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CEPRI

TEST REPORT

CEPRI-EETC02-2021-0034(E)

Client: ZGHD ELECTRIC CO;LTD.

Object: 10kV AC plug in gapless zinc oxide arrester

Type: GHD-15BLQ

Test Category: Type Test

EETC

POWER INDUSTRY QUALITY INSPECTION AND TEST CENTER FOR ELECTRIC EQUIPMENT

Catalogue

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC02-2021-0034(E) Total 20 Page 2
Client	ZGHD ELECTRIC CO;LTD.	Manufacturer	ZGHD ELECTRIC CO;LTD.
Object	10kV AC plug in gapless zinc oxide arrester	Type	GHD-15BLQ (Φ32mm×24mm)
Sampling procedure	By the client delivery	Serial No.	1arresters (001) 10 thermally prorated sections (201～210) 13 resistors (301～313) 1 housings(401) 4 dielectrically prorated section(101~104)
Test Category	Type Test	Date	2021.03.03~2021.04.29
Requirements	GB/T 11032-2020 Metal-oxide surge arresters without gaps for a.c. systems		
Conclusion	The 10kV Screened separable rear connector with arrester type GHD-15BLQ have successfully passed the type test specified in GB/T 11032-2020.		
Note	Note 1: In the event of any difference in meanings of the text, the Chinese report shall take precedence over the English version. Note 2: Since the date of issuance, the routine test which concerns about the related content must be done every 5 years in order to extend the validity of this report. Note 3:See appendix A for sample instruction.		

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Checked by: 王陆璐 **Verified by:** 左中秋

Approved by: 王保山 **Date of issue:** 2021.06.09

Test Results

No.	Item	Requirements		Results	Evaluat -ion
1	D.C. reference voltage test	24.0kV≤U_{1mADC}≤26.5kV		25.5kV	Pass
2	Leakage current test at 0.75 times D.C. reference voltage	$I_L(0.75U_{1mADC})$≤50μA		6μA	Pass
3	Continuous operating current test	I_x≤1000μA I_R≤350μA		I_x=165μA I_R=40μA	Pass
4	A.C.reference voltage test	U_{1mAAC} ≥17$kV_p/\sqrt{2}$		18.8$kV_p/\sqrt{2}$	Pass
5	Partial discharge test	Apply 1.05U_c withstand time 60s,the partial discharge ≤10pC.		2.0pC	Pass
6	Insulation withstand tests on the arrester housing	Power-frequency voltage: Dry≥42kV, for 1min. Lightning impulse voltage : 75.0kV_p, the positive and negative 15 times respectively.		Power-frequency voltage dry:42.2kV_{rms}, 1min. Lightning impulse voltage： 75.2kV_p~75.7kV_p the positive and negative 15 times respectively.	Pass
7	Residual voltage test	Lightning impulse	≤45.0 kV_p	43.06kV_p	Pass
		Steep current	≤38.3 kV_p	34.12kV_p	
		Switching impulse	≤51.8 kV_p	44.90kV_p	
8	Repetitive charge transfer withstand test	10 samples should withstand 20 times 2ms long-duration current impulse and the charge value should not less than 0.2C.		Q_{rs}: 0.220C~0.229C	Pass
9	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}≤1.1P_{start} ; the samples fulfilled the requirements.	Pass
10	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 2.	Pass
11	Operating duty test	Long-duration current impulse 2 times 、 Rated thermal energy injection Q_{th}≥0.7 C The residual voltage shall not have changed by more than 5%.		Q_{th}≥0.707 C The residual voltage changed ratio is from +0.47% to+1.28%.	Pass

12	Power-frequency voltage-versus-time characteristics	$Q_{th} \geqslant 0.7C$; Supply the Power frequency voltage-versus-time characteristics for the range of voltage from $1.20U_r^*$ to $1.00U_r^*$, the range of time from 0.1s to 1200s for with prior duty, $1.20U_r^*$ to $1.05U_r^*$, the range of time from 1.1s to 1200s for without prior duty.	$Q_{th} \geqslant 0.703C$ With prior duty test $1.20U_r^*$ 0.1s $1.15U_r^*$ 1.1s $1.10U_r^*$ 10.1s $1.00U_r^*$ 1200s Without prior duty test $1.20U_r^*$ 1.1s $1.05U_r^*$ 1200s	Pass
13	Test to verify the dielectric withstand of the internal components of an arrester	1 time 65kA-4/10μs	64.1kA, no puncture, flashover, cracking or other significant damage.	Pass

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Content:

1~2 D.C. reference voltage test and leakage current at 0.75 times D.C. reference voltage test

Environment temperature: 12.0℃ humidity:63%

Samples	D.C. reference voltage U_{1mADC} kV		0.75times D.C. reference voltage kV		Leakage current μA	
	Measured value	Specified value	Measured value	Specified value	Measured value	Specified value
001	25.5	$24.0 \leqslant U_{1mADC} \leqslant 26.5$	19.1	$0.75U_{1mADC} \pm 1\%$	6	≤50

Note: The standard only provides the D.C. reference voltage lower limit. The upper limit declared by the manufacturer is used to determine the proportion of the arrester protection level.

Fulfilled the requirements.

3~4 Power-frequency reference voltage test and Continuous current test

Environment temperature: 28.5℃ humidity:58%

Samples	The power-frequency reference voltage U_{1mAAC} $kV_p/\sqrt{2}$		I_R μA_p		I_X μA_{rms}	
	Measured value	Specified value	Measured value	Specified value	Measured value	Specified value
001	18.8	≥17	40	≤200	165	≤1000

Note1: The client claims the power frequency reference current is 1mA.
Note2: The standard specifies the continuous current through the arrester shall not exceed the manufacturer's declared value.

