

China Electric Power Research Institute
Quality Inspection and Test Center for Electric Equipment
of Power Industry

Test Report

EETC2015DL190J

1 Client

Shanghai Chardon Electric Ltd.

2 Sample Description

Name: 24 kV/250 A screened plug-in type separable connector

Type & Size: 24-CL/E250A

Manufacturer: Shanghai Chardon Electric Ltd.

Manufacture Date: Feb., 2015

Sample No. /Details: DL2015-190

3 Standards/Specifications

GB/T 12706.4—2008 Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m=1.2$ kV) up to 35 kV ($U_m=40.5$ kV) — Part 4: Test requirements on accessories for cables with rated voltages from 6 kV ($U_m=7.2$ kV) up to 35kV ($U_m=40.5$ kV)

IEC 60502-4:2010 Power cables with extruded insulation and their accessories for rated voltages from 1 kV($U_m =1.2$ kV)up to 30 kV($U_m =36$ kV) Part 4:Test requirements on accessories for cables with rated voltages from 6 kV($U_m =7.2$ kV)up to 30 kV($U_m =36$ kV)

4 Test Category

Type Tests

5 Test Date

23/04/2015-26/06/2015

6 Conclusion

The 24 kV/250 A screened plug-in type separable connectors, the type and size of which is 24-CL/E250A taken to test by the client's own self have passed the type tests specified in GB/T 12706.4—2008 and IEC 60502-4:2010.

Note: In the event of any difference in meanings of the text, the Chinese report shall take priority over the English version.

Tested by: 韩卫京 赫留洋

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Date of issue: 2015-07-23

7 The Number and Installation of Combination Samples

It was required that four samples to be tested were installed by the manufacturer on the cables forming combination samples on which the type tests sequence 4.1 and 4.2 and 4.3 in table 7 were carried out. The cable used in the combination sample was a XLPE insulated single-core cable with rated voltage 12/20 kV, a cross-section of 50 sq.mm. The length of the cable in the combination sample was greater than 5 m between terminations and the samples. Other type tests listed in table 7 were carried out on other samples.

8 Test Sequence and Results

The test sequence and results were given in Table 1 (sequence 4.1), Table 2(sequence 4.2 and 4.3) and Table 3 (the other items).

Table 1

No.	Items	Requirements	Results	Evaluation				
1	AC withstand voltage test	No breakdown shall occur at 54 kV for 5 min	No breakdown occurred on the combination samples at 54 kV for 5 min	Pass				
2	Partial discharge test at ambient temperature	The magnitude of the discharge at 20 kV shall not exceed 10 pC	Phase	No. 1	No. 2	No. 3	No. 4	Pass
			Voltage (kV)	20	20	20	20	
			Noise background (pC)	1.6	1.6	1.6	1.6	
			Discharge (pC)	≤ 1.6	≤ 1.6	≤ 1.6	2.6	
3	Impulse withstand voltage test at 95 °C~100 °C	No breakdown shall occur at 10 positive and 10 negative impulses of 125 kV	No breakdown occurred on the combination samples at 10 positive and 10 negative impulses of 125 kV (See Annex B)	Pass				
4	Heating cycle voltage test	No breakdown shall occur during 30 cycles in air and 30 cycles under water at the conductor temperature of 95 °C-100 °C and 30 kV	No breakdown occurred on the combination samples subjected to 30 cycles in air and 30 cycles under water at the conductor temperature of 95 °C to 100 °C and 30 kV	Pass				
5	Disconnect/connect	Five times. No visible damage to contact	Five times and no visible damage to contact	Pass				
6	Partial discharge test at 95 °C~100 °C	The magnitude of the discharge at 20 kV shall not exceed 10 pC	Phase	No. 1	No. 2	No. 3	No. 4	Pass
			Voltage (kV)	20	20	20	20	
			Noise background (pC)	1.3	1.3	1.3	1.3	
			Discharge (pC)	≤ 1.3	≤ 1.3	≤ 1.3	2.1	

Table 1(Continued)

