DNV·GL

KEMA INSPECTION REPORT

3150-16

Object	A polymer-housed metal oxide surge arrester without gaps.
Type	YH10W-3, YH10W-6, YH10W-9, YH10W-12, YH10W-15, YH10W-18, YH10W-21, YH10W-24, YH10W-27, YH10W-30, YH10W-33 and YH10W-36. 3-36 kV – 10kA - 50 Hz.
Client	Nanyang Zhongwei Electric Co., Ltd, Nanyang, China.
Manufacturer	Nanyang Zhongwei Electric Co., Ltd, Nanyang, China.
Inspected by	DNV GL Netherlands B.V., Arnhem, the Netherlands
Test location	CEPRI Laboratory, Wuhan, China
Date of tests	1 August to 27 October 2016
Test specification	The tests were in accordance with client's instruction. Test procedure and test parameters were based on IEC60099-4 Edition 3.0 (2014-06).
Regarding	Type Tests
Summary and conclusion	The object passed the tests.

This report applies only to the object tested. The responsibility for conformity of any object having the same type references as that tested rests with the Manufacturer.

This report consists of 75 pages in total.

KEMA Nederland B.V.

J.P. Fonteijne
Executive Vice President
KEMA Laboratories

KEMA Laboratories

Arnhem, 27 March 2017

INFORMATION SHEET

1. Inspection Reports

An Inspection Report contains a record of one or more tests which have been carried out according to the client's instructions. These tests are not necessarily in accordance with a recognized standard. The test results do not verify ratings of the test object.
KEMA Laboratories issues three types of Inspection Reports:

1.1 The tests have been carried out in accordance with....

This sentence will appear on the front page of an Inspection Report if all type tests have been performed in accordance with a recognized standard. The Inspection Report contains verified drawings and a description of the equipment tested. Detailed rules are given in KEMA's Inspection procedure. The condition of the test object after the tests is assessed and recorded in the Inspection Report.

1.2 The tests were in accordance with the client's instructions. Test procedure and test parameters were based on....

This sentence will appear on the front page of an Inspection Report if the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer. If the object does not pass the tests, such behaviour will be mentioned on the front sheet. Verification of the drawings (if submitted) and assessment of the condition after the tests are only done on the client's request.

1.3 The tests were in accordance with the client's instructions.

This sentence will appear on the front page of an Inspection Report if the tests, test procedure and/or test parameters are not in accordance with a recognized standard.

2 Standards

When reference is made to a standard, and the date of issue is not stated, this standard refers to the latest issue, including amendments which have been officially published prior to the date of the tests.

3 Official and uncontrolled test documents

The official test documents of DNV GL are issued in bound form. Uncontrolled copies may be provided as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

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1 IDENTIFICATION OF THE OBJECT TESTED

1.1 Ratings/characteristics of the object tested

Rated voltage (U_r)	3-36 kV
Rated frequency	50 Hz
Nominal discharge current	10 kA

1.2 Description of the object tested

Object	A Polymer-housed metal oxide surge arrester without gaps	
Manufacturer of Arrester	Nanyang Zhongwei Electric Co., Ltd, Nanyang, China.	
Type	YH10W-3	YH10W-36
AC reference voltage (1 mA)	≥ 3 kV	≥ 36 kV
Nominal discharge current	10 kA	10 kA
Continuous operating voltage (U_{cov})	2,4 kV	28,8 kV
Residual voltage at		
• nominal discharge current (8/20 µs)	≤ 8,3 kV	≤ 99,6 kV
• steep current (1/5 µs)	≤ 11,0 kV	≤ 115 kV
Insulation level		
• Lightning impulse	60 kV	185 kV
• Power frequency voltage	28 kV	90 kV
Block dimensions		
• Outer diameter	45 mm	45 mm
• Height	20 mm	20 mm
Number of metal oxide blocks	1	12
Manufacturer of ZnO blocks	Nanyang Zhongwei Electric Co., Ltd, Nanyang, China.	

1.3 List of drawings

According to the client the following drawings and/or documents numbers refer.
KEMA Laboratories has not verified these drawings and/or documents.

Drawing no./document no.	Revision
YH10W-3	1.0
YH10W-6	1.0
YH10W-9	1.0
YH10W-12	1.0
YH10W-15	1.0
YH10W-18	1.0
YH10W-21	1.0
YH10W-24	1.0
YH10W-27	1.0
YH10W-30	1.0
YH10W-33	1.0
YH10W-36	1.0

These drawings are presented in appendix A, page 44 to 55.

2 GENERAL INFORMATION

2.1 Persons attending the inspection

Name	Company
Chenggang Chen	Nanyang Zhongwei Electric Co., Ltd, Nanyang, China.

2.2 The inspection was carried out by

Name	Company
Ernst Hanique	DNV GL Netherlands B.V., Arnhem, the Netherlands

2.3 Purpose of the tests

Purpose of the tests was to verify whether the material complies with the specified requirements.

2.4 Inspection of the test set-up

The tests were carried out at the laboratory of China Electric Power Research Institute (CEPRI), Wuhan, China. The results of the inspection activities are based on the witnessed tests and information about measuring devices and the test set-up as provided by the manufacturer. The measuring devices, the test set-up and the provided calibration reports were verified by KEMA Laboratories.

Result
The inspection did not give rise to remarks.

3 ARRESTER

3.1 Test of the bending moment

Standard and date

Standard	Client's instructions, based on IEC 60099-4, sub clause 8.11
Test date	2 August to 11 August 2016

The test was performed on a complete arrester with the maximum physical length of this design.
For this test three samples were used.

The following initial measurements were performed:
- Watt loss
- Internal partial discharge
- Residual voltage.

This test consists of two parts:
- Bending moment
- Mechanical/thermal preconditioning.

After the above-mentioned test, all three samples were subjected to a water immersion test, were the samples were immersed in boiling water with 1 kg/m^3 of NaCl during 42 h.
The results of this measurement are summarized in appendix A, page 24.

After all tests were completed the initial measurements were repeated and the results compared with the first initial results.

3.1.1 Bending moment

Procedure
For this test two samples were used. The bending load was increased smoothly to the specified short-term load (SSL) of 260 N during 63 s. During this time the deflection was measured. Then the load was realised smoothly. Next the residual deflection was measured.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 21 to 22.

3.1.2 Mechanical/thermal preconditioning

Procedure

For this test one sample was used and subjected to a torque test. The sample was vertically mounted on a rigid support. At the top of the sample an axial torque was applied of 30 N.m during 30 s. Next the sample was mounted on a rigid base inside an environmental chamber. A test load of 100 N was applied in one initial direction for 24 h. After this 24 h the sample was turned 90 physical degrees. This repeated for 180 and 270 physical degrees. During this time span of in total 96 h the temperature in the environmental chamber was changed accordance figure 11 of IEC 60099-4.

Result

The object passed the test.

The results of this measurement are summarized in appendix A, page 19 to 21.

3.2 Weather ageing test

Standard and date

Standard	Client's instructions, based on IEC 60099-4, sub clause 10.8.17
Test date	2 August to 27 October 2016

This test consists of two tests:

- Salt fog test
- UV light test.

3.2.1 Salt-fog

Procedure

The used test sample was the longest electrical section with the minimum specific leakage distance and the highest rated voltage of this type. The sample was cleaned with deionized water before starting the test.

The following initial measurements were performed:

- Reference voltage
- Partial discharge.

Next a time-limited continuous test under salt fog, at constant power-frequency voltage equal to 28,8 kV, was carried out in a moisture-sealed corrosion-proof chamber. An aperture of not more than 80 cm² was provided for the natural exhaust air. A room humidifier of constant spraying capacity was used as the water atomizer.

The fog filled the chamber and was not directly sprayed onto the test sample. The salt water, prepared with NaCl and deionized water, was supplied to the sprayer. For the power-frequency test voltage, a test transformer was used.

The test sample was mounted vertically. There was enough clearance between the roof of the chamber and test sample and from the walls in order to avoid electrical field disturbance.
After this test the initial measurements were repeated and the results compared with the first initial results.

Result

The object passed the test.

The results of this measurement are summarized in appendix A, page 22 to 23.

3.2.2 UV-light test

For this test three samples were used. The insulator housing material was subjected to a 1000 h UV light according ISO 4892-1 and 4892-3, using type 1 fluorescent UV lamp with exposure method 1.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 23 to 24.

4 ARRESTER HOUSING

Standard and date

Standard	Client's instructions, based on IEC 60099-4, sub clause 8.2
Test date	2 August to 27 October 2016

4.1 Lightning impulse voltage test

Procedure

The dry arcing distance was larger than the value given by the equation given in IEC. No test was required. See chapter 8.1.1 of appendix A

4.2 Power-frequency voltage test

Procedure

The dry arcing distance in meter was larger than the test voltage in kV divided by 500 kV/m. No test was required. See chapter 8.1.2 of appendix A

5 ARRESTER SECTION

Standard and date

Standard	Client's instructions, based on IEC 60099-4, sub clauses 8.3 to 8.8 and 8.15
Test date	2 to 11 August 2016

5.1 Residual voltage test

All residual voltage tests were carried out on arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. By multiplying the measured residual voltage by the number of sections per arrester the equivalent residual voltage of the arrester was calculated.

5.1.1 Lightning impulse

Procedure
Three lightning current impulses with a waveform of 8/20 µs with a peak value of respectively 5 kA, 10 kA and 20 kA, this is respectively 0,5, 1 and 2 times the nominal discharge current, were applied to each of the three sections. The maximum value of the residual voltage was recorded.

Requirement
The equivalent residual voltage of the arrester at nominal discharge current (10 kA) should be below the specified residual voltage given in appendix A, page 2 or on the drawings.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 5 to 7. The waveshape is shown on page 25

5.1.2 Steep current

Procedure
One steep current impulse with a waveform of 1/5 µs and a peak value of 10 kA was applied to each of the three sections. The maximum value of the residual voltage was recorded.

Requirement
The equivalent residual voltage of the arrester at nominal discharge current should be below the specified steep current impulse residual voltage given in appendix A, page 2 or on the drawings.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 7 to 10 and the waveshapes are shown on pages 25 to 26.

5.2 Test to verify the repetitive charge transfer rating

Procedure
For this test 10 samples were used. The following initial measurements were performed:

- Residual voltage at nominal discharge current
- Reference voltage.

All samples were subjected to 20 long duration impulse currents with a transfer charge of $1,1 \times Q_{rs} = 1,1 \times 0,4 = 0,44$ C.

After this test the initial measurements were repeated and the results compared with the first initial results.

Requirement

- No evidence of puncture, flashover or other significant damage.
- Change of residual and reference voltage should be less than 5%.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 10 to 12 and the waveshapes are shown on page 26 to 32.

5.3 Test to verify long term stability under continuous operating voltage

Procedure
The test was performed on three new samples placed in a temperature controlled oven heated to 115 °C. The three samples were subjected to a long duration test with a corrected U_{cov} of 2,54 kV during 1000 hours. During the whole test duration, the resistive power losses are measured.

Requirement

- The overall increase of $P_{min} < 1,3 \times P_{min}$.
- The final measurement $P_{end} <= 1,1 \times P_{start}$.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 12 to 14.

5.4 Heat dissipation behavior verification of test sample

In order to prove that the test samples used during the operating duty test were thermal equivalent to the complete arrester, a test procedure explained in IEC 60099-4, Annex B has been carried out.

The result of this test is summarized in appendix A, page 14 to 15 (Fig 1). It has been proven that the test sample was thermal equivalent.

5.5 Operating duty test

Procedure

The operating duty test was carried out on three arrester sections mounted in a thermal equivalent test housing. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. Successively the following tests were carried out according figure 3 of IEC 60099-4.

During this test the test samples were placed in a prorated section. The thermal equivalency of the prorated section was determined in chapter 5.4 of this report.

The following initial measurements were performed:

- Residual voltage ate nominal discharge current
- Reference voltage.

Next, each sample was subjected to one high current impulse of 100 kA as conditioning. After this the samples were pre-heated to 60 °C. Next two lightning current impulses of 8/20 µs were applied, within 1 minute, each with a Q_{th} of 0,56 C to obtain a total Q_{th} of 1,12 C. Next, within 100 ms, a power frequency of 3,36 kV during 10 s and 2,69 kV during 30 minutes was applied.
During these 30 minutes the power dissipation of the sample was measured.

Following this and after the samples are cooled down to ambient temperature, the initial measurements were repeated and the results compared with the first initial results.

Requirement

- The measurement of the losses during the voltage application did not show thermal instability.
- Change of residual voltage should be less than 5%.
- No evidence of puncture, flashover or other significant damage.

Result

The object passed the test.

The results of this measurement are summarized in appendix A, page 15 to 16.

5.6 Power-frequency voltage-versus-time test

Procedure
For this test six samples were used. Two samples were used for the test sequence without prior duty and four samples were used for the test sequence with prior duty. The samples were pre-heated to 60 °C.
For the test sequence with prior duty, two lightning current impulses of 8/20 µs were applied, within 1 minute, each with a Q_{th} of 0,56 C to obtain a total Q_{th} of 1,12 C. Within 100 ms a power frequency voltage of 4,02 kV during 0,1 s for the first sample, 3,69 kV during 1,1 s for the second sample, 3,41 kV during 10,1 s for the third sample and 3,20 kV during 1200 s for the fourth sample was applied, followed by 2,69 kV during 30 minutes.

For the test sequence without prior duty, a power frequency voltage of 4,12 kV during 0,1 s for the first sample and 3,23 kV during 1200 s for the second sample was applied, followed by 2,70 kV during 30 minutes.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 16 to 18.

5.7 Test to verify the dielectric withstand of the internal components of an arrester

Procedure
This test was performed on one sample. The following initial measurements were performed:
- Residual voltage ate nominal discharge current
- Reference voltage.

Next, the sample was pre-heated to 60 °C and subjected to a high current impulse of 100 kA. After the sample was allowed to cool down the initial measurements were repeated and the results compared with the first initial results.

Result
The object passed the test.

The results of this measurement are summarized in appendix A, page 18 to 19.

6 PHOTOGRAPHS OF TEST OBJECT

Photographs of each type of arrester are presented in appendix A, page 41 to 43.

Batch of selected ZnO-blocks.

Mechanical and thermal preconditioning test as part of the bending moment test

Appendix A Test report of CEPRI Laboratory, Wuhan, China

电力工业电气设备质量检验测试中心

CEPRI

CMA 150008250711

ilac-MRA

CNAS 中国认可 国际互认 检测 TESTING CNAS L0699

EETC2016BL153J

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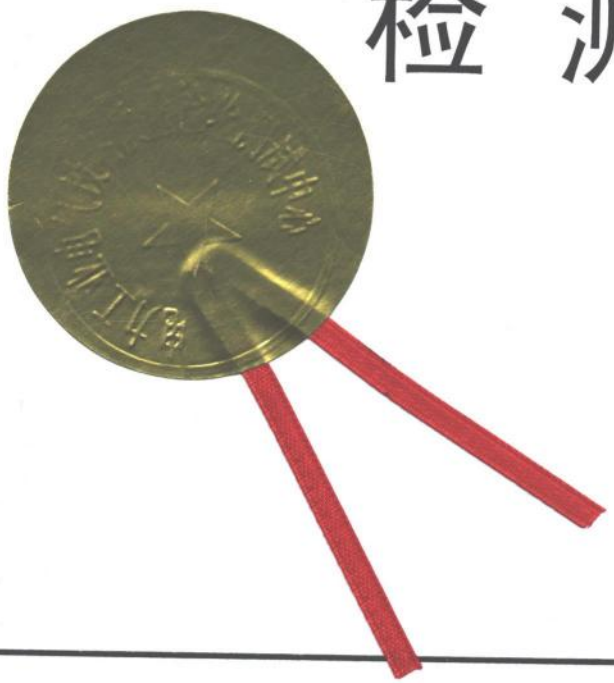


地　　址：　中国电力科学研究院
(湖北省武汉市洪山区珞喻路 143 号)
邮　　编：　430074
电　　话：　4006565689
传　　真：　(027)59378488
网　　址：　http://www.epri.sgcc.com.cn

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

Test Report

EETC2016BL153J

1 Client

Nanyang Zhongwei Electric Co., Ltd.

2 Sample Description

Name: Polymer-housed metal oxide surge arresters without gaps for a.c. systems

Type: YH10W-3, YH10W-6, YH10W-9, YH10W-12, YH10W-15, YH10W-18, YH10W-21, YH10W-24, YH10W-27, YH10W-30, YH10W-33, YH10W-36 (Φ45mm×20mm)

Manufacturer: Nanyang Zhongwei Electric Co., Ltd.

Sample No./Details: 5 complete arresters: type YH10W-36: (A1~A5),
9 thermally prorated sections (O1~O3, T1~T6)
16 resistors (R1~R3, S1~S3, L1~L10) 1 dielectrically prorated section (D1)
3 specimens of shed and housing materials(Y1～Y3) 12 housings (H1~H12)

3 Standards/Specifications

IEC60099-4 Edition 3.0 (2014-06) Metal-oxide surge arresters without gaps for a.c. systems

4 Test Category

Type Test

5 Test Date

01/08/2016-27/10/2016

6 Conclusion

Polymer-housed metal oxide surge arresters without gaps for a.c. systems of YH10W-3, YH10W-6, YH10W-9, YH10W-12, YH10W-15, YH10W-18, YH10W-21, YH10W-24, YH10W-27, YH10W-30, YH10W-33 and YH10W-36 have successfully passed the type test specified in IEC60099-4 Edition 3.0 (2014-06).

Tested by: _____

Checked by: _____

Verified by: _____

Approved by: _____

Date of issue: 2017.03.07

7 Inspection Items and Results

No.	Items		Requirements		Results	Evaluation
1	Insulation withstand tests on the arrester housing		Power-frequency voltage: (wet) $\geqslant 28kV_{r.m.s} \sim 90kV_{r.m.s}$, for 1min. Lightning impulse voltage : $60kV_p \sim 185kV_p$, Positive and negative 15 times each.		The dry arcing distance is larger than the value given by the equation, so the tests were not required.	Pass
2	Residual voltage test	Lightning impulse current	YH10W-3	≤8.3kV	8.1kV	Pass
			YH10W-6	≤16.6kV	16.1kV	
			YH10W-9	≤24.9kV	24.1kV	
			YH10W-12	≤33.2kV	32.2kV	
			YH10W-15	≤41.5kV	40.2kV	
			YH10W-18	≤49.8kV	48.2kV	
			YH10W-21	≤58.1kV	56.1kV	
			YH10W-24	≤66.4kV	64.3kV	
			YH10W-27	≤74.7kV	72.3kV	
			YH10W-30	≤83.0kV	80.3kV	
			YH10W-33	≤91.3kV	88.4kV	
			YH10W-36	≤99.6kV	96.4kV	
		Steep impulse current	YH10W-3	≤11.0kV	10.5kV	
			YH10W-6	≤20.0kV	19.3kV	
			YH10W-9	≤29.5kV	28.5kV	
			YH10W-12	≤39.0kV	37.3kV	
			YH10W-15	≤48.5kV	46.5kV	
			YH10W-18	≤58.0kV	55.2kV	
			YH10W-21	≤67.5kV	64.4kV	
			YH10W-24	≤77.0kV	73.2kV	
			YH10W-27	≤86.5kV	82.9kV	
			YH10W-30	≤96.0kV	91.6kV	
			YH10W-33	≤105.5kV	100.9kV	
			YH10W-36	≤115.0kV	109.6kV	
3	Repetitive charge transfer withstand test		10 samples should withstand 20 times 8/20μs lightning impulses and the charge value and the current should not less than 0.4C.		Q_{rs}: 0.440C~0.451C	Pass
4	Test to verify long term stability under continuous operating voltage		The accelerated ageing test of resistors should be carried out according to the specified procedure.		P_{max}-P_{min} <1.3P_{min}, P_{max} <1.1 P_{start}, the samples fulfilled the requirements.	Pass

No.	Items	Requirements	Results	Evalua-tion
5	Heat dissipation behavior verification test	The test section is for all instants during the cooling period have a temperature higher than the complete arrester.	Fulfilled the requirements. See fig 28.	Pass
6	Operating duty test	The switching surge operating duty test should be carried out according to the specified procedure. The residual voltage shall not have changed by more than 5%.	The three samples are carried out according to the specified procedure. The residual voltage changed ratio is from -1.16% to -0.90%.	
7	Power-frequency voltage-versus-time characteristics	Supply the Power frequency voltage-versus-time characteristics for the range of voltage from $1.22U_r$* to $0.95U_r$*, the range of time from 0.1s to 1200s.	With prior duty $1.20U_r$* 0.1s $1.10U_r$* 1.1s $1.02U_r$* 10.1s $0.95U_r$* 1200s	Pass
			Without prior duty $1.22U_r$* 0.1s $0.96U_r$* 1200s	
8	Test to verify the dielectric withstand of the internal components of an arrester	1 time 100kA-4/10μs	98.20kA, no puncture, flashover, cracking or other significant damage.	Pass
9	Bending moment	Bending load of SSL=260N for 60s～90s,and meet the evaluation requirements.	Bending load of SSL=260N for 63s, fulfilled the requirements.	Pass
10	Weather aging test	Samples should pass salt fog test, and meet the evaluation requirements.	Fulfilled the requirements.	Pass
		Samples should pass UV light test, and meet the evaluation requirements.	Fulfilled the requirements.	
11	Water immersion test	Put the samples into the boiling water with 0.1%NaCl for42 h: The change rate of power loss should not exceed 20%; the change rate of residual voltage should not exceed 5%; The partial discharge≤10pC	Δpower loss =+6.07%~+9.24% Δresidual voltage =-0.36%~+1.56% PD =0.1pC $\Delta U_{1mA.AC}$=-0.54%~-0.27%	Pass

8 Description of the Test

8.1 Insulation withstand tests on the arrester housing

Sample: 12 housings of arrester (H1~H12)

Requirements of standards:

8.1.1 Power-frequency voltage withstand test

Test data: the dry arcing distance value is large than the value given by the equation, so the tests were not required, the test data were listed in table 1.

