the last minute of the test.</td><td>No slipping</td><td>Pass</td></tr>
</table>

******** To be continued ********

TEST REPORT

Report No. : YW161009-47 **Date : 2016/10/09** **Page No. : 16 of 18**

Annex 1- Electrical Test

1. Type of Connectors

Model	Type	Description
1.5-5	Class A	Barrel of terminal lug
70-10	Class A	Barrel of terminal lug
95-6	Class A	Barrel of terminal lug
630-16	Class A	Barrel of terminal lug

2. Installation length

Model	Installation length/mm			
	l_a	l_b	l_j	l_r
1.5-5	10.5	/	11.0	33.0
70-10	32.0	/	32.0	96.0
95-6	32.5	/	35.0	103.0
630-16	68.5		80.0	229.0

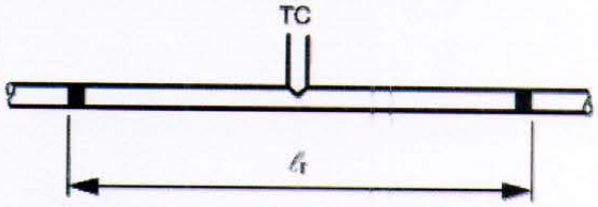
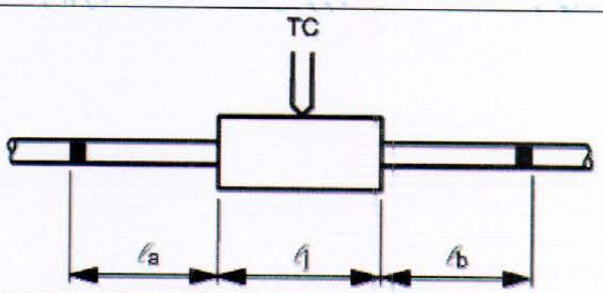
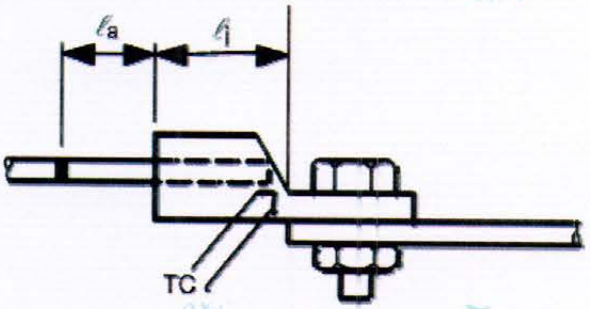
3. Test Results

No.	#1		#2		#3		#4		#5		#6	
	θ_{max}/℃	k	θ_{max}/℃	k	θ_{max}/℃	k	θ_{max}/℃	k	θ_{max}/℃	k	θ_{max}/℃	k
1	108.3	1.84	102.6	1.80	103.7	1.82	105.2	1.84	105.4	1.84	107.5	1.86
2	106.2	1.82	107.3	1.92	106.2	1.84	106.7	1.85	108.6	1.91	107.4	1.91
3	109.4	1.96	107.5	1.89	105.9	1.83	103.2	1.83	107.2	1.85	107.0	1.86
4	107.2	1.83	106.7	1.84	106.1	1.83	109.2	1.92	104.3	1.83	106.5	1.88
5	106.9	1.81	105.9	1.83	103.2	1.81	106.3	1.80	106.0	1.82	103.6	1.81
6	106.9	1.83	108.0	1.89	104.5	1.82	107.4	1.82	107.5	1.86	102.3	1.80
7	107.4	1.85	106.7	1.86	107.0	1.86	106.8	1.84	104.8	1.86	109.6	1.92
8	108.6	1.85	105.3	1.82	104.3	1.83	105.2	1.84	103.9	1.80	106.5	1.88
9	106.3	1.82	106.7	1.83	105.2	1.85	104.8	1.85	104.0	1.83	109.8	1.92
10	106.8	1.87	105.2	1.82	106.4	1.87	105.5	1.87	105.7	1.82	109.2	1.90
11	107.2	1.93	106.5	1.82	104.8	1.83	103.2	1.82	103.5	1.81	104.4	1.83
12	107.7	1.87	103.8	1.81	105.5	1.83	103.8	1.82	106.8	1.89	106.7	1.82
13	105.6	1.81	103.8	1.80	109.0	1.92	103.6	1.81	107.2	1.90	106.6	1.80
14	106.8	1.82	104.6	1.82	106.3	1.86	105.9	1.86	104.3	1.82	104.3	1.87

TEST REPORT

Report No. : YW161009-47 **Date : 2016/10/09**

4. Schematic diagram

Reference Conductor	
Through Connector	
Barrel of terminal lug	

5. Test Results of Parameter

Parameter	#1	#2	#3	#4	#5	#6
δ	0.20	0.21	0.23	0.21	0.23	0.22
β	0.16	0.17	0.16	0.15	0.16	0.17
D	0.13	0.11	0.12	0.11	0.12	0.13
λ	1.4	1.3	1.5	1.5	1.6	1.4
θ_{max}/℃	120.5	120.3	120.2	120.2	120.1	120.3
I_N/A	18.6	19.2	18.3	18.6	18.5	18.7

********* **END OF REPORT** ********

Statement

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11. This report is not regarded as any judicial decision.
12. Since the Company's causes lead to modify the contents of the test report, the Company shall reissue the test report and bear the modification cost. The Client shall return the original test report.
    Since the Client's causes lead to modify the contents of the test report, the Client need to submit an application form for report change to the Company. The Client shall bear the modification cost and return the original test report if the Company approves to reissue the test report.
13. The English version of this statement is translated from Chinese one. So with any disagreement between them, the Chinese version shall prevail.

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