



缆慧检测



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中国认可
国际互认
检测
TESTING
CNAS L9930

Report No.: TN20-0911E

Sample No.: CN19-4671

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Contract No.: ISTCW19-2282

Test Report

Consigner SHENZHEN WOER HEAT-SHRINKABLE MATERIAL CO., LTD.
Wall Industrial Park, Lanjing North Road, Longtian Street, Pingshan District, SHENZHEN

Sample Name Copper Connecting Terminal
Type and Size DTM-10mm²
Kind of test Type test
Sample Received Date December 26th, 2019
Test Duration December 26th, 2019 – April 20th, 2020
Test Conclusion
1. The samples have been subjected to the series tests in accordance with GB/T 9327—2008. The results comply with the type tests requirements (Class A) of GB/T 9327—2008.
2. The surface and dimension of the sample has been tested according to GB/T 14315—2008. The results comply with the requirements of GB/T 14315—2008.

Authorized by
Shanghai Intelligent Service and Technology Co., Ltd.

李骥 Li Ji

Issue date 2020-04-21

Testing Engineer: 贾欣 Jia Xin

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DTM-10mm²

1 Sample Description

Manufacturer	SHENZHEN WOER HEAT-SHRINKABLE MATERIAL CO., LTD. Wall Industrial Park, Lanjing North Road, Longtian Street, Pingshan District, SHENZHEN
Type and Size	DTM-10mm ²
Quantity	10 sets
Marking	WORE DTM-10mm ²
Color	/
Source	Sent by the consigner
Status	Normal appearance

2 Testing and Verdict Standards

2.1 Testing Standards

- 1) GB/T 9327—2008 Compression and mechanical connectors for power cables for rated voltages up to 35kV ($U_m=40.5kV$)—Test methods and requirements
- 2) GB/T 14315—2008 Compression type terminal lugs and ferrules with copper or aluminum for power cables conductors

2.2 Verdict Standards

- 1) GB/T 9327—2008 Compression and mechanical connectors for power cables for rated voltages up to 35kV ($U_m=40.5kV$)—Test methods and requirements
- 2) GB/T 14315—2008 Compression type terminal lugs and ferrules with copper or aluminum for power cables conductors

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3 Other Information

3.1 Description of the testing party

This report is the English version of test report of TN20-0911, the Chinese version shall prevail if any inconsistencies between Chinese version and English version.

3.2 Illustration

- 1) The sample's name, type and manufacturer are provided by the consigner.
- 2) The connecting terminals are tested altogether, including the cylinder part and the connecting plate.
- 3) The short-circuit test is subcontracted, because this test is not included in our testing scope approved by CNAS and CMA. The subcontractor is Machinery Industry High-voltage Transmission and Distribution Equipment Quality Inspection & Testing Center. The certificate number of CNAS for the center is CNASL2550 and the qualification certificate number of CMA for the center is 160008223396, the short-circuit test report number is No.20200034B.
- 4) The short-circuit test was carried out with Sample No. CN19-4675 at the same time.

3.3 Testing Location

The following testing items are tested at No.458, Haixiang Road, Fengxian Area, Shanghai, China, except the subcontracted testing item.

- Heat cycle tests and electrical resistance measurements in electrical test;
- Surface and dimension check.

3.4 Symbol definition

Requirement: / not required by standard

Verdict: P complying with requirement/Pass
F not complying with requirement/Fail
N not required

DTM-10mm²**4 Test Item****4.1 Electrical Test****4.1.1 The 1st electrical resistance measurement (before the 1st heat cycle test)**

According to GB/T 9327—2008, clause 6.3.3.

Test method: GB/T 9327—2008 clause 6.2

Test parameters

Ambient temperature: 17 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.389	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.336	0.343	0.324	0.327	0.342	0.327
- Connecting terminal	mΩ	/	0.0807	0.0882	0.0705	0.0800	0.0899	0.0785

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- before the 1st heat cycle	/	/	0.624	0.691	0.552	0.611	0.705	0.600	N
Initial scatter δ									
- initial scatter	/	≤0.30	0.15						P

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4.1.2 The 1st heat cycle test

According to GB/T 9327—2008, clause 6.3.1.