Fulfilled the requirements.

5 Partial discharge test

Samples	U_r	U_r duration time	$1.05U_c$	$1.05U_c$ duration time	Partial discharge
	kV_{rms}	s	kV_{rms}	s	pC
001	17.0	10	14.4	60	2.0
specified value	17.0	2～10	14.3	60	≤10

Fulfilled the requirements.

6 Housing insulation withstand test

6.1 Power frequency voltage withstand test

t=17.0℃ RH=76% Atmospheric pressure: 100.2kPa

Samples	Specified value	Applied voltage	Duration	Test result
	kV	$kV_p/\sqrt{2}$	s	
401	42(dry)	42.2	60	No flashover

Fulfilled the requirements.

6.2 Lightning impulse voltage withstand test

t=17.0℃ RH=76% Atmospheric pressure: 100.2kPa

Samples	Specified value		Applied voltage	Withstand times	Test result
	kV		kV_p		
401	(+)	75.0	75.2~75.7	15	No breakdown, no flashover
	(-)	75.0	75.2~75.6	15	No breakdown, no flashover

Fulfilled the requirements.

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7 Residual voltage test

7.1 Lightning impulse current residual voltage test

Samples			301	302	303
Resistor	U_{1mADC}	kV	5.25	5.25	5.25
	8/20μs, 2.5kA	kV_p	7.89	7.87	7.89
	8/20μs, 5kA	kV_p	8.53	8.53	8.52
	8/20μs, 10kA	kV_p	9.43	9.44	9.41
	U_{5kA}/U_{1mADC}	-	1.62	1.62	1.62
Complete arrester	U_{1mADC}	kV	$24.0 \leqslant U_{1mADC} \leqslant 26.5$		
	Scale coefficient	-	5.05	5.05	5.05
	Lightning impulse protection level	kV_p	43.06		
	Specified value	kV_p	≤45.0		

Note 1: Shunt 0.025 V/A, divider K_d=203.1

Note 2: According to the determined residual pressure, draw the residual voltage and current curve, in the curve corresponding to the nominal discharge current read residual voltage, defined as the lightning protection lightning protection level.

7.2 Switching impulse current residual voltage test

Samples			301	302	303
Resistor	Residual voltage at 250A	kV_p	6.74	6.76	6.74
Complete arrester	Scale coefficient	-	5.05	5.05	5.05
	Test value	kV_p	34.02	34.12	34.02
	Specified value	kV_p	≤38.3		

Note: Shunt 0.025 V/A, divider K_d=203.1

7.3 Steep impulse current residual voltage test

Samples			301	302	303
Resistor	5 kA U_{res1}	kV_p	9.09	9.08	9.06
	5 kA U_{res2}	kV_p	0.23		
	U_{res2}/U_{res1}	%	2.5	2.5	2.5
	$U_{res1}-U_{res2}$	kV_p	8.86	8.85	8.83
Complete arrester	Scale coefficient	-	5.05	5.05	5.05
	Residual voltage for the arrester	kV_p	44.7	44.7	44.6
	Inductance per unit length	μH/m	0.3		
	Height without resistors	m	0.2355–(0.024×5) =0.116		
	Inductive voltage correction	kV_p	0.3×0.116×5=0.17		
	Residual voltage for the arrester after correction	kV_p	44.90	44.80	44.70
	Specified value	kV_p	≤51.8		

Note1: Shunt 0.0267 V/A, divider K_d=59.0。

Note 2: If U_{res2}/U_{res1} is less than 2%,there is no need to correct Inductive effect.

Fulfilled the requirements. Test waveform is shown in appendix C fig C.1~ fig C.3.

8 Repetitive charge transfer withstand

Samples:10 resistors（304～313）

Requirements of standards: The samples should withstand more than 0.2C by 8/20us current impulse for 20 times, and after test, have no breakdown or flashover or breakage, the change of residual voltage within ±5%, the change of reference voltage within ±5%, also should withstand capability to one 8/20us current impulse of at least 0.5 kA/cm^2 peak current density or 2 times I_n, whichever is lower.

Test data: Fulfilled the requirements , the test waveforms were shown in appendix C fig C.4.

