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CNAS L0681

CHPTL

TEST REPORT

№ : CTQC/ZJ-25. 1399

Test object name:	Self-diagnostic resin-impregnated fiber capacitive transformer bushing
Test object type:	QXZBRGW-126/2500-4
Entrusted by:	Shandong Qixing High Voltage Electric Co., Ltd.
Manufacturer:	Shandong Qixing High Voltage Electric Co., Ltd.
Kind of testing:	Type tests

沈阳变压器研究院有限公司 变压器实验室

沈阳变压器研究院有限公司 检验专用章

SHENYANG TRANSFORMER RESEARCH INSTITUTE CO., LTD.

CHINA NATIONAL TRANSFORMER QUALITY INSPECTION AND TESTING CENTER

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CTQC

Shenyang Transformer Research Institute Co., Ltd.

China National Transformer Quality Inspection And Testing Center

Test Report

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Test object name	Self-diagnostic resin-impregnated fiber capacitive transformer bushing	Test object type	QXZBRGW-126/2500-4
		Brand	/
Entrusted by	Shandong Qixing High Voltage Electric Co., Ltd.	Kind of testing	Type test
Manufac-turer	Shandong Qixing High Voltage Electric Co., Ltd.	Sampling date	/
		Test date	July 17, 2025~July 19, 2025
Address	No.1228, Pengcheng Industrial Park, Pingli Road, Xiazhuang Town, Gaomi City, Weifang City, Shandong Province	Serial №	2507CBT002S
Standards	IEC60137 Edition 7.0 2017-06 GB/T4109-2022 Technical contract	Test items	Routine tests Type tests
Results	The test results of routine tests, type tests of QXZBRGW-126/2500-4 are in accordance with standards and technical contract. The sample passed the above tests. Signing and issuing date: 2025.07.25		
Note			

Approved by: Lv Xiangpeng Checked by: Zhang Guofeng Compiled by: Jiang Anping

Statement: 1. Testing report is invalid without test special seal.
2. Testing report is invalid without compiler, checker and approver's signature.
3. Please inform CTQC in time after received the testing report if you have some disagreement to the testing report.
4. Testing or witnessing only apply to sample.
5. Copying testing certificate or testing report is forbidden without written permission from CTQC(except for copying all the testing report).

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Test Report

Test results

№	Test items	Specified values Standards(Technical contract)	Measured values	Conclu-sions
1	Measurement of dielectric dissipation factor(tanδ) and capacitances at ambient temperature (Before type test)	Applied voltage(kV): 2~20 tanδ: ≤0.004 Providing capacitance of the sample(pF)	10 0.00264 405.4	Passed
		Applied voltage(kV): $1.05U_m/\sqrt{3}$ tanδ: ≤0.004 Providing capacitance of the sample(pF)	76.4 0.00268 405.7	
		Applied voltage(kV): U_m tanδ: ≤0.004 Providing capacitance of the sample(pF)	126 0.00269 405.8	
2	Measurement of partial discharge quantity (Before type test)	Applied voltage(kV): U_m Partial discharge level(pC): ≤10	126 <5	Passed
		Applied voltage(kV): $1.5U_m/\sqrt{3}$ Partial discharge level(pC): ≤10	109.1 <4	
		Applied voltage(kV): $1.05U_m/\sqrt{3}$ Partial discharge level(pC): ≤5	76.4 <4	
3	Dry lightning impulse voltage withstand test (Type test)	Full wave voltage Positive polarity(kV): 909.2(Corrected value) ±3% Negative polarity(kV): 1000.2(Corrected value) ±3% 15 positive and 15 negative polarity Chopped wave voltage(kV): 1100.2(Corrected value) ±3% 5 negative polarity	 895.63~903.00 987.59~1013.86 Each 15 times 1094.32~1101.49 5 times	Passed
4	Wet power-frequency voltage withstand test (Type test)	Applied voltage(kV): 374.2(Corrected value) Duration(s): 60	374.2 60	Passed
5	Long-duration power-frequency voltage withstand test(ACLD) (Type test)	$U_1=U_m$(kV) Duration(s): 60	126 60	Passed
		$U_2=1.5U_m/\sqrt{3}$ (kV) Duration(min): 60 Partial discharge level(pC): ≤10	109.1 60 <5	
		$1.1U_m/\sqrt{3}$ (kV) Duration(min): 5 Partial discharge level(pC): ≤5	80 5 <5	
6	Radio interference voltage test (Type test)	Applied voltage(kV): $1.1Um/\sqrt{3}$ Duration(min): 5 Radio interference level(μV): ≤500	80 5 223	Passed
7	Temperature rise test (Type test)	Temperature limit(℃): 105/120 Temperature rise limit(K): 75/90	See 4.7	Passed

Test Report

№	Test items	Specified values Standards(Technical contract)	Measured values	Conclu-sions
8	Verification of thermal short-time current withstand (Type test)	Thermal short-time current(kA): $25I_r$ Duration(s): 2 Final temperature (℃): ≤180	62.5 2 157.6	Passed
9	Cantilever load withstand test (Type test)	Applied load(N): 5000 Duration(s): 60 Successfully repeat check items	5098 60 Passed	Passed
10	Visual inspection and dimensions check (Type test)	According to standard	See 4.10	Passed
11	Measurement of partial discharge quantity (After type test)	Applied voltage(kV): U_m Partial discharge level(pC): ≤10	126 <4	Passed
		Applied voltage(kV): $1.5U_m/\sqrt{3}$ Partial discharge level(pC): ≤10	109.1 <4	
		Applied voltage(kV): $1.05U_m/\sqrt{3}$ Partial discharge level(pC): ≤5	76.4 <4	
12	Measurement of dielectric dissipation factor(tanδ) and capacitances at ambient temperature (After type test)	Applied voltage(kV): 2~20 tanδ: ≤0.004 Providing capacitance of the sample(pF)	10 0.00294 401.6	Passed
		Applied voltage(kV): $1.05U_m/\sqrt{3}$ tanδ: ≤0.004 Providing capacitance of the sample(pF)	76.4 0.00295 401.9	
		Applied voltage(kV): U_m tanδ: ≤0.004 Providing capacitance of the sample(pF)	126 0.00295 401.9	
13	Test of tap insulation (Routine test)	Dry power-frequency voltage withstand test: Applied voltage(kV): 2~3 Duration(s): 60	 2 60	Passed
		Measurement of dielectric dissipation factor(tanδ) and capacitances Applied voltage(kV): ≥1 tanδ: ≤0.05 Capacitance(pF): ≤10000	 2 0.00651 349.4	
14	Dry lightning impulse voltage withstand test (Routine test)	Negative polarity(kV): 577.5 ±3% 3 negative polarity Chopped wave voltage(kV): 632.5 ±3% 2 negative polarity	560.33~577.58 3 times 629.32~631.94 2 times	Passed
15	Dry power-frequency voltage withstand test (Routine test)	Applied voltage(kV): 255 Duration(s):60	255 60	Passed

Test Report

№	Test items	Specified values Standards(Technical contract)	Measured values	Conclu-sions
16	Measurement of partial discharge quantity (Routine test)	Applied voltage(kV): U_m Partial discharge level(pC): ≤10	126 <4	Passed
		Applied voltage(kV): $1.5U_m/\sqrt{3}$ Partial discharge level(pC): ≤10	109.1 <4	
		Applied voltage(kV): $1.05U_m/\sqrt{3}$ Partial discharge level(pC): ≤5	76.4 <4	
17	Measurement of dielectric dissipation factor(tanδ) and capacitances at ambient temperature (Routine test)	Applied voltage(kV): 2~20 tanδ: ≤0.004 Providing capacitance of the sample(pF)	10 0.00296 401.5	Passed
		Applied voltage(kV): $1.05U_m/\sqrt{3}$ tanδ: ≤0.004 Providing capacitance of the sample(pF)	76.4 0.00298 401.8	
		Applied voltage(kV): U_m tanδ: ≤0.004 Providing capacitance of the sample(pF)	126 0.00298 401.8	
18	Tightness test at the flange or other fixing device (Routine test)	Applied medium Applied pressure(MPa): 0.8 ±0.01 Duration(min): 15 No oil leakage and damage	SF_6 0.8 15 No oil leakage and damage	Passed
19	Visual inspection and dimensions check (Routine test)	According to standard	See 4.19	Passed

Note: 1. All the tests were field tests;

2. Tested in Shandong Qixing High Voltage Electric Co., Ltd. testing station;

3. Enterprise requirements: Did not perform altitude correction in this test, and the relevant test datas were provided by entrusting company.

