

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



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EETC2015BL159J



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# Test Report

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1 Client

Shanghai Chardon electric Ltd.

2 Sample Description

Name: Separable Connectors 34kV/85kV Coupling Head T-Body Surge Arrester

Type: 34-RDTA 85  $\Phi 32\text{mm} \times 31\text{mm}$

Manufacturer: Shanghai Chardon electric Ltd.

Sample No./Details: complete arresters: 3 (A1~A3) resistors: 9 (R1~R9) housings: 3 (H1~H3)  
sections of arrester: 6 (S1~S6)

3 Standards/Specifications

GB11032-2010 Metal-oxide surge arresters without gaps for a.c. systems

4 Test Category

Type Test

5 Test Date

01/11/2015~30/01/2016

6 Conclusion

The Polymer-housed metal-oxide surge arresters without gaps 34kV a.c. systems of 34-RDTA 85 have successfully passed the type test specified in GB11032-2010.

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

Note 2: Since the date of issuance, this report is valid for three years.

Tested by: 万克 梁菊霞

Checked by: 李浩

Verified by: 李浩

Approved by: 王

Date of issue: 2016.06.20

## 7 Inspection Items and Results

No.	Items	Requirements	Results	Evaluation	
1	DC reference voltage	$48.0kV \leq U_{TMDC} \leq 50.0kV$	49.5kV~49.6kV	PASS	
2	Leakage current at 0.75 DC reference voltage test	$I_L(0.75U_{TMDC}) \leq 50\mu A$	3.0 $\mu A$ ~4.0 $\mu A$	PASS	
3	Continuous current test	total current $I_k \leq 500\mu A$ resistive current $I_R \leq 200\mu A$	$I_k = 305\mu A \sim 327\mu A$ $I_R = 61\mu A \sim 66\mu A$	PASS	
4	Power-frequency reference voltage test	$U_{1mAC} \geq 34kV$	40.0 kV~40.1 kV	PASS	
5	Partial discharge test	$1.05U_n$ , $PD \leq 10 pC$	$PD = 3.0 pC \sim 4.0 pC$	PASS	
6	Seal leak rate test	Put the samples into the boiling water with 0.1% NaCl for 42 h: change rate of $U_{TMDC} \leq 5\%$ change of leakage current $I_L \leq 20\mu A$ partial discharge $PD \leq 10 pC$	$\Delta U_{TMDC} = 0.26\% \sim 0.00\%$ $\Delta I_L = 1.0\mu A \sim 2.0\mu A$ $PD = 4.0 pC$	PASS	
7	Bending load test	Bending load $\geq 380N$ for 60s~90s, the surge arrester should not be injured	380N, 60s	PASS	
8	Insulation withstand test	Power-frequency voltage: Dry $\geq 54kV_{r.m.s}$ for 1min. lightning impulse voltage: $125kV_p$ , the positive and negative 15 times respectively.	Power-frequency voltage (dry) $55.7kV_{r.m.s.}$ , 1min. Lightning impulse voltage $126.2kV_p \sim 130.5kV_p$ , the positive and negative 15 times respectively.	PASS	
9	Residual voltage test	lighting impulse current	$\leq 85.0kV_p$	84.1kV	PASS
		steep impulse current	$\leq 95.0kV_p$	91.5 kV	
		switching impulse current	$\leq 75.0kV_p$	69.6 kV	
10	Long duration current impulse withstand test	2000 $\mu s$ , 150A, 18 times	2080 $\mu s$ , 163A~168A	PASS	
11	Operating duty test	Accelerated ageing test	115 $^{\circ}C$ , 1000h	$P2ct < 1.5$ , $P3ct$ , $P2ct < P1ct$	PASS
		High-current impulse operating duty test	4/10 $\mu s$ , 65kA high-current impulse, 2 times	65.2 kA~66.4kA	
12	Power-frequency voltage versus time characteristics test	Supply the Power-frequency voltage versus time characteristics for the range of voltage from $1.10U_R$ to $0.85U_R$ , the range of time from 10s to 24h: for $1.10U_R$ , the time is 10s; for $0.85U_R$ , the time is 24h.	$1.10U_R$ 10s $1.00U_R$ 2h $0.85U_R$ 24h	PASS	

## 8. Test data

### 8.1~8.2 DC reference voltage test and leakage current at 0.75 DC reference voltage test

Environment temperature: 12.0°C humidity: 47%

Samples	measured value kV	specified value kV	0.75 DC reference voltage kV		leakage current $\mu\text{A}$	
			measured value	specified value	measured value	specified value
A1	49.6	$48 \leq U_{1mADC} \leq 50$	37.2	$0.75U_{1mADC} \pm 1\%$	4	$\leq 50$
A2	49.5		37.1		4	
A3	49.5		37.1		3	

Note : The standards formulate the lower limits of DC reference voltage only, the upper limits were declared by the manufacturer to confirm the scale factor and protection level of the arrester.