Samples		304	305	306	307	308	309	310	311	312	313
Before test	U_{1mAAC}, kV	3.96	3.89	3.90	3.90	3.87	3.88	3.90	3.91	3.88	3.89
	8/20μs U_{5kAp}, kV	8.66	8.63	8.64	8.63	8.60	8.61	8.63	8.65	8.60	8.62
Q_{rs}, C		Q_{rs} (Claimed repetitive charge transfer rating) * 1.1=0.22									
1st	Q_{rs}, C	0.224	0.222	0.226	0.222	0.223	0.224	0.227	0.227	0.225	0.224
2nd	Q_{rs}, C	0.226	0.226	0.227	0.226	0.226	0.227	0.222	0.226	0.226	0.227
3rd	Q_{rs}, C	0.222	0.223	0.222	0.227	0.226	0.222	0.227	0.221	0.222	0.222
4th	Q_{rs}, C	0.226	0.226	0.223	0.222	0.227	0.225	0.225	0.228	0.223	0.221
5th	Q_{rs}, C	0.224	0.222	0.226	0.223	0.228	0.223	0.228	0.223	0.224	0.223
6th	Q_{rs}, C	0.226	0.226	0.225	0.226	0.229	0.226	0.222	0.227	0.225	0.224
7th	Q_{rs}, C	0.223	0.227	0.223	0.225	0.224	0.222	0.225	0.222	0.221	0.226
8th	Q_{rs}, C	0.222	0.222	0.222	0.227	0.223	0.227	0.226	0.221	0.222	0.222
9th	Q_{rs}, C	0.228	0.228	0.226	0.222	0.226	0.226	0.227	0.224	0.226	0.223
10th	Q_{rs}, C	0.226	0.223	0.228	0.228	0.225	0.225	0.229	0.228	0.223	0.226
11th	Q_{rs}, C	0.222	0.223	0.229	0.226	0.222	0.224	0.221	0.226	0.221	0.227
12th	Q_{rs}, C	0.223	0.228	0.227	0.224	0.228	0.222	0.223	0.227	0.226	0.228
13th	Q_{rs}, C	0.222	0.227	0.223	0.222	0.227	0.227	0.222	0.221	0.222	0.221
14th	Q_{rs}, C	0.226	0.222	0.226	0.221	0.226	0.226	0.227	0.228	0.227	0.226
15th	Q_{rs}, C	0.225	0.226	0.227	0.226	0.223	0.222	0.226	0.226	0.224	0.221
16th	Q_{rs}, C	0.223	0.228	0.226	0.228	0.222	0.225	0.229	0.223	0.220	0.222
17th	Q_{rs}, C	0.227	0.227	0.225	0.227	0.224	0.223	0.228	0.222	0.226	0.227
18th	Q_{rs}, C	0.226	0.225	0.228	0.228	0.225	0.222	0.223	0.224	0.223	0.228
19th	Q_{rs}, C	0.226	0.222	0.224	0.223	0.221	0.226	0.228	0.223	0.227	0.225
20th	Q_{rs}, C	0.222	0.223	0.226	0.228	0.224	0.227	0.226	0.221	0.222	0.224

Test evaluation	One 8/20 current impulse, kA	4.02 kA （0.5kA/cm^2=0.5×3.14×(3.2/2)^2=4.02kA which is lower than 2 times I_n）									
		4.06	4.08	4.06	4.10	4.09	4.06	4.05	4.03	4.04	4.02
	U_{1mAAC}, kV	3.82	3.73	3.75	3.76	3.73	3.71	3.75	3.75	3.76	3.75
	Change rate, %	-3.29	-4.11	-3.85	-3.59	-3.62	-4.38	-3.85	-4.09	-3.09	-0.60
	8/20μs U_{5kAp}, kV	8.56	8.52	8.55	8.52	8.51	8.49	8.55	8.56	8.56	8.57
	Change rate, %	-1.15	-1.27	-1.04	-1.27	-1.05	-1.39	-0.93	-1.04	-0.47	-0.58
	Visual inspection	All the samples have no puncture, flashover or cracking.									

9.Test to verify long term stability under continuous operating voltage

Samples: 3 dielectrically prorated sections(101~103)

Requirements of standards: 3 resistors should pass the accelerated ageing test.

Test data: Fulfilled the requirements, the accelerated ageing curves were shown in fig 1.

Samples	101	102	103
U_{1mADC}, kV	5.05	5.04	5.08
U_c, kV_{rms}	3.05		
Power losses P_{start}, 3h, W	0.320	0.329	0.255
Power losses P_{100h}, W	0.297	0.306	0.245
Power losses P_{200h}, W	0.296	0.307	0.246
Power losses P_{300h}, W	0.286	0.297	0.239
Power losses P_{400h}, W	0.309	0.317	0.248
Power losses P_{500h}, W	0.261	0.278	0.237
Power losses P_{600h}, W	0.283	0.294	0.251
Power losses P_{700h}, W	0.269	0.285	0.229
Power losses P_{800h}, W	0.288	0.305	0.249
Power losses P_{900h}, W	0.296	0.297	0.240
Power losses P_{end}, 1000+8h,W	0.272	0.281	0.226
P_{max}, W	0.320	0.329	0.255
P_{min}, W	0.261	0.278	0.226
$(P_{max} - P_{min}) / 1.3P_{min}$	0.174	0.141	0.099
$P_{max}/1.1\ P_{start}$	0.91	0.91	0.91

Note: （1）Because$(P_{max} - P_{min}) < 1.3P_{min}$, $P_{max} < 1.1\ P_{start}$, the samples fulfilled the requirements.

（2）The temperature of blocks:115±4 ℃.Note 2: Resistor temperature: 115±4℃.

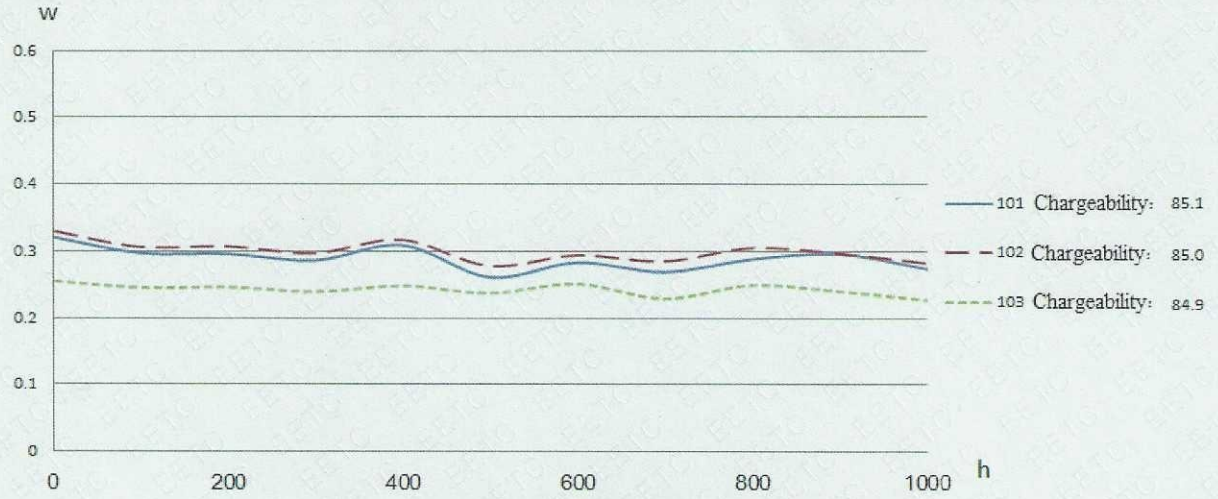

Fig 1 Accelerated ageing test curve

10 Heat dissipation behavior verification of test sample

Samples: 1 thermally prorated section (210), 1 arrester (001)

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 above the measured cooling curve of the arrester.