1. Test object parameters

Highest voltage for equipment(kV): 126
Rated phase-to-earth voltage(kV): $126/\sqrt{3}$
Rated current(A): 2500
Rated frequency(Hz): 50
Altitude(m): ≤5000
Temperature class of insulation: E
Test tap(measured tap, tanδ): With
Insulation type of bushing: RIF
Rated voltage of tap(Tap of electric potential, tap of capactitance)(kV): /

2. Sample condition description

Sample exterior construction and major dimensions(length, outer diameter) are in compliance with outline drawings.
Measured values: length is 3412 mm, outer diameter is Φ400 mm.

Outline dimensions	Rating plate
ZCBT6006GY	8QX.860.009G

Rating plate and outline drawings are in testing report annex.
The design, performance data, specifications of sample rating plate are in compliance with drawing.
The marking of the phase sequence on head terminal and end terminal of the sample is clear and right.
The surface of the sample has no collision and damage.

3. Standards

IEC60137 Edition 7.0 2017-06 Insulated bushings for alternating voltages above 1000V
GB/T4109-2022 Insulated bushings for alternating voltages above 1000V
Technical contract

4. Test items and conclusions

4.1 Measurement of dielectric dissipation factor(tanδ) and capacitances at ambient temperature(Before type test)

Test date: July 17, 2025

Humidity: 51.0%; Ambient temperature: 31.6℃; Atmospheric pressure: 100.5kPa

Applied voltage(kV)	Dielectric dissipation factor(tanδ)	Capacitance(pF)	Result
10	0.00264	405.4	Passed
76.4	0.00268	405.7	
126	0.00269	405.8	

Note: tanδ(126kV)- tanδ(76.4kV) = 0.00001＜0.001(Standard value), passed.

4.2 Measurement of partial discharge quantity(Before type test)

Test date: July 17, 2025

Humidity: 51.0%; Ambient temperature: 31.6℃; Atmospheric pressure: 100.5kPa

Prestress voltage (kV)	Duration(s)	Measured voltage (kV)	Partial discharge level(pC)	Result
255	60	126	<5	Passed
		109.1	<4	
		76.4	<4	

Note: Background level was ＜4pC before and after test.

4.3 Dry lightning impulse voltage withstand test(Type test)

Test date: July 17, 2025

Test atmospheric conditions:

Humidity: 51.0%; Ambient temperature: 31.6℃; Atmospheric pressure: 100.5kPa.

Full wave rated withstand voltage:

Positive polarity(kV): 909.2(Corrected value)

Negative polarity(kV): 100.2(Corrected value) 15 negative and 15 positive polarity impulses;

Chopped wave rated withstand voltage(kV): 1100.2(Corrected value) 5 negative polarity impulses.

Test sequence:

One positive polarity reference voltage full wave impulse;
Fifteen positive polarity rated voltage full wave impulse;
One negative polarity reference voltage full wave impulse;
One negative polarity rated voltage full wave impulse;
Five negative polarity rated chopped wave impulse;
Fourteen negative polarity rated voltage full wave impulse.

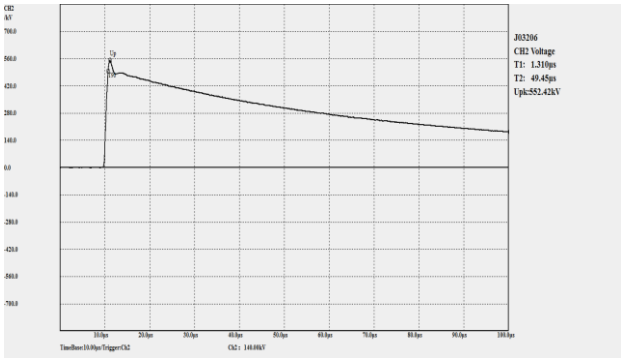
Test oscillogram records:

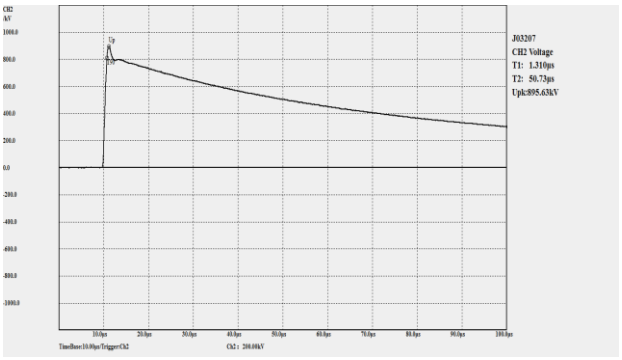
T1: Front time; T2: Time to half value; Upk: Peak voltage;

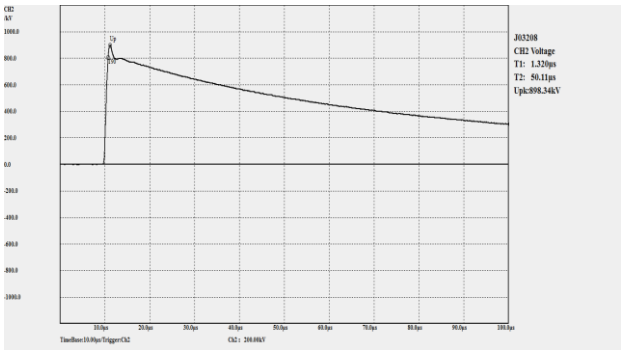
Tc: Time to chopping; Qz: Factor of over crossing

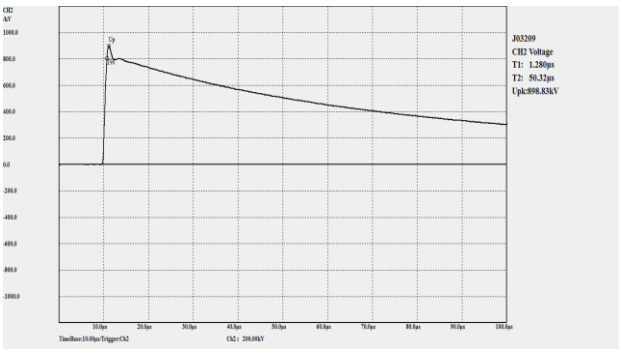
Result: Passed.

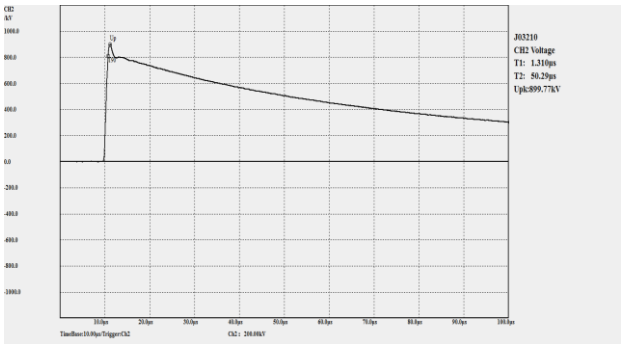
Tested terminal: To earth Test polarity: Positive CH2: Voltage records