Test method: GB/T 9327—2008, clause 6.3.1

Test parameters

Ambient temperature: 11 °C

Required reference conductor temperature (°C)	Reference conductor temperature (°C)	Heat current for steady reference conductor temperature (A)	Median connecting terminal temperature (°C)
120~140	140	134	91

Test Results	The test is finished successfully. The 1st heat cycle temperature curve is shown in Figure 1.
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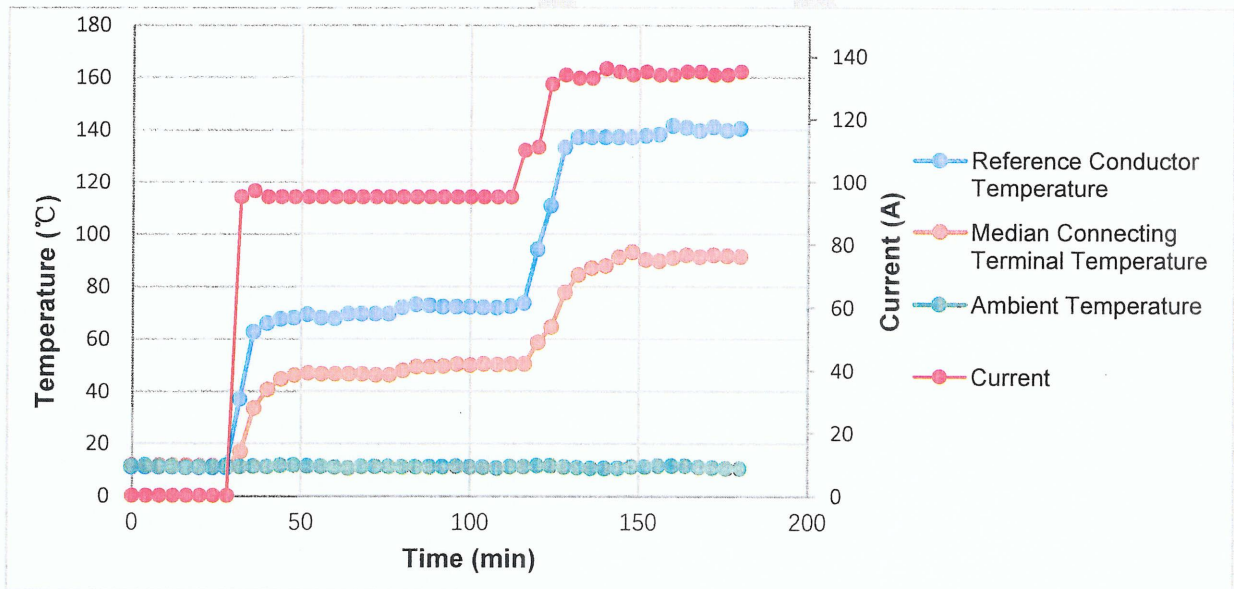


Figure 1 1st heat cycle temperature curve

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4.1.3 The 2nd heat cycle test

According to GB/T 9327—2008, clause 6.3.2.

Test method: GB/T 9327—2008, clause 6.3.2

Test parameters

Ambient temperature: 11 °C

Required reference conductor steady temperature (°C)	Heat current for steady reference conductor temperature (A)	Reference conductor temperature (°C)	Median connecting terminal		Heat cycle time	
			Steady temperature (°C)	Steady time (min)	Heating time (min)	Cooling time (min)
140~146	134	140~145	92~93	10	40	12

Test Results	The test is finished successfully. The 2nd heat cycle temperature curve is shown in Figure 2.
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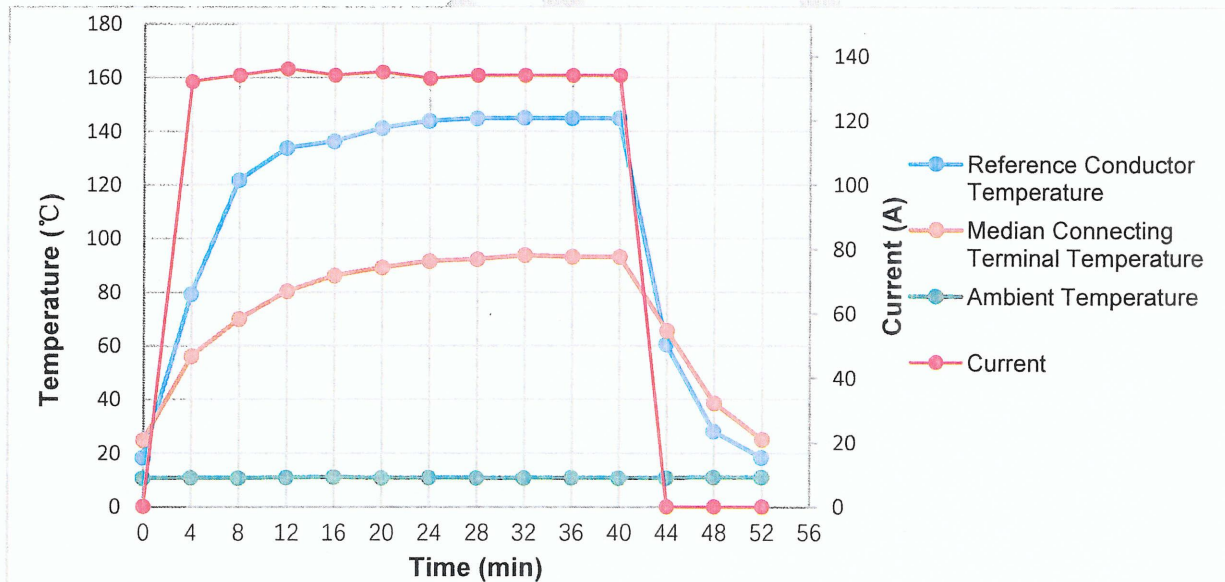