Test data: Fulfilled the requirements, the test waveform was shown in fig 2.

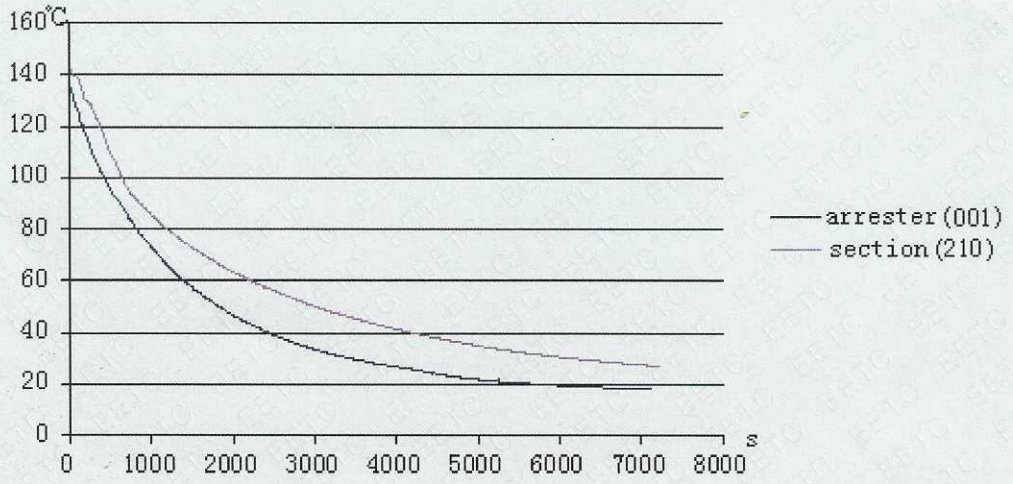

Fig 2 The cooling curve for the section and arrester

11 Operating duty test

Samples: 3 thermally prorated sections（201~203）

Requirements of standards: 3 thermally prorated sections should pass the high current impulse operating duty test.

Test data: Fulfilled the requirements, the test waveforms were shown in appendix C fig C.5～fig C.6.

Samples			201	202	203
U_{1mADC}, kV			5.27	5.27	5.27
U_{sr}, kV_{rms}			3.73	3.73	3.73
U_{sc}, kV_{rms}			2.99	2.99	2.99
8/20μs, U_{5kA} ,before, kV			8.57	8.58	8.57
Conditioning test	1st high current impulse, kA		63.6	64.2	64.2
	2nd high current impulse, kA		64.8	63.8	65.1
preheated samples			preheated samples to 60.0℃±3℃		
Rated thermal energy injection, W_{th},	Lightning current impulse	1st Q_{th} ,C	0.357	0.358	0.352
		2nd Q_{th},C	0.352	0.356	0.355
	Q_{th} rating (2 times), C		0.709	0.714	0.707
Applied voltage after the 3rd impulse	Time	Req.	as short as possible (within 100ms)		
		Actual	82	78	82
	Applied voltage and duration	U^*_{sr}, kV_{rms}	3.73	3.73	3.73
		Duration, s	10	10	10
		U^*_{sc}, kV_{rms}	2.99	2.99	2.99
		Duration, min	30	30	30
Power loss, W	1 s		4.27	4.61	4.18
	5 min		3.12	3.57	3.27
	10 min		2.42	2.72	2.68
	15 min		2.06	2.29	2.12
	20 min		1.78	1.94	1.88
	25 min		1.54	1.68	1.62
	30 min		1.39	1.53	1.45
Samples cooled to			cooled to ambient 20℃±15℃		
8/20μs, U_{5kA} ,after, kV			8.65	8.69	8.61
Variability of the residual voltage, %			+0.93	+1.28	+0.47
Visual inspection			No puncture, flashover, cracking or other significant damage		

12 Power-frequency voltage-versus-time test

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

Samples			204	205	206	207
U_{1mADC}, kV			5.28	5.28	5.28	5.29
U_{sr}, kV_{rms}			3.74	3.74	3.74	3.75
U_{sc}, kV_{rms}			2.99	2.99	2.99	3.00
8/20μs, U_{5kA} ,before, kV			8.60	8.61	8.61	8.64
preheated samples			preheated samples to 85℃±3℃			
2ms long-duration current impulse	1st impulse	Q_{th} ,C	0.356	0.352	0.358	0.356
	2nd impulse	Q_{th},C	0.354	0.351	0.353	0.357
	Q_{th} rating (2 times) , C		0.710	0.703	0.711	0.713
Applied voltage after the 3rd impulse	Time	Req.	as short as possible (within 100ms)			
		Actual	78	82	82	78
	Applied voltage and duration	U^*_{sr}, kV_{rms}	4.49	4.30	4.11	3.75
		TOV scale	1.20	1.15	1.10	1.00
		Duration, s	0.1	1.10	10.1	1200
		U^*_{sc}, kV_{rms}	2.99	2.99	2.99	3.00
		Duration, min	30	30	30	30
Power loss, W	1 s		3.52	4.06	5.46	3.96
	5 min		3.06	3.15	4.29	3.13
	10 min		2.47	2.54	3.32	2.77
	15 min		2.26	2.08	2.78	2.23
	20 min		2.07	1.72	2.33	2.01
	25 min		1.92	1.56	2.07	1.84
	30 min		1.87	1.39	1.98	1.76
Samples cooled to			cooled to ambient 20℃±15℃			
8/20μs, U_{5kA} ,after, kV			8.66	8.72	8.76	8.71
Variability of the residual voltage, %			+0.70	+1.29	+1.74	+0.81
Visual inspection			No puncture, flashover, cracking or other significant damage			