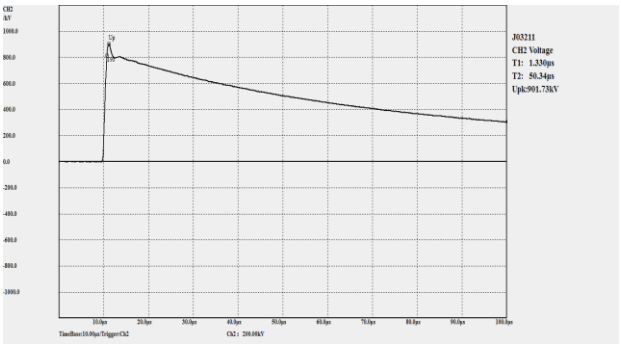


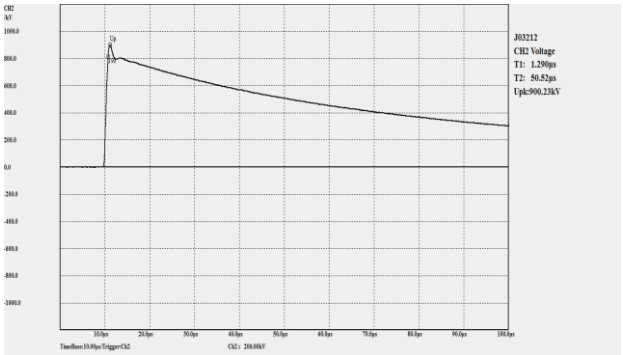


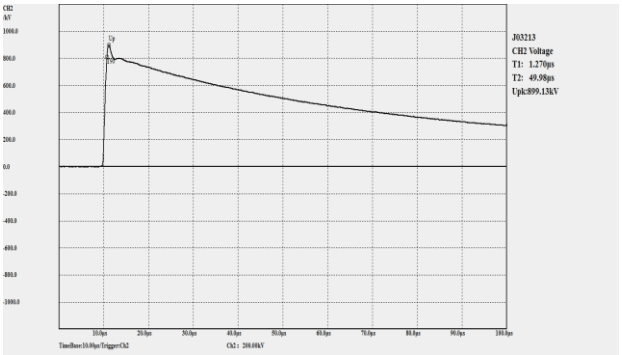




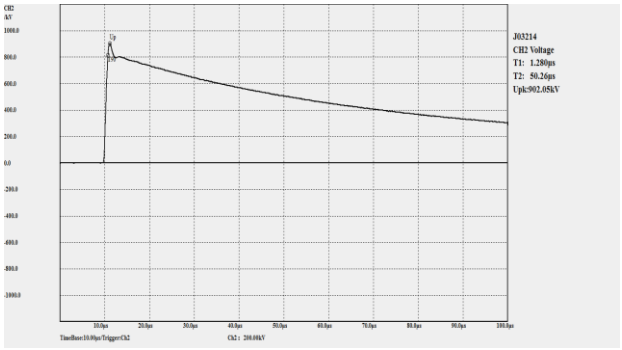


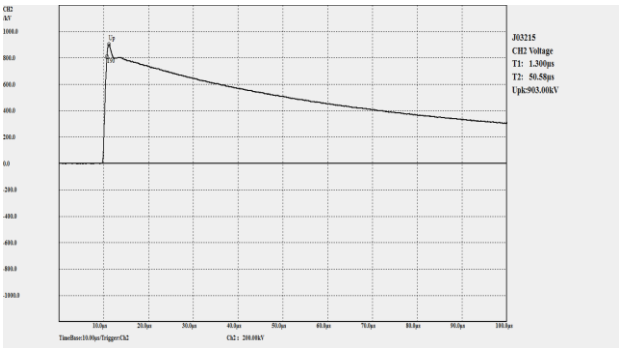


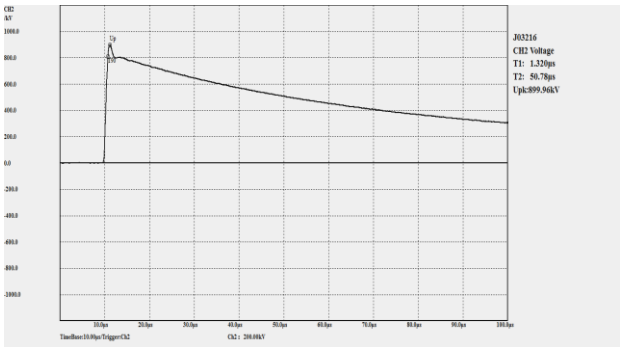


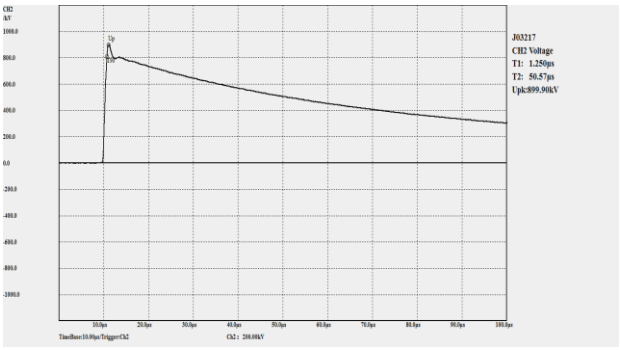


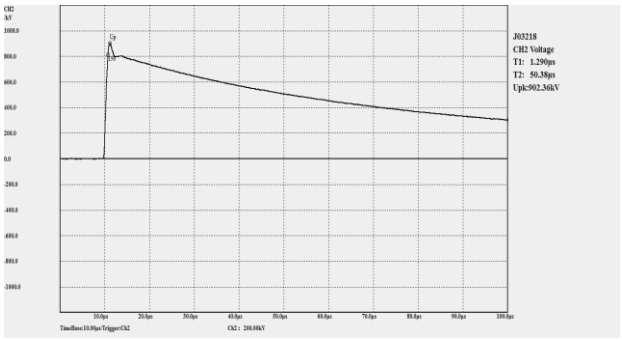
Tested terminal: To earth Test polarity: Positive CH2: Voltage records