Figure 2 2nd heat cycle temperature curve

The following heat cycle according to the heating current and time.

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4.1.4 The 2nd electrical resistance measurement (after the 200th heat cycle, before short-circuit)

According to GB/T 9327—2008, clause 6.3.3.

Test method: GB/T 9327—2008 clause 6.2

Test parameters

Ambient temperature: 18 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.387	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.348	0.337	0.325	0.341	0.366	0.359
- Connecting terminal	mΩ	/	0.0946	0.0835	0.0731	0.0959	0.116	0.112

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k - After the 200th heat cycle (before short-circuit)	/	/	0.736	0.658	0.576	0.738	0.913	0.860	N
Resistance factor ration λ - Resistance factor ration λ ₁	/	≤2.0	1.2	1.0	1.0	1.2	1.3	1.4	P

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4.1.5 Short-circuit test

According to GB/T 9327—2008, clause 6.3.4.

Test method: GB/T 9327—2008, clause 6.3.4

Test parameters

Ambient temperature: 16 °C

Required short-circuit current: 1.86(kA) Duration: 1(s)		Short-circuit	Short-circuit current valid value (kA)	Duration (s)
Current applied	Short-circuit mode	1st	1.88	1.00
Conductor and Connecting Terminal	1 phase	2nd	1.88	1.01
		3rd	1.88	1.01
		4th	1.88	1.01
		5th	1.88	1.01
		6th	1.88	1.01

Test Item	Requirement	Test Result	Verdict
Short-circuit test	/	There is no any sign of damage or deformation for the samples. The waveform and duration of short-circuit are shown in subcontractor test report.	N

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4.1.6 The 3rd electrical resistance measurement (after the 200th heat cycle, after short-circuit test)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 16 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.390	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.354	0.341	0.346	0.347	0.376	0.363
- Connecting terminal	mΩ	/	0.0987	0.0852	0.0921	0.100	0.124	0.114

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k - After the 200th heat cycle (after short-circuit)	/	/	0.763	0.667	0.721	0.765	0.972	0.870	N
Resistance factor ratio λ - Resistance factor ratio λ ₂	/	≤2.0	1.2	1.0	1.3	1.3	1.4	1.5	P

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4.1.7 The 4th electrical resistance measurement (after 250th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 15 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.395	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.355	0.344	0.349	0.347	0.377	0.363
- Connecting terminal	mΩ	/	0.0957	0.0851	0.0921	0.0966	0.122	0.110

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 250th heat cycle	/	/	0.730	0.658	0.712	0.728	0.941	0.832	N
Resistance factor ratio λ									
- Resistance factor ratio λ ₃	/	≤2.0	1.2	1.0	1.3	1.2	1.3	1.4	P

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4.1.8 The 5th electrical resistance measurement (after the 325th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 16 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.394	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.349	0.337	0.348	0.340	0.375	0.359
- Connecting terminal	mΩ	/	0.0909	0.0784	0.0908	0.0898	0.120	0.107

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 325th heat cycle	/	/	0.695	0.606	0.703	0.678	0.928	0.806	N
Resistance factor ratio λ									
- Resistance factor ratio λ ₄	/	≤2.0	1.1	0.9	1.3	1.1	1.3	1.3	P

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4.1.9 The 6th electrical resistance measurement (after the 400th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 17 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.396	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.349	0.338	0.345	0.338	0.371	0.357
- Connecting terminal	mΩ	/	0.0899	0.0784	0.0868	0.0869	0.115	0.104