The result fulfilled the requirements of the standards.

### 8.3~8.4 Power-frequency reference voltage test and Continuous current test

Environment temperature: 12.0°C humidity: 47%

Samples	The power-frequency reference voltage $U_{1mAAC}$ kV (Peak value/ $\sqrt{2}$ )		$I_R$ $\mu\text{A}$ (Peak value)		$I_x$ $\mu\text{A}$ (r.m.s)	
	measured value	specified value	measured value	specified value	measured value	specified value
A1	40.1	$\geq 34$	63	$\leq 200$	312	$\leq 500$
A2	40.1		61		305	
A3	40.0		66		327	

Note : The standard stipulates that the continuous current of arrester under the continuous operating voltage declared by manufacturer.

The result fulfilled the requirements of the standards.

### 8.5 Partial discharge test

Samples	$U_r$ kV <sub>rms</sub>	$U_r$ duration time s	$1.05U_0$	$1.05U_0$ duration time	partial discharge pC
			kV <sub>rms</sub>	s	
A1	34	40	28.6	60	4.0
A2	34	40	28.6	60	3.0
A3	34	10	28.6	60	4.0
specified value	34	2~10	28.6	60	$\leq 10$

The result fulfilled the requirements of the standards.

## 8.6 Sealing test

Samples	Boiling time	Cooling time in air	DC reference voltage			leakage current at $0.75U_{ImDC}$			Partial discharge		Surface check after test
			Before	After	change rate	Before	After	change rate	Before	After	
			h		kV		%	$\mu A$		pC	
A1	42	5	49.6	49.5	-0.26	4.0	5.0	+1.0	4.0	4.0	No visible mechanical damage
A2	42	5	49.5	49.5	0	4.0	5.0	+1.0	3.0	4.0	No visible mechanical damage
A3	42	5	49.5	49.5	-0.26	3.0	5.0	+2.0	4.0	4.0	No visible mechanical damage
specified value	42	$\geq 8$	$\geq 48$	$\geq 48$	$\leq 5$	$\leq 50$	$\leq 20$	$\leq 20$	$\leq 10$	$\leq 10$	Should not have visible mechanical damage

Note 1: NaCl concentration in water for  $1 \text{ kg/m}^3$ .

Note 2: The sample A1 has passed the bending moment test.

The result fulfilled the requirements of the standards.

## 8.7 Mechanical performance test

## 8.7.1 Bending moment

The test load MPSL=380N (The client declared that the MPSL is not less than 380N)

Samples	Actual loading	Time	Maximum deflection	Residual deflection	Housing height	deflection rate	force/deflection curve	Sample check
	N	s	mm	mm	mm	%	-	-
A1	380	60	9.0	2.0	334	0.60	no mutation	No mechanical damage
specified value	380	$60 \sim 90$	/	/	/	$\leq 5$	Should not have mutation	Should not have mechanical damage

## 8.7.2 Data comparison before and after test

Samples	$U_{ImDC}$			leakage current			Partial discharge	
	kV			$\mu A$			pC	
	Before	After	change rate %	Before	After	change rate	Before	After
A1	49.6	49.5	-0.26	4.0	5.0	+1.0	4.0	4.0
specified value	$\geq 25$		$\leq 5$	$\leq 50$		$\leq 5$	$\leq 10$	

The result fulfilled the requirements of the standards.

## 8.8 Insulation withstand test

### 8.8.1 Power-frequency voltage withstand test.

Altitude:  $\leq 1000\text{m}$

Sample	specified value	atmospheric correction factor	altitude correction factor	corrected value	applied voltage	Withstand time	Test result
	$\text{kV}_{\text{rms}}$	$K_t$	$K_a$	$\text{kV}_{\text{rms}}$	$\text{kV}_{\text{rms}}$	s	
H1~H3	54 (dry)	1.000	1.000	54.0	55.7	60	No flashover

Note: The test samples are indoor products, don't make humidity correction.

### 8.8.2 Lightning impulse voltage withstand test

Altitude:  $\leq 1000\text{m}$

Sample	specified value	atmospheric correction factor	altitude correction factor	corrected value	applied voltage	Withstand time	Test result
	kV		$K_a$	$\text{kV}_p$	$\text{kV}_p$		
H1~H3	(+) 125	1.000	1.000	125.0	126.3~130.5	15	No breakdown, no flashover
	(-) 125	1.000	1.000	125.0	126.2~130.3	15	No breakdown, no flashover

Note: The test samples are indoor products, don't need humidity correction.