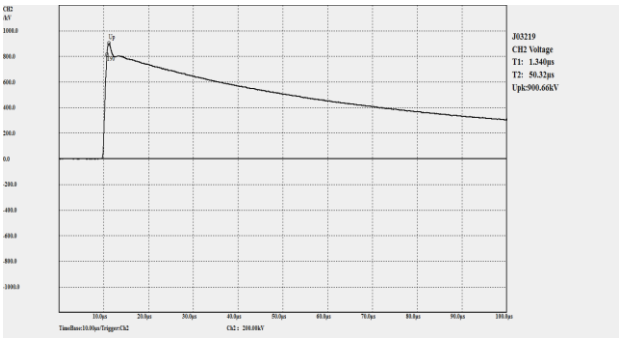


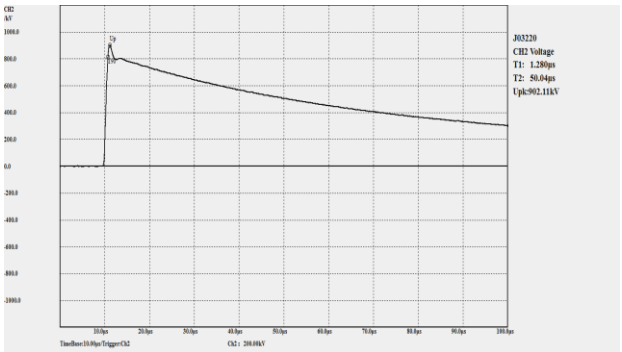


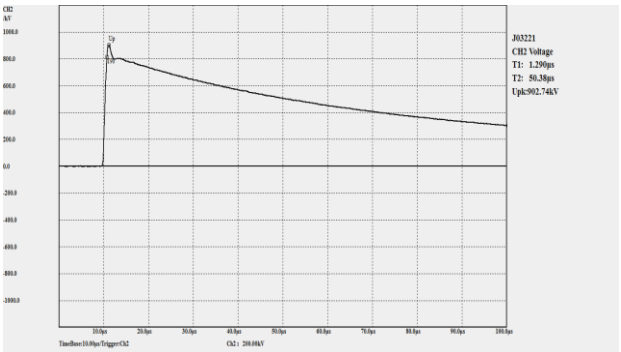








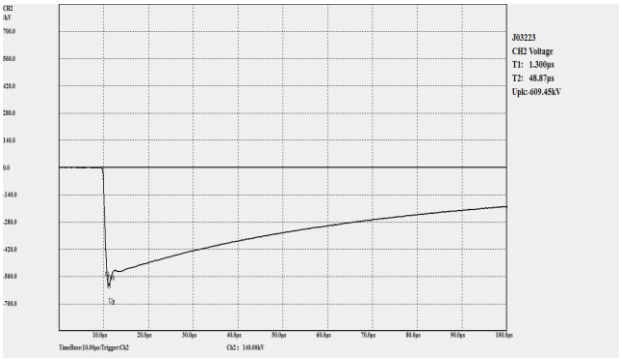


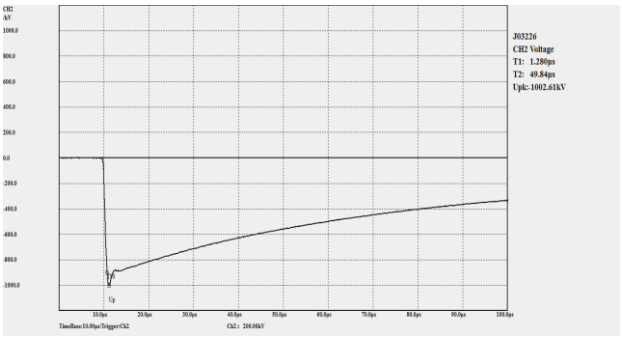


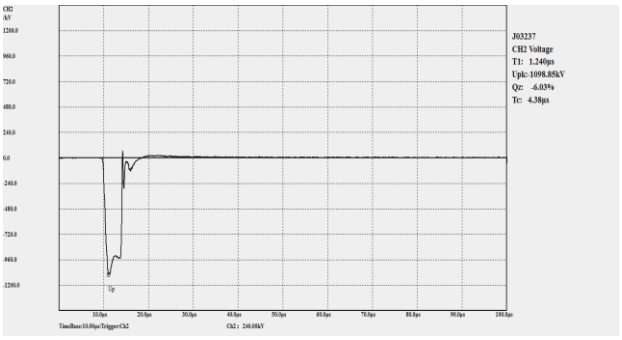
Tested terminal: To earth

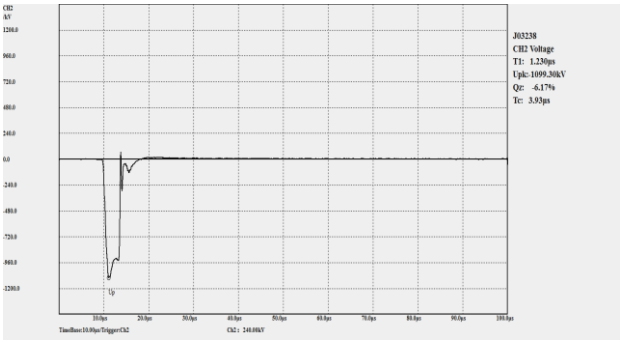
Test polarity: Negative

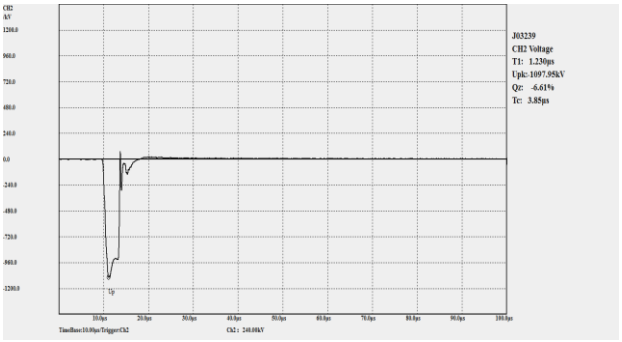
CH2: Voltage records

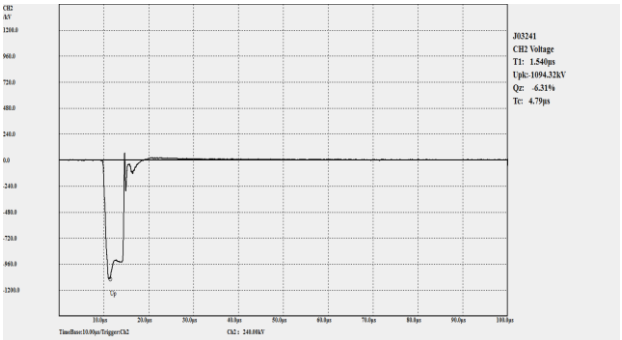


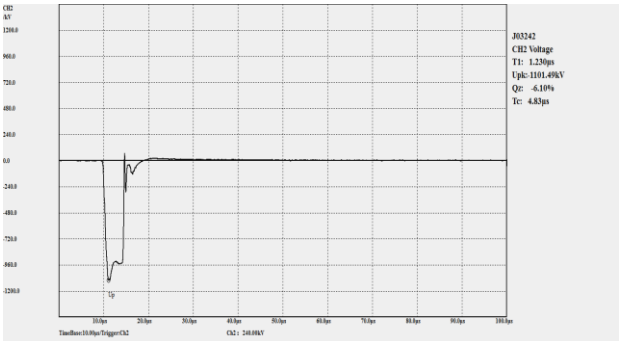




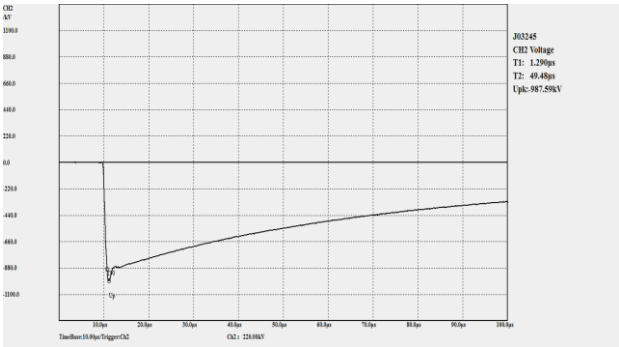


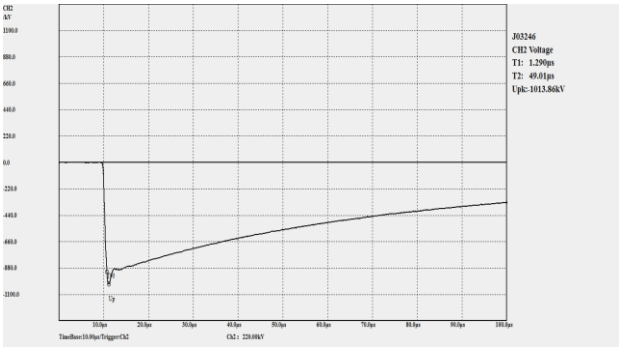


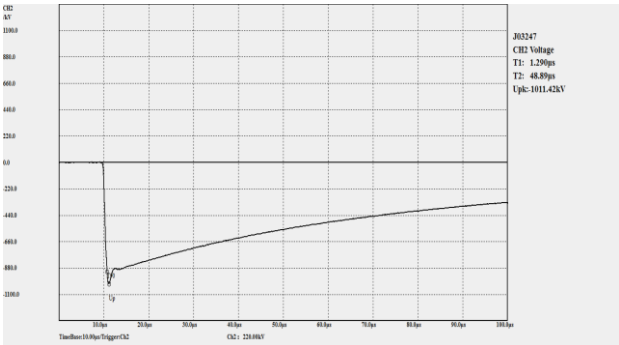


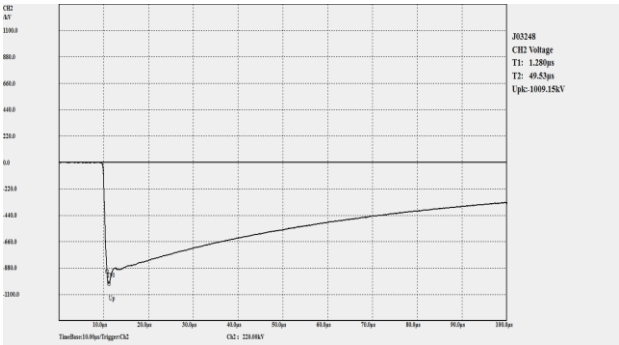


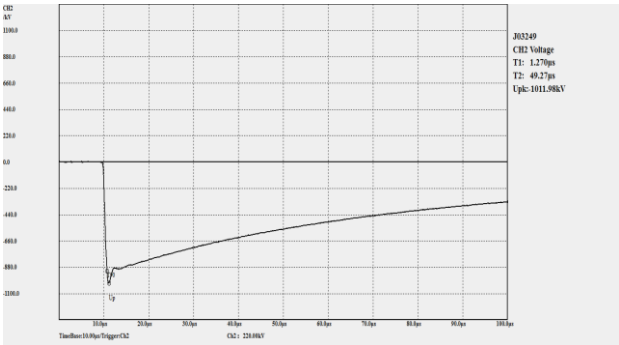
Tested terminal: To earth Test polarity: Negative CH2: Voltage records

