China Electric Power Research Institute
Power Industry Quality Inspection and Testing Center for Electric Equipment and Instruments

EETC2016HG002J

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Test Report

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NOTICE

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2 This report is legally made available accompany with tested, checked, verified and approved signatures.

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Power Industry Quality Inspection and Testing Center for Electric Equipment and Instruments

Test Report

EETC2016HG002J

1 Client

Guangdong SiHui Instrument Transformer Works Co.,Ltd.

2 Sample Description

Name: Current transformer
Type : LB-110W
Manufacturer: Guangdong SiHui Instrument Transformer Works Co.,Ltd.
Manufacture Date: Oct.,2015
Sample No./Details: C150111017

3 Standards/Specifications

GB20840.1-2010 Instrument transformers-Part1: General requirements
GB20840.2-2014 Instrument transformers-Part2: Additional requirements for current transformers
IEC61869-1:2007 Instrument transformers-Part1: General requirements
IEC61869-2:2012 Instrument transformers-Part2: Additional requirements for current transformers

4 Test Category

Routine Test /Type Test / Special Test

5 Test Date

01 Jan. 2016 to 21 Jan. 2016

6 Conclusion

The current transformer with the type of LB-110W offered by Guangdong SiHui Instrument Transformer Works Co.,Ltd. meets the requirements of the corresponding items of the standards GB20840.1-2010,GB20840.2-2014,IEC61869-1:2007,IEC61869-2:2012.

电力工业电气设备质量检验测试中心
检测报告
专用章

Note 1: In the event of any difference in meanings of the text, the Chinese report shall take priority over the English version.

Note 2: (Period of validity: 5 years.)

Tested by:

Checked by:

Verified by:

Approved by:

Date of issue: 2016-02-26

7 Inspection Items and Results

No.	Item	Requirements	Results	Evaluation
1	Verification of markings	The nameplate, sign, earthing terminal, terminal marking shall meet the requirements. The oil level indicator and the oil valve shall be in good condition and in working-order. There shall be no evidence of leakage.	Meet the requirements.	Pass
2	Power-frequency voltage withstand tests on secondary terminals	Applied voltage on winding-to-winding and winding-to-earth shall be 3kV/50Hz/60s.	Test voltage: 3kV/50Hz/60s No flashover and breakdown occurred.	Pass
3	Power-frequency withstand test between sections	Applied voltage between sections of the primary winding shall be 3kV/50Hz/60s	Test voltage: 3kV/50Hz/60s No flashover and breakdown occurred.	Pass
4	Power-frequency voltage withstand test on primary terminals	Applied voltage between primary winding and earth shall be 230kV/50Hz/60s Applied voltage on earthing screen-to-earth shall be 5kV/50Hz/60s.	Test voltage: 230kV/50Hz/60s No flashover and breakdown occurred. Atmosphere correction factor K_t=0.9986 Test voltage: 5kV/50Hz/60s No flashover and breakdown occurred.	Pass
5	Partial discharge measurement	Test frequency : 50 Hz Pre-stress voltage: 230 kV Test voltage: 126 kV Maximum permissible PD level : 10 pC Test voltage 87.3 kV Maximum permissible PD level : 5 pC	Test frequency : 50 Hz Pre-stress voltage: 230 kV Test voltage: 126 kV PD level: 5 pC Test voltage: 87.5 kV PD level: 2 pC	Pass
6	Measurement of capacitance and dielectric dissipation factor	The dielectric dissipation factor at 10kV , $\frac{1}{2}\sqrt{3}\ U_m$ and $\frac{1}{\sqrt{3}}U_m$ shall not exceed 0.5% . The dielectric dissipation factor of earthing screen at 3kV shall not exceed 2 %.	Primary winding to earth: 10kV $tan\delta$: 0.27 % Cx: 529.9 pF 36kV $tan\delta$: 0.28 % Cx: 529.9 pF 73kV $tan\delta$: 0.28 % Cx: 530.0 pF Earthing screen to earth: 3kV $tan\delta$: 0.19 % Cx: 1239 pF	Pass
7	Inter-turn overvoltage test	With the secondary windings open-circuited, the rated primary current (or rated extended primary current) shall be applied for 60s to the primary winding at rated frequency. The peak voltage of the open-circuited secondary windings shall not exceed 4.5kV.	Primary winding in series. $1S_1 1S_2$: 360A 533V 60s $2S_1 2S_2$: 360A 529V 60s $3S_1 3S_2$: 360A 527V 60s $4S_1 4S_2$: 360A 531V 60s $5S_1 5S_3$: 360A 179V 60s	Pass

No.	Item		Requirements		Results		Evaluation
8	Tests for accuracy	Basic error tests	The errors of the secondary windings shall meet the requirements of accuracy classes 0.2S/0.2/10P.		Meet the requirements.		Pass
		Test for composite errors	$1S_1$ $1S_2$	50VA 10P20 primary current≥ 6 kA composite error≤ 10 %	$1S_1$ $1S_2$	50VA 10P20 primary current: 6.22 kA composite error: 6.8 %	Pass
			$2S_1$ $2S_2$	50VA 10P20 primary current≥ 6 kA composite error≤ 10 %	$2S_1$ $2S_2$	50VA 10P20 primary current: 6.22kA composite error: 6.6%	Pass
			$3S_1$ $3S_2$	50VA 10P20 primary current≥ 6 kA composite error≤ 10 %	$3S_1$ $3S_2$	50VA 10P20 primary current: 6.02 kA composite error: 6.8 %	Pass
			$4S_1$ $4S_2$	50VA 10P20 primary current≥ 6 kA composite error≤ 10 %	$4S_1$ $4S_2$	50VA 10P20 primary current: 6.19kA composite error: 6.4%	Pass
		Determination of the instrument security factor(FS)	$5S_1$ $5S_2$	30VA FS5 primary current≤0.75kA composite error≥ 10 %	$5S_1$ $5S_2$	30VA FS5 primary current: 0.31 kA composite error > 50 %	Pass
			$5S_1$ $5S_3$	50VA FS5 primary current≤ 1.5 kA composite error≥ 10 %	$5S_1$ $5S_3$	50VA FS5 primary current: 0.85 kA composite error: 40 %	
9	Temperature-rise test		The rated continuous thermal current is applied on the primary winding. The limited values of temperature rise are shown as follows: Secondary windings ≤ 65 K Connection, bolted or the equivalent ≤ 50K Top oil ≤55K		Primary winding in parallel. Test current: 720A $1S_1 1S_2$: 9 K $2S_1 2S_2$: 9 K $3S_1 3S_2$: 9 K $4S_1 4S_2$: 9 K $5S_1 5S_3$: 10 K Connection of primary terminal:11 K Top oil : 7 K		Pass
10	Impulse voltage test on primary terminals		Standard LI: 550kV/ ±15 Waveform : 1.2/50μs Standard LI-chopped: 633kV/-2 Waveform: (2~5)μs		546kV～557kV ±15 634kV -2 No flashover and breakdown occurred.		Pass
11	Wet test for outdoor type transformers		The test shall be performed in wet condition. Applied voltage between primary winding and earth shall be 230kV/50Hz/60s		Test voltage: 230kV/50Hz/60s No flashover and breakdown occurred. Atmosphere correction factor : K_t=1.006 Water conductivity: 104 μS/cm Vertical precipitation: 1.5mm/min Horizontal precipitation: 1.3mm/min		Pass

No.	Item	Requirements	Results	Evaluation
12	Short-time current tests	Rated dynamic current: $80^{+10\%}_{0}$ kA Rated short-time thermal current: 31.5kA,3s Stable heat quantity: $2977^{+20\%}_{0} \times 10^6 A^2s$	Primary winding in series with secondary windings short-circuited Dynamic current (peak value): 82.74kA Short-time thermal current(r.m.s.): 31.63kA,3.12s Stable heat quantity: $3124\times10^6 A^2s$ Note: The primary winding is of aluminum , and the calculated current density is $89A/mm^2$.	Pass
13	Power-frequency voltage withstand tests on secondary terminals (retrial)	Applied voltage on winding-to-winding and winding-to-earth shall be 2.7kV/50Hz/60s.	Test voltage: 2.7kV/50Hz/60s No flashover and breakdown occurred.	Pass
14	Power-frequency withstand test between sections of (retrial)	Applied voltage between sections of the primary winding shall be 2.7kV/50Hz/60s	Test voltage: 2.7kV/50Hz/60s No flashover and breakdown occurred.	Pass
15	Power-frequency voltage withstand tests on primary terminals (retrial)	Applied voltage between primary winding and earth shall be 207kV/50Hz/60s. Applied voltage on earthing screen -to-earth shall be 4.5kV/50Hz/60s.	Test voltage: 207kV/50Hz/60s No flashover and breakdown occurred. Test voltage: 4.5kV/50Hz/60s No flashover and breakdown occurred.	Pass
16	Partial discharge measurement (retrial)	Test frequency : 50 Hz Pre-stress voltage: 207 kV Test voltage : 126 kV Maximum permissible PD level : 10 pC Test voltage: 87.3 kV Maximum permissible PD level : 5 pC	Test frequency : 50 Hz Pre-stress voltage: 207 kV Test voltage: 126 kV PD level: 6 pC Test voltage: 87.5 kV PD level: 2 pC	Pass
17	Measurement of capacitance and dielectric dissipation factor(retrial)	The dielectric dissipation factor at 10kV , $\frac{1}{2}\sqrt{3}\ U_m$ and $\frac{1}{\sqrt{3}} U_m$ shall not exceed 0.5% . The dielectric dissipation factor of earthing screen at 3kV shall not exceed 2 %.	Primary winding to earth: 10kV $tan\delta$: 0.27 % Cx: 529.6 pF 36kV $tan\delta$: 0.27 % Cx: 529.6 pF 73kV $tan\delta$: 0.27 % Cx: 529.6 pF Earthing screen to earth: 3kV $tan\delta$: 0.18 % Cx: 1238 pF	Pass
18	Inter-turn overvoltage test(retrial)	With the secondary windings open-circuited, the rated primary current(or rated extended primary current) shall be applied for 60s to the primary winding at rated frequency. The peak voltage of the open-circuited secondary windings shall not exceed 4.5kV.	Primary winding in series. $1S_1 1S_2$: 360A 546V 60s $2S_1 2S_2$: 360A 540V 60s $3S_1 3S_2$: 360A 538V 60s $4S_1 4S_2$: 360A 551V 60s $5S_1 5S_3$: 360A 203V 60s	Pass

