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国家绝缘子避雷器质量监督检验中心

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS

检 验 报 告

TEST REPORT

Object 产品名称: 52-1 Ceramic Suspension Insulator

Client 客户名称: Bonle (Fuzhou) International CO., LTD.

Classification 检验类别: Prototype Tests

中国西安 XIAN P.R CHINA

2009 年 04 月 22 日

22 Apr. 2009

CHINA NATIONAL CENTRE FOR QUALITY SUPERVISION AND TEST OF INSULATORS AND SURGE ARRESTERS

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TEST REPORT

Test Object	Ceramic Suspension Insulator
Type	52-1
Trade Mark	Bonle
Manufacturer	Bonle (Fuzhou) International CO., LTD.
Client	
Address	Taiyu Rd 91#, Fuwan Pian, Jinshan Industrial zone, Fuzhou, P. R. China (Post code: 350008)
Telephone	+86 591 88000107
Fax	+86 591 88000111
Test Classification	Prototype tests
Test Items	All test items see Page 2 of this report
Reception Date	13 Apr., 2009
Sample Number	57
Series	No.1～No.57
Test Date	13～16 Apr., 2009
Test Basis	1. GB/T 1001.1-2003 Insulators for overhead lines with a nominal voltage above 1000V Part1: Ceramic or glass insulator units for a. c. systems Definitions, test methods and acceptance criteria (IEC 60383-1:1993 MOD) 2. GB/T 7253-2005 Insulator for overhead lines with a nominal voltage above 1000V-Ceramic or glass insulator units for a.c.systems-Characteristics of insulator units of the cap and pin type (IEC 60305:1995 MOD) 3. JB/T 3567-1999 The method of radio interference test on high-voltage insulators (eqv IEC 60437:1997) 4. The drawing of sample
Test Conclusion	The insulator passed all prototype test items and is deemed to meet the test basis satisfactory. Confirmed on 22 Apr., 2009
Remarks	①The drawing number is HD2.801.001. ②Main dimension (H×D×L): 140×255×180 (mm).

Approved: Checked: Reported:

Test Items

Routine Tests	1	Visual Inspection
	2	Mechanical Test
	3	Electrical Test
Sample Tests	4	Verification of the Dimensions
	5	Verification of the Displacements
	6	Temperature Cycle Test
	7	Electro-mechanical Failing Load Test
	8	Puncture Withstand Test
	9	Porosity Test
	10	Galvanizing Test
Type Tests	11	Verification of the Dimensions
	12	Dry Lightning Impulse Withstand Test
	13	Wet power-frequency Withstand Test
	14	Residual Mechanical Strength Test
	15	Electro-mechanical Failing Load Test
	16	Thermal-mechanical Performance Test
Additional Test	17	Radio Interference Voltage Test
	18	Impact Test

Routine tests

1 Visual Inspection

Specimens No.1～ No.57 had fair appearance. No defects exceeding standard permission were observed, met the test basis satisfactory.

2 Mechanical Test

A tensile load of 22.5kN was applied to specimen No.1～ No.57 for 3s, the specimens passed the test successfully.

3 Electrical Test

All specimens withstood power-frequency sparking voltage for 3min satisfactory.

The specimens passed the routine tests successfully.

Sample Tests

The samples were selected randomly by manufacturer, according to the standard the sample size were E_1=4 and E_2=3.

4 Verification of the Dimensions

Units: mm

Specimen No.	Spacing	Diameter of disk	Creepage distance	Dia. of eyebolt	
				Cap	Pin
5	139.0	162.0	181	17.5	20.5
6	138.5	163.2	183	17.5	20.5
7	140.5	163.7	180	17.5	20.5
Specifications	140±4.5	165±8	180±9	/	/

The length of string (No.1~No.6) was 836mm.

The results met the test basis.

5 Verification of the Displacements

Units: mm

Specimen No.	Variation on A	Variation on B
1	4.8	3.1
2	3.2	3.0
3	3.6	2.9
4	4.0	3.3
5	3.0	2.5
6	3.3	2.6
7	2.5	2.4
Specifications	≤6.6	≤5.0

The results met the test basis.

6 Temperature Cycle Test

Specimens No.1～ No.7, No.23～ No.47 passed the temperature cycle test satisfactory, the temperature of hot water at 87℃ was 70K higher than that of the cold water, specimens withstood 3 cycles of hot and cold bathing for 15min each.