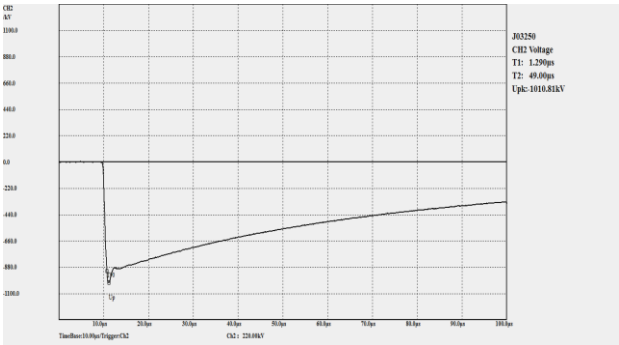


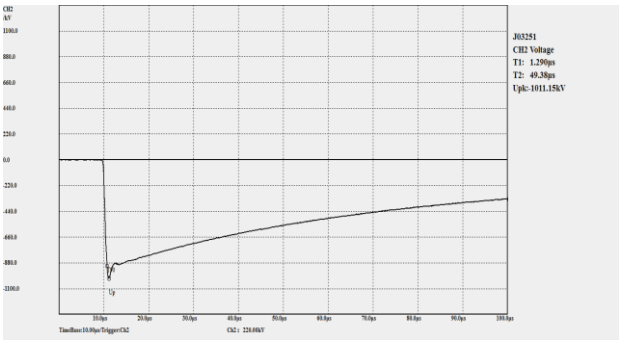


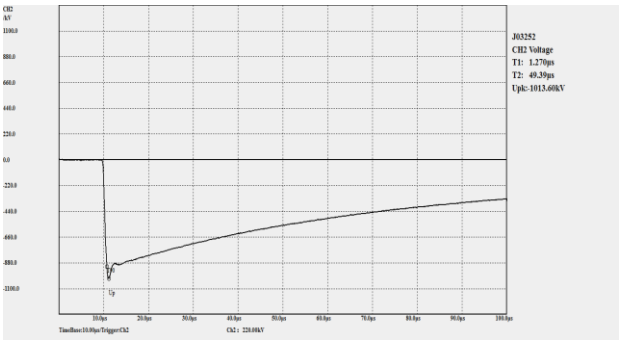




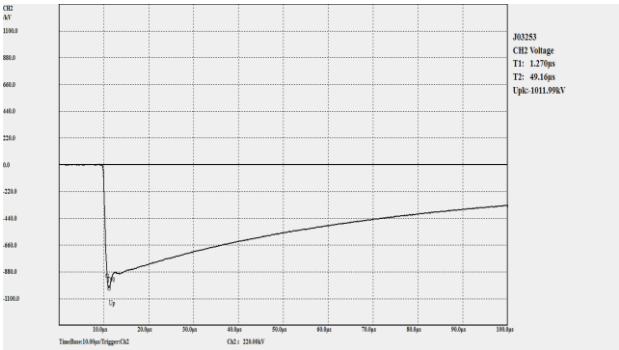


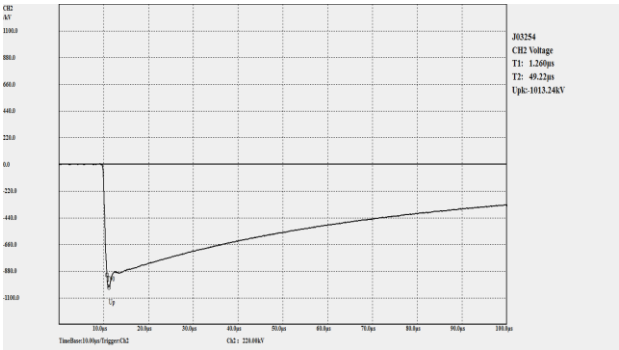


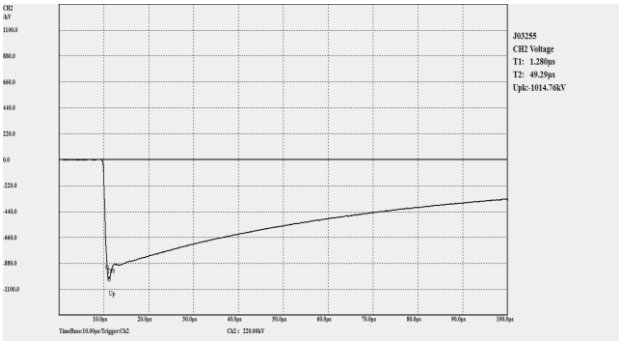


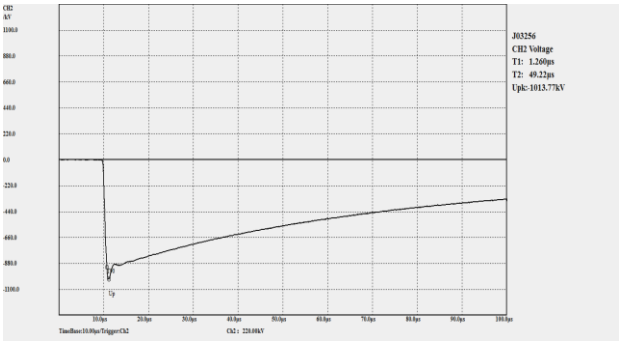


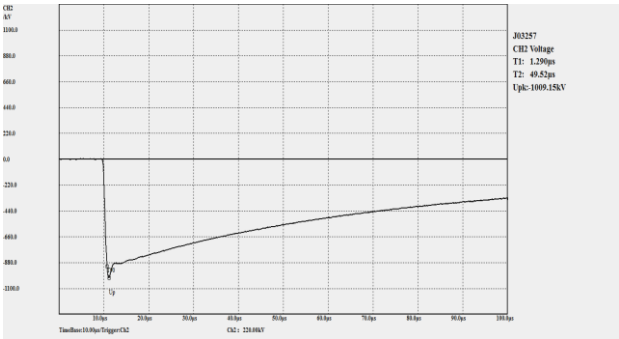
Tested terminal: To earth Test polarity: Negative CH2: Voltage records

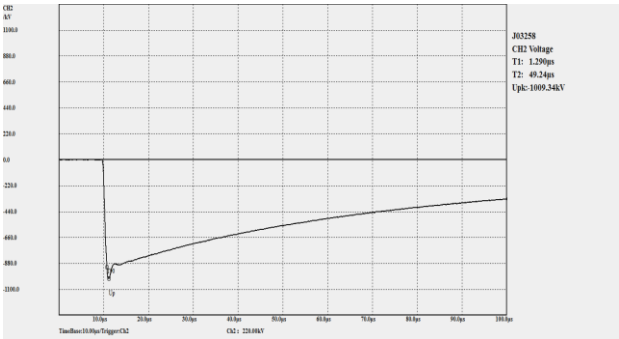












4.4 Wet power-frequency voltage withstand test(Type test) Test date: July 17, 2025

Humidity: 51.0%; Ambient temperature: 31.6℃; Atmospheric pressure: 100.5kPa

Applied position	Applied voltage(kV)				Frequency (Hz)	Duration (s)	Result
	Standard value	Atmospheric corrected value	Altitude corrected value	Applied value			
Terminal-earth	230	374.9	374.2	374.2	50	60	Passed

Note: The conductivity of collected water is 101.5μS/cm at 20℃.
Average precipitation rate: Vertical component 1.7mm/min, horizontal component 1.4mm/min.

4.5 Long-duration power-frequency withstand voltage test(ACLD)(Type test)

Test date: July 18, 2025

Humidity: 48.0%; Ambient temperature: 32.5℃; Atmospheric pressure: 100.6kPa

Applied voltage		Duration(min)	Partial discharge level(pC)
Multiple	Phase-earth(kV)		
$1.1U_m/\sqrt{3}$	80	5	<5
$U_2=1.5U_m/\sqrt{3}$	109.1	5	<5
$U_1=U_m$	126	1	/
$U_2=1.5U_m/\sqrt{3}$	109.1	5	<5
		10	<5
		15	<5
		20	<5
		25	<5
		30	<5
		35	<5
		40	<5
		45	<5
		50	<5
		55	<5
		60	<5
$1.1U_m/\sqrt{3}$	80	5	<5

Note: U_m=126kV; Background level was ＜5pC before and after test.
Result: Passed.