No.	Item	Requirements	Results	Evaluation
19	Tests for accuracy (retrial)	The errors of the secondary windings shall meet the requirement of accuracy classes 0.2S/0.2/10P.	Meet the requirements.	Pass
20	Electromagnetic Compatibility (EMC) tests（RIV test）	The radio interference voltage shall not exceed 2500 μ V at $1.1U_m/\sqrt{3}$.	Test voltage: 80kV/50Hz Radio interference voltage (0.5MHz): <960μV	Pass
21	Transmitted overvoltage test	A low-voltage impulse (U1) (T1=0.5μs±20%, T2≥50μs) shall be applied between one of the primary terminals and earth. The transmitted overvoltage shall not exceed 1.6kV.	Transmitted overvoltage: 423V~682V	Pass
22	Mechanical tests	The test load shall be applied on primary terminal for at least 60s. There shall be no evidence of damage (deformation, rupture or leakage).	Horizontal: 2kN 60s. Vertical: 2kN 60s. There is no evidence of damage (deformation, rupture or leakage).	Pass
23	Insulation oil test	Breakdown voltage: ≥ 45kV Water content: ≤20mg/L *tanδ(90℃)*: ≤ 0.5% Gas-in-oil analysis shall be performed before and after the type tests. There shall be no C_2H_2 generated, and no obvious change of other soluble gas.	Breakdown voltage:73.7kV Water content:3mg/L *tanδ(90℃)*: 0.22% There is no C_2H_2 generate, and no obvious change of other soluble gas.	Pass
24	Enclosure tightness test at ambient temperature	Applied pressure: 0.1 MPa Duration: 6h Remained pressure: ≥0.07MPa There shall be no leakage.	Duration: 6h Remained pressure: 0.1MPa No leakage.	Pass
25	Verification of the degree of protection by enclosures	The degree of protection of low-voltage control and/or auxiliary enclosures for outdoor instrument transformers is IP54. The level of protection against effects of mechanical impacts is impact level IK07.	Meet the requirements. Note: The test was performed on another secondary terminal box of the same type offered by the client.	Pass

1 Identification of the tested object

1.1 Parameters

Name: Current transformer

Type: LB-110W

Sample No: C150111017

Manufacturer: Guangdong SiHui Instrument Transformer Works Co.,Ltd.

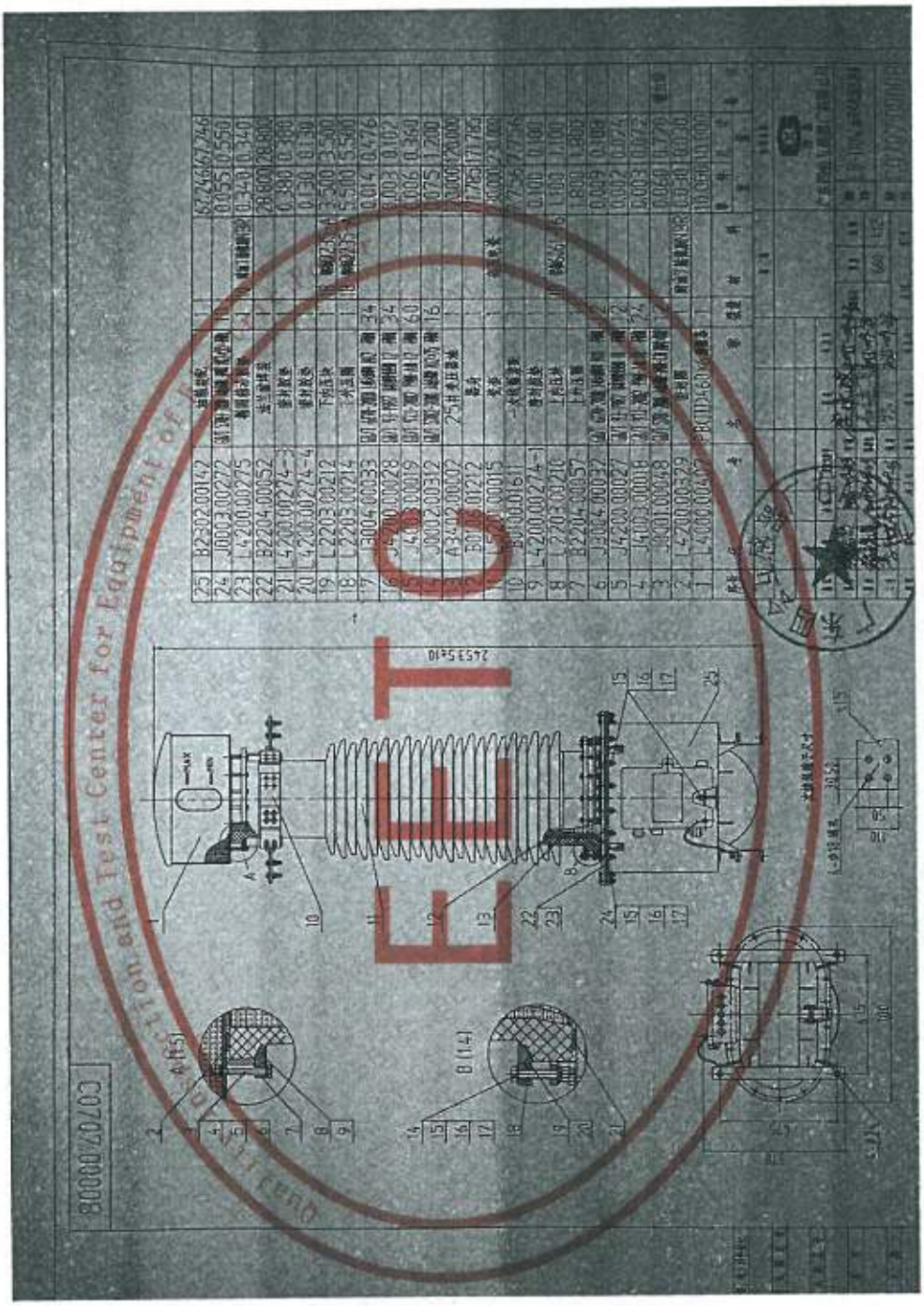
Date of Manufacture: Oct., 2015

Sampling way: Offer by client

Main parameters provided by the manufacturer:

Highest voltage for equipment (U_m)	126kV		Rated primary current (I_{pr})			2×300A
Equipment category	Outdoor		Rated frequency			50Hz
Temperature categories	-25℃/+40℃		Altitude			≤1000m
Rated insulation level	126/230/550 kV					
Rated continuous thermal current	120%I_{pr}					
Rated dynamic current (peak value)	80kA					
Rated short-time thermal current(r.m.s.)	31.5kA, 3s					
Secondary winding /Accuracy class	$1S_1 1S_2$/10P	$2S_1 2S_2$/10P	$3S_1 3S_2$/10P	$4S_1 4S_2$/10P	$5S_1 5S_3$/0.2S	$5S_1 5S_2$/0.2
Rated transformation ratio	2×300/5A	2×300/5A	2×300/5A	2×300/5A	2×300/5A	2×150/5A
Rated burden（VA） /Power factor	50/0.8	50/0.8	50/0.8	50/0.8	2.5～ 50/0.8	2.5～ 30/0.8
Instrument security factor /Accuracy limit factor	20	20	20	20	FS5	FS5

1.2 Drawings



1.3 Statement

图样和资料目录真实代表所送试品的声明

本公司向电力工业电气设备质量检验测试中心提交的型号为 LB-110W 互感器的图样、资料目录与所送试样机一致，能真实代表所送试验样机。

序号	目录	名称	编号/代码
1	总装图	LB-110W 油浸电流互感器	C0707.00008
2	绝缘子详图	瓷套	L5201.00015
3	一、二次端子详图	导电杆焊装 导电杆焊装 二次接线板 端子装配	B1000.01736 B1000.01737 B1100.00811 B1100.00836
4	产品铭牌图	铭牌	L6000.02133
5	使用说明书	电流互感器安装使用说明书	C0707.00008SM
6	产品技术条件/企标	LB-110W 电流互感器技术条件	C0707.00008JT
7	工厂明示的关键材料/部件清单	LB-110W 型互感器关键零部件清单	/
8	制作工艺文件及设计文件目录	制作工艺文件及设计文件目录	GY-016-2014
8.1	一次绕组绕制包扎工艺文件	一次绕组绕制包扎工艺文件	YJ-002-2014
8.2	二次绕组绕制包扎工艺文件	二次绕组绕制包扎工艺文件	YJ-003-2014
8.3	油液体处理工艺文件	变压器油处理工艺文件	YJ-001-2014
8.4	器身干燥工艺文件	器身干燥工艺文件	YJ-004-2014
8.5	产品密封工艺文件	产品密封工艺文件	YJ-005-2014
8.6	产品装配工艺文件	产品装配工艺文件	YJ-006-2014

(单位公章)

1.3.1 The testing laboratory has checked that the drawings and other data submitted by the manufacturer can adequately represent the essential details and parts of the equipment to be tested, but isn't responsible for the accuracy of the detailed information.