7 Electro-mechanical Failing Load Test

The tensile load was applied between cap and pin in line with the axis of the specimen. The load was started at zero smoothly brought up to the failing point. Simultaneously, a power frequency voltage of 20kV was applied to the test specimen.

Specimen No.	Failing load kN	Failing at	Result
1	68.0	Ceramic breakage	$\overline{X}_1=69.875$kN $\sigma_1=8.929$kN $C_1=1.0$ SFL=45kN $SFL+C_1\sigma_1=53.929$kN $\overline{X}_1>SFL+C_1\sigma_1$
2	64.5	Ceramic breakage	
3	64.0	Ceramic breakage	
4	83.0	Ceramic breakage	

The result met the test basis.

8 Puncture Withstand Test

8.1 Puncture withstand test

Specimen No.	Voltage applied kV	Result
5	80	No punctured
6	80	No punctured
7	80	No punctured
Specifications	80	No punctured

The result met the test basis.

9.2 Puncture test

Specimen No.	Voltage applied kV	Result
9	146	Punctured at neck
10	148	Punctured at neck
11	126	Punctured at neck

Provided the test datum only.

9 Porosity Test

Ceramic fragments from the specimens(item 7) were immersed in a 1% alcohol solution of fuchsine. Under a pressure of 20MPa for 9h, No fragments had revealed any dye penetration.

10 Galvanizing Test

Units: μm

Specimen No.	Minimum values of single specimen		Average values of single specimen		Average values of all specimen	
	Cap	Pin	Cap	Pin	Cap	Pin
5	91	85	109	107	115	106
6	80	90	130	110		
7	79	80	106	102		
Specifications	/		≥72		≥86	

The results met the test basis.

The specimens passed the sample tests successfully.

Type Tests

11 Verification of the Dimensions

Units: mm

Specimen No.	Spacing	Diameter of disk	Creepage distance	Dia. of eyebolt	
				Cap	Pin
8	139.0	163.0	183	17.5	20.5
9	138.5	162.2	181	17.5	20.5
10	140.5	162.5	180	17.5	20.5
11	139.0	162.8	182	17.5	20.5
12	140.0	163.2	183	17.5	20.5
13	139.5	162.4	183	17.5	20.5
14	140.0	164.0	185	17.5	20.5
15	138.5	162.7	182	17.5	20.5
16	139.0	163.4	183	17.5	20.5
17	139.5	163.1	182	17.5	20.5
Specifications	140±4.5	165±8	180±9	/	/

The results met the test basis.

12 Dry Lightning Impulse Withstand Tests

12.1 Positive polarity

t_d=18.5℃. t_w=14.5℃. P=96.4kPa. The arcing distance L=689mm.

Voltage specified: 350kV. Correction coefficient K=0.955.

Specimen No.	Times applied	U_{50} kV	Corrected value kV
13～17 (short string)	30	414.5	434.0
Specifications	/	/	⩾364.0, (1.040×350)

The results met the test basis.

12.2 Negative polarity

t_d=18.5℃. t_w=14.5℃. P=96.4kPa. The arcing distance L=689mm.

Voltage specified: 350kV. Correction coefficient K=0.955.

Specimen No.	Times applied	U_{50} kV	Corrected value kV
13～17 (short string)	30	414.8	434.3
Specifications	/	/	⩾364.0, (1.040×350)

The results met the test basis.

13 Wet Power-frequency Withstand Voltage Test

t_d=18.5℃. t_w=14.5℃. t_{water}=17.0℃. P=96.4kPa. The arcing distance L=689mm.

Resistivity of water $\rho_{17.0}$=106.6Ω · m. Corrected resistivity ρ_{20}=98.1Ω · m.

Precipitation rate: Horizontal component is 1.29mm/min. Vertical component is 1.44mm/min.

Specifications: 100kV. Correction coefficient K_t=0.992. Corrected voltage: 99.2kV.

Specimen No.	Voltage applied kV	Duration s	Result
13～17 (short string)	100	60	No flashover
Specifications	⩾99.2	60	No flashover

The results met the test basis.