4.6 Radio interference voltage test(Type test)

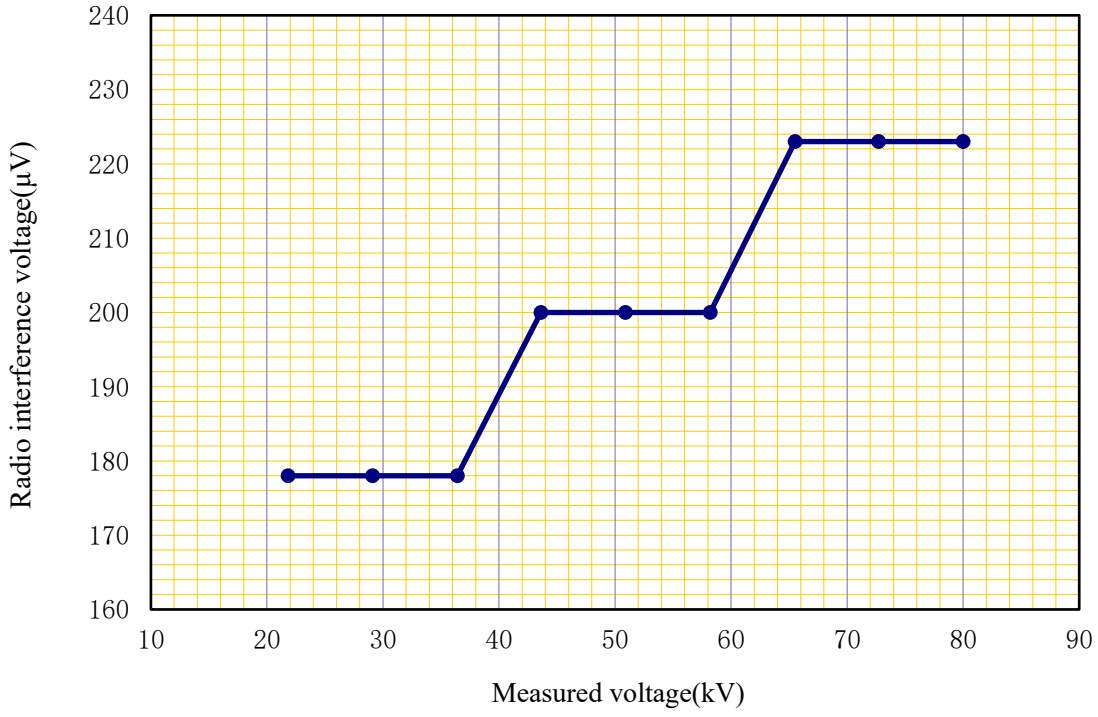
Test date: July 18, 2025

Humidity: 48.0%; Ambient temperature: 32.5℃; Atmospheric pressure: 100.6kPa

Measured frequency (MHz)	Attenuation factor of measurement circuit (dB)	Attenuation factor of resistance network (dB)	Measured voltage (kV)	Duration (min)	Radio interference reading B_m (dB)	Radio interference level (μV)
1.0	7	22	80	5	18	223
			72.7	/	18	223
			65.5		18	223
			58.2		17	200
			50.9		17	200
			43.6		17	200
			36.4		16	178
			29.1		16	178
			21.8		16	178

Result: Passed.

Radio interference curve



4.7 Temperature-rise test(Type test) Test date: July 17, 2025

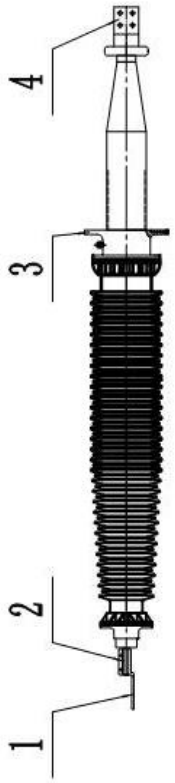
Specified current was 2500A, injected current was 2500A during test, the test duration was 7h, stability duration was 1h.

Calculated result of temperature rise

No.	Measured position	Temperature of bushing (℃)	Temperature rise of bushing(K)	Oil temperature (℃)	Ambient temperature (℃)	Result
1	Terminal in the air	75.6	46.2	29.6	90.8	Passed
2	Fastening of terminals in the air	74.4	44.8			
3	Flange	49.6	20.0			
4	Terminal in the oil	93.0	63.4			

Note: The measurement position drawing is shown in page 16.

Schematic diagram of measured point of temperature rise



1. Terminal in the air 2. Fastening of terminals in the air 3. Flange 4. Terminal in the oil

4.8 Verification of thermal short-time current withstand(Verify by the calculation)

(Type test) Test date: July 19, 2025

The standard value of thermal short-time current of bushing I_{th}=62.5kA, duration t_{th}=2s. According to calculation final temperature of the conductor θ_f =157.6℃. If $\theta_f \leqslant$180℃, it was considered that the bushing could withstand the standard value I_{th} of thermal short-time current.

Sample parameters

Conductor material of sample	Aluminum
Conductor resistivityρ(μΩ·cm)	2.83
Total cross section area S_t(cm^2)	28.26
Measured temperature rise of the bushing(K)	90
Rated current I_r(A)	2500
Standard value of rated thermal short-time current I_{th}(kA)	62.5
Rated duration t_{th}(s)	2
θ_0(℃)	130
Current penetration depth d(cm)	1.197
Diameter of the conductor D(cm)	6.0
α[(K/s)/(kA/cm^2)^2]	1.8
Equivalent cross section area considering the skin effect S_e(cm^2)	18.06

Verify by the calculation:

$$\theta_f = \theta_0 + \alpha \frac{I_{th}^2}{S_t \times S_e} \times t_{th} = 157.6℃$$

Result: Passed.

4.9 Cantilever load withstand test(Type test) Test date: July 19, 2025

Load direction	Applied position	Standard value		Applied value		Result
		Load(N)	Duration(s)	Load(N)	Duration(s)	
Vertical	Terminal	5000	60	5098	60	No damage, distortion, passed

4.10 Visual inspection and dimensions check(Type test) Test date: July 19, 2025

It has smooth surface, no cracks. Dimensional check is accordance with the drawing requirement.

Drawing values(mm): 3410±20 1170±10 1620±10 Φ400 120

Measured values(mm): 3412 1172 1610 Φ400 120

Arcing distance(mm): 1630 Creepage(mm): 5725

Result: Passed.

4.11 Measurement of partial discharge quantity(After type test) Test date: July 19, 2025

Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Prestress voltage (kV)	Duration(s)	Measured voltage(kV)	Partial discharge level(pC)	Result
255	60	126	＜4	Passed
		109.1	＜4	
		76.4	＜4	

Note: Background level was ＜4pC before and after test.

4.12 Measurement of dielectric dissipation factor(tanδ) and capacitances at ambient temperature(After type test) Test date: July 19, 2025

Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Applied voltage(kV)	Dielectric dissipation factor (tanδ)	Capacitance(pF)	Result
10	0.00294	401.6	Passed
76.4	0.00295	401.9	
126	0.00295	401.9	

Note: tanδ(126kV)- tanδ(76.4kV) = 0.00000＜0.001(Standard value), passed.

4.13 Tests of tap insulation(Routine test) Test date: July 19, 2025

Power-frequency voltage withstand test

Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Applied position	Applied voltage(kV)	Frequency(Hz)	Duration(s)	Result
Tap-earth	2	50	60	Passed

Measurement of dielectric dissipation factor(tanδ) and capacitances

Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Applied voltage(kV)	Dielectric dissipation factor(tanδ)	Capacitance(pF)	Result
2	0.00651	349.4	Passed

4.14 Dry lightning impulse voltage withstand test(Routine test) Test date: July 19, 2025

Test atmospheric conditions

Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Full wave rated withstand voltage: negative polarity(kV): 577.5; 3 negative polarity

Chopped wave rated withstand voltage: negative polarity(kV): 632.5; 2 negative polarity

Test sequence

One negative reference full wave impulse;

One negative rated full wave impulses;

Two negative rated chopped wave impulses;

Two negative rated full wave impulses.