1.3.2 Before all the tests, the test object provided by the client is a new, clean current transformer, including frame and all the other parts as in normal operation.

1.3.3 The test object is a single phase current transformer with outer insulation of porcelain insulator. The creepage distance is 4.48m and the arcing distance is 1.25m.

1.3.4 Confirmed date of test object: 05 Jan. 2016

1.3.5 Client representative:Lu Jianyi

1.4 Photographs of test object

2 Test items and results

2.1 Verification of markings

2.1.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Transformer calibrator	HED-H+	#KL003 (YQ331)	2	2017.02.01

2.1.2 Reference standard requirement

The nameplate and the mark of terminals shall meet the requirements. The oil level indicator and the oil valve shall be in good condition and in working-order. There shall be no evidence of leakage.

2.1.3 Data

The nameplate, sign, earthing terminal, terminal marking meet the requirements. The oil level indicator and the oil valve are in good condition and in working-order. There is no evidence of leakage.

2.1.4 Test result

The test object passed the tests.

2.2 Power-frequency voltage withstand tests on secondary terminals

2.2.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2016.10.08

2.2.2 Reference standard requirement

The test voltage of 3kV shall be applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occur.

2.2.3 Data

The test voltage of 3kV was applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occurred.

2.2.4 Test result

The test object passed the tests.

2.3 Power-frequency withstand tests between sections

2.3.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2016.10.08

2.3.2 Reference standard requirement

The test voltage of 3kV shall be applied for 60s between the sections of the primary winding in turn. No flashover and breakdown occur.

2.3.3 Data

The test voltage of 3kV was applied for 60s between the sections of the primary winding in turn.

No flashover and breakdown occurred.

2.3.4 Test result

The test object passed the tests.

2.4 Power-frequency voltage withstand tests on primary terminals

2.4.1The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13
2	Power-frequency voltage testing device	TMZ17 1400kV,2A	# S3-9-36 (SB201)	/	2017.05.06
3	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2016.10.08

2.4.2 Reference standard requirement

The test voltage of 230kV (50Hz) shall be applied between primary winding and the earth for 60s. The short-circuited secondary winding(s) shall be connected to earth. No flashover and breakdown occur.

The test voltage of 5kV (50Hz) shall be applied between earthing screen-to-earth for 60s. No flashover and breakdown occur.

2.4.3 Data

Ambient temperature:9 ℃ Relative humidity:70%

Ambient air pressure:102.6kPa Atmosphere correction factor: Kt=0.9986

The test voltage of 230 kV (50Hz) was applied between primary winding and the earth for 60s. No flashover and breakdown occurred.

The test voltage of 5kV (50Hz) was applied between earthing screen-to-earth for 60s. No flashover and breakdown occurred.

2.4.4 Test result

The test object passed the tests.

2.5 Partial discharge measurement

2.5.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Partial discharge detector	JFD-251	#20071203 (YQ380)	10	2017.03.01
2	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13
3	Power-frequency voltage testing device	TMZ17 1400kV,2A	# S3-9-36 (SB201)	/	2017.05.06

2.5.2 Reference standard requirement

Pre-stress voltage: 230 kV, Test frequency: 50Hz

Test voltage: 126kV, Maximum permissible PD level: 10 pC

Test voltage: 87.3kV, Maximum permissible PD level: 5 pC

2.5.3 Data

Ambient temperature: 9 ℃ Relative humidity: 70 %

Test frequency (Hz)	50	
Pre-stress voltage (kV)	230	
Test voltage (kV)	126	87.5
PD level (pC)	5	2

2.5.4 Test result

The test object passed the tests.

2.6 Measurement of capacitance and dielectric dissipation factor

2.6.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard capacitor	YL150-100 150kV	#060903 (YQ393)	D:0.0001	2017.11.06
2	High Voltage Bridge	KMSB-30a	#031302Z (YQ404)	X:±(0.005%RNX+ 0.5%RND) D: ±0.5%(D+0.01)	2017.06.04
3	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13
4	Power-frequency voltage testing device	TMZ17 1400kV,2A	# S3-9-36 (SB201)	/	2017.05.06

2.6.2 Reference standard requirement

The dielectric dissipation factor at 10kV, $\frac{1}{2}\sqrt{3}$ U_m and $\frac{1}{\sqrt{3}}$ U_m shall not exceed 0.5%.

The dielectric dissipation factor of earthing screen at 3kV shall not exceed 2 %.

2.6.3 Data

Ambient temperature:9 ℃ Relative humidity:70%

Part	Test voltage (kV)	Dielectric dissipation factor (%)	Capacitance (pF)
Primary wingding to earth	10	0.27	529.9
	36	0.28	529.9
	73	0.28	530.0
Earthing screen to earth	3	0.19	1239

2.6.4 Test result

The test object passed the tests.

2.7 Inter-turn overvoltage test

2.7.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard current transformer	HL23/8	#4613 (YQ341)	0.02	2017.10.19
2	Current generator	YL30	#910 (SB306)	/	2017.05.06
3	Open-circuited voltage tester	CT106	#072043 (YQ396)	2	2017.02.12

2.7.2 Reference standard requirement

With the secondary windings open-circuited, the rated primary current (or rated extended primary current) shall be applied for 60s to the primary winding at rated frequency. The peak voltage of the open-circuited secondary windings shall not exceed 4.5kV.The applied current shall be limited if the test voltage of 4.5kV (peak) is obtained before reaching the rated current (or extended rated current).

2.7.3 Data

Ambient temperature: 9℃ Relative humidity: 70%

Primary winding in series:

Secondary winding	Primary current (A)	Peak voltage (kV)	Duration(s)
$1S_1 1S_2$	360	533	60
$2S_1 2S_2$	360	529	60
$3S_1 3S_2$	360	527	60
$4S_1 4S_2$	360	531	60
$5S_1 5S_3$	360	179	60

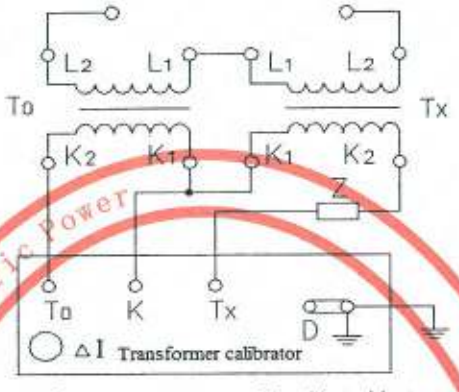
2.7.4 Test result

The test object passed the tests.

2.8 Tests for accuracy

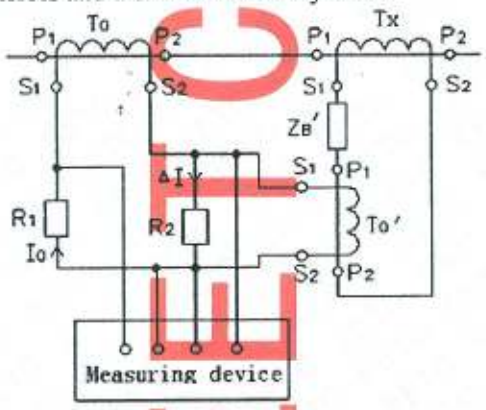
2.8.1 Test circuit diagram

1. Basic error tests



T_O: Standard current transformer T_X: Test object Z: Burden

2. Determination of composite errors and instrument security factor



T_X: Test object T_o, T_o' :Standard current transformer R_1,R_2: Sampling resistance Z_B' :Burden

2.8.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard current transformer	HL23/8	#4613 (YQ341)	0.02	2017.10.19
2	Current generator	YL30	#910 (SB306)	/	2017.05.06
3	Transformer calibrator	HED-H+	#KL003 (YQ331)	2	2017.02.01
4	Current transformer	LMF98	#98001 (YQ312)	0.1	2016.10.29
5	Composite errors measuring device	CEM-3C	#A20110208 (YQ406)	0.5	2017.04.19

2.8.3 Reference standard requirement

The errors of the secondary windings shall meet the requirements of the accuracy classes 0.2S/0.2/10P.