Table 1 Power-frequency voltage withstand value calculation

Rated voltage，kV	3/6	9/12	15/18	21/24	27/30	33/36
IEC standard, kV_p	7.30/14.61	21.91/29.22	36.52/43.82	51.13/58.43	65.74/73.04	80.34/87.65
Manufacturer claimed, $kV_{r.m.s}$	28	35	45	60	75	90
Manufacturer claimed, kV_p	39.59	49.49	63.63	84.84	106.1	127.3
$d = [1.82 \times (e^{(U/859)} - 1)]^{0.833}$, m	0.129	0.157	0.194	0.250	0.304	0.357
Dry arcing distance actual, m	0.151	0.196	0.245	0.292	0.390	0.440

8.1.2 Lightning impulse voltage withstand test

Test data: The dry arcing distance value is large than the value given by the equation, so the tests were not required, the test data were listed in table 2.

Table 2 Lightning impulse voltage withstand value calculation

Rated voltage, kV	3/6	9/12	15/18	21/24	27/30	33/36
IEC standard, kV_p	10.79/21.58	32.37/43.16	53.95/64.74	75.53/86.32	97.11/107.9	118.7/129.5
Manufacturer claimed, kV_p	60	75	95	125	170	185
$d = U/500$, m	0.120	0.150	0.190	0.250	0.340	0.370
Dry arcing distance actual, m	0.151	0.196	0.245	0.292	0.390	0.440

8.2 Residual voltage test

Samples: 3 resistors (R1~R3)

Requirements of standards:

a. The residual voltage of samples are measured at 5kA, 10kA, 20kA by 8/20μs, then multiply a factor get the residual voltages of arrester. The maximum value of the determined residual voltages shall be drawn in a residual voltage versus discharge current curve. The residual voltage read on the

curve corresponding to the 10kA is defined as the lightning impulse protection level of the arrester.

b. The residual voltage of samples are measured at 10kA by 1/5μs, then ①multiply the sample impulse voltage curve by the scale factor, ② Use inductive voltage time function to ensure the inductive voltage drop of the arrester terminal. Add the result of ① and ② on a curve basis, the peak value of the resulting curve is the steep current impulse residual voltage of the arrester.

Test data: Fulfilled the requirements, the test data were listed in table 3～4, the test waveforms were shown in appendix A fig A.1.

8.2.1 Residual voltage test of lightning impulse current

Table 3 Residual voltages of lightning impulse current

Samples			R1	R2	R3
Residual voltage of the resistors, kV		8/20μs, 5kA	7.38	7.40	7.35
		8/20μs, 10kA	7.99	8.03	7.97
		8/20μs, 20kA	8.88	8.86	8.82
Residual voltage converted to complete arresters, kV	YH10W-3	Ratio, n	1		
		8/20μs, 5kA	7.38	7.40	7.35
		8/20μs, 10kA	7.99	8.03	7.97
		8/20μs, 20kA	8.88	8.86	8.82
		Equivalent U_{10kA}	8.1		
		U_{10kA} Required	8.3		
	YH10W-6	Ratio, n	2		
		8/20μs, 5kA	14.76	14.80	14.70
		8/20μs, 10kA	15.98	16.06	15.94
		8/20μs, 20kA	17.76	17.72	17.64
		Equivalent U_{10kA}	16.1		
		U_{10kA} Required	16.6		
	YH10W-9	Ratio, n	3		
		8/20μs, 5kA	22.14	22.20	22.05
		8/20μs, 10kA	23.97	24.09	23.91
		8/20μs, 20kA	26.64	26.58	26.46
		Equivalent U_{10kA}	24.1		
		U_{10kA} Required	24.9		
	YH10W-12	Ratio, n	4		
		8/20μs, 5kA	29.52	29.60	29.40

		8/20μs, 10kA	31.96	32.12	31.88
		8/20μs, 20kA	35.52	35.44	35.28
		Equivalent U_{10kA}	32.2		
		U_{10kA} Required	33.2		
	YH10W-15	Ratio, n	5		
		8/20μs, 5kA	36.90	37.00	36.75
		8/20μs, 10kA	39.95	40.15	39.85
		8/20μs, 20kA	44.40	44.30	44.10
		Equivalent U_{10kA}	40.2		
		U_{10kA} Required	41.5		
	YH10W-18	Ratio, n	6		
		8/20μs, 5kA	44.28	44.40	44.10
		8/20μs, 10kA	47.94	48.18	47.82
		8/20μs, 20kA	53.28	53.16	52.92
		Equivalent U_{10kA}	48.2		
		U_{10kA} Required	49.8		
	YH10W-21	Ratio, n	7		
		8/20μs, 5kA	51.66	51.80	51.45
		8/20μs, 10kA	55.93	56.21	55.79
		8/20μs, 20kA	62.16	62.02	61.74
		Equivalent U_{10kA}	56.3		
		U_{10kA} Required	58.1		
	YH10W-24	Ratio, n	8		
		8/20μs, 5kA	59.04	59.20	58.80
		8/20μs, 10kA	63.92	64.24	63.76
		8/20μs, 20kA	71.04	70.88	70.56
		Equivalent U_{10kA}	64.3		
		U_{10kA} Required	66.4		
	YH10W-27	Ratio, n	9		
		8/20μs, 5kA	66.42	66.60	66.15
		8/20μs, 10kA	71.91	72.27	71.73
		8/20μs, 20kA	79.92	79.74	79.38
		Equivalent U_{10kA}	72.3		
		U_{10kA} Required	74.7		

	YH10W-30	Ratio, n	10		
		8/20μs, 5kA	73.80	74.00	73.50
		8/20μs, 10kA	79.90	80.30	79.70
		8/20μs, 20kA	88.80	88.60	88.20
		Equivalent U_{10kA}	80.3		
		U_{10kA} Required	83.0		
	YH10W-33	Ratio, n	11		
		8/20μs, 5kA	81.18	81.40	80.85
		8/20μs, 10kA	87.89	88.33	87.67
		8/20μs, 20kA	97.68	97.46	97.02
		Equivalent U_{10kA}	88.4		
		U_{10kA} Required	91.3		
	YH10W-36	Ratio, n	12		
		8/20μs, 5kA	88.56	88.80	88.20
		8/20μs, 10kA	95.88	96.36	95.64
		8/20μs, 20kA	106.6	106.3	105.8
		Equivalent U_{10kA}	96.4		
		U_{10kA} Required	99.6		

8.3.2 Residual voltage test of steep impulse current

Table 4 Residual voltages steep impulse current

Samples			R1	R2	R3
Residual voltage of the metal blocks and resistors at 10kA, kV	Residual voltage of section		8.98	8.95	8.95
	Residual voltage of metal block		0.24		
	Residual voltage after correction		8.74	8.71	8.71
YH10W-3	①Residual voltage converted to complete arresters, kV	Ratio, n	1		
		U_{10kA}	8.74	8.71	8.71
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.175×10＝1.75		
	①+②:Residual voltage of arrester	After correction	10.49	10.46	10.46
		Equivalent U_{10kA}	10.5		
		U_{10kA} Required	11.0		

YH10W-6	①Residual voltage converted to complete arresters, kV	Ratio, n	2		
		U_{10kA}	17.48	17.42	17.42
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.175×10=1.75		
	①+②:Residual voltage of arrester	After correction	19.23	19.17	19.17
		Equivalent U_{10kA}	19.3		
		U_{10kA} Required	20.0		
YH10W-9	①Residual voltage converted to complete arresters, kV	Ratio, n	3		
		U_{10kA}	26.22	26.13	26.13
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.225×10=2.25		
	①+②:Residual voltage of arrester	After correction	28.47	28.38	28.38
		Equivalent U_{10kA}	28.5		
		U_{10kA} Required	29.5		
YH10W-12	①Residual voltage converted to complete arresters, kV	Ratio, n	4		
		U_{10kA}	34.96	34.84	34.84
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.225×10=2.25		
	①+②:Residual voltage of arrester	After correction	37.21	37.09	37.09
		Equivalent U_{10kA}	37.3		
		U_{10kA} Required	39.0		
YH10W-15	①Residual voltage converted to complete arresters, kV	Ratio, n	5		
		U_{10kA}	43.70	43.55	43.55
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.275×10=2.75		
	①+②:Residual voltage of arrester	After correction	46.45	46.30	46.30
		Equivalent U_{10kA}	46.5		
		U_{10kA} Required	48.5		

YH10W-18	①Residual voltage converted to complete arresters, kV	Ratio, n	6		
		U_{10kA}	52.44	52.26	52.26
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.275×10=2.75		
	①+②:Residual voltage of arrester	After correction	55.19	55.01	55.01
		Equivalent U_{10kA}	55.2		
		U_{10kA} Required	58.0		
YH10W-21	①Residual voltage converted to complete arresters, kV	Ratio, n	7		
		U_{10kA}	61.18	60.97	60.97
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.320×10=3.20		
	①+②:Residual voltage of arrester	After correction	64.38	64.17	64.17
		Equivalent U_{10kA}	64.4		
		U_{10kA} Required	67.5		
YH10W-24	①Residual voltage converted to complete arresters, kV	Ratio, n	8		
		U_{10kA}	69.92	69.68	69.68
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.320×10=3.20		
	①+②:Residual voltage of arrester	After correction	73.12	72.88	72.88
		Equivalent U_{10kA}	73.2		
		U_{10kA} Required	77.0		
YH10W-27	①Residual voltage converted to complete arresters, kV	Ratio, n	9		
		U_{10kA}	78.66	78.39	78.39
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.415×10=4.15		
	①+②:Residual voltage of arrester	After correction	82.81	82.54	82.54
		Equivalent U_{10kA}	82.9		
		U_{10kA} Required	86.5		

YH10W-30	①Residual voltage converted to complete arresters, kV	Ratio, n	10		
		U_{10kA}	87.40	87.10	87.10
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.415×10=4.15		
	①+②:Residual voltage of arrester	After correction	91.55	91.25	91.25
		Equivalent U_{10kA}	91.6		
		U_{10kA} Required	96.0		
YH10W-33	①Residual voltage converted to complete arresters, kV	Ratio, n	11		
		U_{10kA}	96.14	95.81	95.81
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.465×10=4.65		
	①+②:Residual voltage of arrester	After correction	100.8	100.5	100.5
		Equivalent U_{10kA}	100.9		
		U_{10kA} Required	105.5		
YH10W-36	①Residual voltage converted to complete arresters, kV	Ratio, n	12		
		U_{10kA}	104.9	104.5	104.5
	②inductive voltage drop, kV	$U_L=h\times I_n$	0.465×10=4.65		
	①+②:Residual voltage of arrester	After correction	109.5	109.2	109.2
		Equivalent U_{10kA}	109.6		
		U_{10kA} Required	115.0		

8.3 Repetitive charge transfer withstand test

Samples: 10 resistors (L1~L10)

Requirements of standards: 10 samples should withstand 20 times 8/20μs lightning impulses and the charge value should not less than claimed repetitive charge rating multiplied by 1.1. If not more than one sample failure during the 20 times impulse, test passed. After test, the samples should have no mechanical damage at visual inspection; the change of reference voltage and residual voltage at I_n should not exceed 5%.

Test data: Fulfilled the requirements, the test data were listed in the table 5, the test waveforms were shown in appendix A fig A.2.

Table 5 Repetitive charge transfer withstand test

Samples		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
Before test	$U_{1mA\cdot AC}$, kV	3.40	3.39	3.37	3.37	3.41	3.37	3.37	3.40	3.41	3.41
	8/20μsU_{10kA}, kV	7.83	7.81	7.82	7.88	7.98	7.78	7.77	7.99	7.97	8.04
Q_{rs}, C		0.4									
1st	Q_{rs}, C	0.448	0.448	0.448	0.446	0.443	0.447	0.451	0.442	0.443	0.443
2nd	Q_{rs}, C	0.447	0.449	0.447	0.446	0.441	0.446	0.448	0.442	0.443	0.441
3rd	Q_{rs}, C	0.447	0.448	0.448	0.446	0.442	0.447	0.448	0.442	0.443	0.441
4th	Q_{rs}, C	0.446	0.447	0.448	0.445	0.441	0.446	0.447	0.440	0.442	0.440
5th	Q_{rs}, C	0.447	0.447	0.447	0.446	0.443	0.447	0.448	0.443	0.442	0.440
6th	Q_{rs}, C	0.446	0.447	0.445	0.445	0.442	0.446	0.447	0.440	0.442	0.441
7th	Q_{rs}, C	0.446	0.448	0.446	0.445	0.443	0.446	0.447	0.442	0.442	0.440
8th	Q_{rs}, C	0.445	0.446	0.447	0.444	0.441	0.446	0.448	0.441	0.441	0.441
9th	Q_{rs}, C	0.449	0.448	0.447	0.446	0.442	0.446	0.447	0.441	0.442	0.442
10th	Q_{rs}, C	0.449	0.446	0.446	0.444	0.441	0.445	0.446	0.440	0.440	0.441
11th	Q_{rs}, C	0.447	0.447	0.446	0.445	0.442	0.447	0.446	0.441	0.442	0.442
12th	Q_{rs}, C	0.446	0.446	0.446	0.444	0.441	0.445	0.447	0.440	0.442	0.441
13th	Q_{rs}, C	0.448	0.447	0.446	0.445	0.441	0.446	0.446	0.441	0.441	0.441
14th	Q_{rs}, C	0.445	0.446	0.445	0.444	0.440	0.446	0.446	0.440	0.441	0.442
15th	Q_{rs}, C	0.447	0.447	0.446	0.445	0.441	0.446	0.447	0.442	0.443	0.441
16th	Q_{rs}, C	0.445	0.445	0.446	0.444	0.440	0.444	0.446	0.441	0.442	0.440
17th	Q_{rs}, C	0.446	0.447	0.449	0.446	0.443	0.446	0.448	0.440	0.441	0.440
18th	Q_{rs}, C	0.446	0.445	0.445	0.445	0.441	0.446	0.445	0.441	0.440	0.441
19th	Q_{rs}, C	0.446	0.446	0.446	0.444	0.440	0.446	0.446	0.441	0.443	0.443
20th	Q_{rs}, C	0.445	0.445	0.445	0.444	0.441	0.444	0.446	0.441	0.443	0.443
Test evaluation	One 8/20 current impulse, kA	$0.5kA/cm^2=0.5*3.14*(4.5/2)^2=7.95kA$									
		8.38	8.37	8.37	8.25	8.11	8.38	8.39	8.04	8.28	8.18
	$U_{1mA\cdot AC}$, kV	3.32	3.31	3.28	3.31	3.38	3.33	3.30	3.38	3.36	3.35
	Change rate, %	-2.35	-2.36	-2.67	-1.78	-0.88	-1.19	-2.08	-0.59	-1.47	-1.76

	8/20μsU_{10kA}, kV	7.90	7.81	7.87	7.88	8.01	7.84	7.84	8.01	8.04	8.06
	Change rate, %	+0.89	0	+0.64	0	+0.38	+0.77	+0.90	+0.25	+0.88	+0.25
	Visual inspection	No puncture, flashover or cracking.									

8.4 Test to verify long term stability under continuous operating voltage

Samples: 3 resistors (S1～S3)

Requirements of standards: the MO resistors shall be heated to 115℃±4K for 1000h and the power loss shall be measured at U_c after the voltage application. If any increase of power losses from P_{min} is not greater than 1.3 times P_{min} during the remaining test period and all measurements of power losses throughout the ageing period, including the final measurement P_{end} is not greater than 1.1 times P_{start}, the test passed.

Test data: Fulfilled the requirements, the test data were listed in table 6 and table 7, the accelerated ageing curves were shown in appendix A fig A.3.

8.4.1 Accelerated ageing test

Table 6 Accelerated ageing test

Time	Power losses, W		
	Φ45mm×20mm，voltage applied=2.54kV, 114℃～116℃		
	S1	S2	S3
2016/8/9	1.29	1.28	1.26
2016/8/10	1.18	1.15	1.13
2016/8/11	1.11	1.08	1.06
2016/8/12	1.07	1.04	1.02
2016/8/13	1.04	1.01	0.99
2016/8/14	1.02	0.99	0.97
2016/8/15	1.01	0.97	0.95
2016/8/16	0.99	0.95	0.93
2016/8/17	0.97	0.94	0.92
2016/8/18	0.93	0.89	0.87
2016/8/19	0.93	0.89	0.88
2016/8/20	0.92	0.89	0.87
2016/8/21	0.91	0.88	0.86

2016/8/22	0.91	0.87	0.85
2016/8/23	0.90	0.87	0.85
2016/8/24	0.90	0.86	0.84
2016/8/25	0.89	0.85	0.84
2016/8/26	0.89	0.85	0.83
2016/8/27	0.88	0.84	0.83
2016/8/28	0.88	0.84	0.83
2016/8/29	0.88	0.84	0.82
2016/8/30	0.87	0.84	0.82
2016/8/31	0.87	0.83	0.81
2016/9/1	0.86	0.82	0.80
2016/9/2	0.86	0.83	0.81
2016/9/3	0.86	0.82	0.80
2016/9/4	0.86	0.82	0.80
2016/9/5	0.85	0.82	0.80
2016/9/6	0.85	0.81	0.79
2016/9/7	0.85	0.81	0.79
2016/9/8	0.85	0.81	0.79
2016/9/9	0.84	0.81	0.79
2016/9/10	0.83	0.80	0.78
2016/9/11	0.83	0.80	0.78
2016/9/12	0.83	0.80	0.78
2016/9/13	0.83	0.79	0.77
2016/9/14	0.82	0.79	0.77
2016/9/15	0.83	0.79	0.77
2016/9/16	0.83	0.79	0.77
2016/9/17	0.83	0.79	0.77
2016/9/18	0.82	0.78	0.76
2016/9/19	0.82	0.78	0.76
2016/9/20	0.82	0.78	0.76

Table 7 Power losses relationship

Samples	S1	S2	S3
$U_{1mA\cdot AC}$, kV	3.28	3.28	3.28
U_C, $kV_{r.m.s.}$	2.54		
Power losses P_{start}, 3h, W	1.29	1.28	1.26
Power losses P_{end}, 1000+11h, W	0.82	0.78	0.76
P_{max}, W	1.29	1.28	1.26
P_{min}, W	0.82	0.78	0.76
$(P_{max}- P_{min}) / 1.3P_{min}$	0.44	0.49	0.51
$P_{max}/1.1P_{start}$	0.91	0.91	0.91
Note：（1）Because $P_{max}- P_{min} < 1.3P_{min}$, $P_{max} < 1.1P_{start}$, the samples fulfilled the requirements. （2）The temperature of samples:115±4℃.			