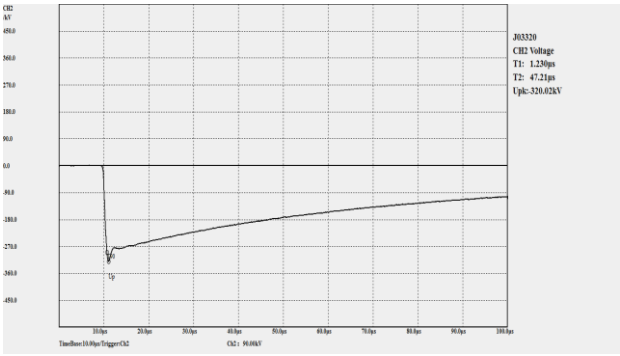
Test records:

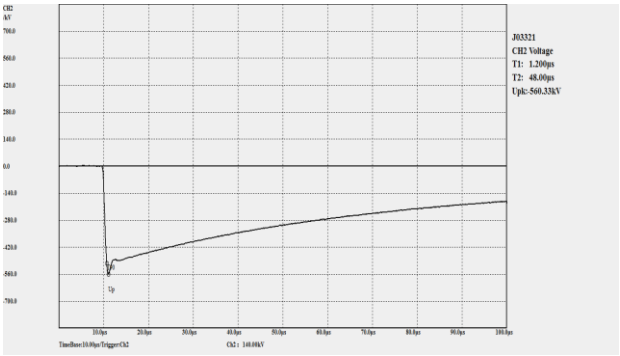
T1: Front time; T2: Time to half value; Upk: Peak voltage;

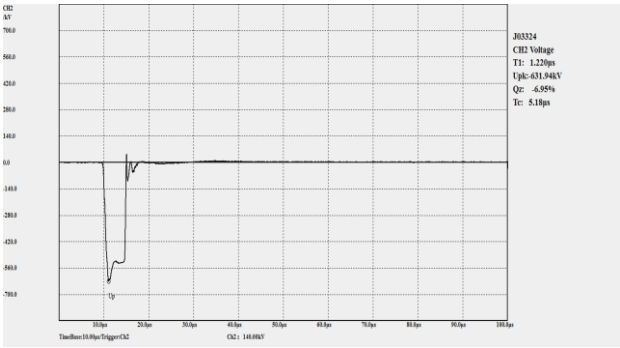
Tc: Time to chopping; Qz: Factor of over crossing.

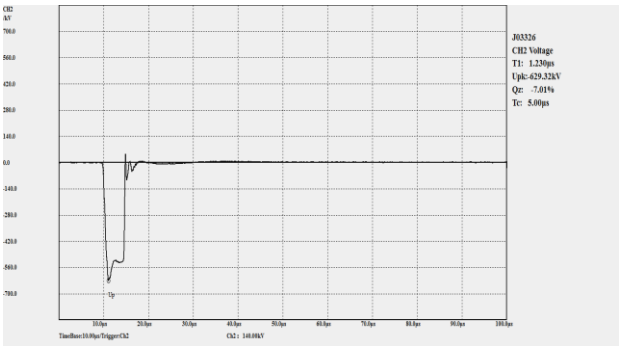
Result: Passed.

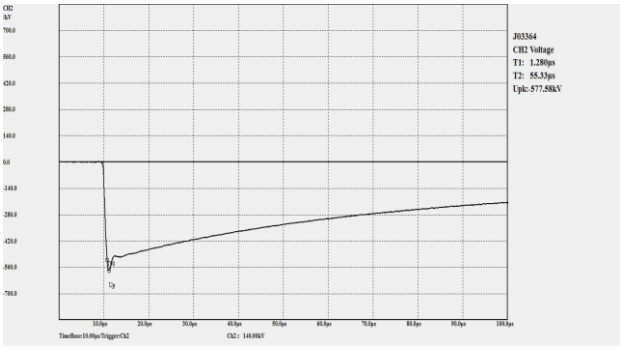
Tested terminal: To earth Test polarity: Negative CH2: Voltage wave

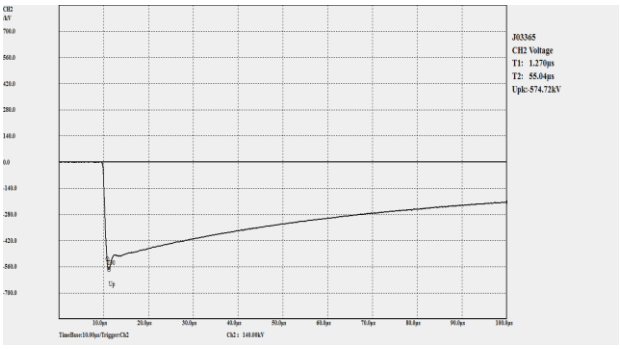












4.15 Dry power-frequency voltage withstand test(Routine test) Test date: July 19, 2025
Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Applied position	Applied voltage(kV)		Frequency (Hz)	Duration (s)	Result
	Standard value	Applied value			
Terminal-earth	255	255	50	60	Passed

4.16 Measurement of partial discharge quantity(Routine test) Test date: July 19, 2025
Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Prestress voltage (kV)	Duration(s)	Measured voltage(kV)	Partial discharge level(pC)	Result
255	60	126	＜4	Passed
		109.1	＜4	
		76.4	＜4	

Note: Background level was ＜4pC before and after test.

4.17 Measurement of dielectric dissipation factor(tan δ) and capacitances at ambient temperature(Routine test) Test date: July 19, 2025
Humidity: 50.0%; Ambient temperature: 33.1℃; Atmospheric pressure: 100.8kPa

Applied voltage(kV)	Dielectric dissipation factor(tanδ)	Capacitance(pF)	Result
10	0.00296	401.5	Passed
76.4	0.00298	401.8	
126	0.00298	401.8	

Note: tanδ(126kV)- tanδ (76.4kV) = 0.00000＜0.001(Standard value), Passed.

4.18 Tightness test at the flange or other fixing device(Routine test) Test date: July 19, 2025
Ambient temperature: 33.1℃

Applied medium	Applied pressure(MPa)	Duration(h)	Residual pressure(MPa)	Result
SF_6	0.8	15	0.8	No leakage or damage, passed

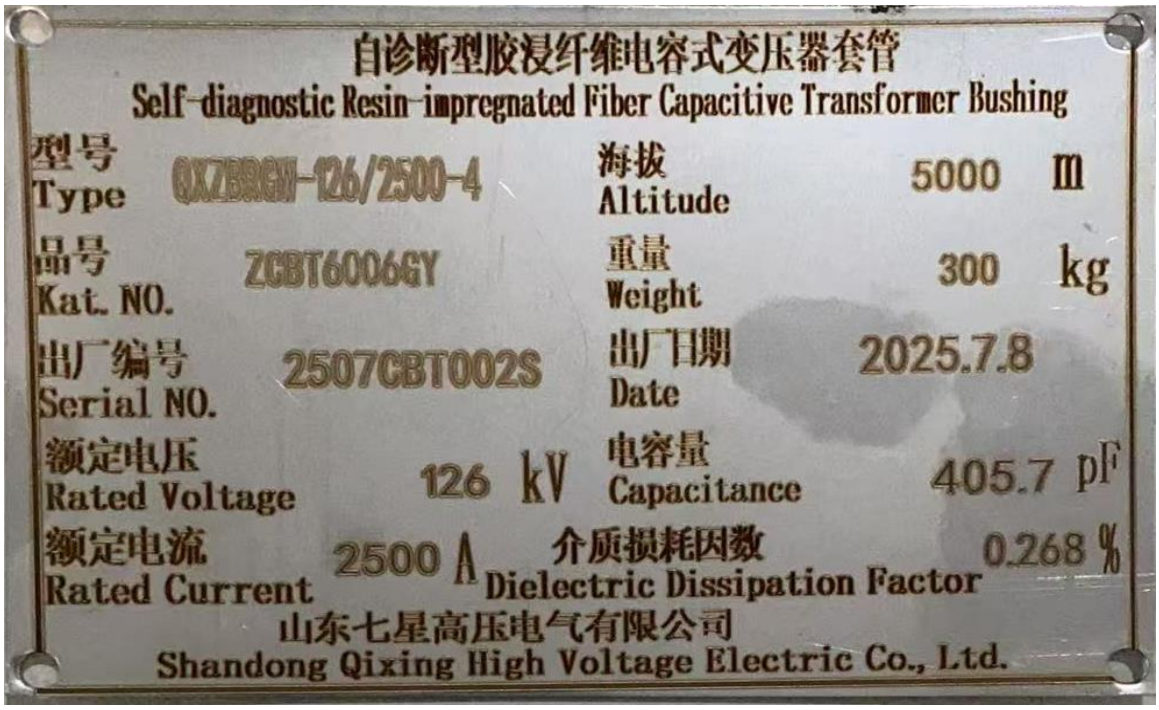
4.19 Visual inspection and dimensions check(Routine test) Test date: July 19, 2025
It has smooth surface, no cracks. Dimensional check is accordance with the drawing requirement.
Dimensional inspection see 4.10.
Result: Passed.