Instrument security factor:

50VA FS5 Primary current≤ 1.5 kA Composite errors≥ 10 %($5S_1$$5S_3$)

30VA FS5 Primary current≤ 0.75 kA Composite errors≥ 10 %($5S_1$$5S_2$)

Composite errors:

50VA 10P20 Primary current≥ 6kA Composite errors≤ 10 %

2.8.4 Data

Ambient temperature: 9℃ Relative humidity :70%

Basic error tests

Primary winding in parallel:

Secondary windings	Ratio	Accuracy class	I_{pr} (%)	Ratio error(%)	Phase displacement(′)	Burden (VA) cosφ=0.8	Ratio error(%)	Phase displacement(′)	Burden (VA) cosφ=0.8
$5S_1$ $5S_3$	600/5	0.2S	1	-0.20	+10	50	+0.08	+1	2.5
			5	-0.18	+4		+0.08	+1	
			20	-0.08	0		+0.08	+1	
			100	0	-1		+0.08	0	
			120	0	-1		+0.08	0	
$5S_1$ $5S_2$	300/5	0.2	5	-0.42	+7	30	+0.12	+4	2.5
			20	-0.22	+2		+0.12	+3	
			100	-0.04	-2		+0.14	+1	
			120	-0.02	-2		+0.14	0	
$4S_1$ $4S_2$	600/5	10P	100	-0.20	+1	50	/	/	/
$3S_1$ $3S_2$	600/5	10P	100	-0.20	+1	50	/	/	/
$2S_1$ $2S_2$	600/5	10P	100	-0.20	+1	50	/	/	/
$1S_1$ $1S_2$	600/5	10P	100	-0.22	+1	50	/	/	/

Primary winding in series:

Secondary windings	Ratio	Accuracy class	I_{pr} (%)	Ratio error(%)	Phase displacement(')	Burden (VA) cosφ=0.8	Ratio error(%)	Phase displacement(')	Burden (VA) cosφ=0.8
$5S_1$ $5S_3$	300/5	0.2S	1	-0.20	+11	50	+0.08	+1	2.5
			5	-0.18	+5		+0.08	+1	
			20	-0.08	0		+0.08	+1	
			100	0	-1		+0.08	0	
			120	0	-1		+0.08	0	
$4S_1$ $4S_2$	300/5	10P	100	-0.22	+1	50	/	/	/
$3S_1$ $3S_2$	300/5	10P	100	-0.20	+1	50	/	/	/
$2S_1$ $2S_2$	300/5	10P	100	-0.20	+1	50	/	/	/
$1S_1$ $1S_2$	300/5	10P	100	-0.20	+1	50	/	/	/

Determination of composite errors and instrument security factor:

Ambient temperature:7℃ Relative humidity :70%

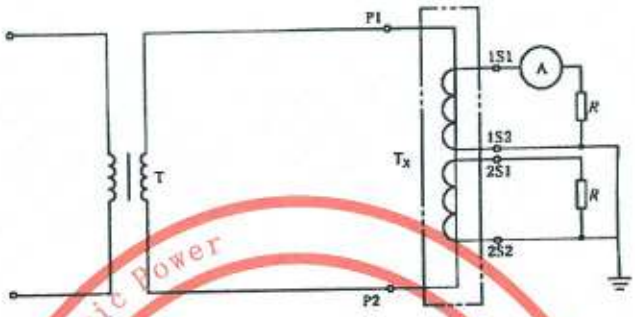
Secondary windings	Burden (VA)	Instrument security factor /Accuracy limit factor	Primary current (kA)	Composite errors
$1S_1 1S_2$	50	20	6.22	6.8 %
$2S_1 2S_2$	50	20	6.22	6.6 %
$3S_1 3S_2$	50	20	6.02	6.8 %
$4S_1 4S_2$	50	20	6.19	6.4 %
$5S_1 5S_3$	50	FS5	0.85	40 %
$5S_1 5S_2$	30	FS5	0.31	>50 %

2.8.5 Test result

The test object passed the tests.

2.9 Temperature-rise test

2.9.1 Test circuit diagram



T: Current generator A: Ammeter R:Burden Tx: Test object
P1、P2: Primary terminals 1S1, 1S2, 2S2, 2S2: Secondary terminals

2.9.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	DC bridge	JY44B	#01124972 (YQ210)	0.5	2017.01.25
2	Multi-channel thermometer	TP1048	#TPV91986 (YQ383)	±1℃	2017.01.25
3	Ammeter	T19-A	#1124.18 (BJ315)	0.5	2017.01.25

2.9.3 Reference standard requirement

The rated continuous thermal current is applied on the primary winding. The limited values of temperature rise are shown as follows: secondary windings:≤60 K; Connection, bolted or the equivalent≤ 50 K; Top oil:55 K.

2.9.4 Data

Primary winding in parallel

Winding	$1S_1 1S_2$	$2S_1 2S_2$	$3S_1 3S_2$	$4S_1 4S_2$	$5S_1 5S_3$	/	Ambient temperature (℃)
Resistance at ambient temperature	190.8mΩ	191.6mΩ	192.5mΩ	190.7mΩ	122.9mΩ	/	8

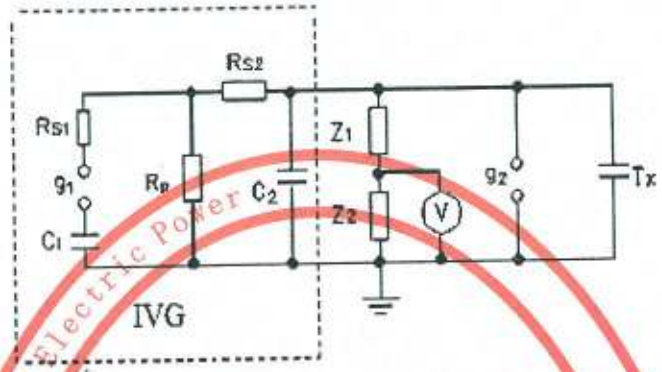
Test current	Connection of primary terminal (K)	$1S_1 1S_2$ (K)	$2S_1 2S_2$ (K)	$3S_1 3S_2$ (K)	$4S_1 4S_2$ (K)	$5S_1 5S_3$ (K)	Top oil (K)	Ambient temperature (℃)
$120\%I_{pr}$ (720A)	11K	9K	9K	9K	9K	10K	7K	8

2.9.5 Test result

The test object passed the tests.

2.10 Impulse voltage test on primary terminals

2.10.1 Test circuit diagram



IVG: Impulse voltage generator Z_1,Z_2:High voltage divider g_2:Chopped device Tx: Test object

2.10.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Impulse voltage generator	4000kV, 300kJ	#17020001003 (SB202)	/	2017.05.06
2	Chopped device	3600kV	#463889 (SB205)	3%	2017.08.06
3	Impulse voltage measuring system	CCK-2712	#BHT201305002 (YQ212-2)	3	2017.08.05

2.10.3 Reference standard requirement

The test object shall be subject to 15 full lighting impulses of positive and negative polarity at 550kV (peak value),2 chopped lighting impulses of negative polarity at 633 kV (peak value).

No disruptive discharge on non-self restoring insulation shall occur and the number of disruptive discharge shall not exceed two for each series. No evidence of insulation failure shall be detected.

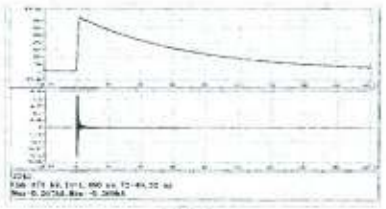
2.10.4 Date

Ambient temperature:8℃ Relative humidity:70 %

No.	Voltage polarity	Test voltage (peak)(kV)	Chopped time (μs)	Waveform No.	Result
1	Pos.LI	373	/	1	Pass
2	Pos.LI	548	/	2	Pass
3	Pos.LI	546	/	3	Pass
4	Pos.LI	555	/	4	Pass
5	Pos.LI	554	/	5	Pass

No.	Voltage polarity	Test voltage (peak)(kV)	Chopped time (μs)	Waveform No.	Result
6	Pos.LI	555	/	6	Pass
7	Pos.LI	554	/	7	Pass
8	Pos.LI	553	/	8	Pass
9	Pos.LI	555	/	9	Pass
10	Pos.LI	555	/	10	Pass
11	Pos.LI	556	/	11	Pass
12	Pos.LI	555	/	12	Pass
13	Pos.LI	555	/	13	Pass
14	Pos.LI	554	/	14	Pass
15	Pos.LI	554	/	15	Pass
16	Pos.LI	554	/	16	Pass
17	Neg.LI	373	/	17	Pass
18	Neg.LI	549	/	18	Pass
19	Neg.LI-chopped	432	2.6	19	Pass
20	Neg.LI-chopped	634	4.0	20	Pass
21	Neg.LI-chopped	634	4.2	21	Pass
22	Neg.LI	548	/	22	Pass
23	Neg.LI	554	/	23	Pass
24	Neg.LI	553	/	24	Pass
25	Neg.LI	553	/	25	Pass
26	Neg.LI	554	/	26	Pass
27	Neg.LI	553	/	27	Pass
28	Neg.LI	555	/	28	Pass
29	Neg.LI	556	/	29	Pass
30	Neg.LI	553	/	30	Pass
31	Neg.LI	557	/	31	Pass
32	Neg.LI	555	/	32	Pass
33	Neg.LI	555	/	33	Pass
34	Neg.LI	556	/	34	Pass
35	Neg.LI	555	/	35	Pass

waveform:



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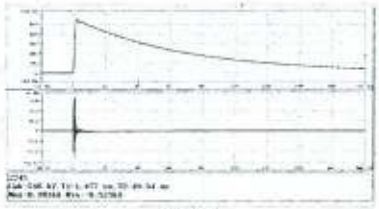