8.5 Heat dissipation behavior verification of test sample

Samples: 1 thermally prorated section (O1), 1 arrester (A5)

Requirements of standards: the MO resistors in the sample shall be heated to 140℃ by the application of power-frequency voltage. When the temperature is reached, the voltage source shall be disconnected and the cooling time curve shall be determined. At any time, the measured cooling curve of section falls shall below the measured cooling curve of the unit.

Test data: Fulfilled the requirements, the test curve was shown in fig 1.

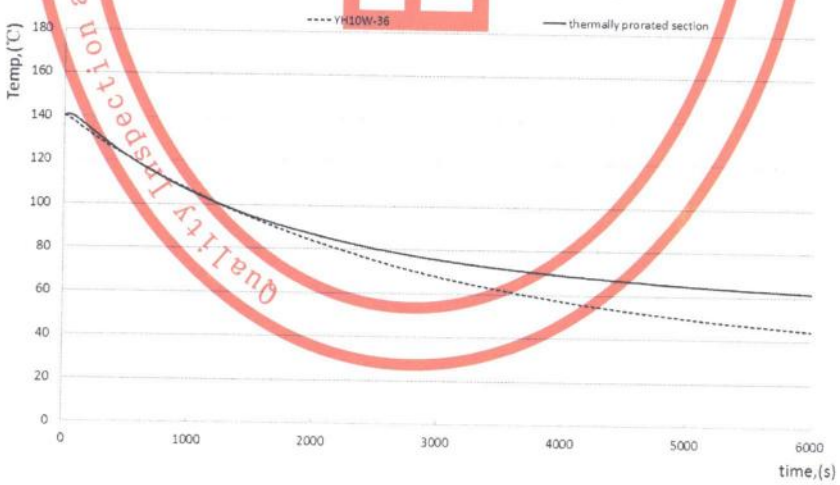


Fig 1 the cooling curve for the section and arrester

The test section is for all instants during the cooling period have a temperature higher than the complete arrester, it proved thermal equivalency.

8.6 operating duty test

Samples: 3 thermally prorated sections (O1~O3)

Requirements of standards: The 3 sections should pass the test of operating duty test of established procedure.

Test data: The tests are carried out according to the specified procedure, the test data are listed in table 8. The waveforms are shown in appendix A fig A.4.

Table 8 operating duty test

Samples			O1	O2	O3
$U_{1mA.AC}$, kV			3.36	3.36	3.36
U_{sr}, $kV_{r.m.s.}$			3.36	3.36	3.36
U_{sc}, $kV_{r.m.s.}$			2.69	2.69	2.69
8/20μs, U_{10kA} ,before, kV			7.75	7.78	7.76
Conditioning test	One high current impulse, kA		100.0	99.6	99.6
preheated samples			preheated samples to 60℃±3℃		
Rated thermal charge transfer, Q_{th}	Lightning current impulse	1st Q_{th} , C	0.564	0.561	0.565
		2nd Q_{th}, C	0.563	0.560	0.565
	Q_{th} rating (2 times) , C		1.127	1.121	1.130
Applied voltage after 2nd impulse	Time	Req.	as short as possible (within 100ms)		
		Actual	85.6	85.8	86.6
	Applied voltage and duration	U_{sr}*, $kV_{r.m.s}$	3.36	3.36	3.36
		Duration, s	10	10	10
		U_{sc}*, $kV_{r.m.s}$	2.69	2.69	2.69
		Duration, min	30	30	30
Power loss, W	5 min		5.15	7.48	5.08
	10 min		5.03	6.90	4.93
	15 min		4.96	6.45	4.79
	20 min		4.82	6.11	4.65

	25 min	4.98	5.85	4.47
	30 min	4.87	5.74	4.56
Samples cooled to		cooled to ambient 20℃±15℃		
8/20μs, U_{10kA} ,after, kV		7.66	7.71	7.66
Variability of the residual voltage, %		-1.16	-0.90	-1.29
Visual inspection		No puncture, flashover, cracking or other significant damage		

8.7 Power-frequency voltage-versus-time test

Samples: 6 thermally prorated sections (T1~T6)

Requirements of standards: The 6 sections of arrester should pass the power-frequency voltage-versus-time test.

Test data: Fulfilled the requirements, the test data were listed in table 9 and table 10, the TOV curve was shown in fig 2, the test waveforms were shown in appendix A fig A.5.

Table 9 Power-frequency voltage-versus-time test data (with prior duty)

Samples			T1	T2	T3	T4
$U_{1mA.AC}$, kV			3.35	3.35	3.34	3.37
U_{sr}, $kV_{r.m.s.}$			3.35	3.35	3.34	3.37
U_{sc}, $kV_{r.m.s.}$			2.68	2.68	2.67	2.70
8/20μs, U_{10kA} ,before, kV			7.76	7.72	7.74	7.85
preheated samples			preheated samples to 60℃±3℃			
Lightning current impulse	1st impulse	Q_{th} ,C	0.565	0.567	0.565	0.562
	2nd impulse	Q_{th},C	0.562	0.564	0.565	0.560
	Q_{th} rating (2 times)	C	1.127	1.131	1.13	1.122
Applied voltage after 2nd impulse	Time	Req.	as short as possible (within 100ms)			
		Actual	85.0	87.2	87.2	88.0
	Applied voltage and duration	U^*_{sr}, $kV_{r.m.s}$	4.02	3.69	3.41	3.20
		TOV scale	1.20	1.10	1.02	0.95
		Duration, s	0.1	1.1	10.1	1200
		U^*_{sc}, $kV_{r.m.s}$	2.69	2.69	2.67	2.67

		Duration, min	30	30	30	30
Power loss, W	5 min		2.60	2.75	2.74	4.32
	10 min		2.55	2.55	2.79	3.89
	15 min		2.49	2.49	2.61	3.46
	20 min		2.41	2.44	2.55	3.23
	25 min		2.38	2.39	2.49	3.01
	30 min		2.34	2.35	2.45	2.92
Samples cooled to			cooled to ambient 20℃±15℃			
8/20μs, U_{10kA} ,after, kV			7.76	7.71	7.71	7.88
Variability of the residual voltage, %			0	-0.13	-0.39	+0.38
Visual inspection			No puncture, flashover, cracking or other significant damage			

Table 10 Power-frequency voltage-versus-time test data (without prior duty)

Samples			T5	T6
$U_{1mA.AC}$, kV			3.38	3.36
U_{sr}, $kV_{r.m.s.}$			3.38	3.36
U_{sc}, $kV_{r.m.s.}$			2.70	2.69
8/20μs, U_{10kA} ,before, kV			7.92	7.82
preheated samples			preheated samples to 60℃±3℃	
Applied voltage	Applied voltage and duration	U^*_{sr}, $kV_{r.m.s}$	4.12	3.23
		TOV scale	1.22	0.96
		Duration, s	0.1	1200
		U^*_{sc}, $kV_{r.m.s}$	2.70	2.70
		Duration, min	30	30
Power loss, W	5 min		1.79	2.58
	10 min		1.80	2.41
	15 min		1.77	2.36
	20 min		1.78	2.32

	25 min	1.77	2.23
	30 min	1.80	2.22
Samples cooled to		cooled to ambient 20℃±15℃	
8/20μs, U_{10kA} ,after, kV		7.92	7.83
Variability of the residual voltage, %		0	+0.13
Visual inspection		No puncture, flashover, cracking or other significant damage	

The test results: Fulfilled the requirements.

Fig 2 Power-frequency voltage-versus-time curve

8.8 Test to verify the dielectric withstand of the internal components of an arrester

Samples: 1 dielectrically prorated section (D1)

Requirements of standards: preheat the sample to 60℃, consists of one application of a 100kA high-current impulse. There should be no evidence of a dielectric breakdown. The test data were listed in table 11, the test waveforms were shown in appendix A fig A.6., the dimensional of dielectrically prorated section were shown in fig D19.

Table 11 Test to verify the dielectric withstand of the internal components of an arrester

Sample	D1
$U_{1mA.AC}$, kV	3.33
8/20μs, U_{10kA}, before, kV	8.10
Preheated samples	preheated samples to 60℃±3℃
high-current impulse, kA	98.20

Samples cooled to	cooled to ambient 20℃±15℃
8/20μs, U_{10kA}, after, kV	8.02
Variability of the residual voltage, %	-0.99
Visual inspection	No puncture, flashover, cracking or other significant damage

8.9 Bending moment

Samples: 3 arresters(A1～A3)

Requirements of standards: the test of bending moment shall be performed one after the other on three samples as follows:

Step 1.1: subject two of the samples to a bending moment test. The bending load shall be increased smoothly to specified short-term load (SSL) within 30s to 90s. When the test load is reached, it shall be maintained for 60s to 90s.

Step 1.2: subject the third sample to mechanical/thermal preconditioning test.

Step 2: subject all three samples to the water immersion test.

8.9.1 Bending moment (part 1: on sample A1)

（1） Measure the power loss, partial discharge, residual voltage before the thermo-mechanical preconditioning test;

（2） After terminal torque preconditioning of established procedure, the sample should withstand the cold-heat cycling test at +60℃±5K to -25℃±5K, and +45℃±5K to -40℃±5K. Each cycling time is 48 hours. The temperature of the hot and cold periods shall be maintained for at least 16h. During the test, the continuous static mechanical load of 50% F_s should be applied, its direction change rates every 24 hours, the interruption time should not exceed 1h.

（3） The test samples shall be kept immersed in a vessel, in boiling deionized water with 1kg/m^3 of NaCl for 42h.

（4） Measure the power loss and partial discharge ,and then put two successive impulses at nominal discharge current in 50 to 60s, which the wave shape shall be in the range of T_1/T_2=(4 to 10)/(10 to 25)μs.

（5） After test, there should be no visible mechanical damage. The change rate of power loss should not exceed 20%, the change rate of $U_{1mA.AC}$ should not exceed 2%, the change rate of residual voltage should not exceed 5%, the change of leakage current should not exceed 20μA, the partial discharge should not exceed 10pC.

Test data: Fulfilled the requirements, the test data were listed in table 12.

Table 12 Bending moment test part 1

Sample			A1
Before test	Power loss, mW		2147
	Partial discharge, pC		0.1
	Residual voltage, 10kA, 7/16μs, kV		83.6
	$U_{1mA.AC}$, kV		36.9
Terminal torque preconditioning	Torque applied to arrester, N·m		30.0
	Duration, s		30
Thermo-mechanical preconditioning	Specified short-term load(SLL), N		100
	Actual applied, N		100
	Load angle, temperature and duration		Time: 2016.08,05,17:30~2016.08,06,17:30 Temperature: +58~+62°C，Load angle:0°
			Time: 2016.08,06,17:30~2016.08,07,17:30 Temperature: -26~-23°C，Load angle:180°
			Time: 2016.08,07,17:30~2016.08,08,17:30 Temperature: +43~+46°C，Load angle:270°
			Time: 2016.08,08,17:30~2016.08,09,17:30 Temperature: -41~-38°C，Load angle:90°
			Maintained time of highest and lowest temperature > 16 h Interruption time < 0.5 h
Boiling water immersion test	The test samples shall be kept immersed in a vessel, in boiling deionized water with 1kg/m^3 of NaCl for 42h.		Time: 2016.08.09,17:40~2016.08.11,12:00. Put the sample into the boiling water with 0.1%NaCl, then remove the sample placed under ambient temperature, dry 7h after the sample has cooled to ambient temperature then finish the verification test in 1h
Verification test	Power loss	Value, mW	2327
		Change rate, %	+8.38
	Partial discharge, pC		0.1
	2 times impulses at nominal	1st impulse	9.98kA, 85.3kV
		2nd impulse	9.94kA, 84.9kV

	discharge current	Residual voltage change rate, %	-0.47
	Residual voltage 10kA, 7/16μs	Value, kV	84.9
		Change rate %	+1.56
	$U_{1mA.AC}$	Value, kV	36.8
		Change rate,%	-0.27
Sample check	No visible mechanical damage		

8.9.2 Bending moment (part 2: on sample A2 and A3)

（1） Measure the power loss, partial discharge, residual voltage before the bending moment test.

（2） The arresters were mounted to the horizontal base of the test equipment and loading was applied at a rate necessary to reach the desired bending moment in 30s to 90 s. After reaching the target load, the load should maintained 60s to 90s and the deflection shall be measured. After release of load, the residual deflection shall be measured.

（3） After the bending moment test, there is no visible mechanical damage and no mutating at the deflection-load, the remaining permanent deflection should not exceed 5% of the length of the housing.

（4） The samples shall pass water immersion test. The change rate of power loss should not exceed 20%, the change rate of residual voltage should not exceed 5%, the partial discharge should not exceed 10pC.

Test data: Fulfilled the requirements, the test data were listed in table 13, the waveforms were shown in appendix A fig A.7.

Note [1]: Polymer-housed metal-oxide surge arresters without enclosed gas volume need not seal checks before test.

Table 13 Bending moment test part 2

Samples		A2	A3
Before bending moment test	Power loss, mW	2060	2078
	Partial discharge, pC	0.1	0.1
	Residual voltage, 10kA, 7/16μs, kV	85.0	84.5
	$U_{1mA.AC}$, kV	36.9	36.7
Bending moment test	Specified short-term load(SSL), N	260	
	Actual applied, N	260	260
	Time, s	63	63

After bending moment test	Sample check		No visible mechanical damage	
	Residual deflection	Housing height, mm	465	465
		Maximum deflection, mm	40.36	25.03
		Residual deflection, mm	16.4	9.58
	Seal inspection	Hot water immersion test	No continuous bubbles	
Boiling water immersion test	Boiling water with 0.1%NaCl for 42 h		Time: 2016.08.09,17:40~2016.08.11,12:00.	
Verification test	Power loss	Value, mW	2185	2270
		Change rate, %	+6.07	+9.24
	Partial discharge, pC		0.1	0.1
	2 times impulses at nominal discharge current	1st impulse	10.28kA, 86.6kV	10.04kA, 84.3kV
		2nd impulse	10.40kA, 85.7kV	10.01kA, 84.2kV
		Residual voltage change rate, %	-1.04	-0.12
	Residual voltage, 10kA, 7/16μs	Value, kV	85.7	84.2
		Change rate, %	+0.82	-0.36
	$U_{1mA.AC}$	Value, kV	36.7	36.5
		Change rate, %	-0.54	-0.54
Sample check	No visible mechanical damage.			

8.10 Weather ageing test

8.10.1 Salt fog test

Sample: 1 arrester(A4)

Requirements of standards: The sample should pass salt fog test of established procedure.

Test data: Fulfilled the requirements, the test data were listed in table 14. The test sample successfully withstood the 1000h salt fog test with no evidence of surface tracking, erosion, or puncturing.

Table 14 Weather ageing test

Sample		A4
Before test	$U_{1mA.AC}$, kV	37.1
	Partial discharge, pC	0.1
Test condition	Test time: 1008h Water flow rate: 0.4L/m^3·h Size of droplets: 5~10μm	

	Temperature: 21~25 ºC NaCl content of water: 1.0kg/m^3		
Test procedure	The sample should withstand salt fog test for 1000h while the continuous operating voltage is applied. It is allowed to have 6 times power supply interruptions during the test, every interruption may not exceed 15min.		①Applied voltage U_c = 28.8$kV_{r.m.s}$
			②Begin time：2016.08.05 17:00 End time：2016.09.16 10:00
			③Power supply interruption times: 1, each interruption < 10min; salt-frog interruption times:2, each interruption < 15 min.
Test estimate	Corrosion tests without tracking, not through the entire thickness of the outer layer until the next layer of material, the shed and housing should be no breakdown.		Arrester over current a time, no leakage and trial traces of corrosion is not through the entire thickness of the outer layer until the next layer of material, the shed is not breakdown.
After test	$U_{1mA\cdot AC}$	value, kV	37.5
		change rate, %	+1.08
	Partial discharge, pC		0.1

8.10.2 UV light test

Samples: 3 specimens of shed and housing materials(Y1~Y3)

Requirements of standards: The samples should pass UV light test of established procedure, the roughness R_z should not exceed 0.1mm.

Test data: Fulfilled the requirements, the test data were listed in table 15. The test specimens successfully withstood the 1000 hours UV light test, the surface of specimens had no cracks and raised areas.

Table 15 UV light test

Samples	Y1	Y2	Y3
Test condition	Test time: 1000 h Irradiance of around: 0.76W/m^2		
	Temperature: 60～63℃ for 8h UV light 49～52 ºC for 4h condensation		
Test procedure	The sample should withstand UV light test for 1000 hours. 4 hours condensation after 8 hours UV light		Begin time：2016.08.11 16:00 End time：2016.09.22 17:00

	test, circular 1000 hours.		
R_z, μs	0.213	0.311	0.203
$R_z \leqslant 0.01$mm, Fulfilled the requirements			
Sample check	No visible cracks and raised areas		

8.11 Water immersion test

Samples:3 arresters(A1～A3)

Requirements of standards: Before test, measure the power loss, partial discharge, residual voltage, then immerse the samples into the boiling water of 0.1% NaCl for 42h, then cooled to normal temperature in air for 8 hours; After the test, measure the power loss, partial discharge, residual voltage. The requirements as following:

a. The change rate of power loss should not exceed 20%;

b. the change rate of residual voltage should not exceed 5%;

c. The partial discharge $\leqslant$ 10pC;

d. The change rate of $U_{1mA.AC}$ should not exceed 2%;

Test data: Fulfilled the requirements, the test data were listed in table 16.