14 Residual Mechanical Strength Test

Specimen No.	Failing load value kN	Failing at	Specimen No.	Failing load value kN	Failing at
23	39.5	Separated	40	47.0	Separated
24	40.0	Separated	41	39.5	Separated
25	42.5	Separated	42	46.5	Separated
26	34.5	Separated	43	42.0	Separated
27	58.5	Separated	44	44.0	Separated
28	36.5	Separated	45	48.0	Separated
29	37.0	Separated	46	44.0	Separated
30	41.5	Separated	47	37.5	Separated
31	44.0	Separated			
32	44.0	Separated			
33	38.0	Separated			
34	38.0	Separated			
35	40.5	Separated			
36	43.0	Separated			
37	27.5	Separated			
38	39.0	Separated			
39	37.5	Separated			

There were 25 specimens whose failing status was separated of cap or pin. The results were calculated as following formulas:

SFL=45kN $\overline{X}$=41.200kN

S=5.690kN K=0.65

$Q_s=(\overline{X}-1.645S)/SFL=0.71$

$Q_s>K$

The results met the test basis.

15 Electro-mechanical Failing Load Test

The tensile load were applied between cap and pin in line with the axis of the specimen. The load was started at zero smoothly brought up to the failing point. Simultaneously, a power frequency voltage of 20 kV was applied to the test specimen.

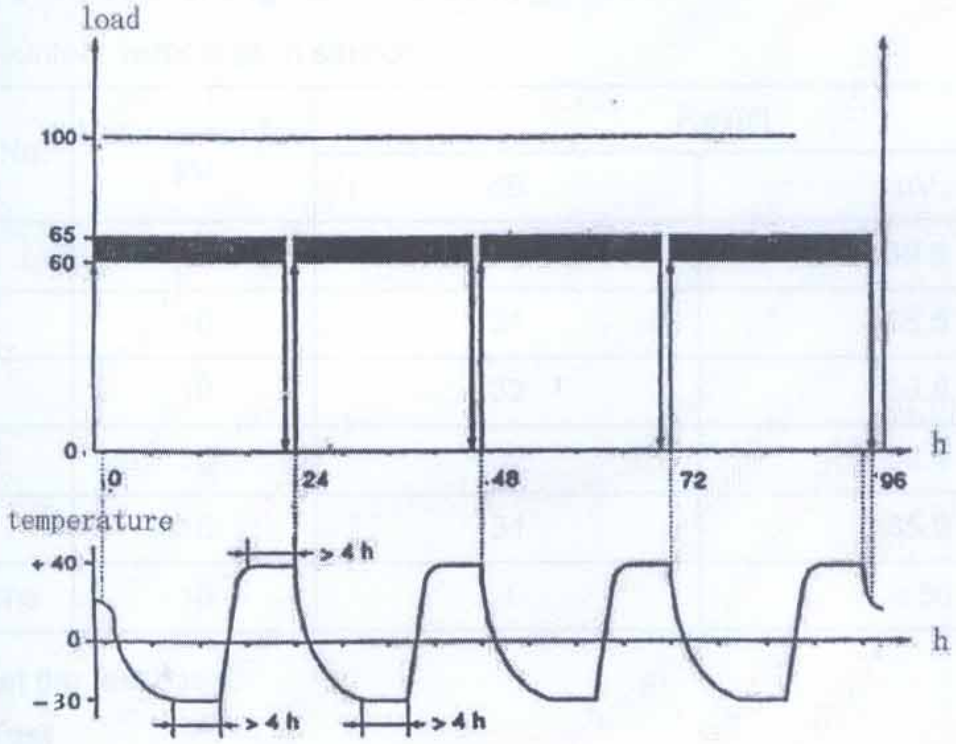
Specimen No.	Failing load kN	Failing at	Result
13	60.5	Ceramic breakage	
14	91.5	Pin	$\overline{X}_t$=76.600kN
15	76.0	Ceramic breakage	σ_t=16.121kN
16	55.0	Ceramic breakage	C_0=0.72
17	81.5	Ceramic breakage	SFL=45kN
18	48.5	Ceramic breakage	$SFL+C_0\sigma_t=56.607kN$
19	87.0	Ceramic breakage	$\overline{X}_t>SFL+C_0\sigma_t$
20	84.5	Pin	
21	89.0	Ceramic breakage	
22	92.5	Ceramic breakage	

The result met the test basis

16 Thermal-mechanical Performance Test

16.1 Thermal-mechanical performance test

Specimen No.48～No.57 were subjected to four 24-hour cycles to cooling and heating with a simultaneously applied tensile load maintained at 60% of the specified electromechanical failing load.