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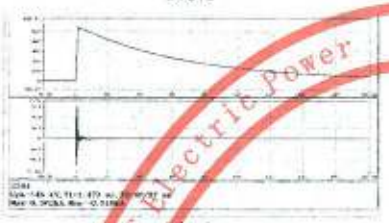

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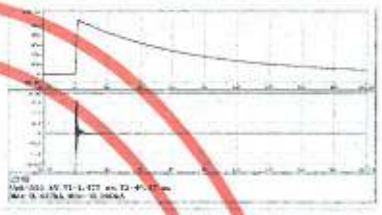

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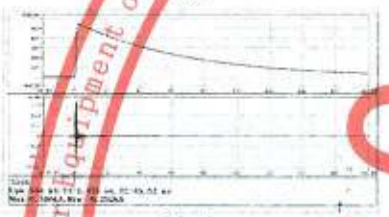

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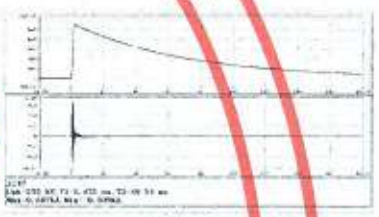

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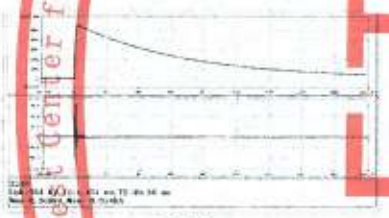

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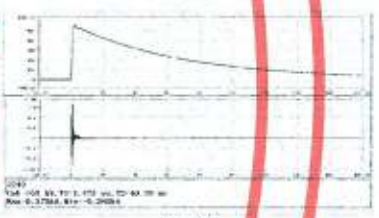

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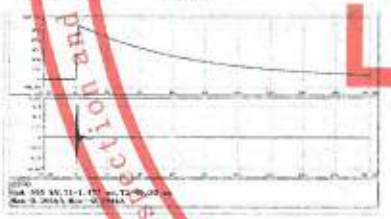

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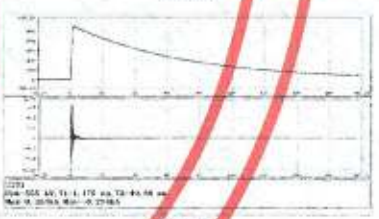

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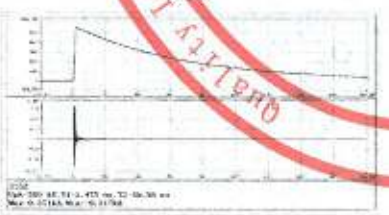

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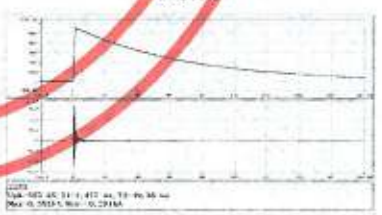

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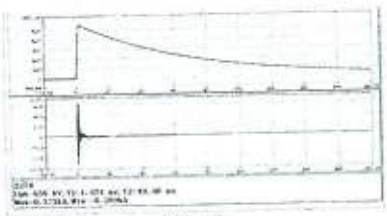

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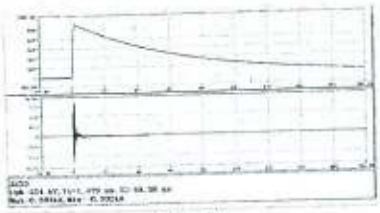

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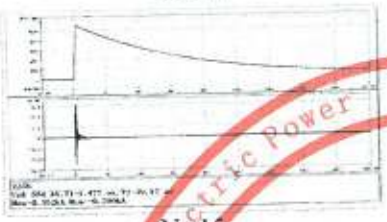

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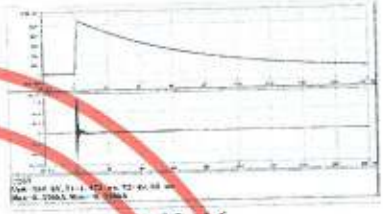

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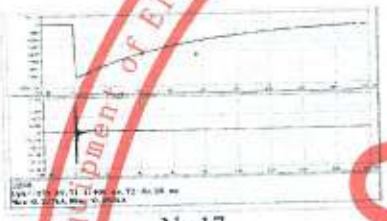

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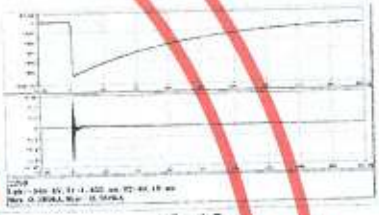

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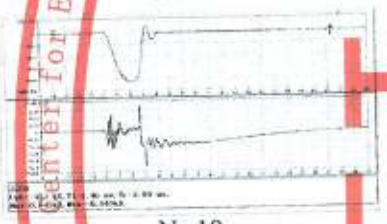

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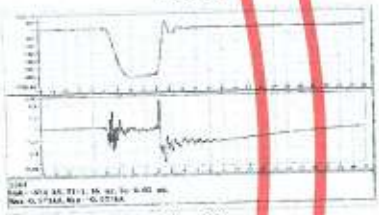

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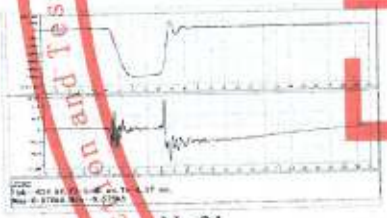

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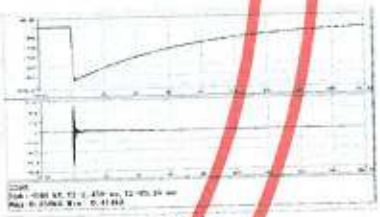

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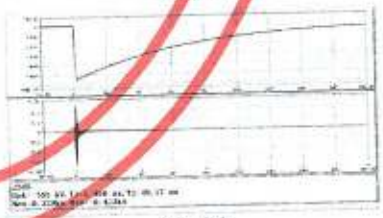

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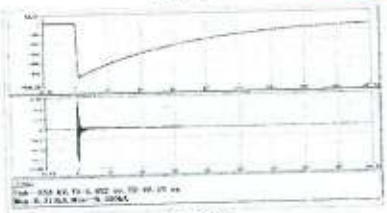

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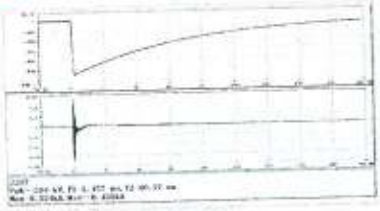

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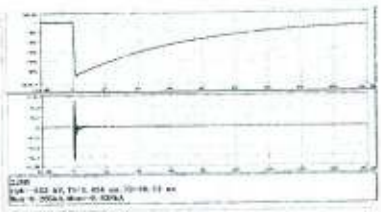

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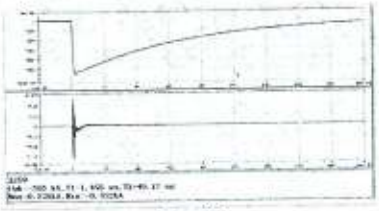

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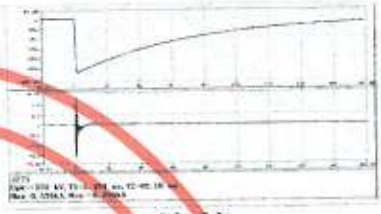

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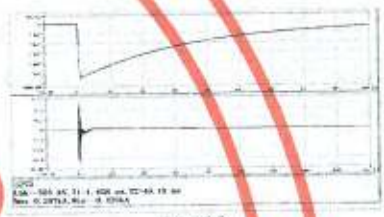

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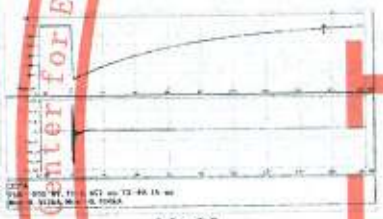

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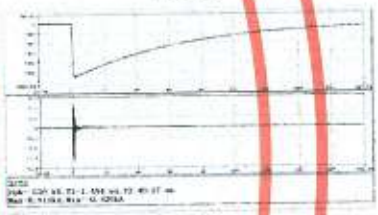

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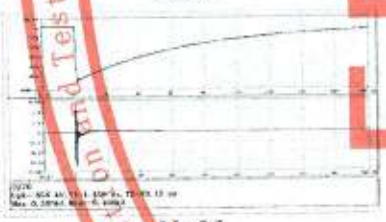


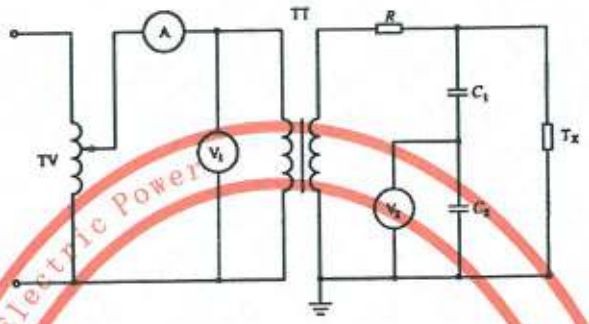
No.35

2.10.5 Test result

The test object passed the tests.