Table 16 Water immersion test

Samples			A1	A2	A2
Before test	Power loss, mW		2147	2060	2078
	Partial discharge, pC		0.1	0.1	0.1
	Residual voltage,10kA, kV		83.6	85.0	84.5
	$U_{1mA.AC}$, kV		36.9	36.9	36.7
Water immersion test	Put into boiling water with 0.1%NaCl for 42 h				
After test	Power loss	Value, mW	2327	2185	2270
		Change rate, %	+8.38	+6.07	+9.24
	Partial discharge, pC		0.1	0.1	0.1
	Residual voltage, 10kA	Value, kV	84.9	85.7	84.2
		Change rate, %	+1.56	+0.82	-0.36
	$U_{1mA.AC}$	Value，kV	36.8	36.7	36.5
		Change rate, %	-0.27	-0.54	-0.54

Appendix A: The typical test waveform

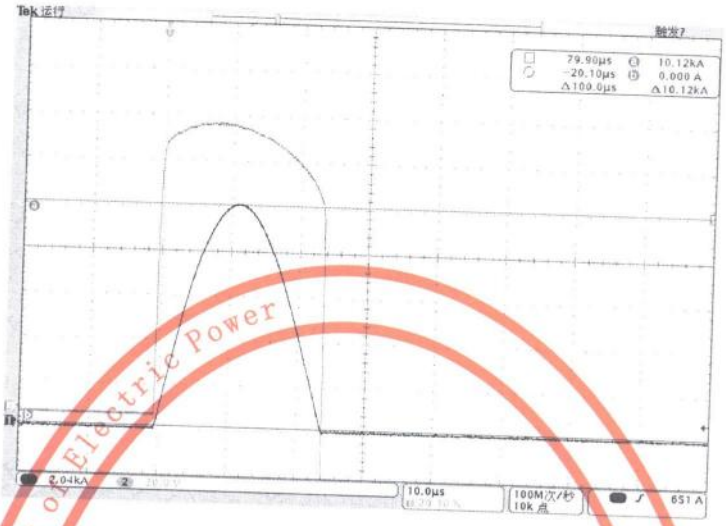


Fig A.1.1 Lightning impulse current, Sample R1, 8/20μs, 0.025V/A

Fig A.1.2 Lightning impulse residual voltage, Sample R1, 8/20μs, K_d=62.0

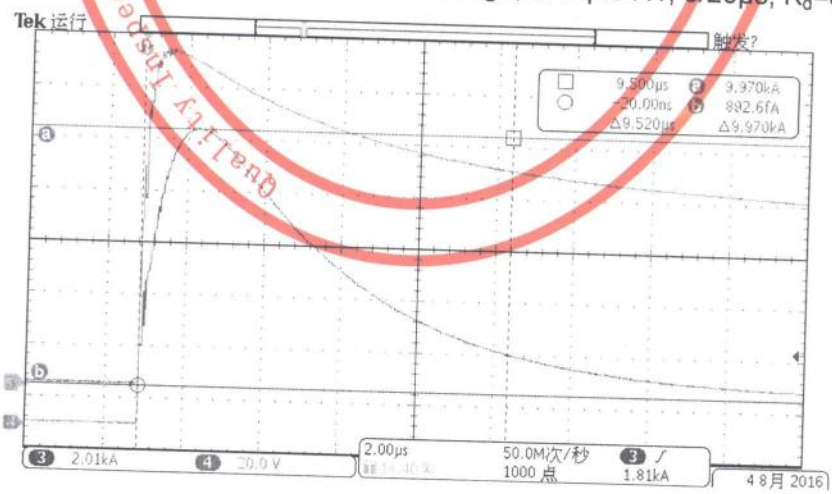


Fig A.1.3 Steep impulse current, Sample R1, 1/5μs, 0.025V/A

Fig A.1.4 Steep impulse residual voltage, Sample R1, 1/5μs, K_d=62.0

Fig A.2.1 the 1st time of sample L1, Repetitive charge transfer withstand, 0.001V/A

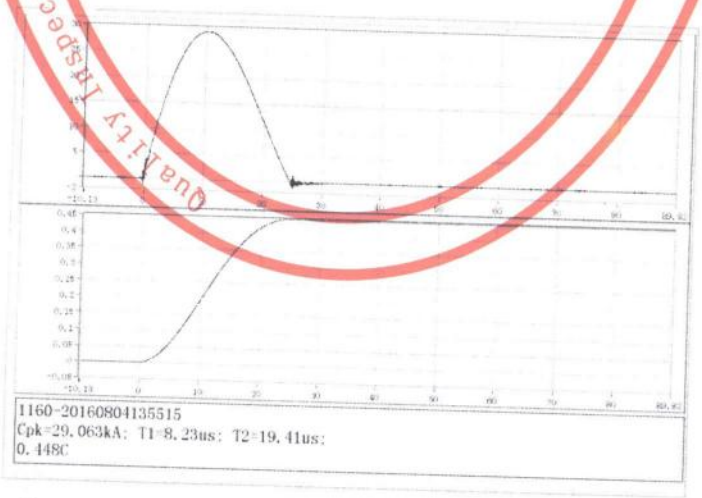


Fig A.2.2 the 1st time of sample L2, Repetitive charge transfer withstand, 0.001V/A

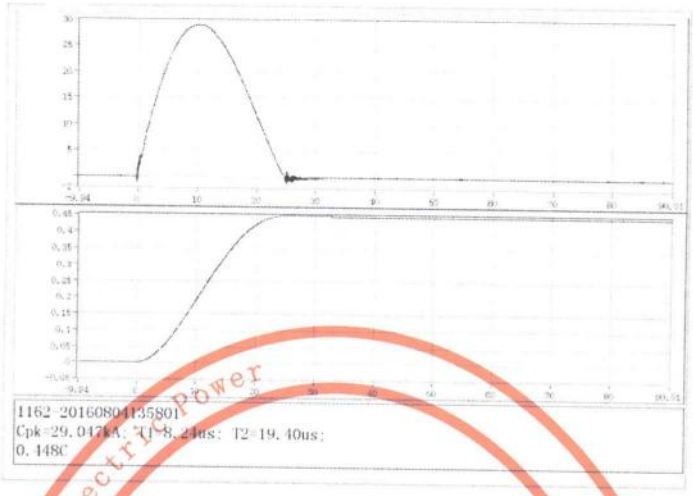


Fig A.2.3 the 1st time of sample L3, Repetitive charge transfer withstand, 0.001V/A

Fig A.2.4 the 1st time of sample L4, Repetitive charge transfer withstand, 0.001V/A

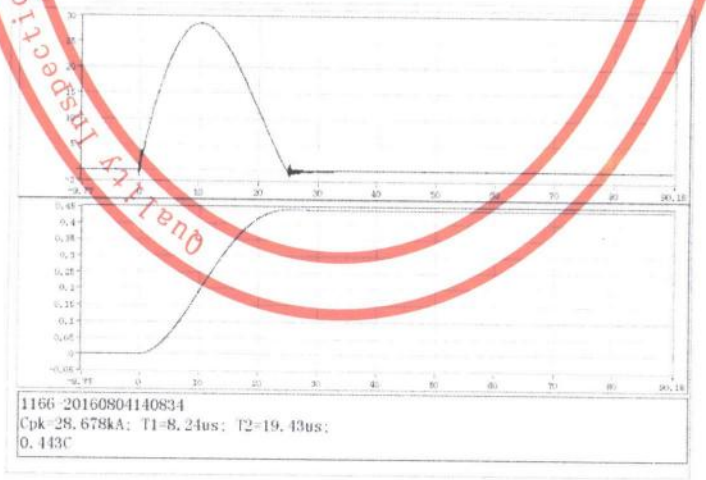


Fig A.2.5 the 1st time of sample L5, Repetitive charge transfer withstand, 0.001V/A

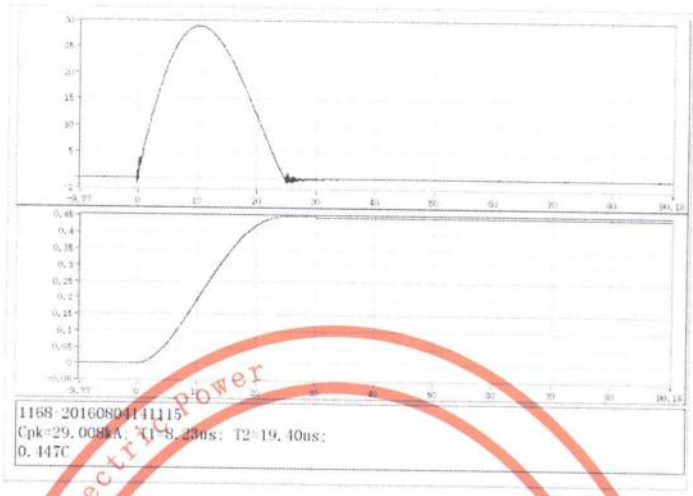


Fig A.2.6 the 1st time of sample L6, Repetitive charge transfer withstand, 0.001V/A

Fig A.2.7 the 1st time of sample L7, Repetitive charge transfer withstand, 0.001V/A

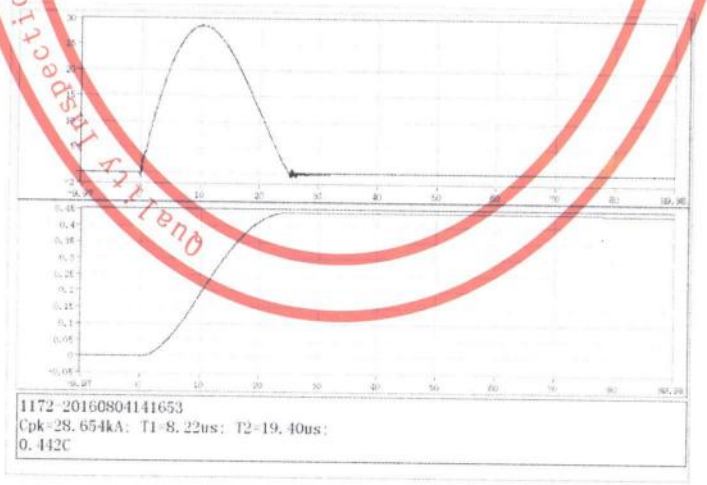


Fig A.2.8 the 1st time of sample L8, Repetitive charge transfer withstand, 0.001V/A

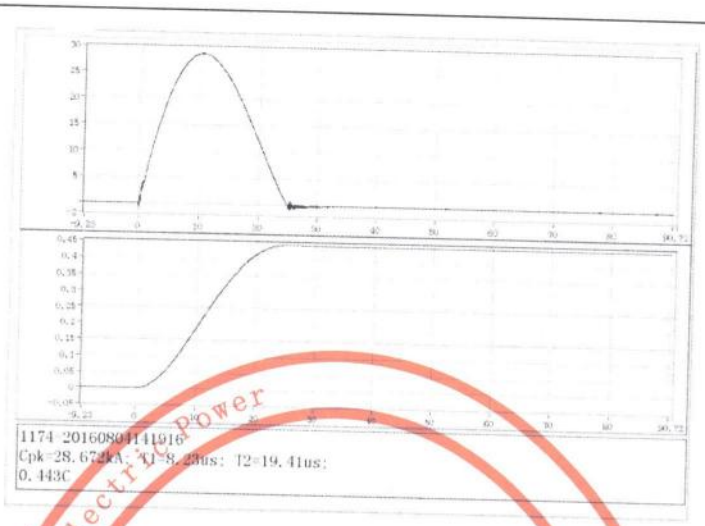


Fig A.2.9 the 1st time of sample L9, Repetitive charge transfer withstand, 0.001V/A

Fig A.2.10 the 1st time of sample L10, Repetitive charge transfer withstand, 0.001V/A

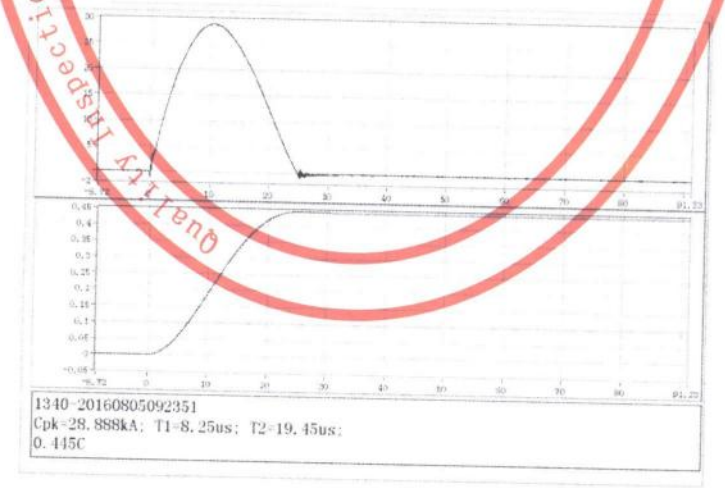


Fig A.2.11 the 20th time of sample L1, Repetitive charge transfer withstand, 0.001V/A

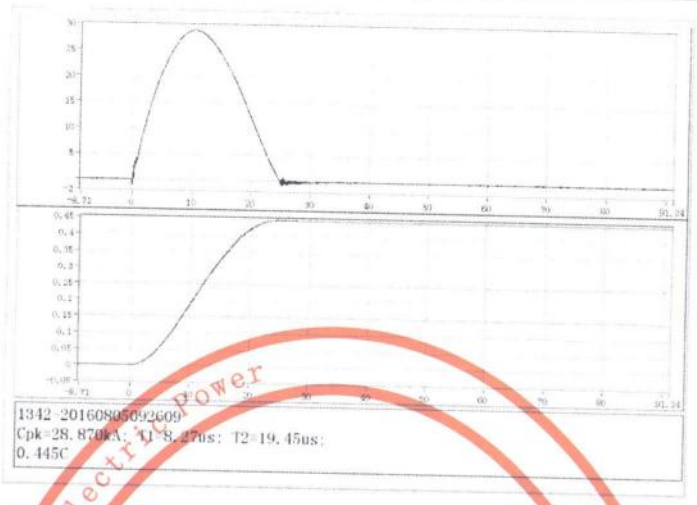


Fig A.2.12 the 20th time of sample L2, Repetitive charge transfer withstand, 0.001V/A

Fig A.2.13 the 20th time of sample L3, Repetitive charge transfer withstand, 0.001V/A

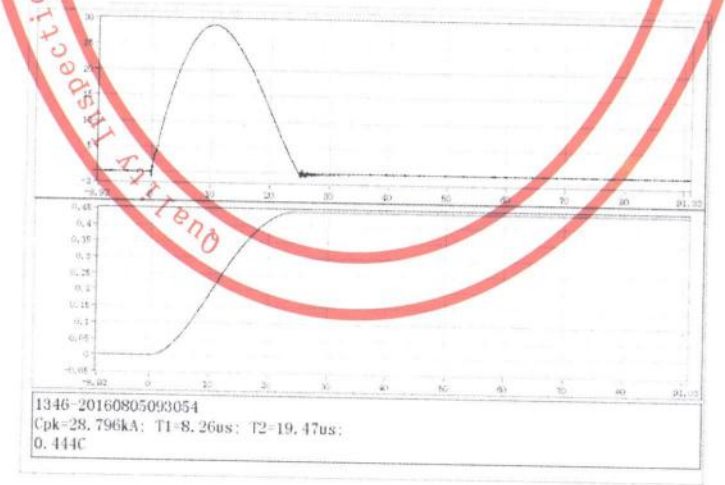


Fig A.2.14 the 20th time of sample L4, Repetitive charge transfer withstand, 0.001V/A

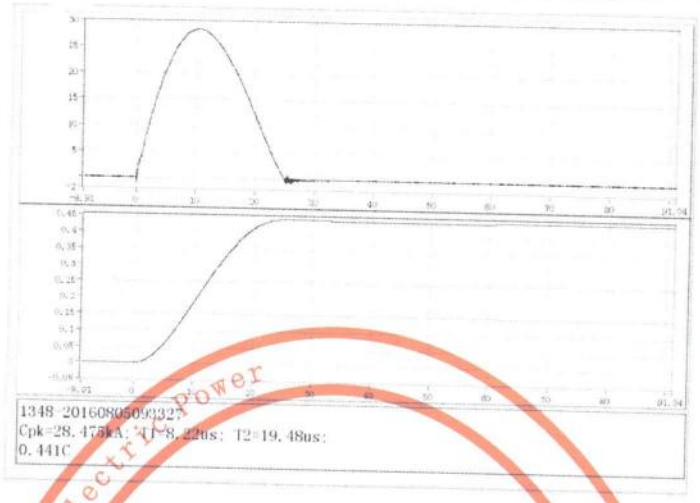


Fig A.2.15 the 20th time of sample L5, Repetitive charge transfer withstand, 0.001V/A

Fig A.2.16 the 20th time of sample L6, Repetitive charge transfer withstand, 0.001V/A

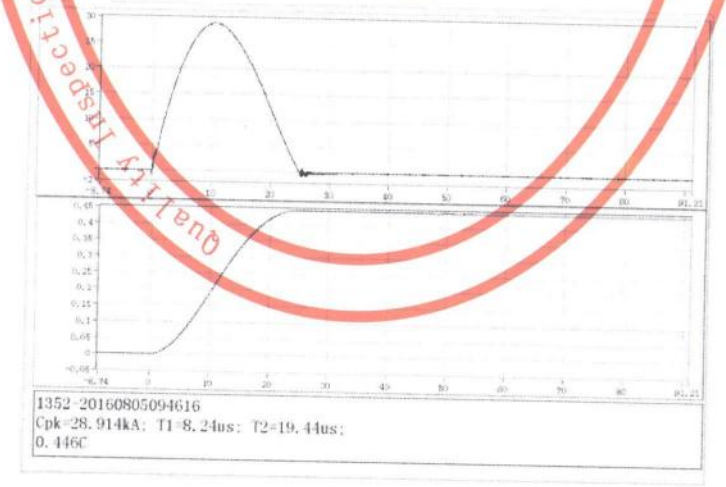


Fig A.2.17 the 20th time of sample L7, Repetitive charge transfer withstand, 0.001V/A

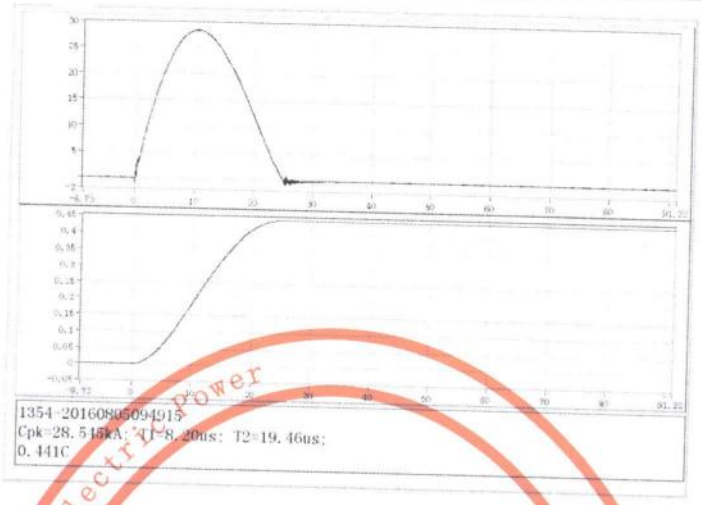


Fig A.2.18 the 20th time of sample L8, Repetitive charge transfer withstand, 0.001V/A

Fig A.2.19 the 20th time of sample L9, Repetitive charge transfer withstand, 0.001V/A

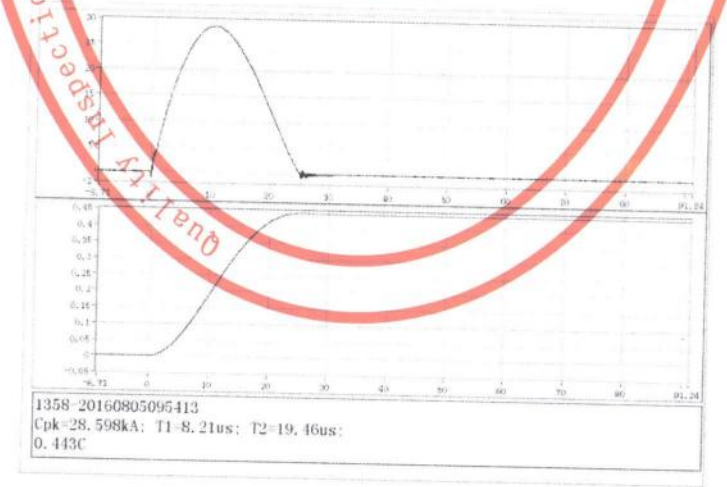


Fig A.2.20 the 20th time of sample L10, Repetitive charge transfer withstand, 0.001V/A