No.	Items	Requirements	Results				Evaluation	
			Phase	No. 1	No. 2	No. 3		No. 4
7	Partial discharge test at ambient temperature	The magnitude of the discharge at 20 kV shall not exceed 10 pC	Voltage (kV)	20	20	20	20	Pass
			Noise background (pC)	1.5	1.5	1.5	1.5	
			Discharge (pC)	≤ 1.5	≤ 1.5	≤ 1.5	3.0	
8	Impulse withstand voltage test	No breakdown shall occur at 10 positive and 10 negative impulses of 125 kV	No breakdown occurred on the combination samples at 10 positive and 10 negative impulses of 125 kV (See Annex C)				Pass	
9	AC withstand voltage test	No breakdown shall occur at 30 kV for 15 min	No breakdown occurred on the combination samples at 30 kV for 15 min				Pass	

Table 2

No.	Items	Requirements	Results	Evaluation
1	AC withstand voltage test	No breakdown shall occur at 54 kV for 5 min	No breakdown occurred on the combination samples at 54 kV for 5 min	Pass
2	Thermal short-circuit test (conductor)	No visible deterioration at 9.12 kA, 1 s, twice	No visible deterioration at 9.421 kA, 1.00 s and 9.405 kA, 1.00 s (See Annex E2)	Pass
3	Dynamic short-circuit test (conductor)	No visible deterioration at 22.8 kA, not less than 10 ms	No visible deterioration at 23.03 kA, 114 ms (See Annex E1)	Pass
4	Disconnect/connect	Five times, No visible damage to contact	Five times and no visible damage to contact	Pass
5	Impulse withstand voltage test	No breakdown shall occur at 10 positive and 10 negative impulses of 125 kV	No breakdown occurred on the combination samples at 10 positive and 10 negative impulses of 125 kV (See Annex D)	Pass
6	AC withstand voltage test	No breakdown shall occur at 30 kV for 15 min	No breakdown occurred on the combination samples at 30 kV for 15 min	Pass

Table 3

No.	Items	Requirements	Results			Evaluation	
1	Operating eye	Axial force 2200 N for 1 min Clockwise torque and Anticlockwise torque 14 N·m	Axial force 2200 N for 1 min Clockwise torque and Anticlockwise torque 14 N·m			Pass	
2	Partial discharge test	The magnitude of the discharge at 20 kV shall not exceed 10 pC	The magnitude of the discharge of the combination samples didn't exceed 1.1 pC at 20 kV (the level of maximum noise background being 1.1 pC during the tests)			Pass	
3	Screen resistance tests	Screen resistance before and after the heating period shall not exceed 5000 Ω		before ageing	after ageing	Pass	
			straight connector	572 Ω	742 Ω		
			elbow connector	982 Ω	510 Ω		
4	Screen leakage	Screen leakage shall not exceed 0.5 mA at 24 kV	Screen leakage didn't exceed 0.5 mA at 24 kV			Pass	
5	Operating force	Force shall be less than 900 N	Straight connector opening-force is 360 N, closing-force is 340 N; Elbow connector opening-force is 350 N, closing-force is 330 N			Pass	
6	Capacitive test point	Capacitive of test point to cable conductor: $C_{TC} > 1.0 \text{ pF}$ Ratio of capacitance of test point to earth C_{TE} and capacitive of test point to cable conductor C_{TC} : $C_{TE}/C_{TC} \leq 12.0$		C_{TC}	C_{TE}	C_{TE}/C_{TC}	Pass
			straight connector	3.9 pF	22.8 pF	5.8	
			elbow connector	4.1 pF	23.2 pF	5.7	

Annex A List of the main equipment and instruments used in tests.