Fulfilled the requirements, the test waveforms were shown in appendix C fig C.7～C.9.

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

Samples			208	209
U_{1mADC}, kV			5.29	5.29
U_{sr}, kV_{rms}			3.75	3.75
U_{sc}, kV_{rms}			3.00	3.00
8/20μs, U_{5kA} ,before, kV			8.64	8.66
preheated samples			preheated samples to 60.0℃±3℃	
Applied voltage	Applied voltage and duration	U_{sr}^{*}, kV_{rms}	4.50	3.75
		TOV scale	1.20	1.00
		Duration, s	1.1	1200
		U_{sc}^{*}, kV_{rms}	3.00	3.00
		Duration, min	30	30
Power loss, W	1 s		3.20	2.58
	5 min		2.72	2.03
	10 min		2.27	1.66
	15 min		2.83	1.37
	20 min		2.39	1.15
	25 min		1.96	0.98
	30 min		1.67	0.82
Samples cooled to			cooled to ambient 20℃±15℃	
8/20μs, U_{5kA} ,after, kV			8.68	8.69
Variability of the residual voltage, %			+0.46	+0.35
Visual inspection			No puncture, flashover, cracking or other significant damage	

Fulfilled the requirements, the test waveforms were shown in appendix C fig C.10.

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

Samples: 1 dielectrically prorated section（104）

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 the test waveforms were shown in appendix C fig C.10.

Sample			104
U_{1mAAC}, kV			8.61
preheated samples			preheated samples to 60℃±3℃
high-current impulse, kA			64.1
Samples cooled to			cooled to ambient 20℃±15℃
8/20μs, U_{10kA} ,after, kV			8.58
Variability of the residual voltage, %			-0.35
Visual inspection	The block can not remove from the section	8/20μs current impulse, 2 times	4.02 kA（0.5kA/cm^2=0.5×3.14×(3.2/2)^2=4.02kA which is lower than 2 times I_n）
		1st impulse, kA_p	4.08
		2nd impulse, kA_p	4.10
		Curve check	No puncture, flashover, cracking or other significant damage

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Appendix A: Object Parameters

Rated voltage U_r: 17kV　　Continuous operating voltage U_c: 13.6kV_{rms}

Nominal discharge current I_n: 5kA　　Lightning impulse residual voltage: U_{res}: ≤45kV_P

Sample instruction:

①1 arrester, number EETC02-21/02/15-0034-001, short for 001 in report; ②10 thermally prorated sections, number EETC02-21/02/15-0034-201~ EETC02-21/02/15-0034-210 short for 201~210 in report; ③13 resistors, number EETC02-21/02/15-0034-301~ EETC02-21/02/15-0034-313, short for 301~313 in report; ④1 housings, number EETC02-21/02/15-0034-401, short for 401 in report.⑤4 dielectrically prorated sections, number EETC02-21/02/15-0034-101~ EETC02-21/02/15-0034-104, short for 101~104 in report.

Appendix B: Main test device

NO.	Device name	Device NO.	Measurement	Uncertainty /Accuracy	Calibration institution	Expiration date
1	impulse current generator	EETC02-0003	8/20 μs 40 kA 4/10 μs 130 kA	U_{rel}=0.015 k=2	National center for high voltage measurement	2021-06-04
2	impulse current generator	EETC02-0005	8/20 μs 40 kA, 30kV 30/80 μs 12kA, 30kV	U_{rel}=0.015 k=2 U_{rel}=0.019 k=2	National center for high voltage measurement	2021-06-04
3	800kV impulse voltage generator	EETC02-0007	0~800 kV 0~20 kA	U_{rel}=0.013 k=2	National center for high voltage measurement	2021-06-04
4	400kV DC high voltage generator	EETC02-0008	0~400 kV	U_{rel}=0.012 k=2	National center for high voltage measurement	2021-07-13
5	Operating duty test system-voltage	EETC02-0009	0~10kV	U_{rel}=0.012 k=2	Beijing Aerospace measurement and testing technology institute	2021-11-03
6	Salt spray test chamber	EETC02-0023	0-200℃ 0-100g/cm2	U_{rel}=0.3℃ k=2 U_{rel}=0.1g k=2	Hubei province meteorological metrological verification station	2021-09-10
7	UV light test chamber	EETC02-0027	/	U_{rel}=0.3℃ k=2 U_{rel}=20% k=2	Hubei province meteorological metrological verification station	2022-01-04
8	Bending test machine	EETC02-0031	0-20kN	U_{rel}=0.3% k=2 U_{rel}=0.3% k=2	Hubei province meteorological metrological verification station	2021-09-10
9	Thermal-humidity test chamber	EETC02-0029	-45~100℃	U_{rel}=0.3℃ k=2	Hubei province meteorological metrological verification station	2021-09-10
10	JFD-251 PD tester	EETC02-0043	/	U_{rel}=0.015 k=2	Beijing Aerospace measurement and testing technology institute	2021-08-15
11	Temperature measuring system	EETC02-0053	0-150℃	U_{rel}=0.2℃ k=2	Hubei province meteorological metrological verification station	2021-12-11