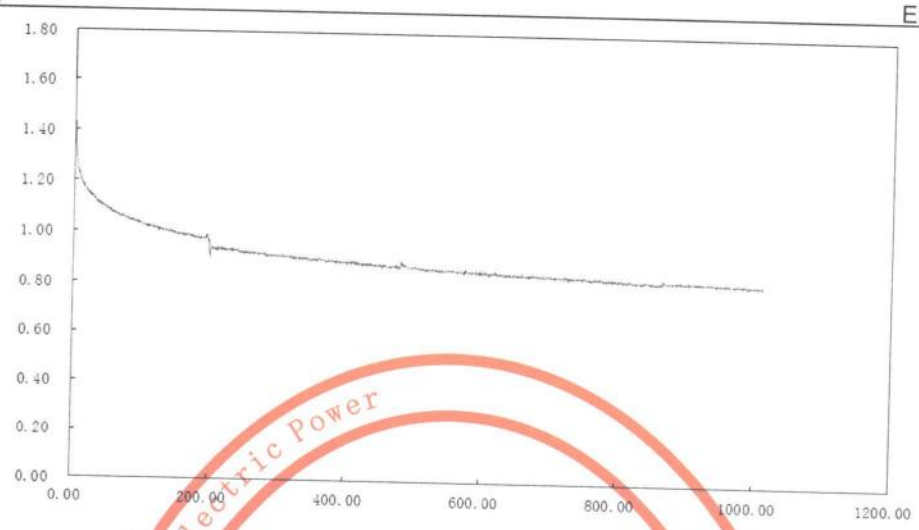


Fig A.3.1 The Acc elerated ageing curve of sample S1

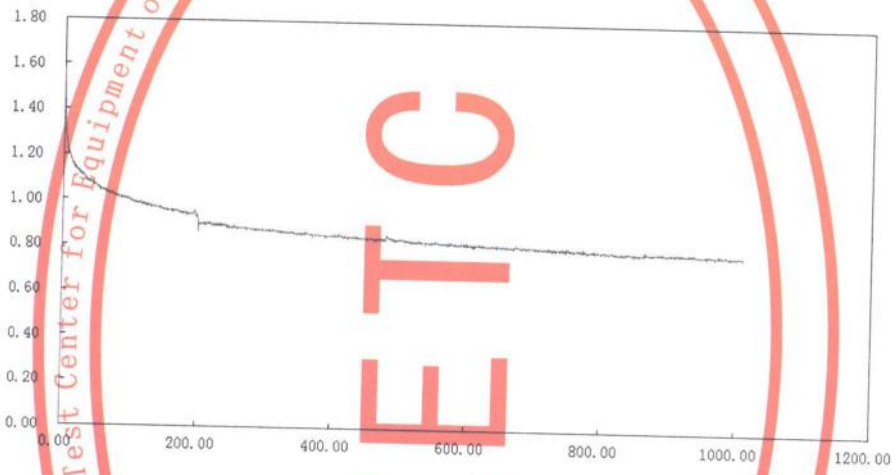


Fig A.3.2 The Accelerated ageing curve of sample S2

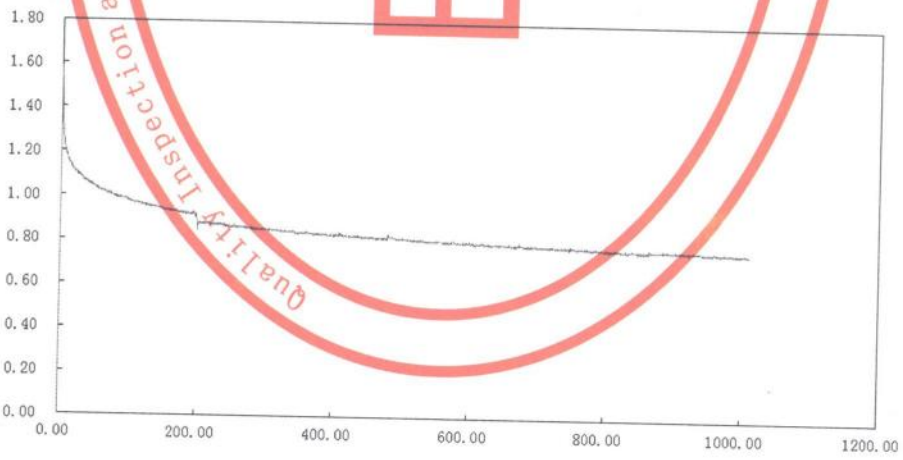


Fig A.3.3 The Accelerated ageing curve of sample S3

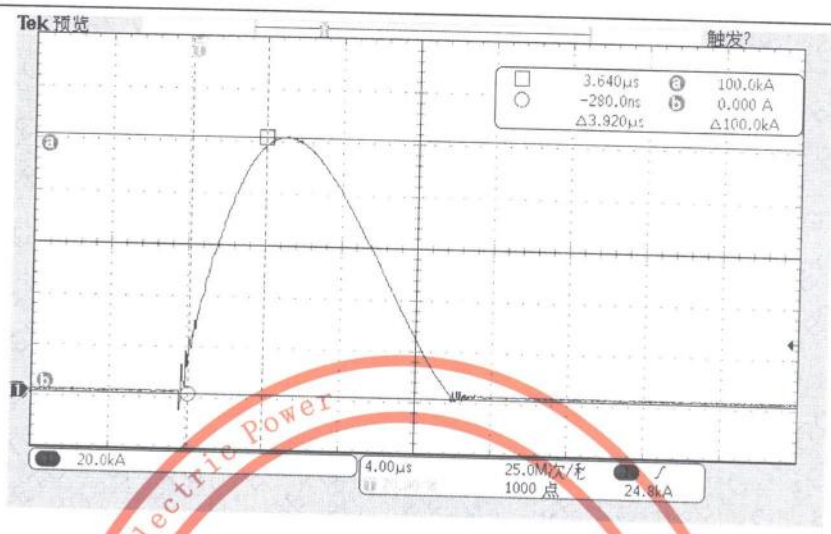


Fig A.4.1 High current waveform, sample O1, 0.001V/A

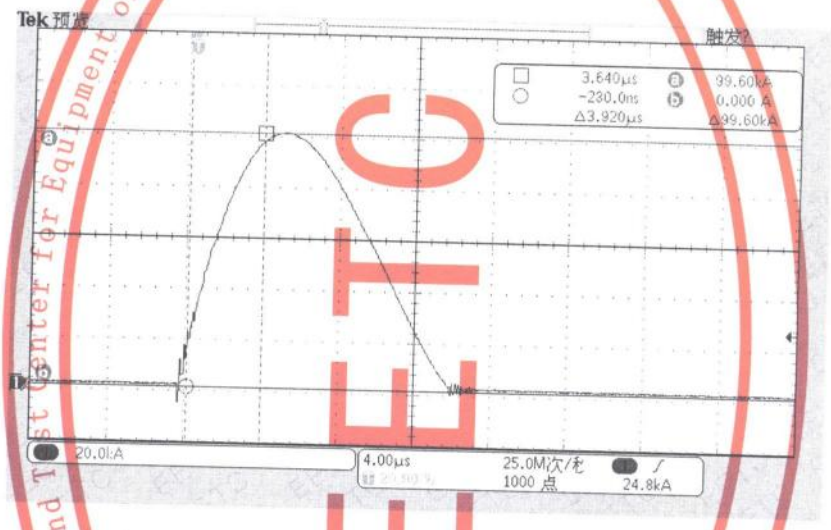


Fig A.4.2 High current waveform, sample O2, 0.001V/A

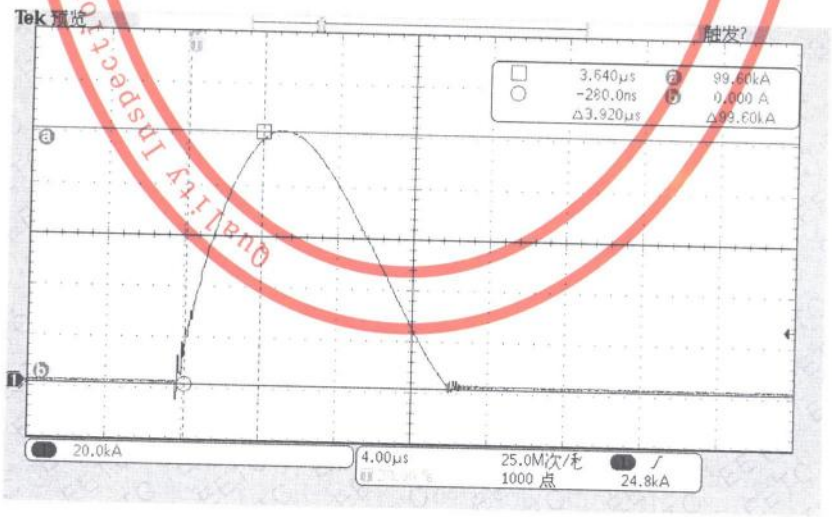


Fig A.4.3 High current waveform, sample O3, 0.001V/A

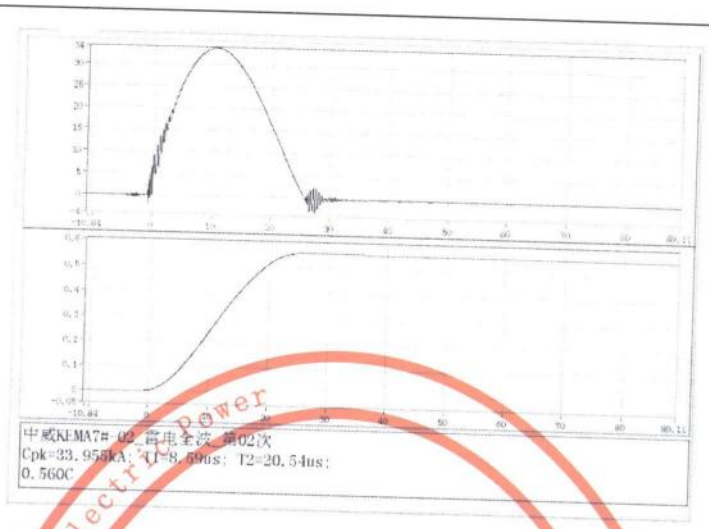


Fig A.4.4 Lightning impulse current, 2nd time, sample O2, 0.001V/A

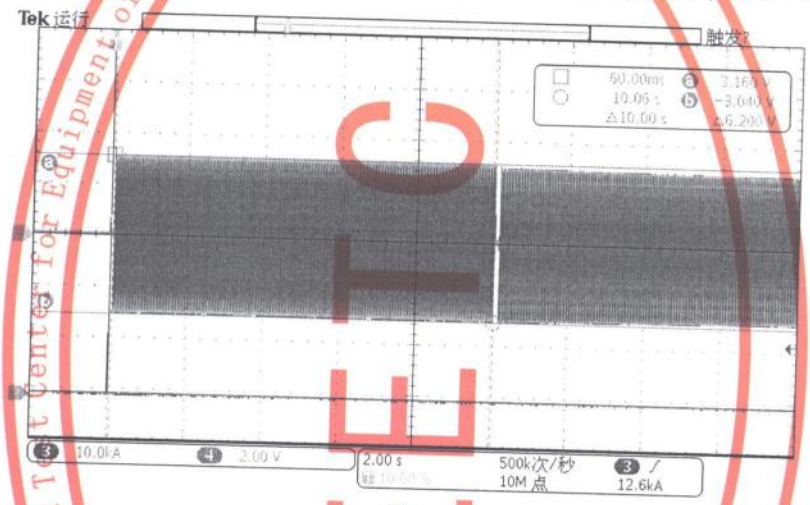


Fig A.4.5 Operating duty waveform, sample O1, K_s=1540

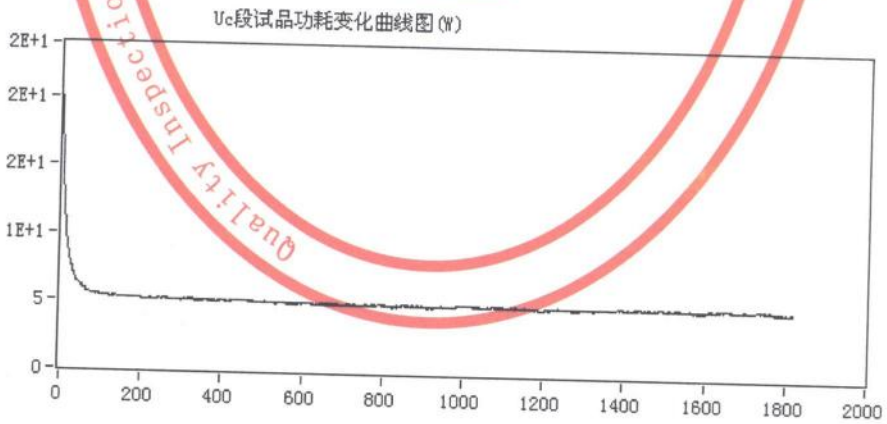


Fig A.4.6 sample O1, power loss curve on U_c

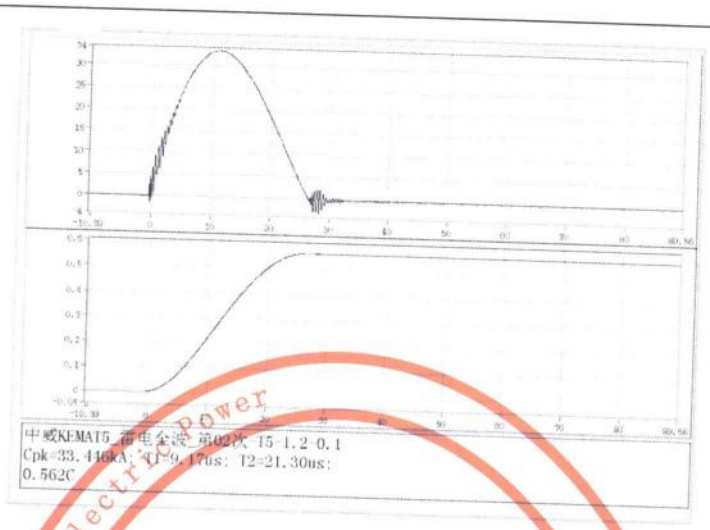


Fig A.5.1 Lightning impulse current, 2nd time, sample T1, 0.001V/A

Fig A.5.2 Power frequency voltage-versus-time characteristics sample T1, 1.20U_r*, 0.1s, K_s=1540

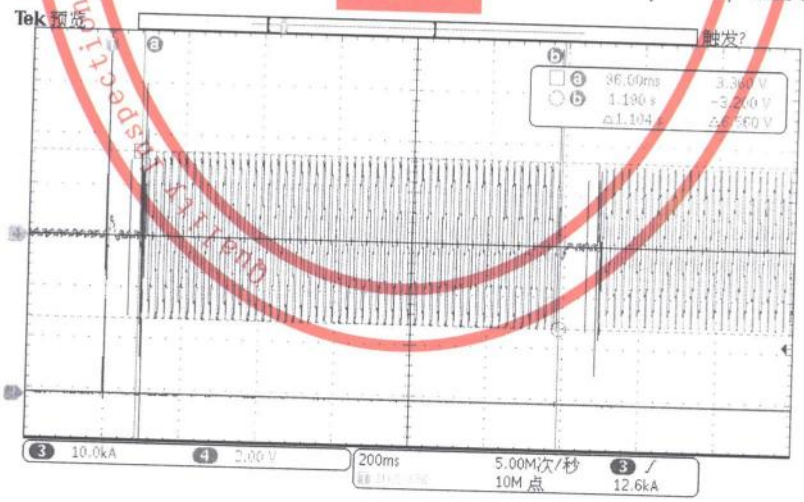


Fig A.5.3 Power frequency voltage-versus-time characteristics sample T2, 1.10U_r*, 1.1s, K_s=1540

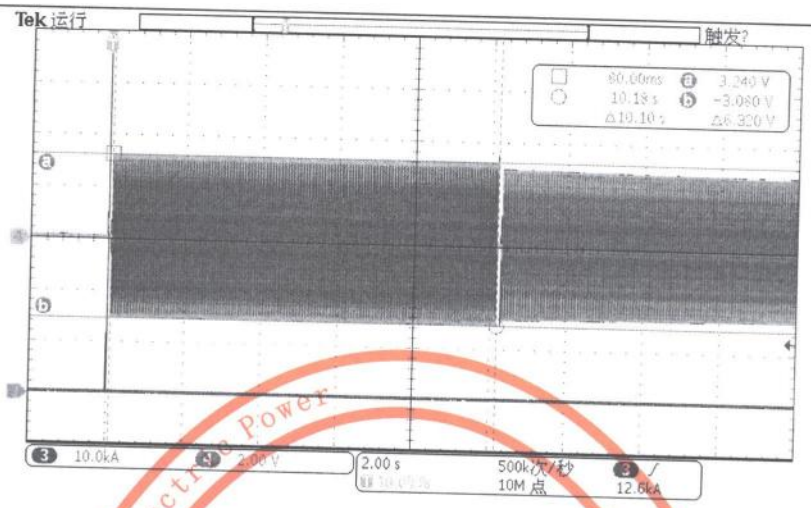


Fig A.5.4 Power frequency voltage-versus-time characteristics sample T3, 1.02U_r*, 10.1s, K_s=1540

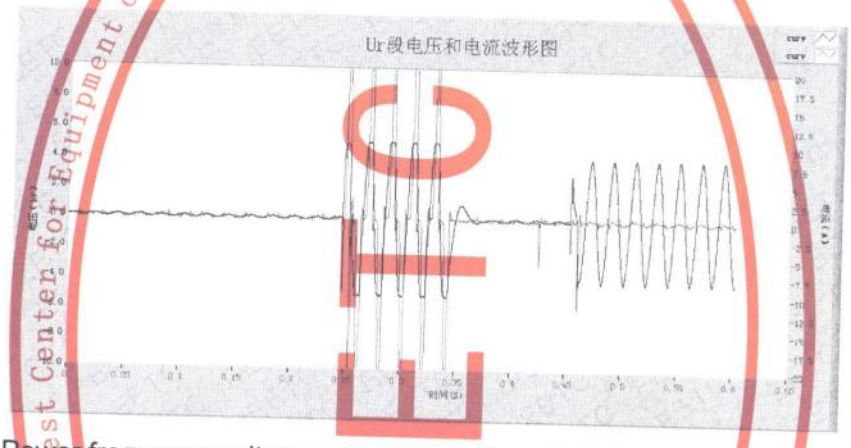


Fig A.5.5 Power frequency voltage-versus-time characteristics sample T5, 1.22U_r*, 0.1s

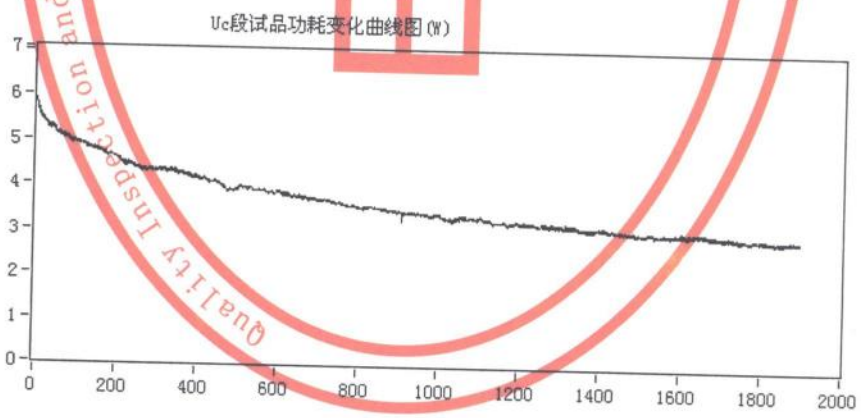


Fig A.5.6 sample T4, power loss curve on U_c

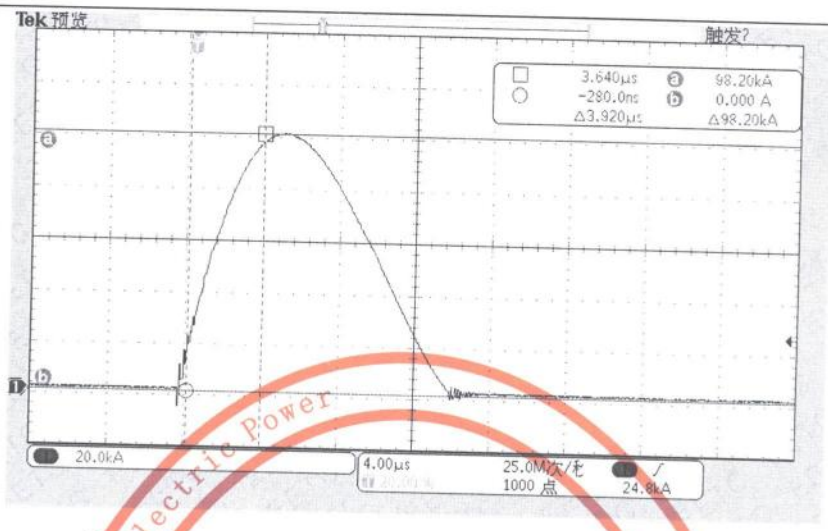


Fig A.6 High current waveform, sample D1, 0.001V/A

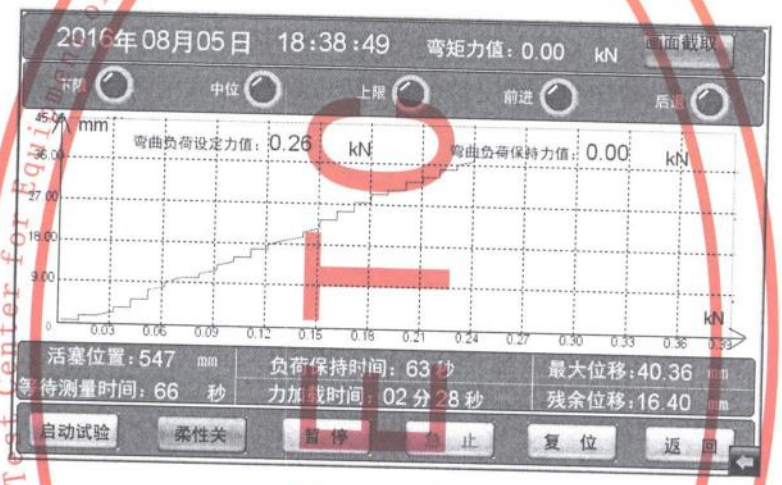


Fig A.7.1 short-term load withstand curve of A2

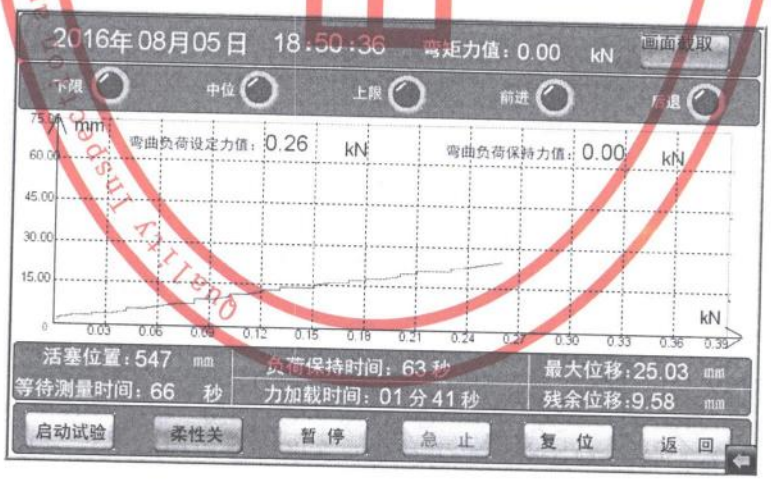


Fig A.7.2 short-term load withstand curve of A3

Appendix B: Main performance parameters of arrester

YH10W-3

Rated voltage U_r: 3kV Continuous operating voltage U_c: 2.4kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 8.3kV