No insulator failed during the cycles of heating and cooling.

16.2 Electro-mechanical failing load test

The tensile load were applied between cap and pin in line with the axis of the specimen. The load was started at zero smoothly brought up to the failing point. Simultaneously, a power frequency voltage of 20kV was applied to the test specimen.

Specimen No.	Failing load kN	Failing at	Result
48	54.0	Ceramic breakage	
49	68.5	Ceramic breakage	$\overline{X}_t$=67.450kN
50	73.0	Ceramic breakage	σ_t=9.163kN
51	77.0	Ceramic breakage	C_0=0.72
52	65.0	Ceramic breakage	SFL=45kN
53	70.0	Ceramic breakage	SFL+$C_0\sigma_t$=51.597kN
54	72.5	Ceramic breakage	$\overline{X}_t$>SFL+$C_0\sigma_t$
55	49.5	Punctured	
56	77.0	Ceramic breakage	
57	68.0	Ceramic breakage	

The result met the test basis.

The results of type tests met the test basis.

Additional Test

17 Radio Interference Voltage Test

t_d=19.0℃. RH=55%. P=96.7kPa.

Test frequency:1.0MHz. Background noise level: 6dB.

Specimen mounted: vertical as in service.

Specimen No.	Voltage applied kV	Result	
		dB	μV
18	10	32	39.8
19	10	31	35.5
20	10	32	39.8
21	10	32	39.8
22	10	31	35.5
Specifications	10	/	≤50

The result met the test basis.

18 Impact Test

Specimen No.	Tensile load kN	Impact load N·cm	Result
1	8.9	500	No breakage
2	8.9	500	No breakage
3	8.9	500	No breakage
Specifications	8.9	500	No breakage

The results met the test basis.

Test Performed: MENG fan sen

ZHONG yan dong

HE yuan hua

WANG ping he

ZHAO lei

Annex 1: Typical Waveform of Impulse Voltage

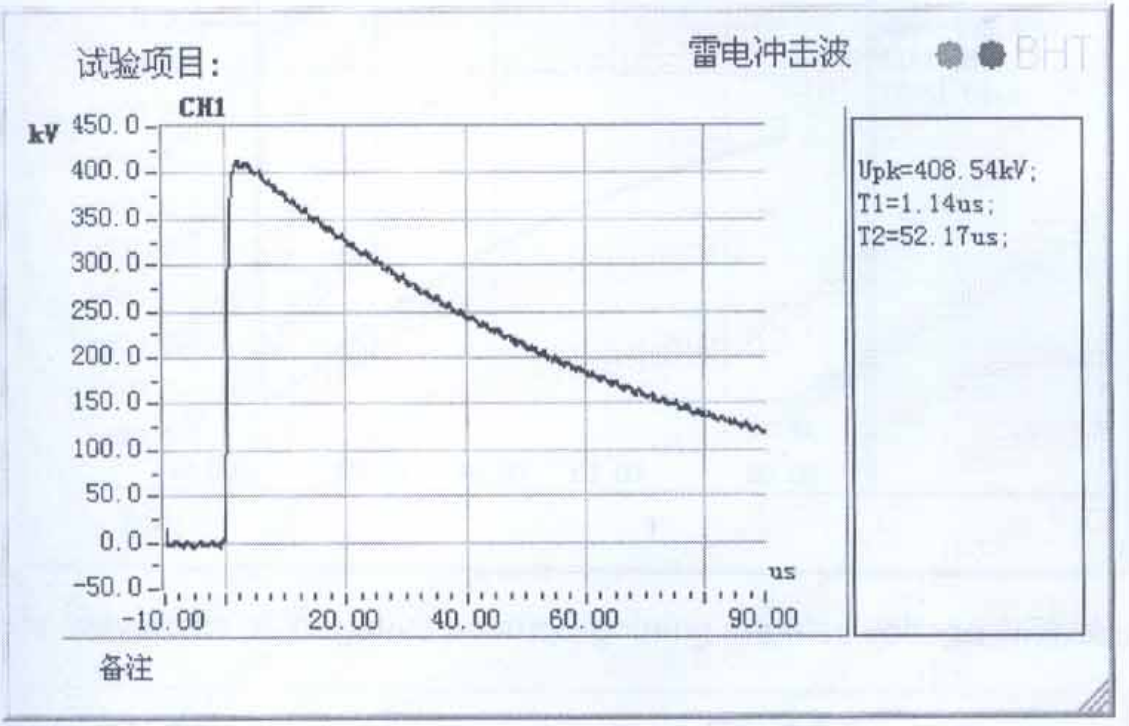


Fig 1: waveform of positive polarity lightning impulse voltage (withstand)