The result fulfilled the requirements of the standards.

## 8.9 Residual voltage test

### 8.9.1 Lightning impulse residual voltage test

Samples		R1	R2	R3	
Resistor	$U_{1mA,DC}$	$\text{kV}$	6.75	6.75	6.73
	2.5kA	$\text{kV}_p$	10.84	10.85	10.76
	5kA	$\text{kV}_p$	11.33	11.35	11.28
	10kA	$\text{kV}_p$	12.62	12.63	12.55
	$U_{5kA}/U_{1mA,DC}$		1.68	1.68	1.68
Complete arrester	$U_{1mA,DC}$	$\text{kV}$	$48 \leq U_{1mA,DC} \leq 50$		
	ratio	-	7.41	7.41	7.41
	measured value	$\text{kV}_p$	84.1		
	specified value	$\text{kV}_p$	$\leq 85.0$		

Note 1: Current measuring coil output  $0.025\text{V/A}$ , divider ratio  $K_d=59.0$ .

Note 2: The maximum residual voltage should be drawn on voltage-current curve, the residual voltage in the curve in correspondence with the nominal discharge current is defined as the lightning impulse protection level.

## 8.9.2 Switching impulse residual voltage test

Samples			R1	R2	R3
Resistor	Residual voltage 100A	kV <sub>p</sub>	9.39	9.37	9.31
complete arresters	ratio	-	7.41	7.41	7.41
	measured value	kV <sub>p</sub>	69.6		
	specified value	kV <sub>p</sub>	≤75.0		

Note : Current measuring coil output 0.025V/A, divider ratio K<sub>v</sub>=59.0.

## 8.9.3 Steep current impulse residual voltage test

Samples			R1	R2	R3
Resistor	5 kA ,residual voltage U <sub>res1</sub>	kV <sub>p</sub>	12.57	12.59	12.51
	5 kA ,residual voltage of metal block U <sub>res2</sub>	kV <sub>p</sub>		0.29	
	Ratio, U <sub>res2</sub> /U <sub>res1</sub>	%	2.30%	2.30%	2.32%
	5kA ,residual voltage after correction	kV <sub>p</sub>	12.28	12.30	12.22
Complete arrester	Ratio	-	7.41	7.41	7.41
	Residual voltage	kV <sub>p</sub>	90.96	91.11	90.79
	Inductance per unit length	μH/m	1		
	Length without resistors	m	0.334-(0.032×8)=0.08		
	inductive voltage drop	kV <sub>p</sub>	1×0.08×5=0.4		
	After correction	kV <sub>p</sub>	91.5		
	specified value	kV <sub>p</sub>	≤95.0		

Note 1 : Current measuring coil output 0.025V/A, divider ratio K<sub>v</sub>=61.0.  
Note 2: if U<sub>res2</sub>/U<sub>res1</sub> less than 2%, inductive voltage drop is needless.

The result fulfilled the requirements of the standards, the test waveforms were shown in figure A.1 ~ figure A.4.





## 8.11 Operating duty test

## 8.11.1 Accelerated ageing test

Items	Unit	Samples		
		R7	R8	R9
$U_{1mADC}$	kV	6.64	6.64	6.64
$U_c$	$kV_{rms}$	4.00	4.00	4.00
Arrester voltage rate	%	85.0	85.0	85.0
Power losses $P_{1ct}$ , 2h	mW	879	964	892
Power losses $P_{2ct}$ , 1000+8h	mW	774	788	776
Minimum power losses $P_{3ct}$	mW	727	763	752
$P_{2ct} / 1.1P_{3ct}$	-	0.97	0.94	0.94
$P_{2ct} / P_{1ct}$	-	0.88	0.82	0.87
Note: (1) Because $P_{2ct} < 1.1 \times P_{3ct} < P_{1ct}$ , the following test should be performed on the sections made of new resistors. The applied voltage: $U_p$ & $U_s$ (2) The temperature of resistors: $115 \pm 4^\circ C$ .				