YH10W-6

Rated voltage U_r: 6kV Continuous operating voltage U_c: 4.8kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 16.6kV

YH10W-9

Rated voltage U_r: 9kV Continuous operating voltage U_c: 7.2kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 24.9kV

YH10W-12

Rated voltage U_r: 12kV Continuous operating voltage U_c: 9.6kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 33.2kV

YH10W-15

Rated voltage U_r: 15kV Continuous operating voltage U_c: 12kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 41.5kV

YH10W-18

Rated voltage U_r: 18kV Continuous operating voltage U_c: 14.4kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 49.8kV

YH10W-21

Rated voltage U_r: 21kV Continuous operating voltage U_c: 16.8kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 58.1kV

YH10W-24

Rated voltage U_r: 24kV Continuous operating voltage U_c: 19.2kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 66.4kV

YH10W-27

Rated voltage U_r: 27kV Continuous operating voltage U_c: 21.6kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 74.7kV

YH10W-30

Rated voltage U_r: 30kV Continuous operating voltage U_c: 24kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 83kV

YH10W-33

Rated voltage U_r: 33kV Continuous operating voltage U_c: 26.4kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 91.3kV

YH10W-36

Rated voltage U_r: 36kV Continuous operating voltage U_c: 28.8kV

Nominal discharge current I_n: 10kA Lightning impulse residual voltage U_{res}: ⩽ 99.6kV

Appendix C: Main test device

NO	Device name	Device NO.	Measurement	Uncertainty /Accuracy	Calibration institution	Expiration date
1	Current impulse generator	BL003	8/20μs: 0~100kA 4/10μs: 0~150kA 30/80μs: 0~50kA Voltage: 0~20kV	2%	The fifth (xi'an) measurement and test center of mechanical industry	2017-06-05
2	Long-duration (rectangular) current impulse generator	BL002	Current: 0~1 kA Voltage: 0~20 kV	2%	The fifth (xi'an) measurement and test center of mechanical industry	2017-06-05
3	Steep current impulse generator	BL004	1/5μs: 20 kA Voltage: 0~20 kV	2%	The fifth (xi'an) measurement and test center of mechanical industry	2017-06-05
4	DP04034 Digital storage oscilloscope	BLW067	0~300V	2%	Hubei institute of measurement and testing technology	2017-07-11
5	MOA-RCD4_4 resistance current tester	BLW003	0~10mA	3%	National center for high voltage measurement	2017-03-11
6	1400 kV AC High Voltage generator	S3-9-36	0~1400kV	/	/	/
	AC capacitive voltage divider	YQ209	0~1200kV	3%	National center for high voltage measurement	2017-03-12
7	4000 kV impulse voltage generator	17020001003	0~4000kV	/	/	/
	Damping impulse voltage divider	YQ212	0~3000kV	3%	National center for high voltage measurement	2018-08-05
8	Digital high voltage table	BL010	0~300kV	3%	National center for high voltage measurement	2017-09-24
9	DMI Digital voltage table	BLW017	0~1600V	1%	National center for high voltage measurement	2017-08-03
10	60kN mechanical testing machine	BL014	0~60kN	3%	Hubei institute of measurement and testing technology	2017-09-02
11	Laser Displacement Sensor	BLW014	/	3%	Hubei institute of measurement and testing technology	2017-09-18
12	Aneroid barometer	BLW023	/	1%	Hubei province meteorological metrological verification station	2017-10-16

Appendix D: Visual and dimensional check

Fig D1: Outside view of YH10W-3 and YH10W-6

Fig D2: Outside view of YH10W-9 and YH10W-12

Fig D3: Outside view of YH10W-15 and YH10W-18

Fig D4: Outside view of YH10W-21 and YH10W-24

Fig D5: Outside view of YH10W-27 and YH10W-30

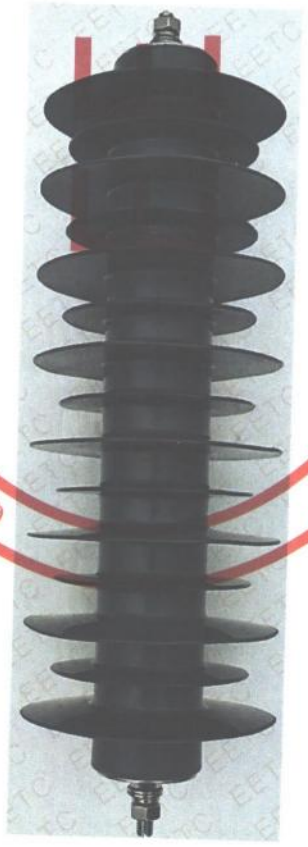
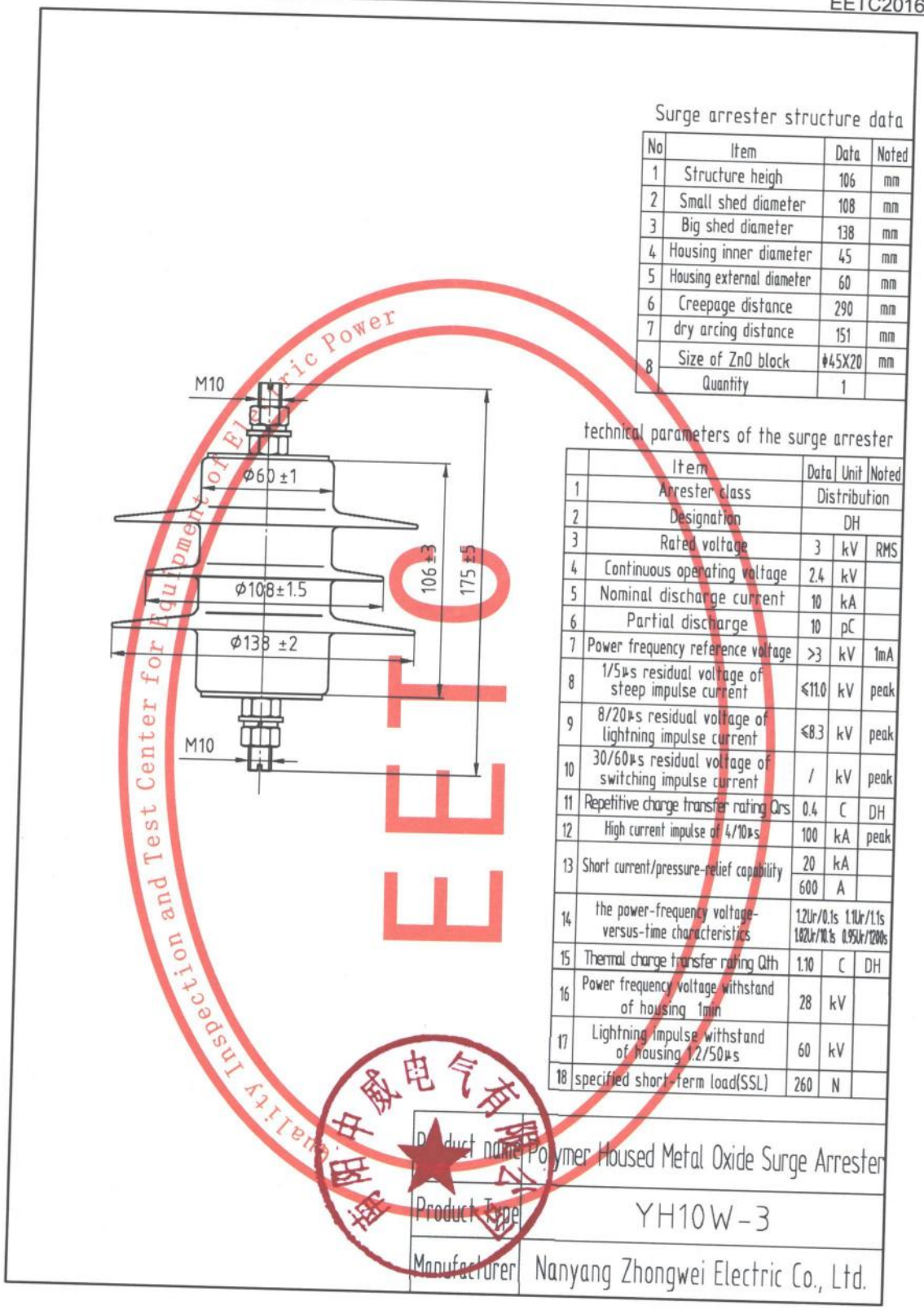


Fig D6: Outside view of YH10W-33 and YH10W-36



Surge arrester structure data

No	Item	Data	Noted
1	Structure heigh	106	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	290	mm
7	dry arcing distance	151	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	1	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	3	kV	RMS
4	Continuous operating voltage	2.4	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>3	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤11.0	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤8.3	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 0.82Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	28	kV	
17	Lightning impulse withstand of housing 1.2/50μs	60	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-3
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D7: Dimensional drawing of YH10W-3

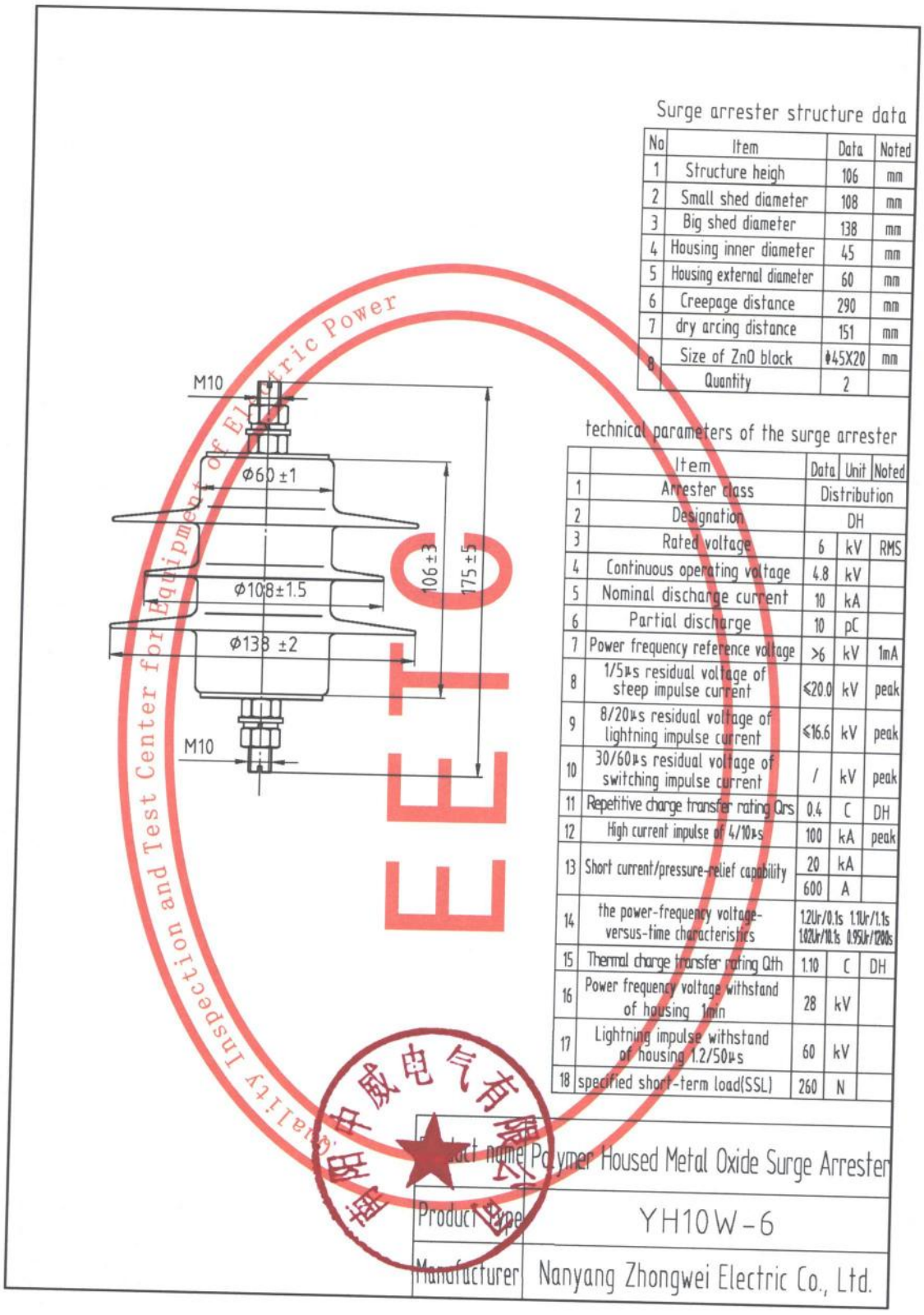
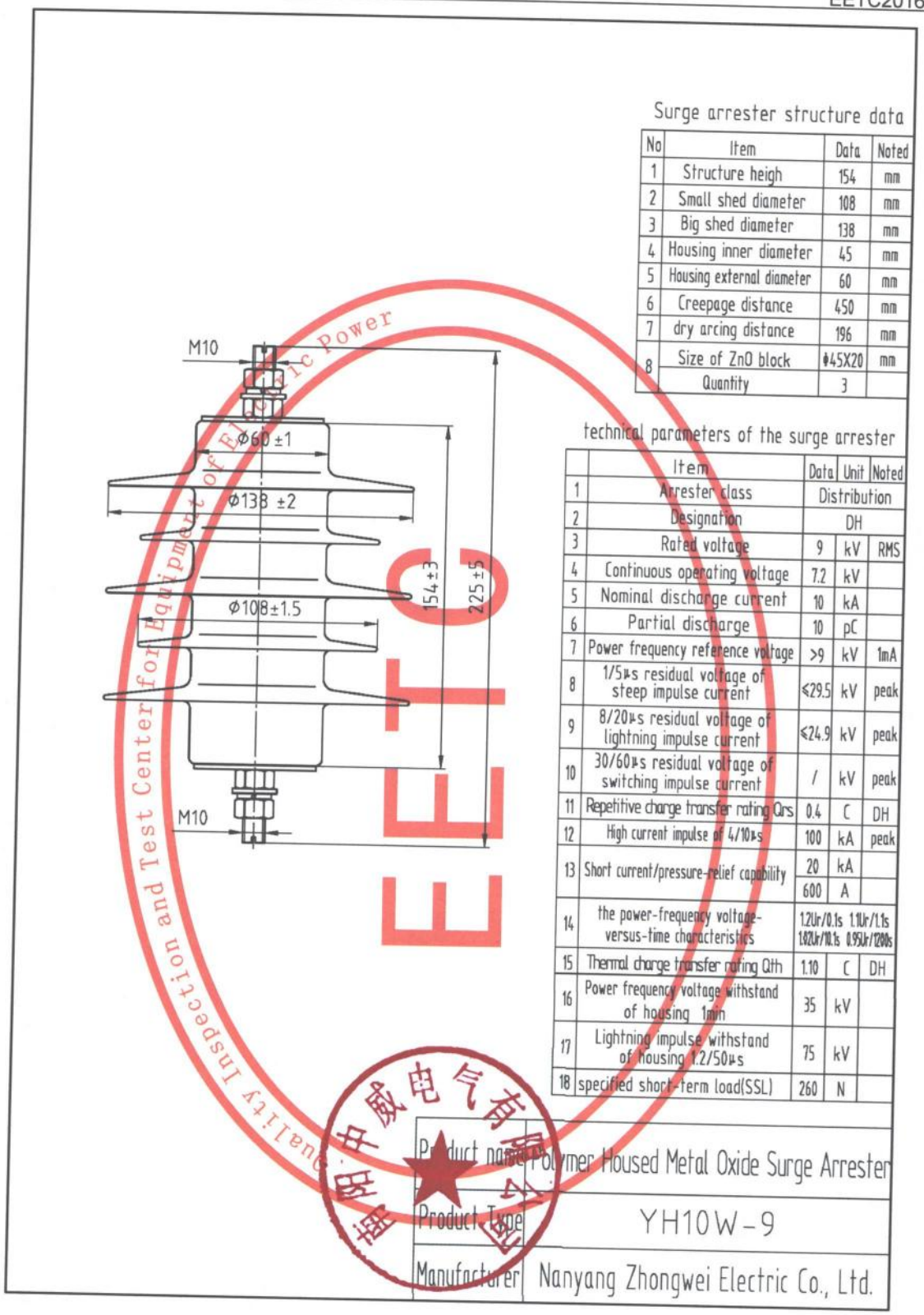


Fig D8: Dimensional drawing of YH10W-6



Surge arrester structure data

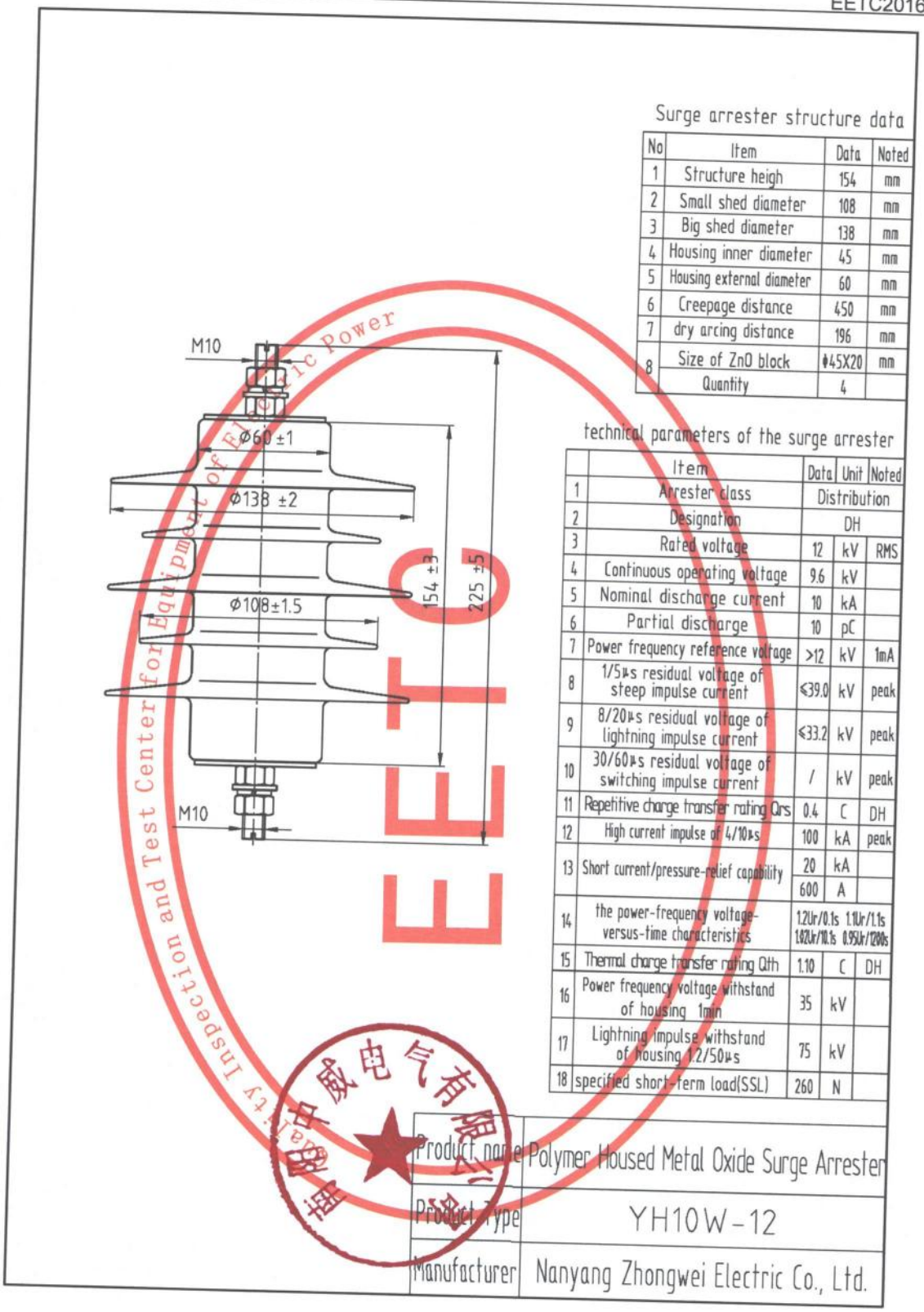
No	Item	Data	Noted
1	Structure heigh	154	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	450	mm
7	dry arcing distance	196	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	3	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	9	kV	RMS
4	Continuous operating voltage	7.2	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>9	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤29.5	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤24.9	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	35	kV	
17	Lightning impulse withstand of housing 1.2/50μs	75	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-9
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D9: Dimensional drawing of YH10W-9