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 400th heat cycle	/	/	0.684	0.604	0.669	0.653	0.888	0.782	N
Resistance factor ration λ									
- Resistance factor ration λ ₅	/	≤2.0	1.1	0.9	1.2	1.1	1.3	1.3	P

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4.1.10 The 7th electrical resistance measurement (after the 475th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 17 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.397	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.349	0.338	0.345	0.341	0.371	0.358
- Connecting terminal	mΩ	/	0.0885	0.0775	0.0864	0.0887	0.114	0.105

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k - After the 475th heat cycle	/	/	0.671	0.595	0.663	0.664	0.877	0.783	N
Resistance factor ratio λ - Resistance factor ratio λ ₆	/	≤2.0	1.1	0.9	1.2	1.1	1.2	1.3	P

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4.1.11 The 8th electrical resistance measurement (after the 550th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 17 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.397	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.344	0.342	0.345	0.342	0.370	0.358
- Connecting terminal	mΩ	/	0.0837	0.0822	0.0864	0.0901	0.113	0.105

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 550th heat cycle	/	/	0.636	0.632	0.665	0.676	0.871	0.786	N
Resistance factor ratio λ									
- Resistance factor ratio λ ₇	/	≤2.0	1.0	0.9	1.2	1.1	1.2	1.3	P

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4.1.12 The 9th electrical resistance measurement (after the 625th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 18 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.396	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.346	0.342	0.341	0.341	0.372	0.358
- Connecting terminal	mΩ	/	0.0860	0.0827	0.0835	0.0899	0.116	0.105

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 625th heat cycle	/	/	0.654	0.637	0.643	0.675	0.893	0.792	N
Resistance factor ratio λ									
- Resistance factor ratio λ ₈	/	≤2.0	1.0	0.9	1.2	1.1	1.3	1.3	P

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4.1.13 The 10th electrical resistance measurement (after the 700th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 18 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.397	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.343	0.346	0.344	0.341	0.379	0.359
- Connecting terminal	mΩ	/	0.0831	0.0860	0.0861	0.0889	0.122	0.105

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 700th heat cycle	/	/	0.631	0.661	0.662	0.667	0.940	0.791	N
Resistance factor ration λ									
- Resistance factor ration λ ₉	/	≤2.0	1.0	1.0	1.2	1.1	1.3	1.3	P

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4.1.14 The 11th electrical resistance measurement (after the 775th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 18 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.398	/	/	/	/	/	
- Equalizer—Terminal top	mΩ	/	0.348	0.348	0.346	0.346	0.379	0.352
- Connecting terminal	mΩ	/	0.0876	0.0870	0.0873	0.0936	0.122	0.098

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k - After the 775th heat cycle	/	/	0.663	0.667	0.670	0.700	0.935	0.736	N
Resistance factor ration λ - Resistance factor ration λ ₁₀	/	≤2.0	1.1	1.0	1.2	1.1	1.3	1.2	P

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4.1.15 The 12th electrical resistance measurement (after the 850th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 19 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.399	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.350	0.348	0.347	0.346	0.377	0.353
- Connecting terminal	mΩ	/	0.0879	0.0859	0.0872	0.0922	0.119	0.0981

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 850th heat cycle	/	/	0.663	0.656	0.666	0.687	0.909	0.730	N
Resistance factor ration λ									
- Resistance factor ration λ ₁₁	/	≤2.0	1.1	0.9	1.2	1.1	1.3	1.2	P

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4.1.16 The 13th electrical resistance measurement (after the 925th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 19 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.400	/	/	/	/	/	/
- Equalizer—Terminal top	mΩ	/	0.353	0.348	0.346	0.348	0.373	0.358
- Connecting terminal	mΩ	/	0.0906	0.0862	0.0855	0.0939	0.114	0.103

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 925th heat cycle	/	/	0.682	0.657	0.652	0.698	0.868	0.764	N
Resistance factor ration λ									
- Resistance factor ration λ ₁₂	/	≤2.0	1.1	1.0	1.2	1.1	1.2	1.3	P

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4.1.17 The 14th electrical resistance measurement (after the 1000th heat cycle)

According to GB/T 9327—2008 clause 6.3.3.