No.	Name of the equipment and instruments Model / Type	Serial No.	Measuring range	Uncertainty / Veracity	Verification / Calibration institution	Valid period
1	35 kV High voltage test system	105	(0~35) kV	Class 3	National high voltage measurement station	2016-01-01
2	TAWF Series resonance system	312068	(0~75) kV	Class 3	National high voltage measurement station	2015-09-07

No.	Name of the equipment and instruments Model / Type	Serial No.	Measuring range	Uncertainty / Veracity	Verification /Calibration institution	Valid period
3	JFD-2H PD measurement system	20041202	(0.5~1000) pC	Class 10	National high voltage measurement station	2016-05-20
4	FY 1 900/600 Weakly damped capacitive voltage divider	11165-2-1	(0~900) kV	Class 3	National high voltage measurement station	2016-07-01
5	H-DJF-2 Data collected system	CJ06	(0~100) kA	Class 0.5	National high voltage measurement station	2016-01-03
6	LM-0.5 Current transformer	811	(0~3000) A	Class 0.5	National high voltage measurement station	2016-10-17
7	MAS-II digital microammeter	20001	(0~2000) μ A	Class 1.5	National high voltage measurement station	2015-09-29
8	UT56 Digital voltage meter	30800995 22	(0~700) V	Class 1	Hubei Institute of Measurement and Testing Technology	2015-09-28
9	QS97A Digital high voltage bridge	211201	-0.9999 ~ 0.9999	2%+ 0.0002	National high voltage measurement station	2015-12-09

Annex B The values and oscillograms of impulse voltages on the combination samples before heating cycles voltage test (at high temperature, 125 kV, $\pm 3\%$ tolerance)