## 8.11.2 High-current impulse operating duty test data

Samples		S1	S2	S3
$U_{1mADC}$	kV	6.77	6.78	6.78
$U_r$	$kV_{rms}$	4.80	4.80	4.80
$U_c$	$kV_{rms}$	3.84	3.84	3.84
$K_{ct}$	-	1.0	1.0	1.0
$U_r^*$	$kV_{rms}$	4.80	4.80	4.80
$U_c^*$	$kV_{rms}$	3.84	3.84	3.84
$1.20 \times U_c^*$	$kV_{rms}$	4.60	4.61	4.61

## 8.11.3 High-current impulse operating duty test

Environment temperature: 6.5°C humidity: 53%

Samples		S1	S2	S3	specified value	
8/20 $\mu$ s	$U_{5kA}$ before test	kV <sub>p</sub>	11.38	11.40	11.41	/
Conditioning test	1.20 $\times$ U <sub>c</sub> *	kV <sub>rms</sub>	4.60	4.61	4.61	1.20 $\times$ U <sub>c</sub> *
	Trigger degree	°	60.1	66.6	60.6	60° $\pm$ 15° (before peak value)
	The 1st group	kA	4.9~5.1	4.9~5.1	4.9~5.1	20 times of 5kA, 8/20 $\mu$ s 4 groups of 5 times
	The 2nd group		4.9~5.1	4.9~5.1	4.9~5.1	
	The 3rd group		4.9~5.1	4.9~5.1	4.9~5.1	
The 4th group	4.9~5.1		4.9~5.1	4.9~5.1		
High-current impulse	1 <sup>st</sup> impulse	kA	65.3	65.2	65.5	Between two impulse, cooled samples to ambient temperature
	2 <sup>nd</sup> impulse	kA	66.4	66.2	66.1	
Applied voltage after 2 <sup>nd</sup> impulse	Time	ms	78	78	80	within 100ms
	U*	kV <sub>rms</sub>	4.80	4.80	4.80	peak/ $\sqrt{2}$
	U* Duration	s	10	10	10	10
	U <sub>c</sub> *	kV <sub>rms</sub>	3.84	3.84	3.84	-
	U <sub>c</sub> * Duration	min	30min	30min	30min	30
Power loss within 30 min, U <sub>c</sub> *	0min	mW	576	597	572	In the last 15 min power loss should reduce steadily
	5min		509	529	516	
	10min		455	485	473	
	15min		428	447	454	
	20min		414	423	418	
	25min		403	411	401	
	30min		392	396	387	
8/20 $\mu$ s	$U_{5kA}$ after	kV <sub>p</sub>	11.32	11.35	11.34	-
8/20 $\mu$ s	$U_{5kA}$ change rate	%	-0.53	-0.44	-0.61	$\leq 5$
Visual inspection	-	No breakdown, flashover, cracking or other significant damage			No breakdown, flashover, cracking or other significant damage	

The result fulfilled the requirements of the standards.

## 8.12 Power frequency voltage versus time characteristics test

## 8.12.1 Power frequency voltage versus time characteristics test data

Samples		S4	S5	S6
$U_{1mA,DC}$	kV	6.78	6.78	6.78
$U_r$	$kV_{rms}$	4.80	4.80	4.80
$U_c$	$kV_{rms}$	3.84	3.84	3.84
$K_{ct}$	-	1.00	1.00	1.00
$U_r^*$	$kV_{rms}$	4.80	4.80	4.80
$U_c^*$	$kV_{rms}$	3.84	3.84	3.84

## 8.12.2 Power frequency voltage versus time characteristics test

Environment temperature: 7.0°C humidity: 45%

Samples		S4	S5	S6	specified value	
8/20 $\mu$ s $U_{5kA}$ before	kV	11.42	11.44	11.42	/	
High-current impulse	kA	65.3	66.2	66.2	preheated samples to 60°C $\pm$ 3°C	
Applied voltage after high-current impulse	Time	ms	78	78	82	within 100ms
	$U_r$	$kV_{rms}$	4.08	4.80	5.28	peak/ $\sqrt{2}$
	Times of $U_r$	-	0.85	1.00	1.10	-
	$U_r^*$ Duration	s	24 h	2 h	10 s	-
	$U_c^*$	$kV_{rms}$	3.84	3.84	3.84	-
	$U_c^*$ Duration	min	30	30	30	30
Power loss within 30 min	0min	W	1.97	2.38	4.37	In the last 15 min power loss should reduce steadily
	5min		1.34	1.46	2.66	
	10min		1.13	1.18	2.17	
	15min		0.96	0.93	1.86	
	20min		0.83	0.85	1.57	
	25min		0.72	0.76	1.29	
	30min		0.66	0.69	1.03	
8/20 $\mu$ s $U_{5kA}$ after	$kV_p$	11.38	11.34	11.31	-	
8/20 $\mu$ s $U_{5kA}$ change rate	%	-0.35	-0.87	-0.96	$\leq 5$	
Visual inspection	-	No breakdown, flashover, cracking or other significant damage			No breakdown, flashover, cracking or other significant damage	

The result fulfilled the requirements of the standards.