2.11 Wet test for outdoor type transformers

2.11.1 Test circuit diagram



TV: Voltage regulator TT: Test transformer C_1,C_2: High voltage divider T_x: Test object

2.11.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Series resonance measuring system	TRF1200-0.002	#111030 (YQ220)	3	2017.12.18
2	Series resonance testing device	YDGK-1200/3×400	#111023 (SB220)	/	2018.01.25
3	Conductivity Meter	DDS-307	#722014072713 (YQ307)	1.0	2017.01.30

2.11.3 Reference standard requirement

In wet condition, the test voltage of 230kV (50Hz) shall be applied between primary winding and the earth for 60s. The short-circuited secondary winding(s) shall be connected to earth. No flashover and breakdown occur.

2.11.4 Data

Atmosphere correction factor:K_t=0.9977 Water conductivity :98μS/cm
Vertical precipitation 1.1mm/min Horizontal precipitation 1.2mm/min
Ambient temperature:24℃ Relative humidity: 80 % Ambient air pressure: 100.2kPa

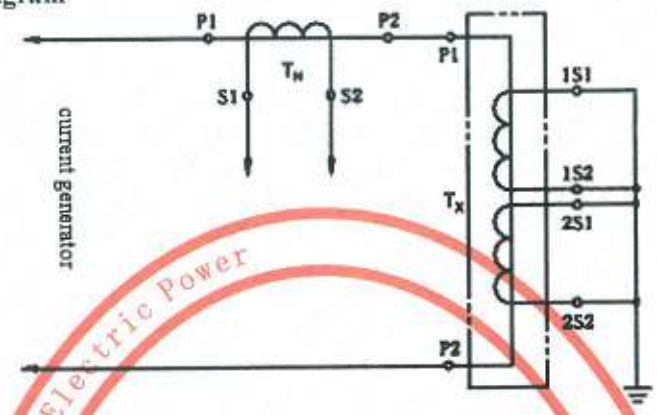
The test voltage of 230kV (50Hz) was applied between primary winding and the earth for 60s. No flashover and breakdown occurred.

2.11.5 Test result

The test object passed the tests.

2.12 Short-time current tests

2.12.1 Test circuit diagram



T_N: Standard current transformer S1,S2: Data acquisition system
T_x: Test object P1、P2: Primary terminals 1S1, 1S2, 2S2, 2S2: Secondary terminals

2.12.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Data acquisition system	/	(CJ06)	0.5	2017.01.03

2.12.3 Reference standard requirement

Primary winding is connected in parallel/series, and applied current on primary winding with secondary windings short-circuited. Rated dynamic current $80^{+10\%}_{0}$ kA, rated short-time thermal current 31.5kA, continuous time 3s,stable heat quantity $2977^{+20\%}_{0} \times 10^6 A^2s$. The transformer shall be deemed to have passed this test if it satisfies the following requirements:①it is not visibly damaged ;②its errors after demagnetization do not differ from those recorded before the tests by more than half the limits of error appropriate to its accuracy class;③it withstands the routine dielectric test, but with the test voltages or currents reduced to 90 % of those given;④on examination, the insulation next to the surface of the conductor does not show significant deterioration(this examination is not required if the current density in the winding does not exceed 180A/mm^2 where the winding is of copper , if the current density in the winding does not exceed 120 A/mm^2 where the winding is of aluminum).

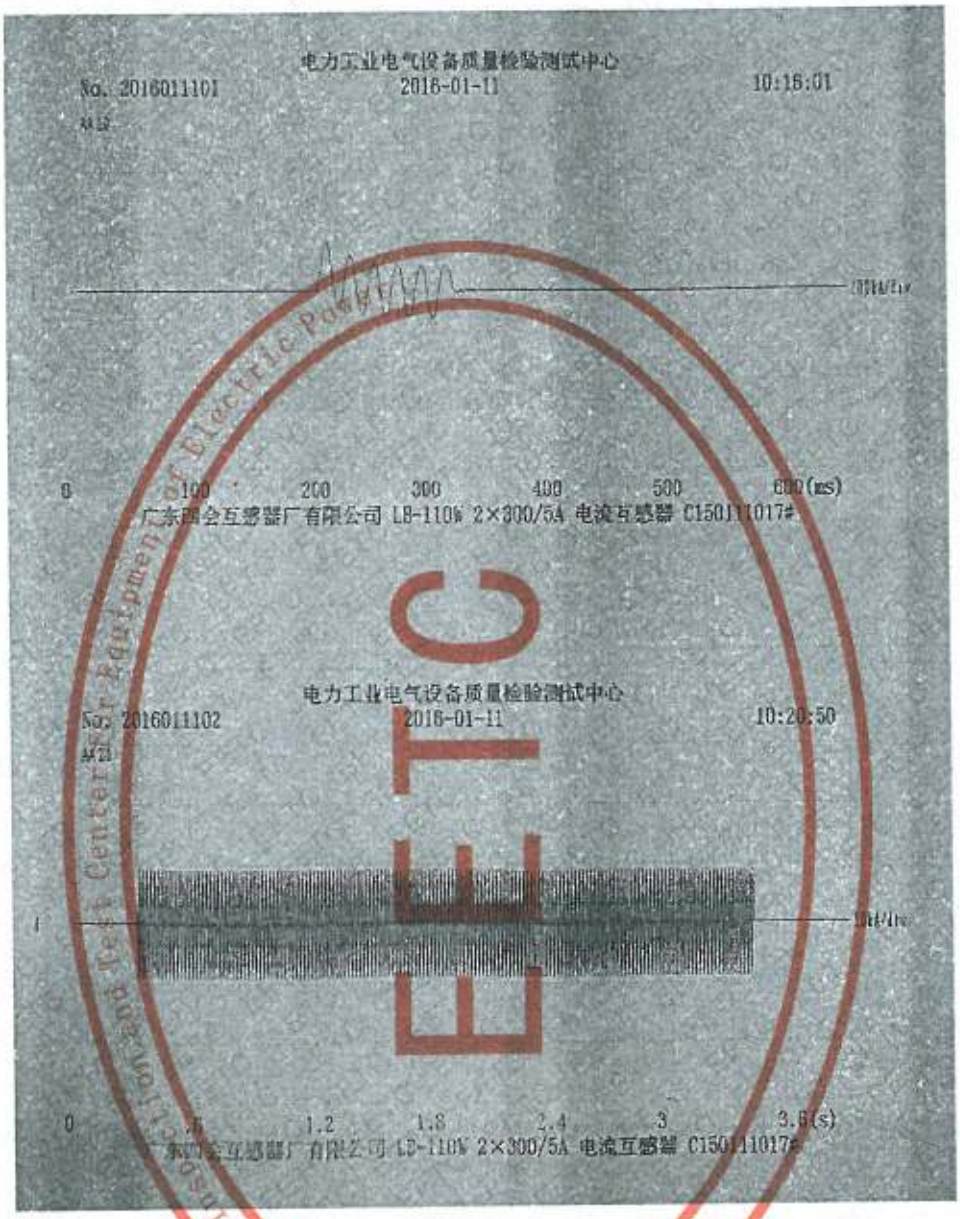
2.12.4 Data

Ambient temperature:7℃ Relative humidity:70%

Rated dynamic current (kA)	Rated short-time thermal current (kA)	Duration (s)	Stable heat quantity ($10^6 A^2s$)
82.74	31.63	3.12	3124

Note: The primary winding is of aluminum, and the calculated current density is 89 A/mm2.

Waveform of short-time current test:



2.12.5 Test result

The test object was in good conditions before and after this test. The test object passed the tests.

2.13 Power-frequency voltage withstand tests on secondary terminals (retrial)

2.13.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2016.10.08

2.13.2 Reference standard requirement

The test voltage of 2.7kV shall be applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occur.

2.13.3 Data

The test voltage of 2.7kV was applied for 60s between the short-circuited terminals of each winding and earth in turn. No flashover and breakdown occurred.

2.13.4 Test result

The test object passed the tests.

2.14 Power-frequency withstand tests between sections (retrial)

2.14.1The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2016.10.08

2.14.2 Reference standard requirement

The test voltage of 2.7kV shall be applied for 60s between the sections of the primary winding in turn. No flashover and breakdown occur.

2.14.2Data

The test voltage of 2.7kV was applied for 60s between the sections of the primary winding in turn. No flashover and breakdown occurred.

2.14.3Test result

The test object passed the tests.

2.15 Power-frequency voltage withstand tests on primary terminals (retrial)

2.15.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13
2	Power-frequency voltage testing device	TMZ17 1400kV,2A	# S3-9-36 (SB201)	/	2017.05.06
3	Equipment for secondary voltage withstand tests	HZSY-S	#6120611 (SB210)	3	2016.10.08

2.15.2 Reference standard requirement

The test voltage of 207kV (50Hz) shall be applied between primary winding and the earth for 60s. The short-circuited secondary winding(s) shall be connected to earth. No flashover and breakdown occur.

The test voltage of 4.5kV (50Hz) shall be applied between earthing screen-to-earth for 60s. No flashover and breakdown occur.

2.15.3 Data

Ambient temperature:6℃ Relative humidity:64%

The test voltage of 207 kV (50Hz) was applied between primary winding and the earth for 60s. No flashover and breakdown occurred.

The test voltage of 4.5kV (50Hz) was applied between earthing screen-to-earth for 60s. No flashover and breakdown occurred.

2.15.4 Test result

The test object passed the tests.