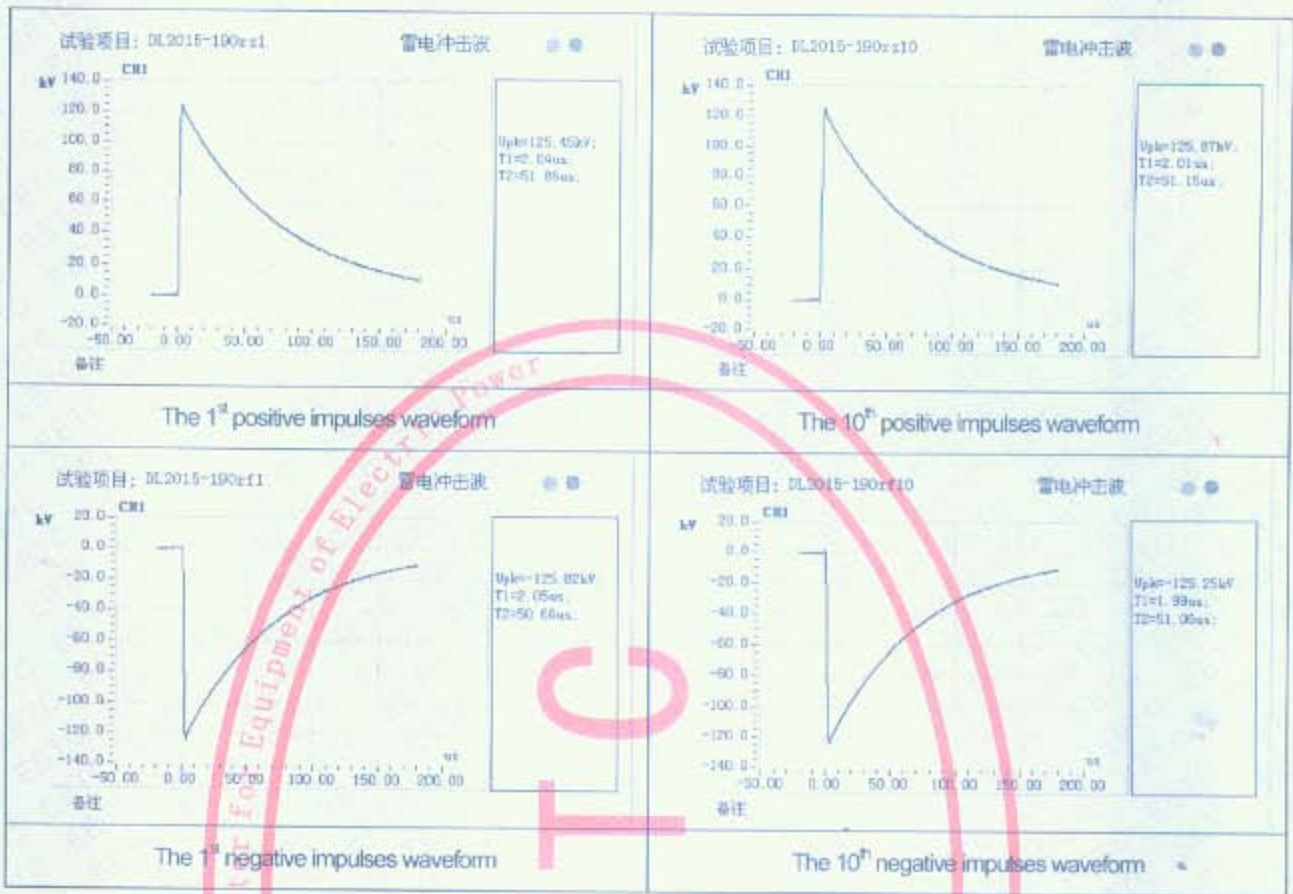
B1 The values of impulse voltages

Ambient temperature: 22.5 $^{\circ}$ C, Relative humidity: 60 %, Atmosphere: 0.1017 MPa

Unit kV

Positive polarity	125.4	125.7	125.6	126.1	124.3	125.2	125.5	125.9	125.2	125.9
Negative polarity	125.8	126.6	125.2	124.1	127.0	125.8	125.8	125.2	126.1	125.2

B2 Oscillograms of the impulse voltages waveform



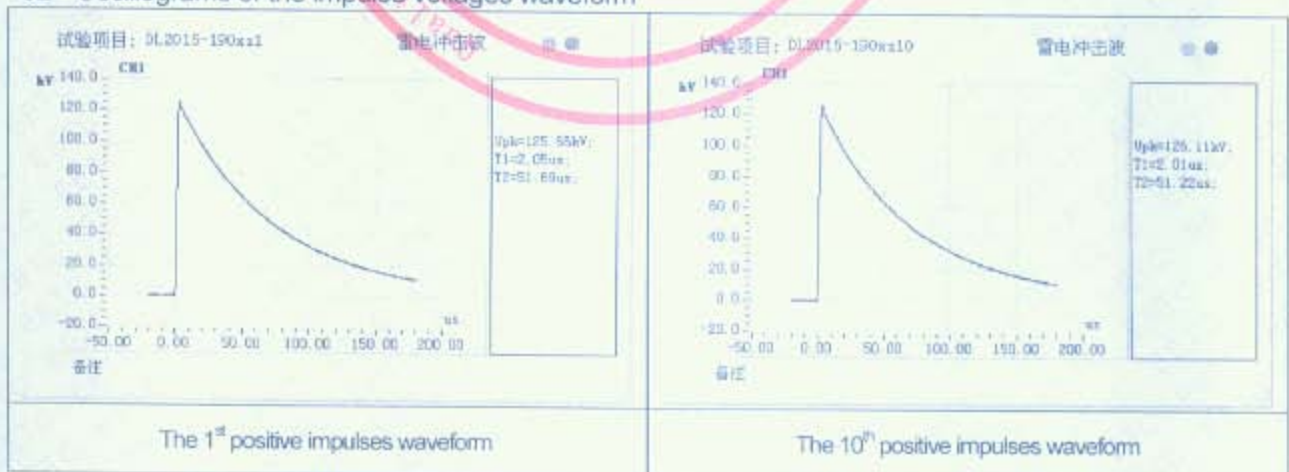
Annex C The values and oscillograms of impulse voltages on the combination samples after heating cycles voltage test (at ambient temperature, 125 kV±3 % tolerance)