Appendix A: The typical test waveform

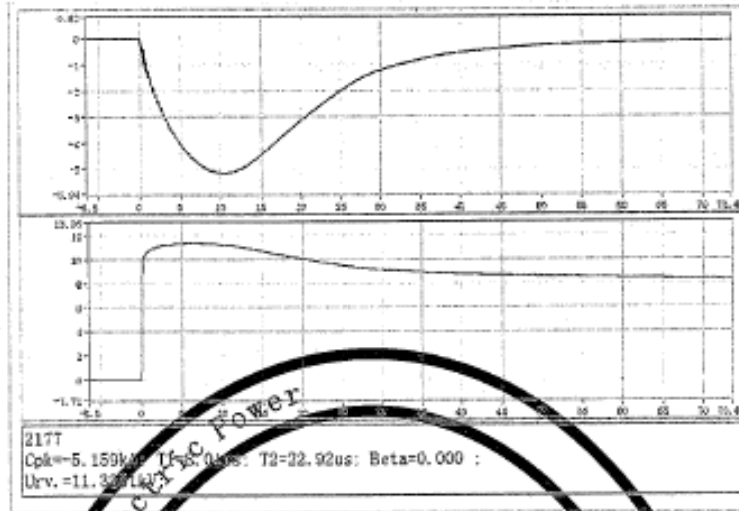


Fig.A.1 Sample R1, Lighting impulse current - residual voltage curve,  
Current measuring coil output 0.025V/A, divider ratio  $K=59$

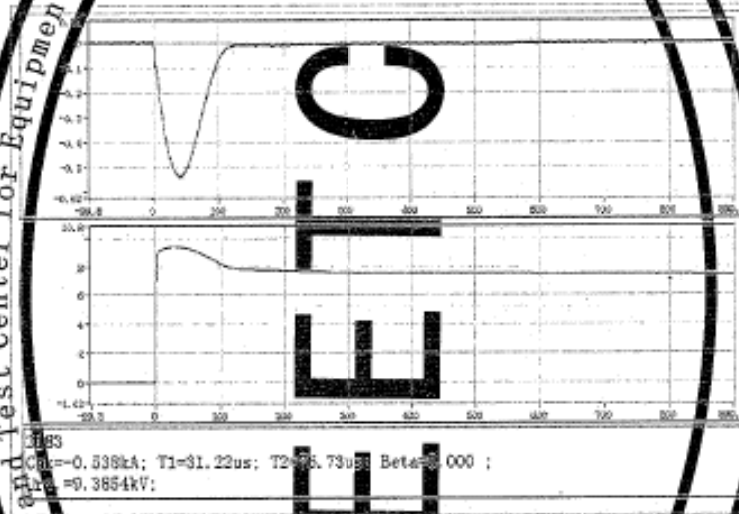


Fig.A.2 Sample R1, Switching impulse current - residual voltage curve,  
Current measuring coil output 0.025V/A, divider ratio  $K=59$

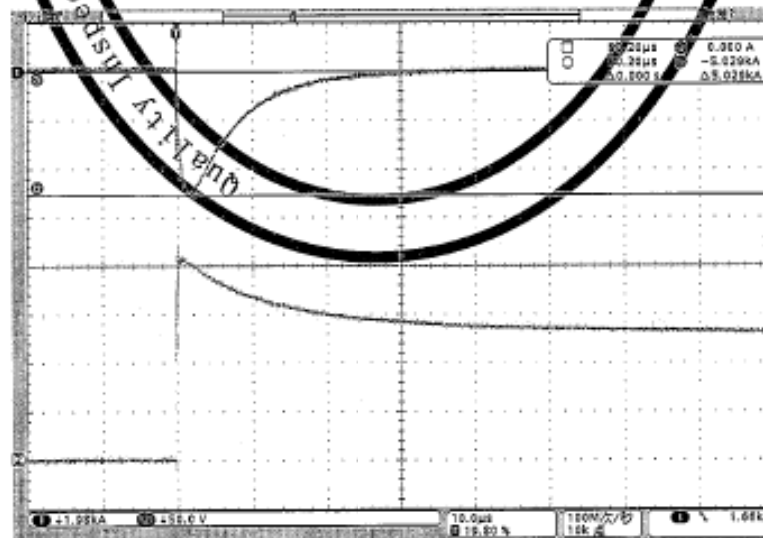


Fig.A.3 Sample R1, Steep impulse current - residual voltage curve. Current measuring coil output 0.025V/A,