2.16 Partial discharge measurement (retrial)

2.16.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Partial discharge detector	JFD-251	#20071203 (YQ380)	10	2017.03.01
2	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13
3	Power-frequency voltage testing device	TMZ17 1400kV,2A	# S3-9-36 (SB201)	/	2017.05.06

2.16.2 Reference standard requirement

Pre-stress voltage: 207kV, Test frequency: 50Hz

Test voltage: 126kV, Maximum permissible PD level: 10 pC

Test voltage: 87.3kV, Maximum permissible PD level: 5 pC

2.16.3 Data

Ambient temperature:6℃ Relative humidity:64%

Test frequency (Hz)	50	
Pre-stress voltage (kV)	207	
Test voltage (kV)	126	87.5
PD level (pC)	6	2

2.16.4Test result

The test object passed the tests.

2.17 Measurement of capacitance and dielectric dissipation factor (retrial)

2.17.1The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard capacitor	YL150-100 150kV	#060903 (YQ393)	D:0.0001	2017.11.06
2	High Voltage Bridge	KMSB-30a	#031302Z (YQ404)	X:±(0.005%R_NX+ 0.5%R_ND) D: ±0.5%(D+0.01)	2017.06.04
3	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13
4	Power-frequency voltage testing device	TMZ17 1400kV,2A	# S3-9-36 (SB201)	/	2017.05.06

2.17.2 Reference standard requirement

The dielectric dissipation factor at 10kV , $\frac{1}{2}\sqrt{3}$ U_m and $\frac{1}{\sqrt{3}}U_m$ shall not exceed 0.5% .

The dielectric dissipation factor of earthing screen at 3kV shall not exceed 2 %.

2.17.3 Data

Ambient temperature:6℃ Relative humidity:64%

Part	Test Voltage（kV）	Dielectric dissipation factor （%）	Capacitance（pF）
Primary winding to earth	10	0.27	529.6
	36	0.27	529.6
	73	0.27	529.6
Earthing screen to earth	3	0.18	1238

2.17.4 Test result

The test object passed the tests.

2.18 Inter-turn overvoltage test (retrial)

2.18.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard current transformer	HL23/8	#4613 (YQ341)	0.02	2017.10.19
2	Current generator	YL30	#910 (SB306)	/	2017.05.06
3	Open circuit test instrument	CT106	#072043 (YQ396)	2	2017.02.12

2.18.2 Reference standard requirement

With the secondary windings open-circuited, the rated primary current (or rated extended primary current) shall be applied for 60s to the primary winding at rated frequency. The peak voltage of the open-circuited secondary windings shall not exceed 4.5kV.The applied current shall be limited if the test voltage of 4.5kV (peak) is obtained before reaching the rated current (or extended rated current).

2.18.3 Data

Ambient temperature:7℃ Relative humidity: 68 %

Primary winding in series:

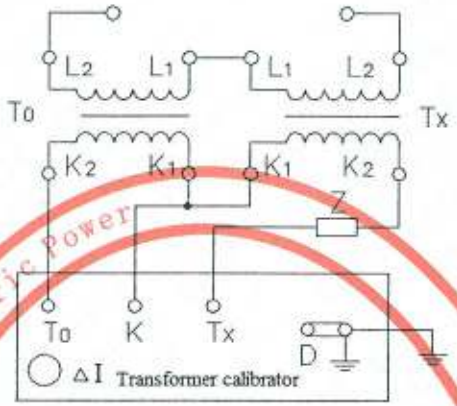
Secondary winding	Primary current（A）	Peak voltage（V）	Duration(s)
$1S_1 1S_2$	360	546	60
$2S_1 2S_2$	360	540	60
$3S_1 3S_2$	360	528	60
$4S_1 4S_2$	360	551	60
$5S_1 5S_3$	360	203	60

2.18.4 Test result

The test object passed the tests.

2.19 Tests for accuracy (retrial)

2.15.1 Test circuit diagram



To: Standard current transformer Tx: Test object Z: Burden

2.19.2 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Standard current transformer	HL23/8	#4613 (YQ341)	0.02	2017.10.19
2	Current generator	YL30	#910 (SB306)	/	2017.05.06
3	Transformer calibrator	HED-H÷	#KL003 (YQ331)	2	2017.02.01

2.19.3 Reference standard requirement

The errors of the secondary windings shall meet the requirements of the accuracy classes 0.2S/0.2/10P.

2.19.4 Data

Ambient temperature: 7℃ Relative humidity :68%

Primary winding in series:

Secondry windings	Ratio	Accuracy class	I_{pr} (%)	Ratio error(%)	Phase displacement(')	Burden (VA) cosφ=0.8	Ratio error(%)	Phase displacement(')	Burden (VA) cosφ=0.8
$5S_1$ $5S_3$	300/5	0.2S	1	-0.20	+12	50	+0.08	+2	2.5
			5	-0.18	+4		+0.08	+1	
			20	-0.08	0		+0.08	+1	
			100	0	-1		+0.08	0	
			120	0	-1		+0.08	0	
$4S_1$ $4S_2$	300/5	10P	100	-0.20	+1	50	/	/	/

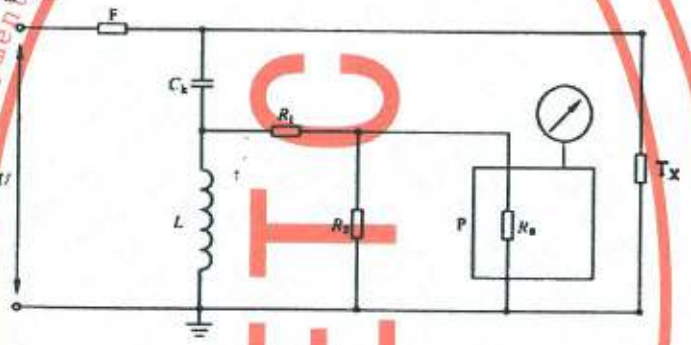
Secondary windings	Ratio	Accuracy class	I_{pr} (%)	Ratio error(%)	Phase displacement(')	Burden (VA) cosφ=0.8	Ratio error(%)	Phase displacement(')	Burden (VA) cosφ=0.8
$3S_1$ $3S_2$	300/5	10P	100	-0.20	+1	50	/	/	/
$2S_1$ $2S_2$	300/5	10P	100	-0.20	+1	50	/	/	/
$1S_1$ $1S_2$	300/5	10P	100	-0.22	+1	50	/	/	/

2.19.5 Test result

The test object passed the tests.

2.20 Electromagnetic Compatibility (EMC) tests （RIV test）

2.20.1 Test circuit diagram



F:Filter C_k:Coupling capacitor L:Reactance R_1,R_2:Resistance
P:Radio interference tester with input resistance R_0 T_X:Test object

2.20.2 The main device used during the test

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Radio interference tester	ZN3950	#051205 (YQ392)	±2dB	2017.02.17
2	Power-frequency voltage measuring system	TJF1200-1000 1200kV	#1105415 (YQ209)	3	2017.03.13

2.20.3 Reference standard requirement

A pre-stress voltage of $1.5U_m/\sqrt{3}$ shall be applied and maintained for 30s.The voltage shall then be decreased to $1.1U_m/\sqrt{3}$ in about 10s and maintained to this value for 30s before measuring the radio interference voltage. The radio interference voltage shall not exceed 2500μV at $1.1U_m/\sqrt{3}$.

2.20.4 Data

Ambient temperature:8 ℃ Relative humidity:72%

Test voltage（kV）	Tuning frequency of measuring circuit（MHz）	Radio interference voltage （μV）
80	0.5	<960

2.20.5 Test result

The test object passed the tests.

2.21 Transmitted overvoltage test

2.21.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Oscilloscope	DPO4104	#C022104 (YQ302)	±1%	2017.02.03

2.21.2 Reference standard requirement

A low-voltage impulse (U_1) (T_1=50 μs±20%, T_2≥50 μs) shall be applied between one of the primary terminals and earth. The transmitted overvoltage shall not exceed 1.6kV.

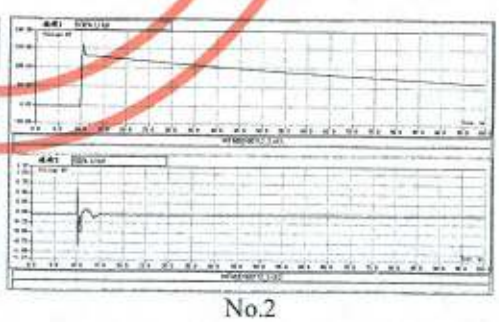
2.21.3 Data

Second winding	Type of impulse	Peak voltage of primary winding(U_1) (kV)	Peak voltage of secondary winding(U_2) (V)	Calculated transmitted overvoltage (U_s) (V)	Wave No.
$1S_1 1S_2$	Type A impulse	162	670	682	1
$2S_1 2S_2$	Type A impulse	162	650	662	2
$3S_1 3S_2$	Type A impulse	160	410	423	3
$4S_1 4S_2$	Type A impulse	160	430	443	4
$5S_1 5S_3$	Type A impulse	159	430	446	5

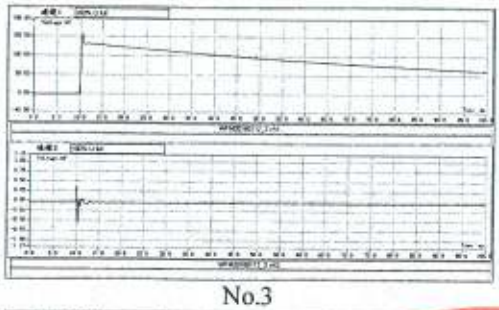
Note: $U_s = \frac{U_2}{U_1} \times U_P$ $U_P = 1.6\frac{\sqrt{2}U_m}{\sqrt{3}}$