Test method: GB/T 9327—2008, clause 6.2

Test parameters

Ambient temperature: 18 °C

Measurement Item	Unit	Measurement Results						
		Reference conductor	Connecting Terminal					
			1#	2#	3#	4#	5#	6#
Electrical resistance (20°C)								
- Between the two equalizers	mΩ	0.399	/	/	/	/	/	
- Equalizer—Terminal top	mΩ	/	0.357	0.346	0.342	0.346	0.379	0.359
- Connecting terminal	mΩ	/	0.0951	0.0847	0.0823	0.0928	0.120	0.104

Test Item	Unit	Requirement	Test Results						Verdict
			1#	2#	3#	4#	5#	6#	
Resistance factor k									
- After the 1000th heat cycle	/	/	0.717	0.647	0.629	0.691	0.918	0.774	N
Resistance factor ration λ									
- Resistance factor ration λ ₁₃	/	≤2.0	1.1	0.9	1.1	1.1	1.3	1.3	P
Mean scatter β									
- Mean scatter	/	≤0.30	0.23						P
Change in resistance factor D									
- Change in resistance factor	/	≤0.15	0.12	0.14	0.13	0.07	0.08	0.14	P
Maximum temperature θ_{max}									
- Reference conductor θ _{ref}	°C	140~146	146	144	145	145	145	146	P
- Connecting terminal maximum temperature θ _{max}	°C	≤θ _{ref}	106	97	95	90	92	105	P

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3 samples experienced with 1000 heat cycles were tested for mechanical tests.

4.2 Mechanical test

According to GB/T 9327—2008 clause 7.

Test method: GB/T 9327—2008, clause 7.1

Test parameters

Total tensile force: 600 N

Load rate: ≤ 10 N/(s·mm²)

Duration: 1 min

Test Item	Requirement	Test Result	Verdict
Mechanical tests	No slipping shall occur during the last minute of the test.	There is no slipping for the 3 samples in the tests.	P

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4.3 Surface and dimension check

4.3.1 Surface check

According to GB/T 14315—2008 Table 10, No.1.

Test method: GB/T 14315—2008, Table 10

Test parameter

Ambient temperature: 18 °C

Test Item	Requirement	Test Result	Verdict
Surface check	Sample surface shall be bright, clean and smooth. There shall be no burr formation, crack, sharp edge, overlap, the plate shall be smooth. The cladding layer shall be well-distributed, no desquamated. There shall be no sharp angle and edge roll on the compression cylinder part of the terminal.	By visual checking, the surface is smooth, there is no burr, or crack, or sharp edge, or overlap. The cladding layer is no desquamated. There is no sharp angle, or edge roll on the compression cylinder part.	N

4.3.2 Dimension check

According to GB/T 14315—2008 Table 10, No.2.

Test method: GB/T 14315—2008, Table 10

Test parameter

Ambient temperature: 18 °C

Test Item	Unit	Requirement	Test Result	Verdict
Dimension check				
- ΦH	mm	/	8.4	N
- d	mm	5.5 ^{+0.36} ₀	5.70	P
- D	mm	9 ^{+0.2} _{-0.12}	9.08	P
- L1	mm	≥30	31	P
- C	mm	12 ^{+0.43} _{-0.43}	11.82	P
- N	mm	7 ^{+0.36} _{-0.36}	6.88	P
- W	mm	16 ^{+0.3} _{-0.3}	15.9	P
- S	mm	2.2 ^{+0.6} ₀	2.4	P
- L	mm	66 ^{+1.5} _{-1.5}	65.7	P
- e	mm	≥1.0	1.1	P

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Appendix A: Conductor structure for the tests and installation information

Appendix A.1 Conductor structure

Nominal section area	Material	Type	Outer diameter	Nominal diameter for single wire	The number of single wires	Structure
10	Cu	Circle, stranded	Φ4.0	Φ1.32	7	2 layer, 1+6

Appendix A.2 Parameters of the pressure clamp

Terminal type & size	Clamp type	Working pressure	Stamper type & size	Diagonal line length	Shape of stamper
DTM-10mm ²	EZ-400	120kN	Cu10	6.0mm	Hexagon confining pressure

Appendix A.3 Distance between the compressions

There are two compression in the center part of the terminal cylinder. The distance is 3mm between the impressions. The distance between the last compression and the terminal cylinder end is 2mm.

Appendix A.4 Requirements of bolts, nuts, washer and torque for connecting the terminal

Terminal type & size	Outer hexagon bolt	Effective length of the helical burr	Thickness of the connection	Recommended torque	Note
DTM-10mm ²	M8×25	20mm	8mm	12N·m	Including spring washer, ping pads, nut

Appendix B: Samples length

Item	Length (mm)						
	Reference conductor	Connecting Terminal					
		1#	2#	3#	4#	5#	6#
Between two equalizers	238	/	/	/	/	/	/
Equalizer—Terminal end (I _a)	/	156	156	155	151	154	152
Terminal end—Terminal top (I _j)	/	79	78	78	80	78	80