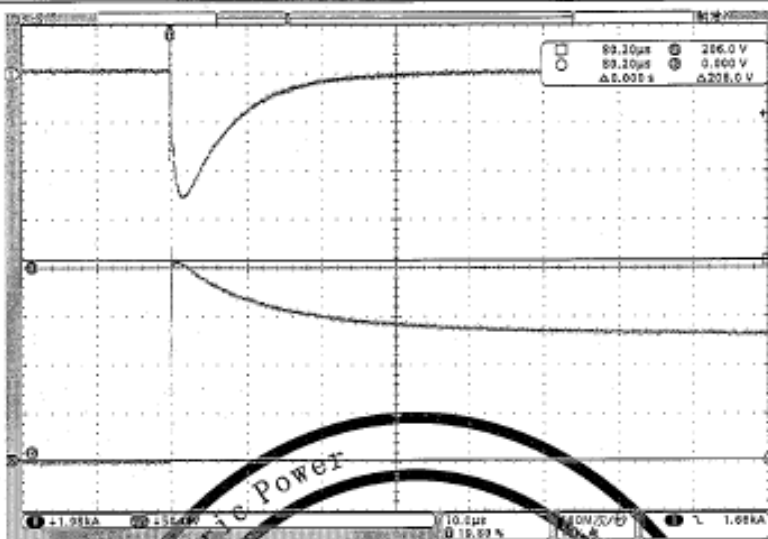


Fig.A.4 Sample R1, Step impulse current – residual voltage curves, divider ratio  $K_f=61$

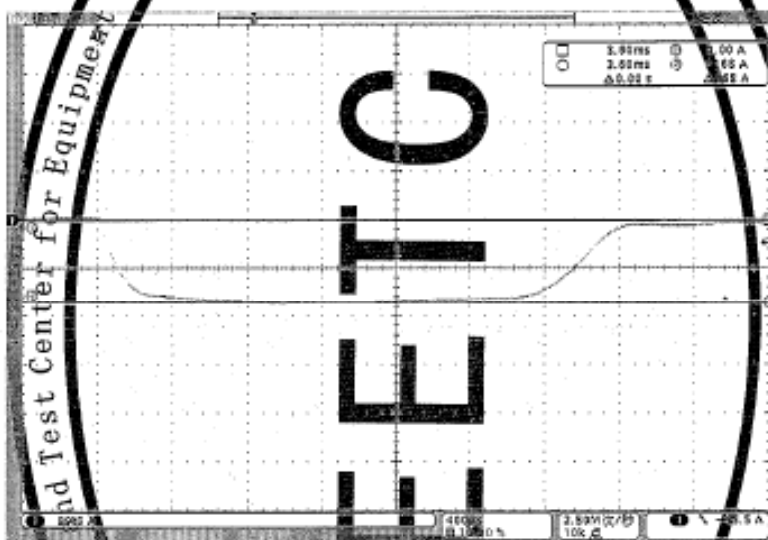


Fig.A.4 Sample R4, the 1<sup>st</sup> time, Rectangular current impulse test curve  
Current measuring coil output 0.01V/A

**Appendix B: Main performance parameters of arrester**Rated voltage  $U_r$ : 34kVContinuous operating voltage  $U_c$ : 27.2kVNominal discharge current  $I_n$ : 5kALightning impulse residual voltage  $U_{res}$ :  $\leq 85kV_p$ **Appendix C: Main test device**

NO.	Device name	Device NO.	Measurement	Uncertainty/Accuracy	Calibration institution	Expiration date
1	400 kV DC High Voltage generator	BL008	0~400 kV	/	National center for high voltage measurement	2017-05-03
2	300 kV AC High Voltage generator	BL010	0~300kV	/	/	/
	Digital high-voltage table	BLW072	0~300 kV	1%	National center for high voltage measurement	2016-09-25
3	Multi-waveform impulse current generator	BL002	8/20 $\mu$ s, 100kA; 4/10 $\mu$ s, 150kA; 50/120 $\mu$ s, 10kA;	/	/	/
	PDR-50 voltage divider	BLW049	0~50 kV	1%	National center for high voltage measurement	2017-02-15
4	Long duration (rectangular current impulse generator	BL001	2ms 10kA 10ms 2kA	/	/	/
	301x type current sensor	BLW060	0~50kA	2%	The fifth (x'an) measurement and test center of mechanical industry	2016-07-02
	FYC-30kW weak damping voltage divider	BLW074	0~30 kV	1%	National center for high voltage measurement	2016-06-12
5	MOA-II DC reference voltage detector	BLW002	0~10 kV	3%	National center for high voltage measurement	2017-03-10
6	Combined load power frequency test device	BL007	0~10 kV	3%	National center for high voltage measurement	2016-07-14
7	DPO4034 oscilloscope	BLW067	0~300V	2%	Hubei province measurement and test academy	2016-07-12
8	DMI Digital voltage table	BLW017	0~1600V	1%	National center for high voltage measurement	2016-7-13
9	JFD-251 partial discharge test device	BLW063	/	0.5pC	National center for high voltage measurement	2016-05-01
10	1/5 $\mu$ s steep impulse current generator	BL004	1/5 $\mu$ s 0~20 kA	/	/	/
	1025 type current sensor	BLW053	0~20 kA	2%	The fifth (x'an) measurement and test center of mechanical industry	2016-07-02
	PDR-20 voltage divider	BLW047	0~20 kV	1%	National center for high voltage measurement	2017-02-16