Waveform

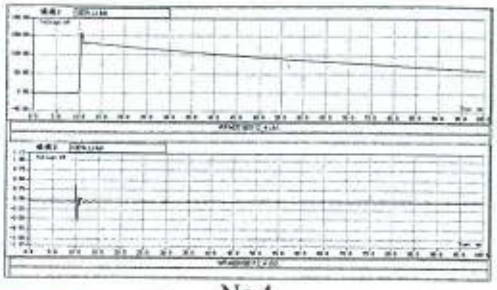
No.1



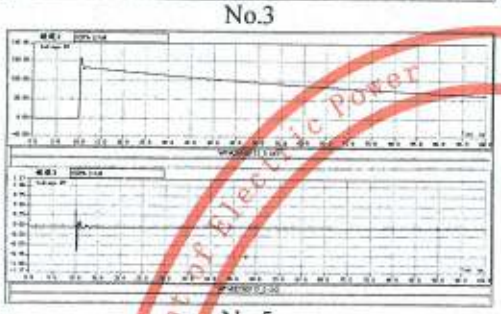
No.2



No.3



No.4



No.5

2.21.4 Test result

The test object passed the tests.

2.22 Mechanical tests

2.22.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Ergometer	XK3100-B1	#9119/C004 (YQ371)	1	2017.07.07

2.22. 2Reference standard requirement

The test load (2kN) shall be applied on primary terminal for at least 60s. There shall be no evidence of damage (deformation, rupture or leakage).

2.22.3 Data

Modality of application		Duration（s）	Test results
Horizontal(landscape orientation)	2000N	60	No evidence of damage (deformation, rupture or leakage) .
Horizontal(longitudinal orientation)	2000N	60	
Vertical	2000N	60	

2.22.4 Test result

The test object passed the tests.

2.23 Insulation oil test

2.23.1 The main device used during the test

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Gas chromatograph	2000B	#110388-1 (YQ610)	U_{rel}=4.8% k=2	2017.07.17
2	Trace moisture tester	SFY-01F	#2190 (YQ611)	5	2017.07.17
3	Dielectric strength tester	XLNY/100	#261101 (YQ612)	2	2017.01.17
4	Dielectric dissipation tester	XLDR-2000a	#081101 (YQ613)	C: ±2%Reading D: ±2%Reading +0.0001	2017.01.20

2.23.2 Reference standard requirement

Breakdown voltage ≥ 45kV Water content≤20mg/L, *tanδ(90 ℃)*≤ 0.5%

Gas-in-oil analysis should be performed before and after the type tests. There shall be no C_2H_2 generated, and no obvious change of other soluble gas.

2.23.3 Data

Breakdown voltage (kV)	*tanδ(90 ℃)* (%)	Water content (mg/L)
73.7	0.22	3

	Gas-in-oil analysis (μL/L)							
	H_2	CO	CO_2	CH_4	C_2H_4	C_2H_6	C_2H_2	Total hydrocarbon
Before the type tests	9.18	6.79	98.41	0.10	0	0.36	0	0.48
After the type tests	9.35	6.87	97.48	0.10	0	0.35	0	0.45

2.23.4 Test result

The test object passed the tests.

2.24 Enclosure tightness test at ambient temperature

2.24.1 The main test device

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Manometer	Y-100	#1984 (BJ324)	2	2017.06.22

2.24.2 Reference standard requirement

Applied pressure: 0.1 MPa Duration:6 h Remained pressure: ≥0.07MPa . There shall be no leakage.

2.24.3 Data

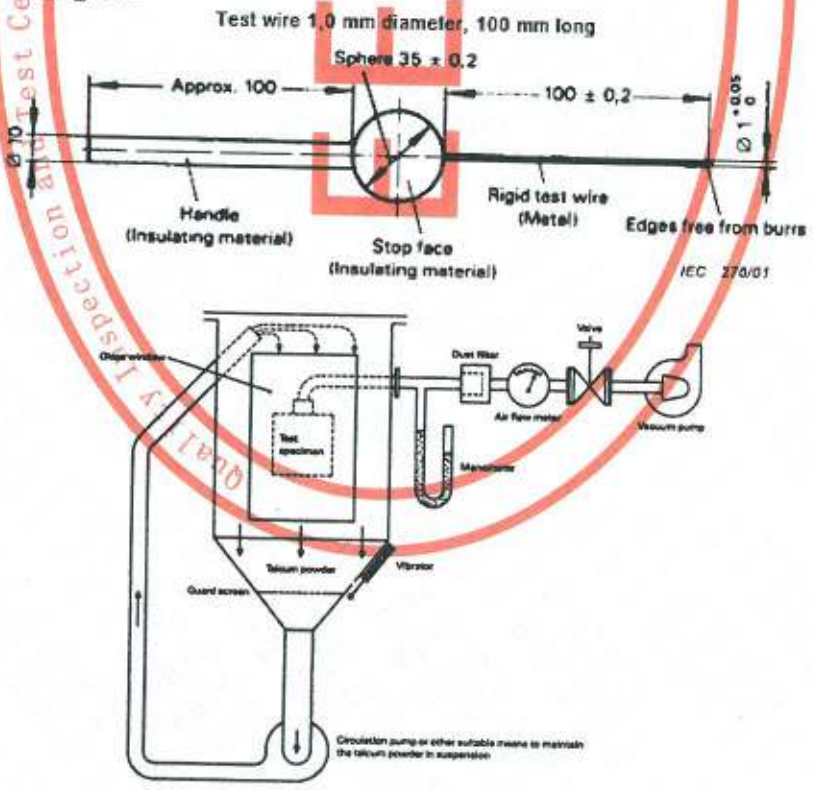
Applied pressure	Duration	Remained pressure	Result
0.1 MPa	6 hours	0.1MPa	No leakage

2.24.4 Test result

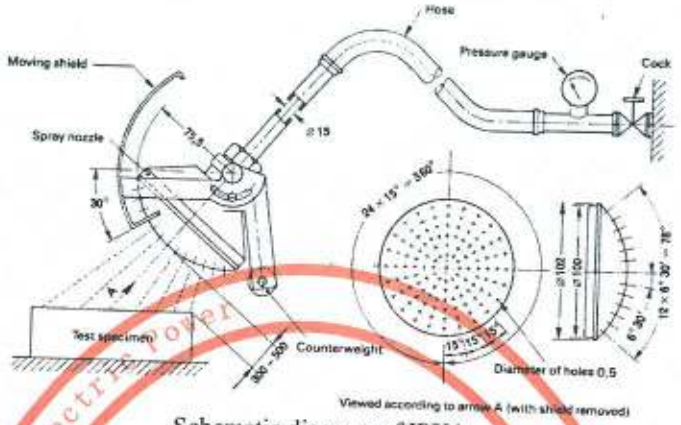
The test object passed the tests.

2.25 Verification of the degree of protection by enclosures

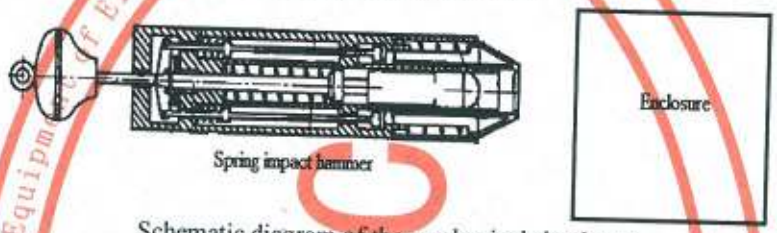
2.25.1 Test circuit diagram



Schematic diagram of IP5X



Schematic diagram of IPX4



Schematic diagram of the mechanical shock test

2.25.2 The main device used during the test

No.	Name	Type/ Specification	Serial No.	Uncertainty / Accuracy class / Maximum Permissible Error	Valid date
1	Object probe	SC-50	1050101086 236 (YQ304)	±5%	2017.03.18
2	Raining control system	JL-1-2	200912088 (SB326)	/	2017.05.06
3	Spring impact hammer	SN3406	#08111320 (YQ339)	5%	2016.12.10
4	Dust chamber	SC-080	1508060 (SB221)	/	2016.10.22

2.25.3 Reference standard requirement

Verification of the IP coding: The degree of protection of low-voltage control and /or auxiliary enclosures for outdoor instrument transformers is IP54.

Mechanical impact test: The level of protection against effects of mechanical impacts is impact level IK07.

2.25.4 Data

Verification of the IP coding: First characteristic Number of IP code: 5	
The test for protection against access to hazardous parts.	The test for protection against solid foreign objects.
Test load: 1 N The test wire of 1.0mm Φ did not penetrate and kept adequate clearance .	Duration:8h Ingress of dust was not totally prevented, but the dust did not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety.

Verification of the IP coding: Second characteristic Number of IP code: 4		
The test for protection against water		
Water flow（L/min）	Test pressure（kPa）	Duration（min）
11.5	100	5

Mechanical impact test（IK07):		
Standard kinetic energy（J）	Test kinetic energy（J）	Test times
2.00±0.10	2	3

2.25.5 Test result

The test object passed the tests.