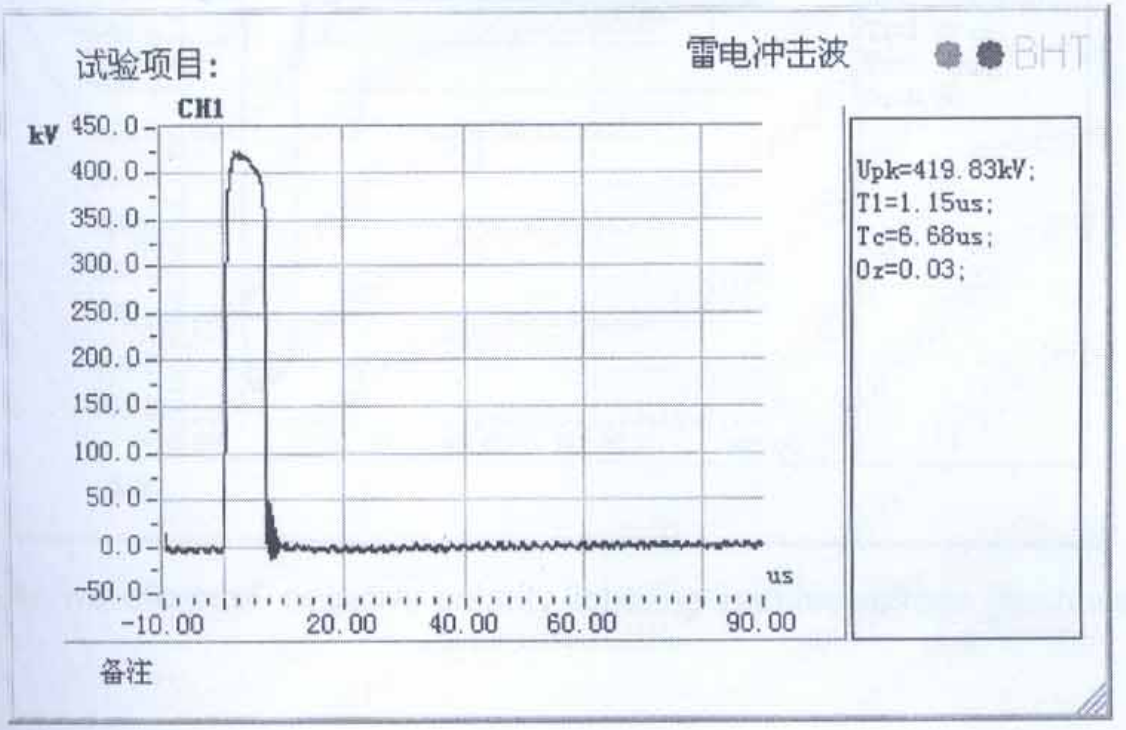


Fig 2: waveform of positive polarity lightning impulse voltage (flashover)