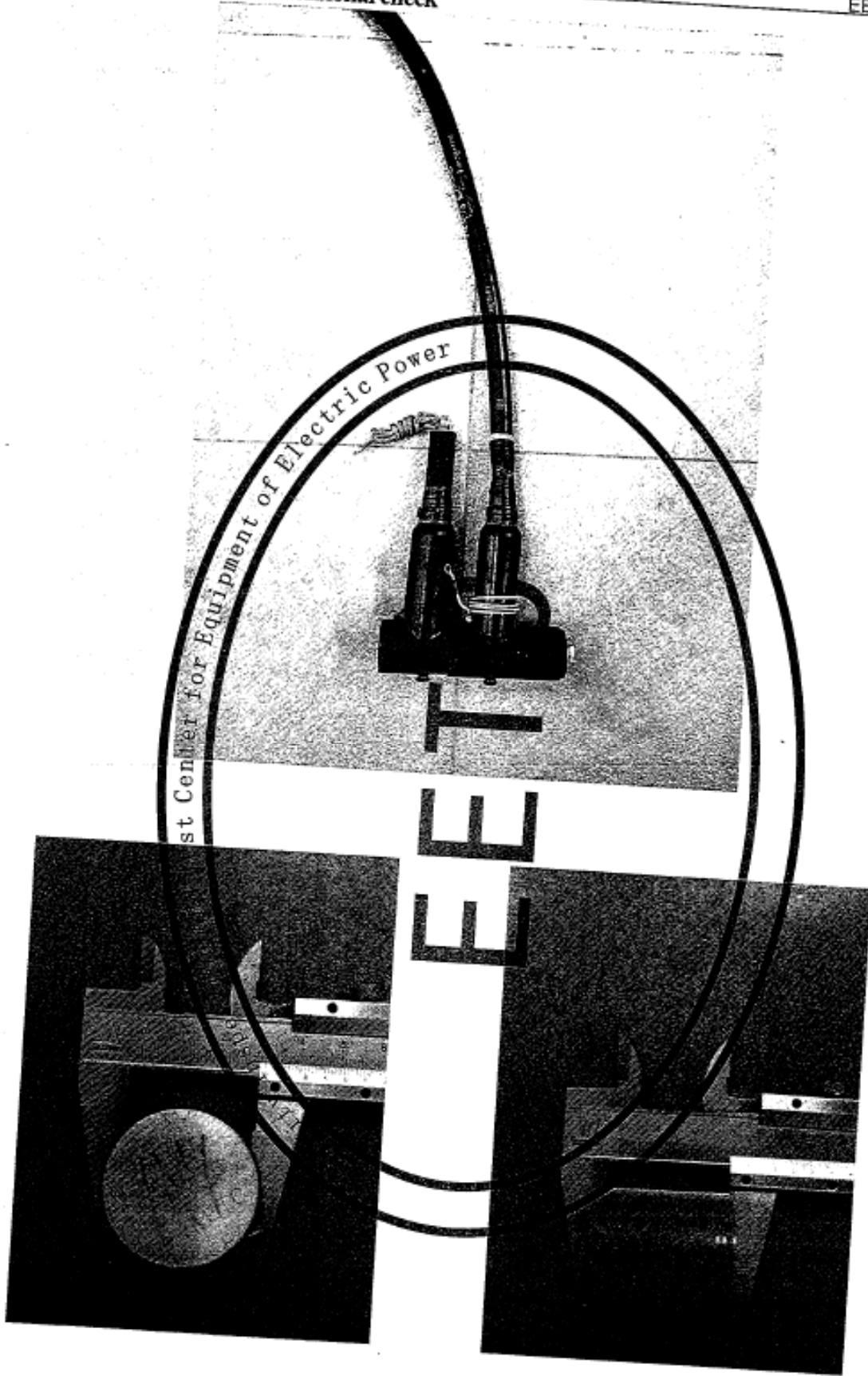
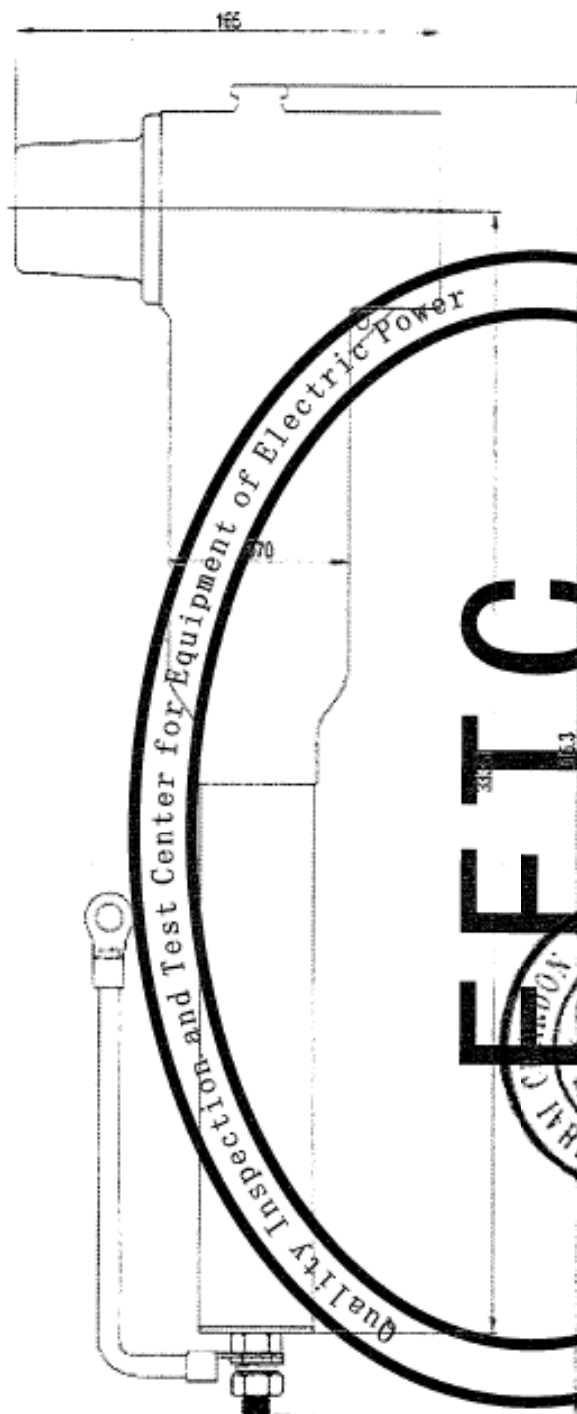