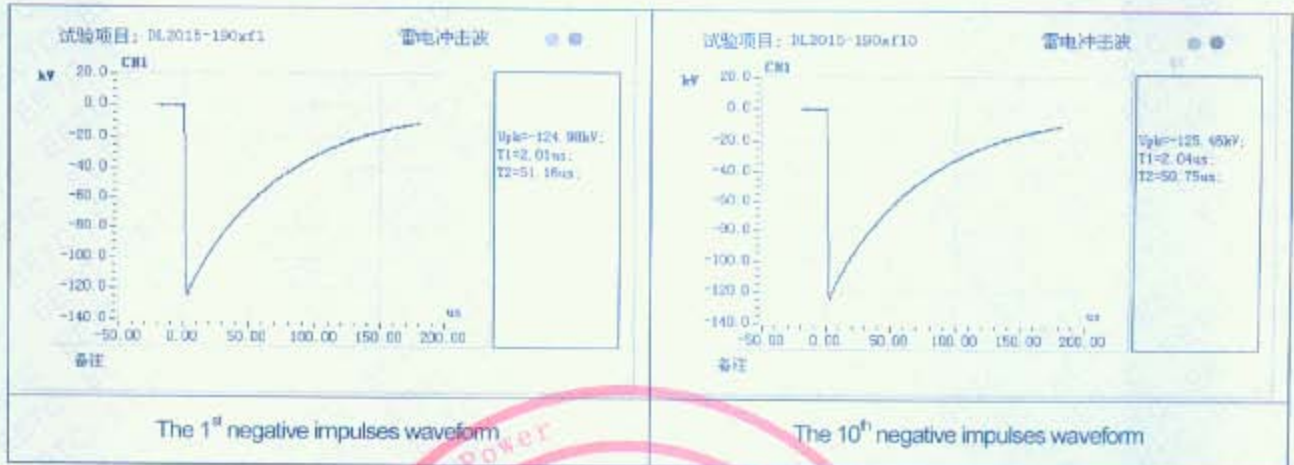
C1 The values of impulse voltages

Ambient temperature: 28.5 °C, Relative humidity: 64 %, Atmosphere: 0.1000 MPa

	Unit: kV									
Positive polarity	125.7	126.4	125.9	125.6	124.3	125.5	125.8	125.2	125.3	126.1
Negative polarity	125.0	124.7	125.8	126.3	125.7	123.8	125.1	125.0	125.1	125.5

C2 Oscillograms of the impulse voltages waveform





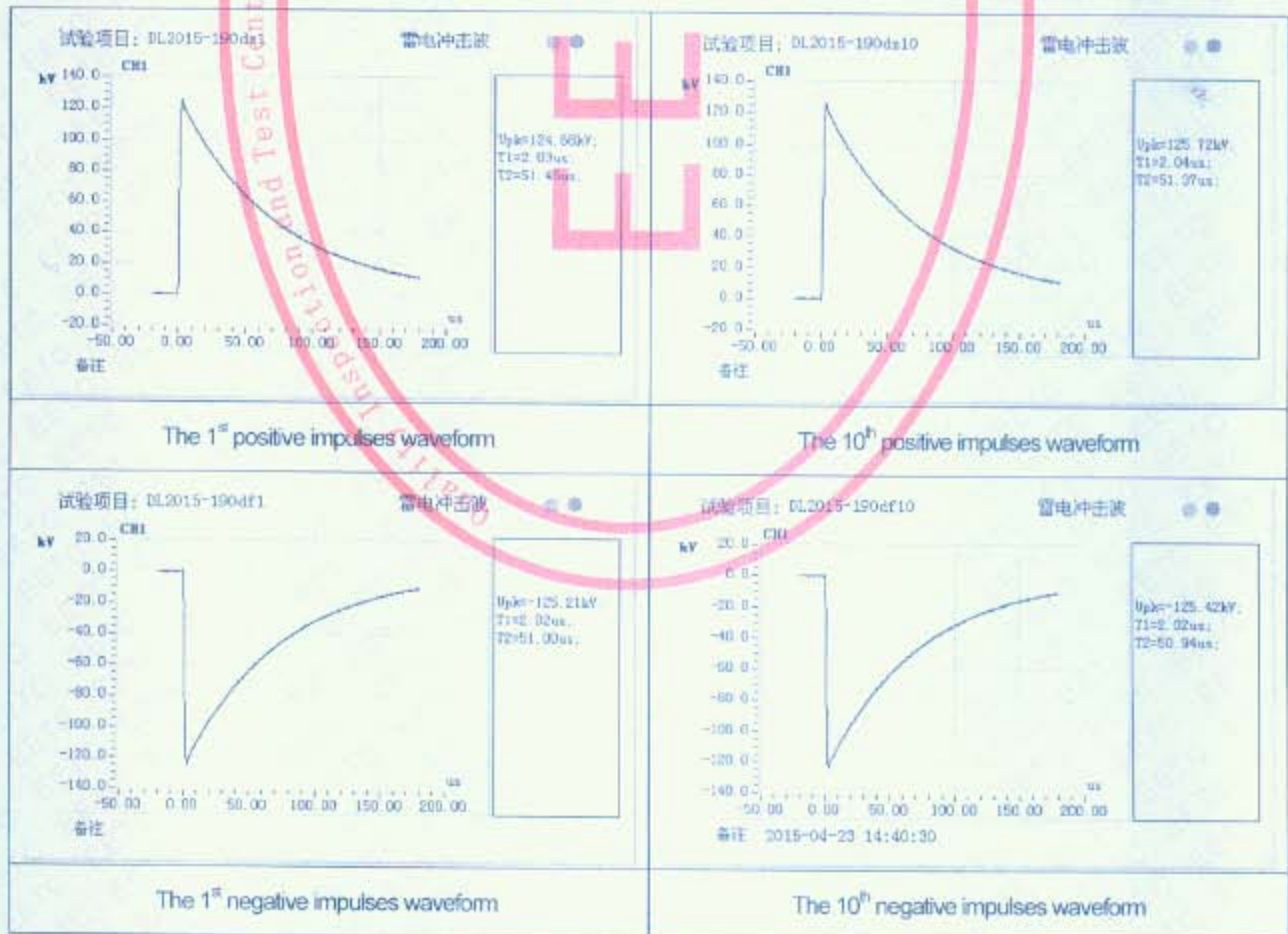
Annex D The values of impulse voltages on the combination samples after thermal short-circuit tests (at ambient temperature, 125 kV±3 % tolerance)