Surge arrester structure data

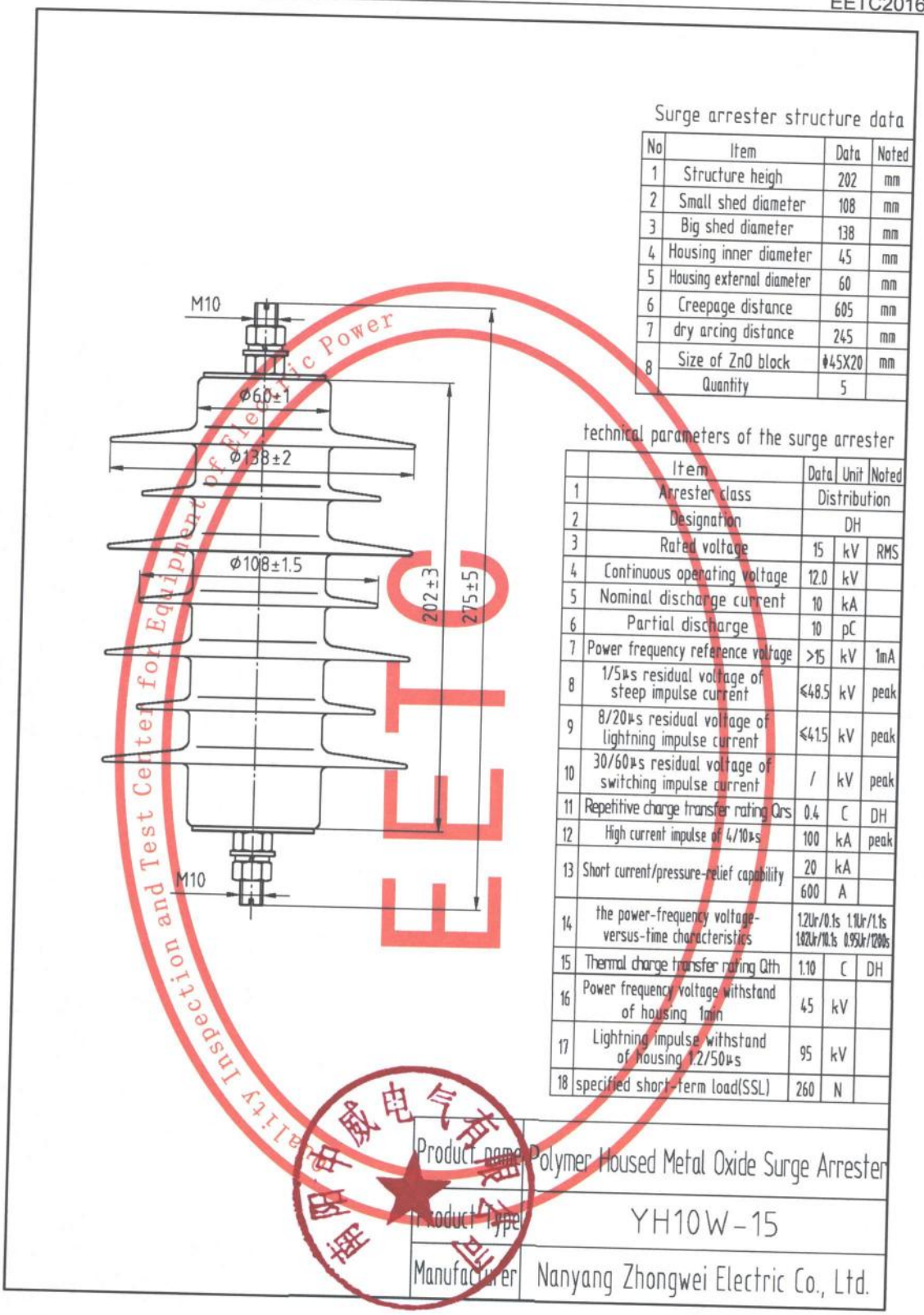
No	Item	Data	Noted
1	Structure heigh	154	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	450	mm
7	dry arcing distance	196	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	4	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	12	kV	RMS
4	Continuous operating voltage	9.6	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>12	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤39.0	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤33.2	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	35	kV	
17	Lightning impulse withstand of housing 1.2/50μs	75	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-12
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D10: Dimensional drawing of YH10W-12



Surge arrester structure data

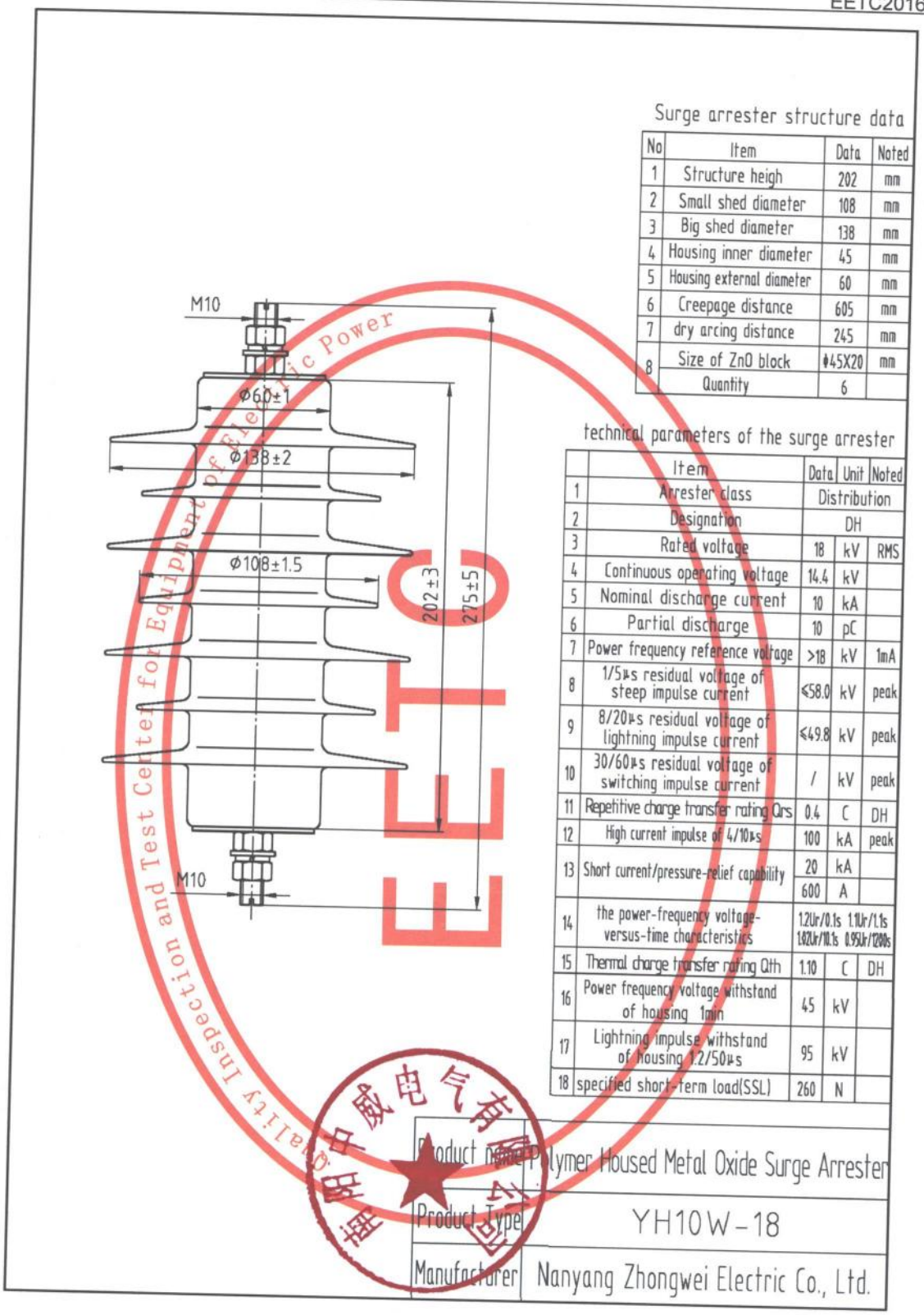
No	Item	Data	Noted
1	Structure heigh	202	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	605	mm
7	dry arcing distance	245	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	5	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	15	kV	RMS
4	Continuous operating voltage	12.0	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>15	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤48.5	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤41.5	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	45	kV	
17	Lightning impulse withstand of housing 1.2/50μs	95	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-15
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D11: Dimensional drawing of YH10W-15



Surge arrester structure data

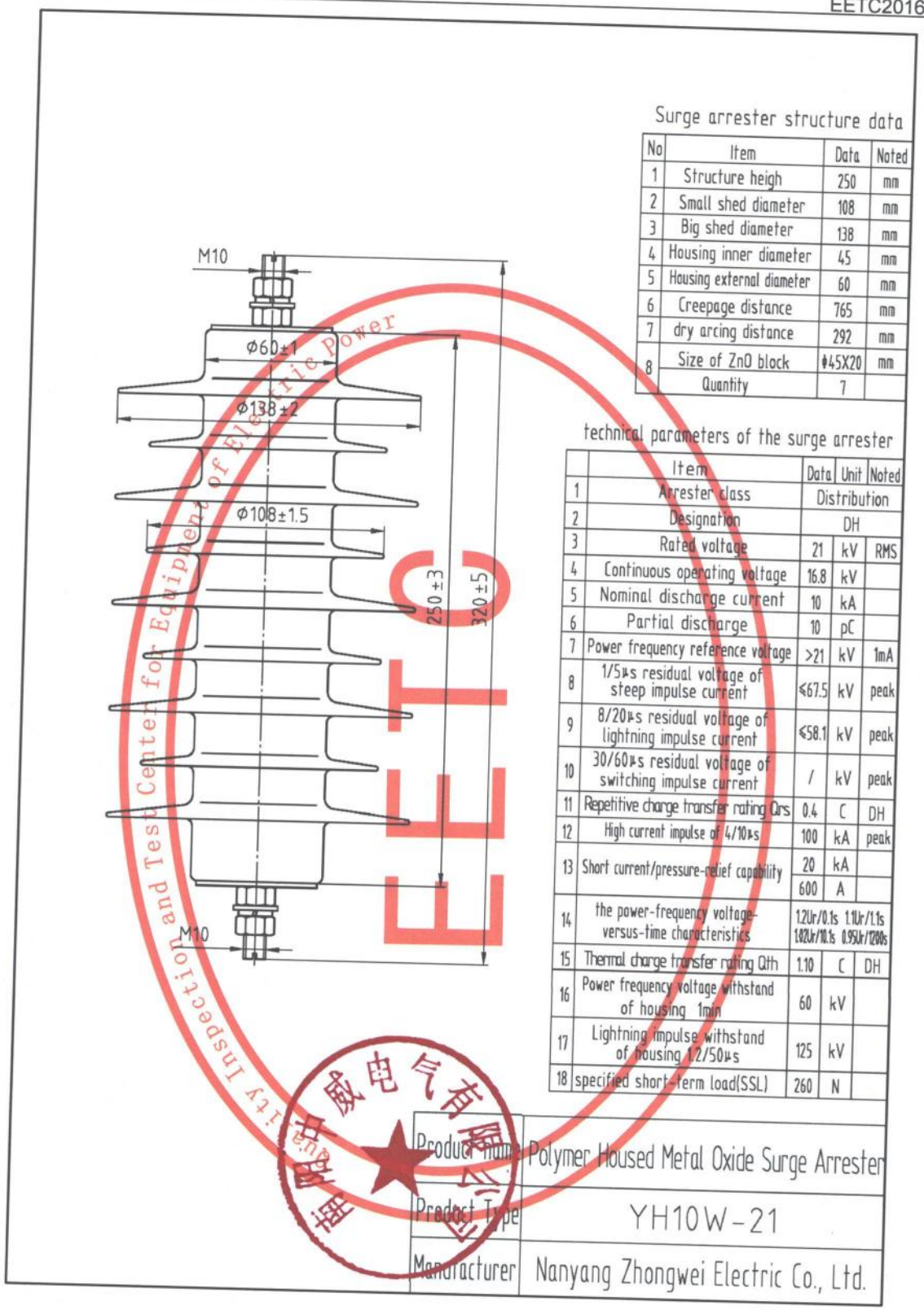
No	Item	Data	Noted
1	Structure heigh	202	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	605	mm
7	dry arcing distance	245	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	6	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	18	kV	RMS
4	Continuous operating voltage	14.4	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>18	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤58.0	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤49.8	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	45	kV	
17	Lightning impulse withstand of housing 1.2/50μs	95	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-18
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D12: Dimensional drawing of YH10W-18



Surge arrester structure data

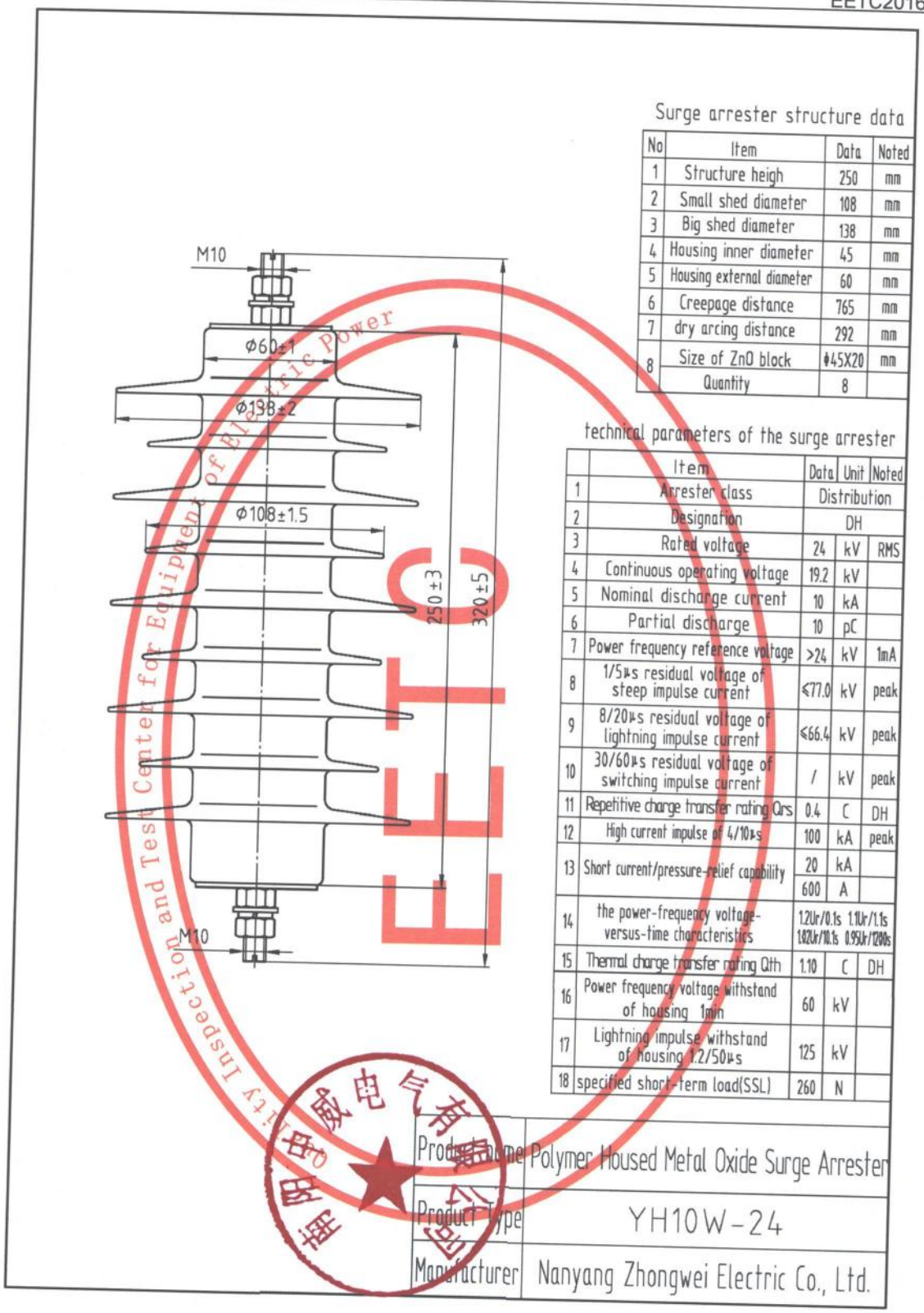
No	Item	Data	Noted
1	Structure heigh	250	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	765	mm
7	dry arcing distance	292	mm
8	Size of ZnO block	φ45X20	mm
	Quantity	7	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	21	kV	RMS
4	Continuous operating voltage	16.8	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>21	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤67.5	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤58.1	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	60	kV	
17	Lightning impulse withstand of housing 1.2/50μs	125	kV	
18	specified short-term load(SSL)	260	N	

Product Name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-21
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D13: Dimensional drawing of YH10W-21



Surge arrester structure data

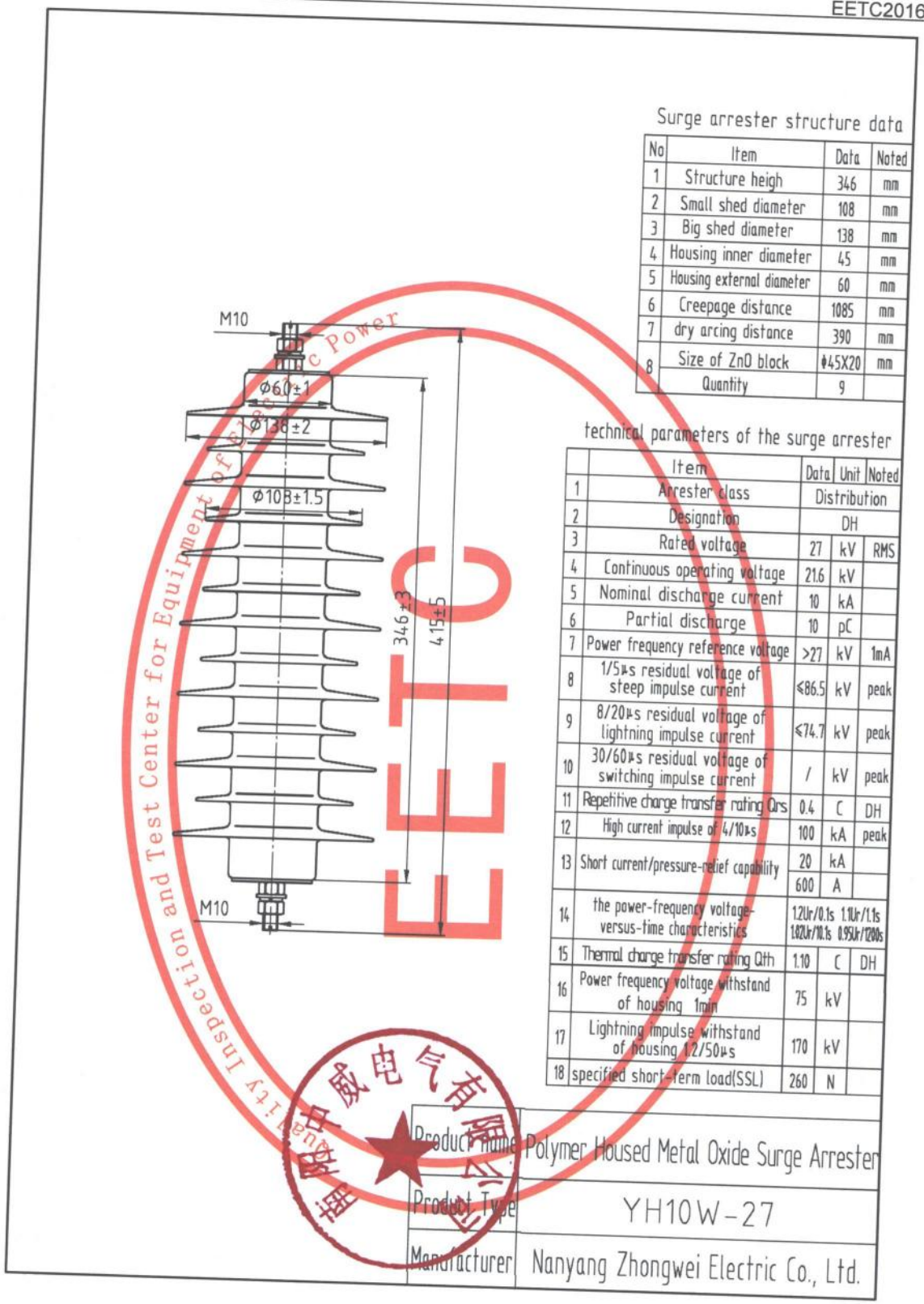
No	Item	Data	Noted
1	Structure heigh	250	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	765	mm
7	dry arcing distance	292	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	8	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	24	kV	RMS
4	Continuous operating voltage	19.2	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>24	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤77.0	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤66.4	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.82Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	60	kV	
17	Lightning impulse withstand of housing 1.2/50μs	125	kV	
18	specified short-term load(SSL)	260	N	