Appendix C: Waveforms

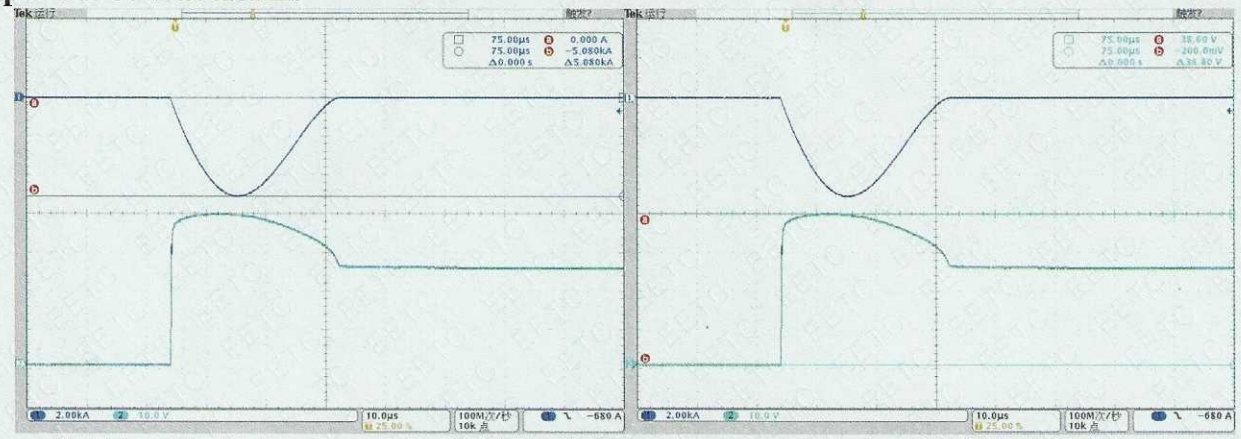

Fig C.1 Lightning impulse current and residual voltage waveform (sample 301, shunt 0.025V/A, divider K_d=203.1)

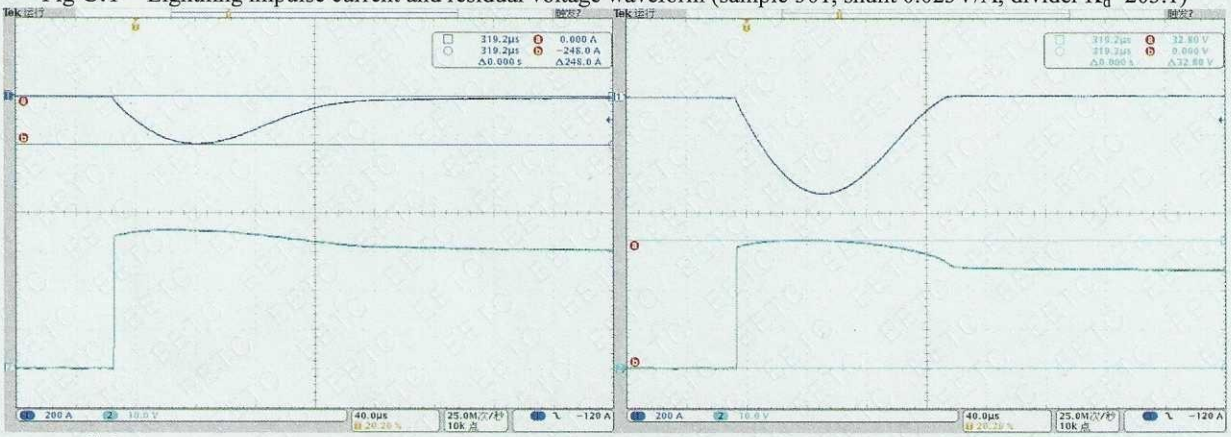

Fig C.2 Switching impulse current and residual voltage waveform (sample 301, shunt 0.025V/A, divider K_d=203.1)

Fig C.3 Steep impulse current and residual voltage waveform (sample 301, shunt 0.0267V/A, divider K_d=59.0)

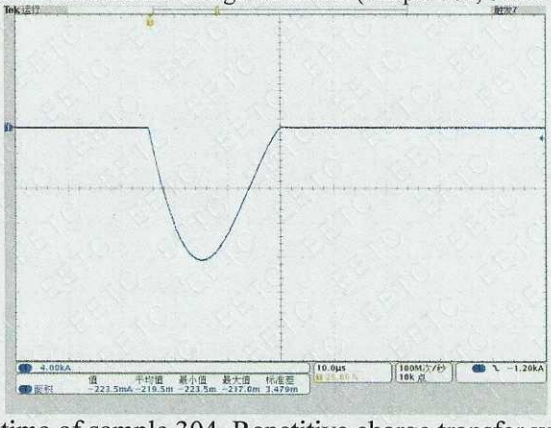

Fig C.4 The 1st time of sample 304, Repetitive charge transfer withstand, 0.01V/A