Annex 1

RATING PLATE AND OUTLINE PHOTOS

№：CTQC/ZJ-25.1399

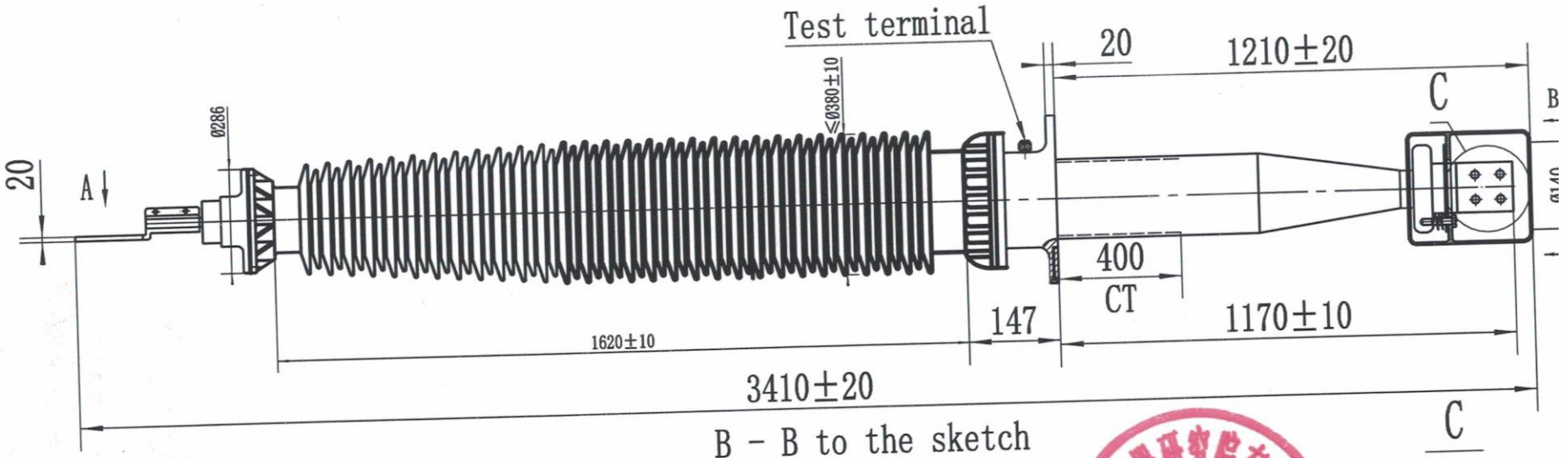
Rating plate:



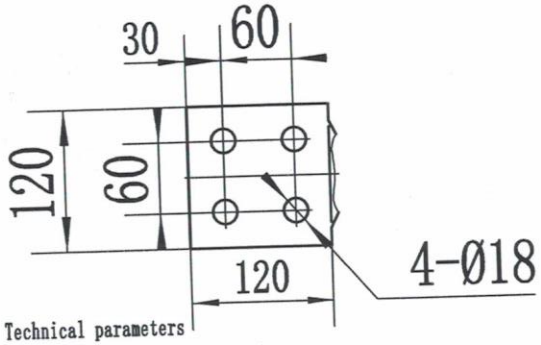
Outline:

Annex 2

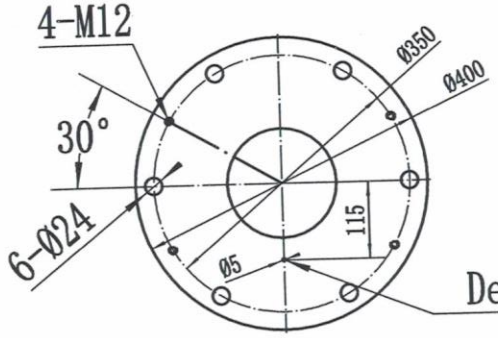
BUSHING DRAWINGS



Schematic diagram in direction a

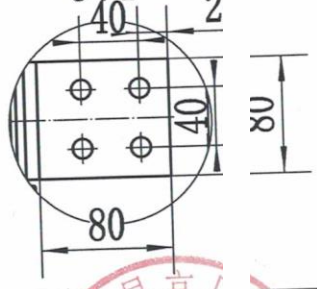


B - B to the sketch



C

3:1



Technical parameters

1. Rated voltage: 126kV
2. Rated current :2500A
3. 1min power frequency withstand voltage: 255kV
4. Lightning impulse withstand voltage: 550kV
5. Dielectric loss tangent: ⩽ 0.4%
6. PD: Um measured ⩽ 10
7. Bending load: 5000N
8. Creepage distance: 5720mm
9. weight:300kg
10. Altitude:5000m

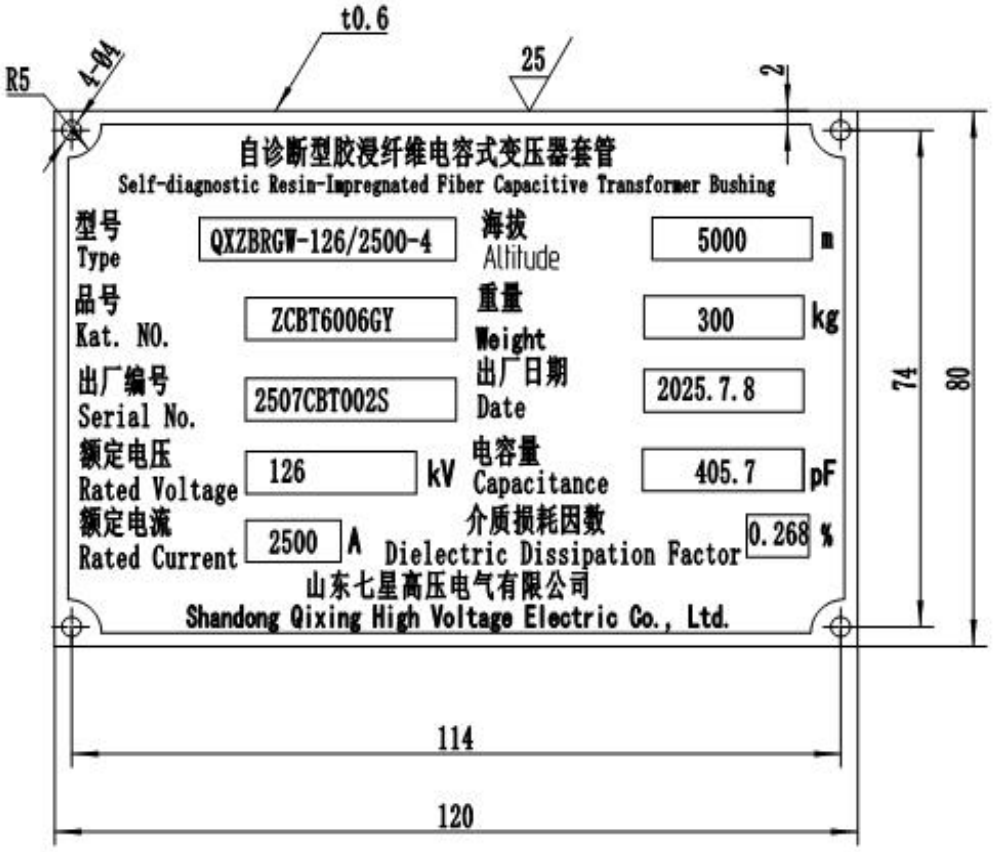
标记	处数	分区	更改文件号	签名	年、月、日
设计	张艺潇	2025.7.8	标准化		
审核	石孝刚	2025.7.8			
工艺			批准	曹明波	2025.7.8

QXZBRGW-126/2500-4		
阶段标记	重量	比例
		1:10
共 张 第 张		

Shandong Qixing High Voltage Electric Co. LTD

Dry type transformer bushing outline

Product number: ZCBT6006GY



借(通)用件登记											
旧底图总号								产品型号		装配图代号	序号
底图总号								铭牌nameplate		8QX.860.009G	
签字										图样标记	重量 比例
											0.030 1:1
日期	标记	处数	分区	更改文件号		签字	日期				
	设计	张艺潇	2025.7.1	标准化						共 张	第 张
档案员 日期	校核	石孝刚	2025.7.1	审定				316L			
	会签			批准		曹明波	2025.2.1			山东七星高压电气有限公司	

CHPTL

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China Electrical Power Research Institute (CEPRI)

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Liaoning High Voltage Apparatus Quality Test Co., Ltd. (AQTC)

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