D1 The values of impulse voltages

Ambient temperature: 31.5 °C, Relative humidity: 63 %, Atmosphere: 0.1001 MPa

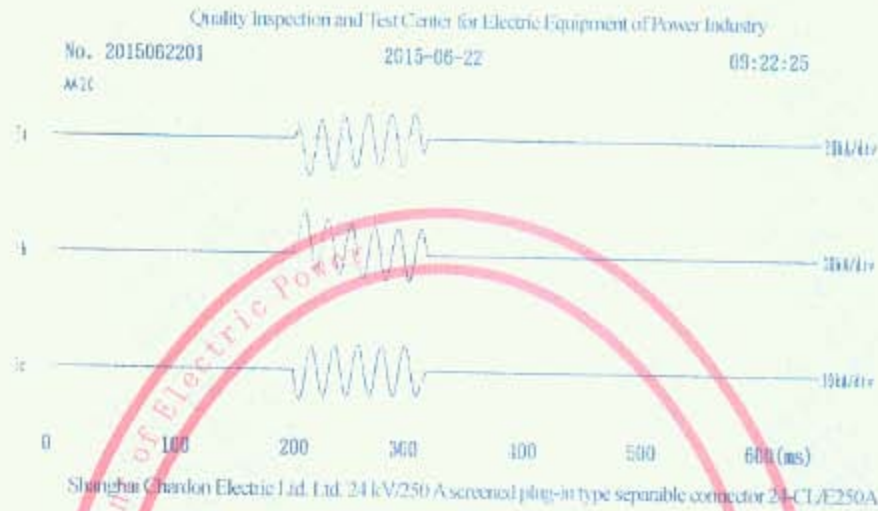
	Unit: kV									
Positive polarity	124.7	125.6	126.1	124.9	125.5	125.6	125.6	126.0	125.5	125.7
Negative polarity	125.2	124.8	125.0	125.1	125.0	125.2	125.8	126.6	126.4	125.4