Product Name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-24
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D14: Dimensional drawing of YH10W-24



Surge arrester structure data

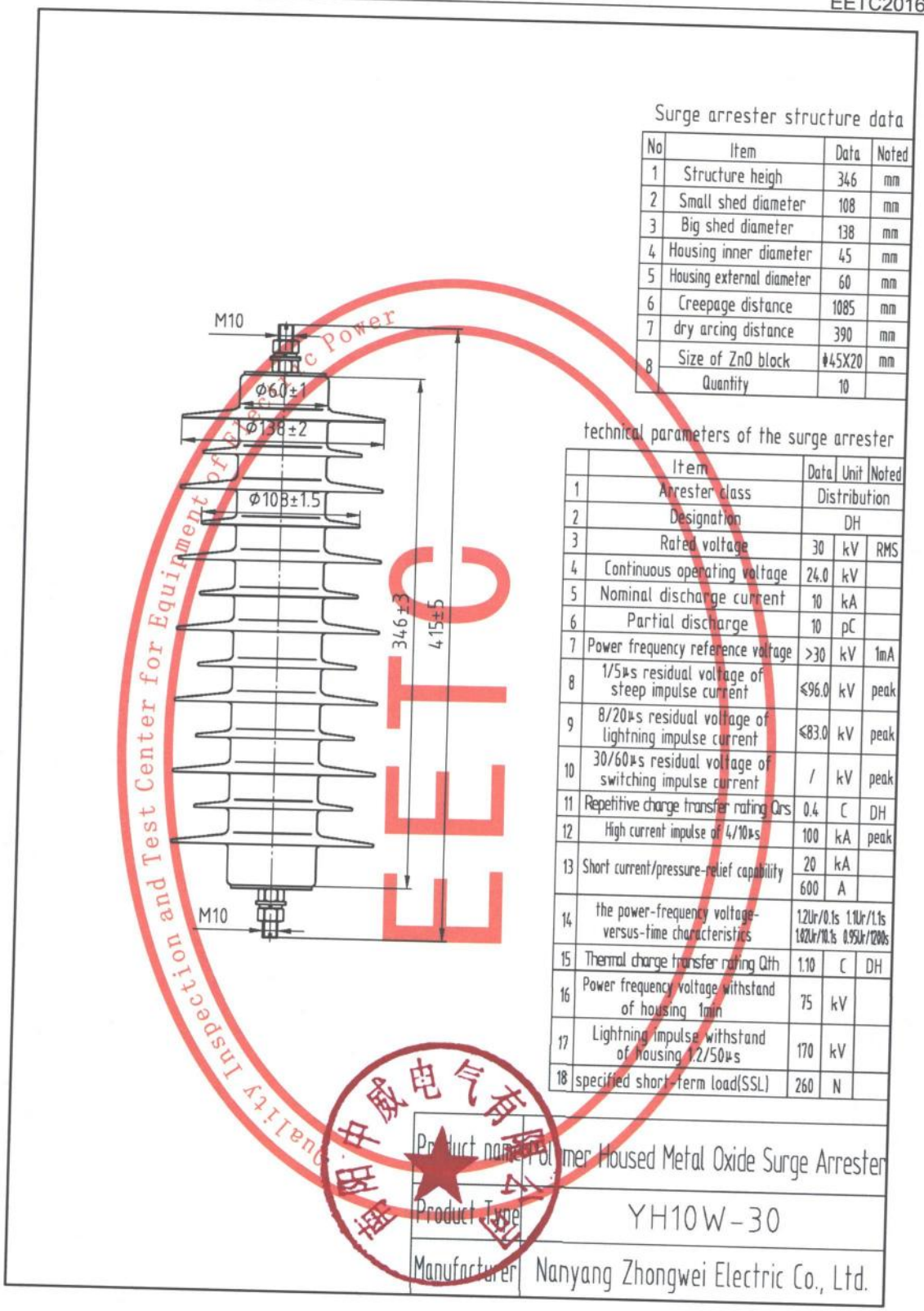
No	Item	Data	Noted
1	Structure heigh	346	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	1085	mm
7	dry arcing distance	390	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	9	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	27	kV	RMS
4	Continuous operating voltage	21.6	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>27	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤86.5	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤74.7	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.82Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	75	kV	
17	Lightning impulse withstand of housing 1.2/50μs	170	kV	
18	specified short-term load(SSL)	260	N	

Product Name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-27
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D15: Dimensional drawing of YH10W-27



Surge arrester structure data

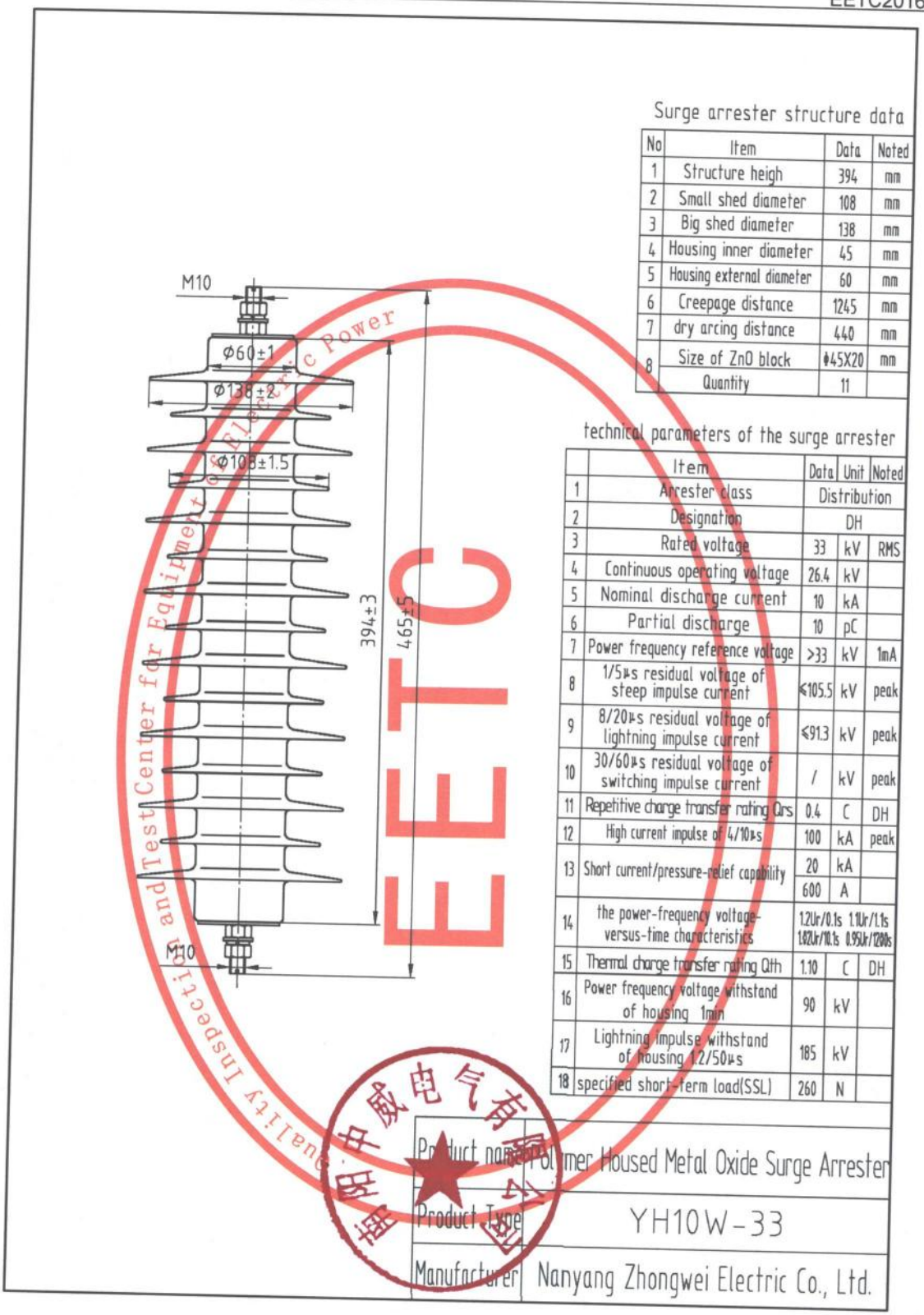
No	Item	Data	Noted
1	Structure heigh	346	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	1085	mm
7	dry arcing distance	390	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	10	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	30	kV	RMS
4	Continuous operating voltage	24.0	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>30	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤96.0	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤83.0	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	75	kV	
17	Lightning impulse withstand of housing 1.2/50μs	170	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-30
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D16: Dimensional drawing of YH10W-30



Surge arrester structure data

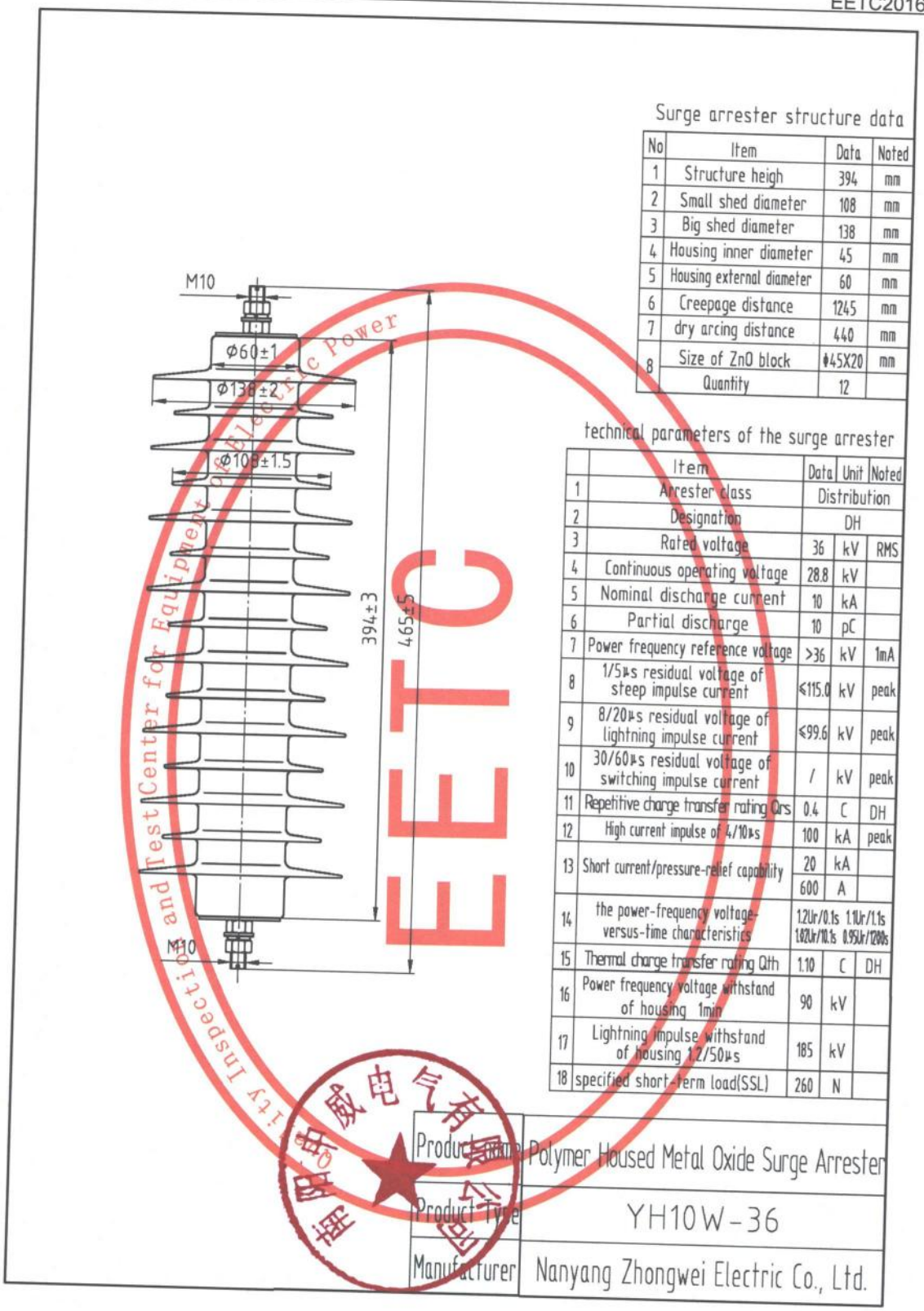
No	Item	Data	Noted
1	Structure heigh	394	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	1245	mm
7	dry arcing distance	440	mm
8	Size of ZnO block	φ45X20	mm
	Quantity	11	

technical parameters of the surge arrester

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	33	kV	RMS
4	Continuous operating voltage	26.4	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>33	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤105.5	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤91.3	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.0Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	90	kV	
17	Lightning impulse withstand of housing 1.2/50μs	185	kV	
18	specified short-term load(SSL)	260	N	

Product name	Polymer Housed Metal Oxide Surge Arrester
Product Type	YH10W-33
Manufacturer	Nanyang Zhongwei Electric Co., Ltd.

Fig D17: Dimensional drawing of YH10W-33



No	Item	Data	Noted
1	Structure heigh	394	mm
2	Small shed diameter	108	mm
3	Big shed diameter	138	mm
4	Housing inner diameter	45	mm
5	Housing external diameter	60	mm
6	Creepage distance	1245	mm
7	dry arcing distance	440	mm
8	Size of ZnO block	Φ45X20	mm
	Quantity	12	

	Item	Data	Unit	Noted
1	Arrester class	Distribution		
2	Designation	DH		
3	Rated voltage	36	kV	RMS
4	Continuous operating voltage	28.8	kV	
5	Nominal discharge current	10	kA	
6	Partial discharge	10	pC	
7	Power frequency reference voltage	>36	kV	1mA
8	1/5μs residual voltage of steep impulse current	≤115.0	kV	peak
9	8/20μs residual voltage of lightning impulse current	≤99.6	kV	peak
10	30/60μs residual voltage of switching impulse current	/	kV	peak
11	Repetitive charge transfer rating Qrs	0.4	C	DH
12	High current impulse of 4/10μs	100	kA	peak
13	Short current/pressure-relief capability	20	kA	
		600	A	
14	the power-frequency voltage-versus-time characteristics	1.2Ur/0.1s 1.1Ur/1.1s 1.02Ur/10.1s 0.95Ur/1200s		
15	Thermal charge transfer rating Qth	1.10	C	DH
16	Power frequency voltage withstand of housing 1min	90	kV	
17	Lightning impulse withstand of housing 1.2/50μs	185	kV	
18	specified short-term load(SSL)	260	N	

Fig D18: Dimensional drawing of YH10W-36

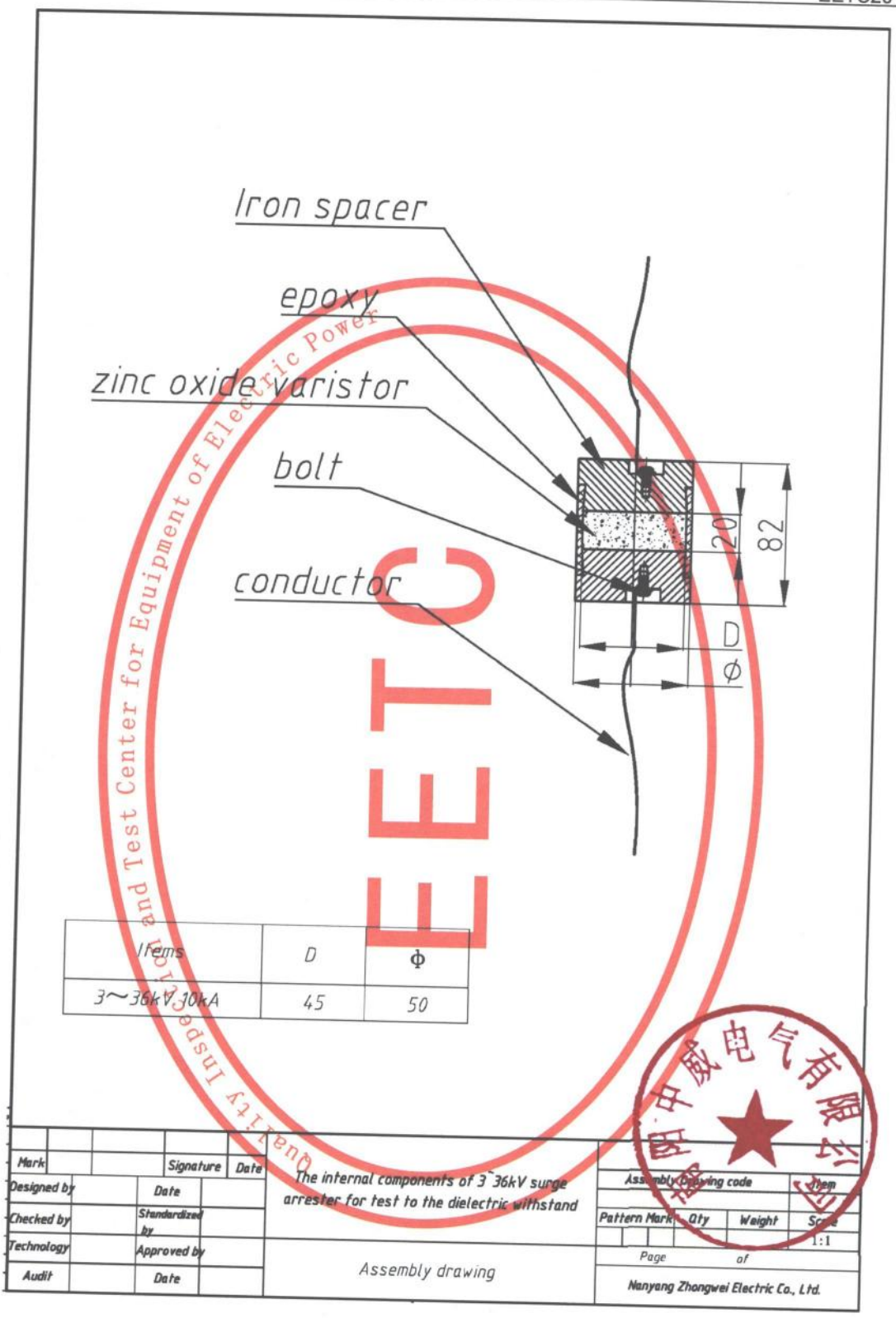


Fig D19: Dimensional drawing of dielectrically prorated section