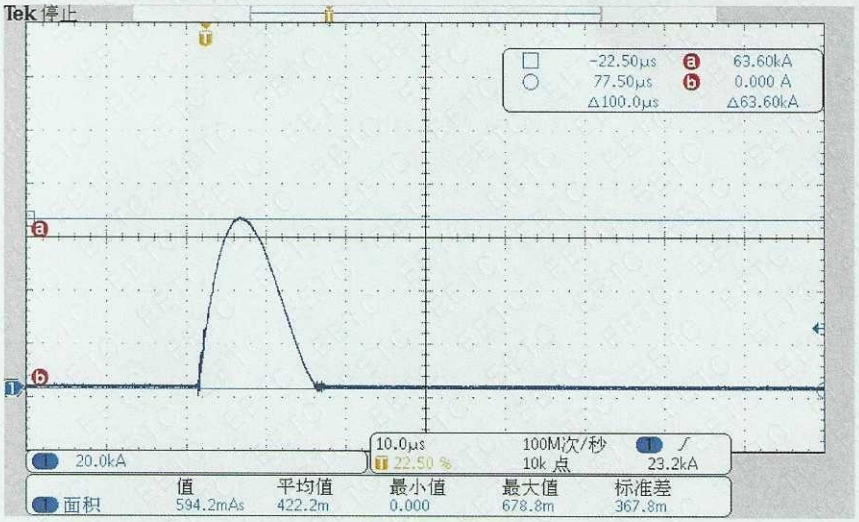

Fig C.5 Waveform of 201 conditioning test (first impulse)