Fig D1: Outside view of 34-RDTA 85arrester and resistor

### The arrester technical parameter table



No	Item	Parameter	Unit	Remark	
A	Height of Arrester	415.3	mm		
B	Width of Arrester	165	mm	With Plug Cap	
C	The Inner Diameter of EPDM Housing	/	mm		
D	The Outside Diameter of EPDM Housing	∅70	mm		
E	Creep Distance	/	mm		
F	MkV Disks Diameter	∅32	mm	Quantity:3 pieces	
G	Rating Voltage	34	kV		
1	MOV Rating	27.2	kV		
2	Nominal Discharge Current of Arrester	5	kA		
3	Minimum Crest Voltage Level(30kV)	≤10	μC		
4	Bending Strength	380	N	MOV Module	
5	Reference Voltage	Power-Frequency Reference Voltage	/	kV	1mA
		DC Reference Voltage	48-51	kV	1mA
6	Residual Voltage	Sleep Current Impulse	≤5	kV	
		Lightning Current Impulse	≤5	kV	
		Switching Current Impulse	≤75	kV	250A
		Rectangular Current Impulse	150	A	
8	Withstand Voltage of EPDM Housing	Power-Frequency Withstand Voltage	54	kV	
		Lightning Impulse Withstand Voltage	125	kV	
9	Application Include	Operational Impulse Withstand Voltage	/	kV	
		Application Environment	≤1000	m	
Product Name		Separable Connectors 34kV/85kV Coupling(Rear)T-Box Surge Arrester			
Product Model		34-RDTA85			
Manufacturer		SHANGHAI CHARDON ELECTRIC LTD.			

Fig D2: Dimensional and main parameters drawing of 34-RDTA 85