D2 Oscillograms of the impulse voltages waveform

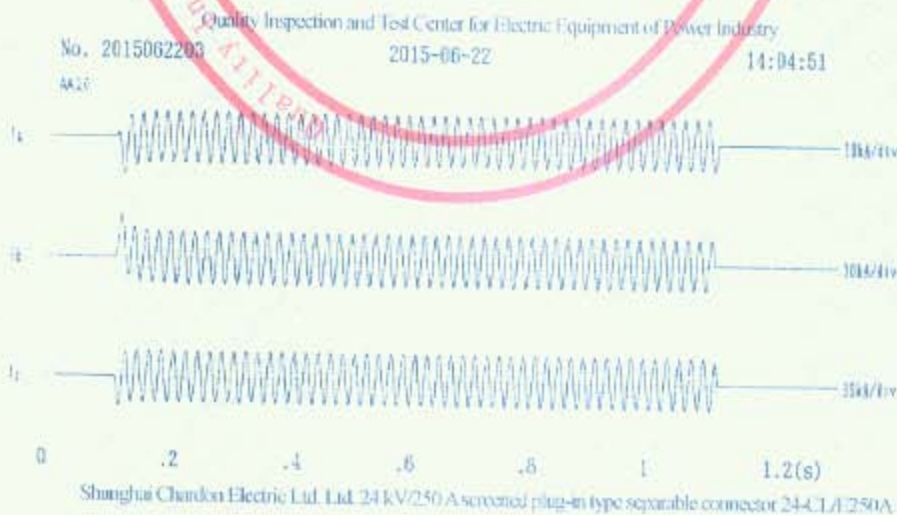
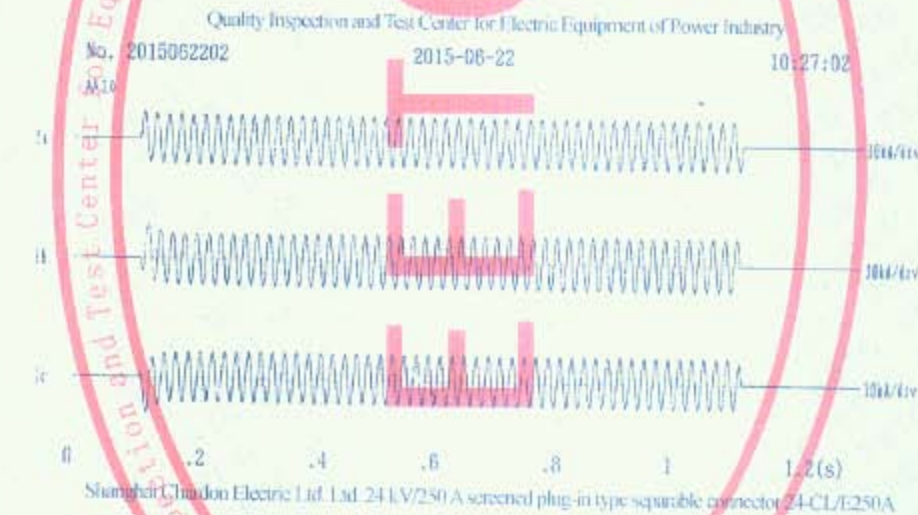


Annex E The waveform of dynamic short-circuit tests and thermal short-circuit tests of the combination sample

E1 The waveform of dynamic short-circuit tests of the combination sample(conductor)



E2 The waveform of thermal short-circuit tests of the combination sample(conductor)



Annex F Photograph about test



Annex G Identification of test cable (specified in GB/T 12706.2—2008)

rated voltage $U_j/U(U_m)$		12/20(24) kV
construction	core	single-core
	construction of screen	separated screen
conductor	material	copper
	type	round compact stranded
	cross section	50 mm ²
	diameter	8.6 mm
insulation	material	XLPE
	thickness	5.5 mm
	diameter	21.7 mm
screen	thickness of conductor screen	1.0 mm
	thickness of insulation screen	0.9 mm
	strippability of insulation screen	strippable
	diameter of insulation screen	23.5 mm
	metallic screen	copper tape
armour		/
oversheath	material	PVC
	diameter	28.6 mm
mark of cable		YJV-12/20 1×50