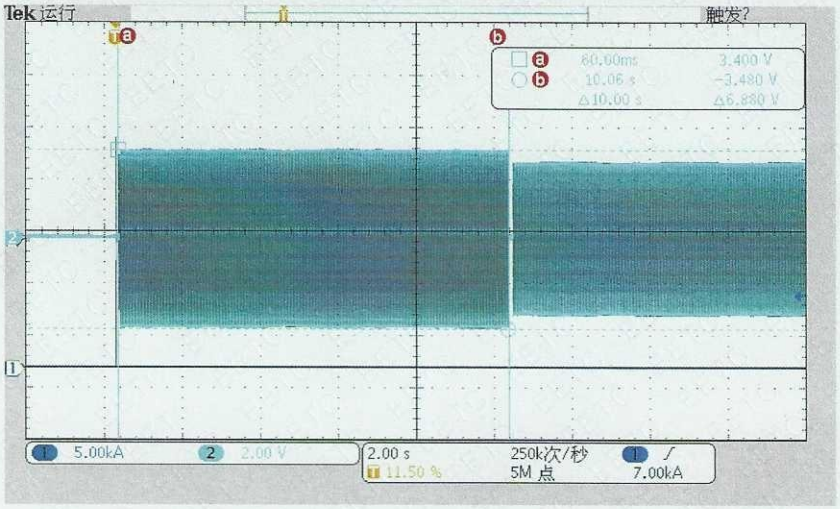

Fig C.6 Operating duty waveform, sample 201, K_d=1540

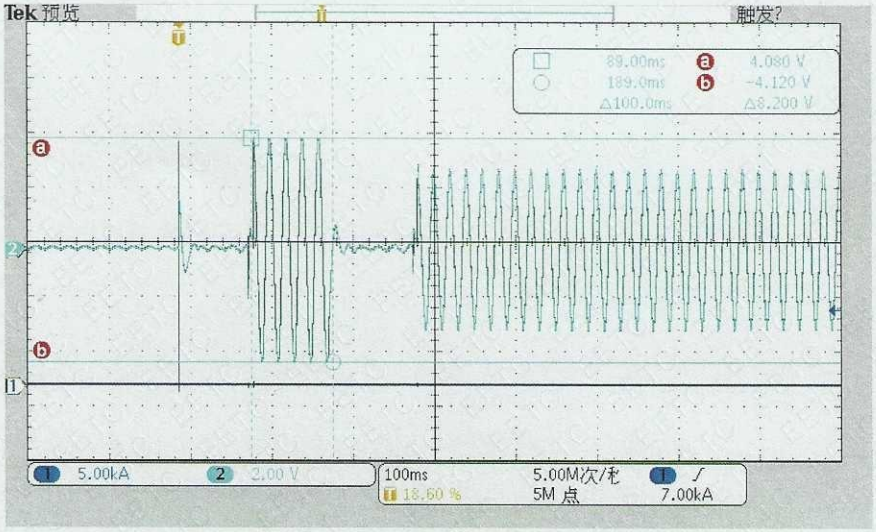

Fig C.7 Power-frequency voltage-versus-time test waveform, sample 204, K_d=1540

Fig C.8 Power-frequency voltage-versus-time test waveform, sample 205, K_d=1540

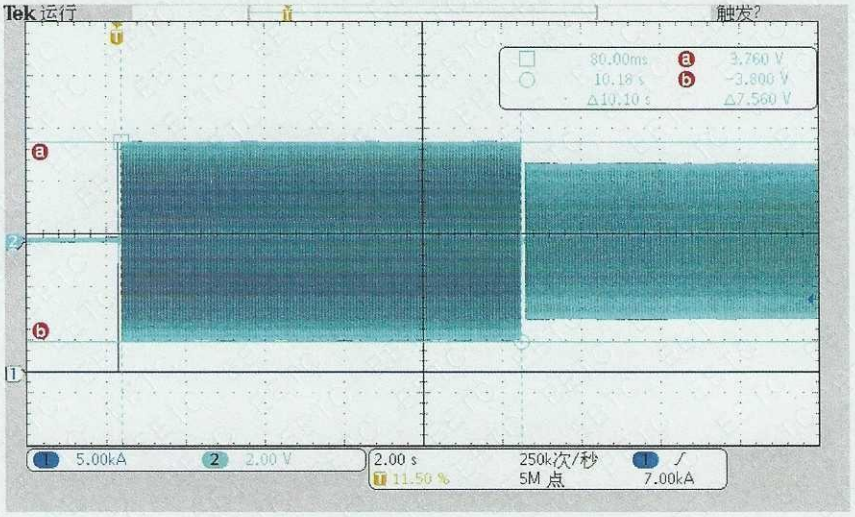

Fig C.9 Power-frequency voltage-versus-time test waveform, sample 206, K_d=1540

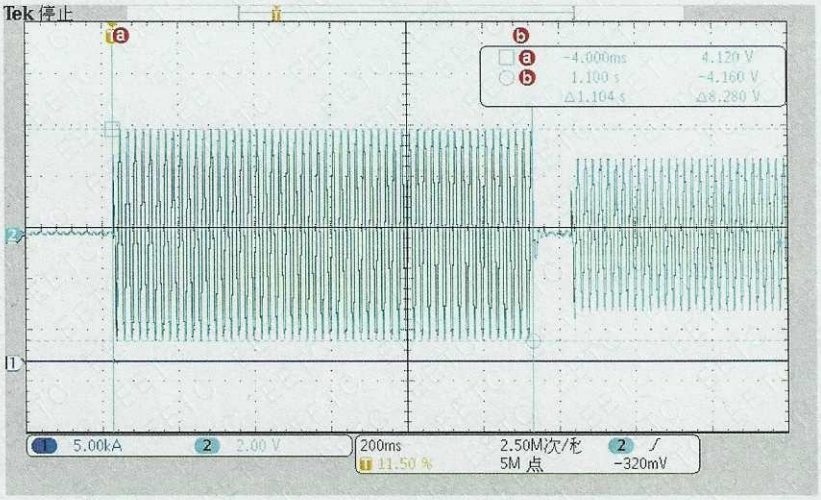

Fig C.10 Power-frequency voltage-versus-time test waveform, sample 208, K_d=1540

Appendix D: Visual and dimensional check

Fig. D1 GHD-15BLQ type arrester and resistor

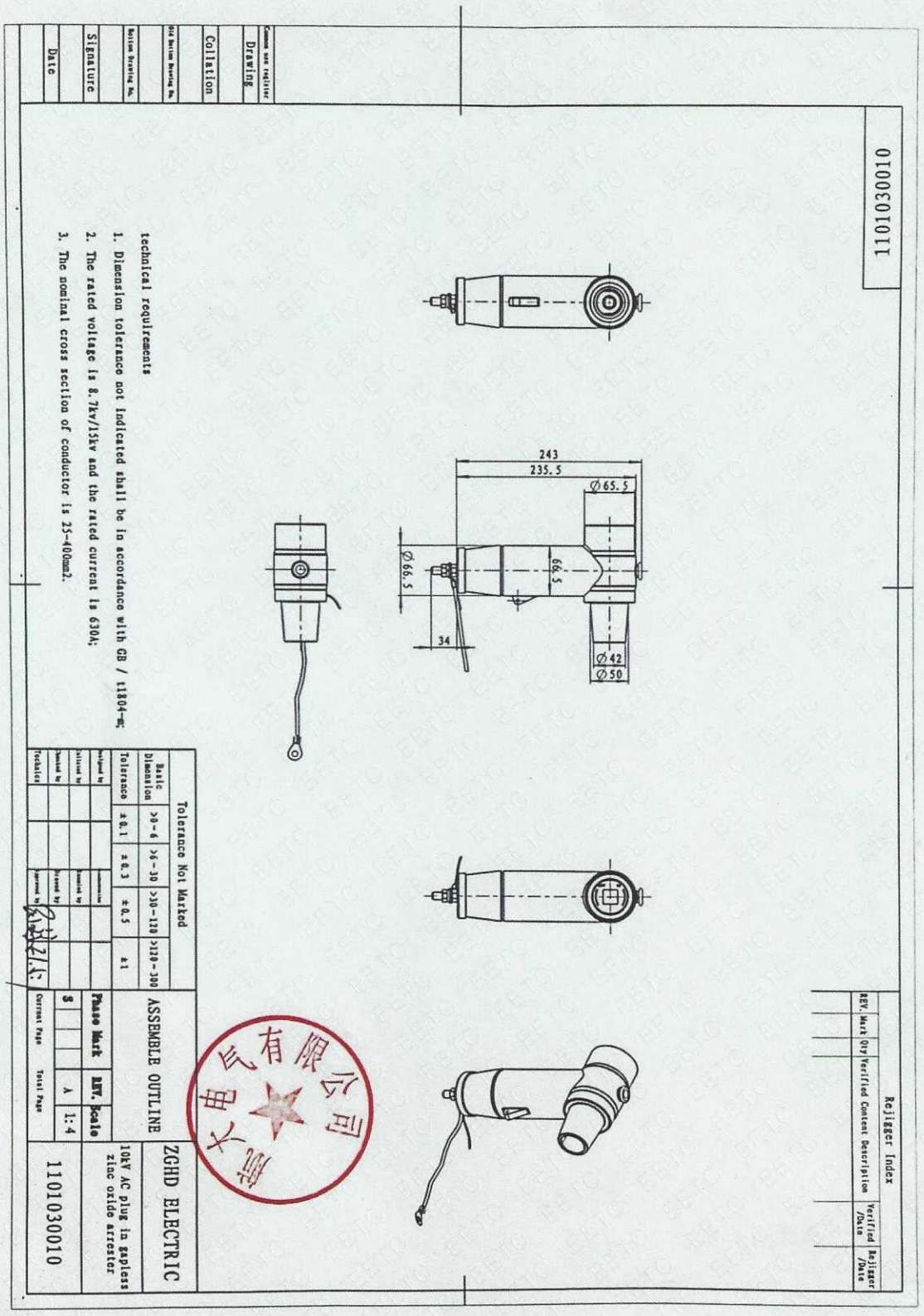

Fig D2 : Dimensional drawing of GHD-15BLQ