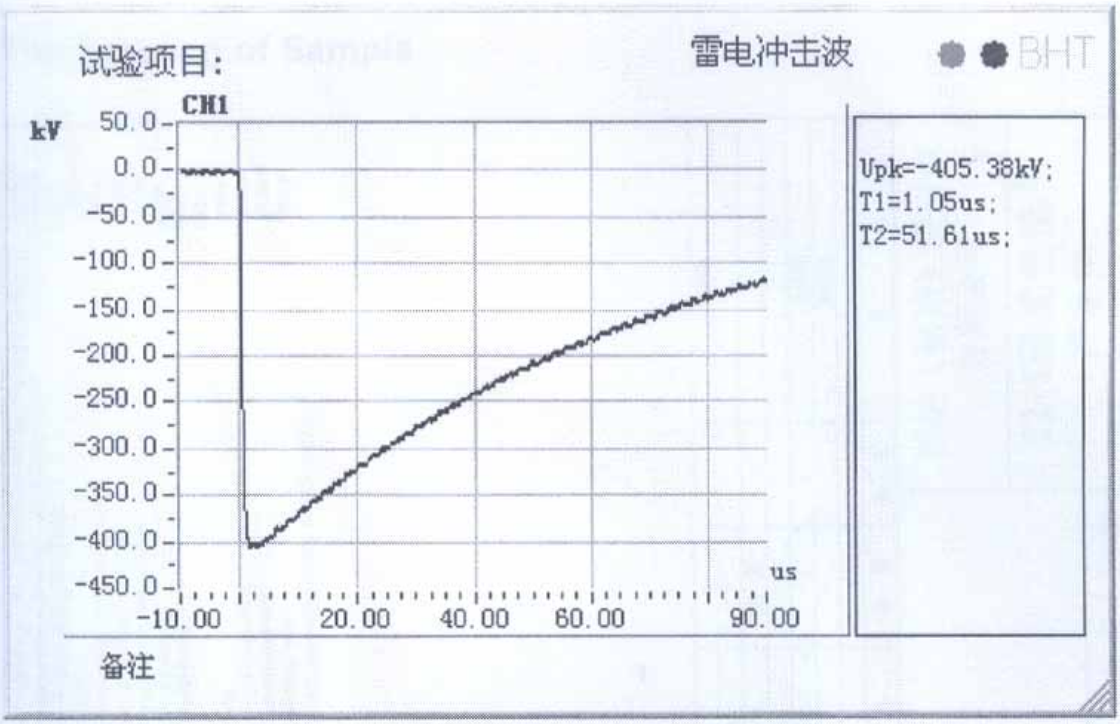


Fig 3: waveform of negative polarity lightning impulse voltage (withstand)

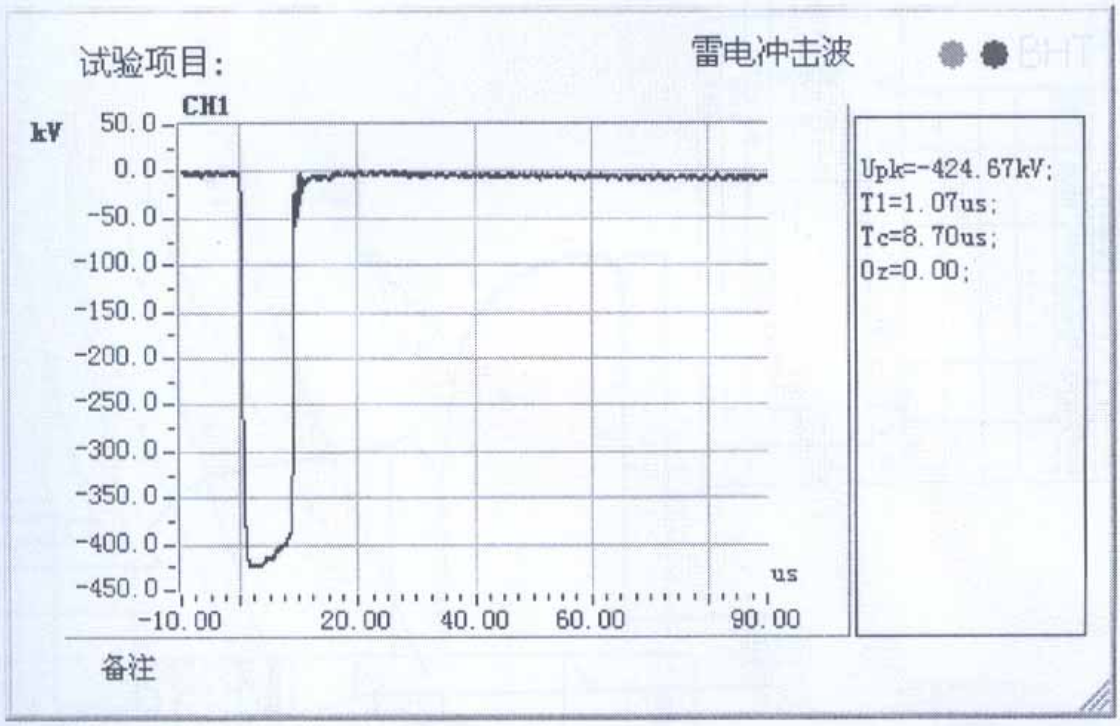


Fig 4: waveform of negative polarity lightning impulse voltage (flashover)

Annex 2: The Drawing of Sample